

Hawai‘i’s Green Workforce

Beyond the Baseline

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Foreword

The Department of Labor and Industrial Relations (DLIR) has actively sought to become a more effective partner in steering the State of Hawaii toward a sustainable green economy. Recognizing the rapidly evolving needs of the clean energy sector and the limitations of existing labor market information (LMI), Hawaii was one of several states selected by the U.S. Department of Labor's Employment & Training Administration to receive an LMI Improvement Grant funded through the *American Recovery and Reinvestment Act* (ARRA).

This publication was prepared by the Economic Research Organization at the University of Hawai'i (UHERO). It supplements a report released in December 2010, *Hawai'i's Green Workforce: A Baseline Assessment*.

Survey data from the 2010 Hawaii Green Jobs Survey form the basis for the projections presented in this report. Econometric models generate near- and long-term trajectories of Hawaii's green labor market needs based on current trends, conditions, and policies and incentives impacting green investments. The forecasts offer high- and low-growth scenario analyses across major industry and occupational groups.

Practical applications are broad and far-reaching. Career counselors and other service providers rely on standardized labor market information to meet the needs of different clients, from displaced engineers who require training in green applications to lower-skilled job-seekers who require basic training to obtain entry-level jobs in the green sector. Information on green jobs and the requisite skills companies seek when filling them can also be used by leaders in the field of education to better identify relevant degrees, certifications and training programs. Universities, community colleges, and trade and vocational schools are important partners in bridging job-seekers and employers with innovative programs and curricula that address the needs of a rapidly evolving green economy. Within this context, the private sector becomes a vested stakeholder by providing the demand for a pool of skilled workers to grow its businesses. Such symbiosis spurs activity and innovation in the broader economy.

While we have made every effort to validate the accuracy of data in this publication, the State of Hawaii and Department of Labor & Industrial Relations provide this assessment for educational and informational purposes only. References to specific products, services or companies are for illustrative purposes only, and do not reflect an endorsement by the State of Hawaii, DLIR or its affiliated agencies.

Hawai'i Green Jobs Outlook: Model-Based Projections

Introduction

The Economic Research Organization at the University of Hawaii (UHERO) developed projections for green jobs counts in the Hawaii economy in collaboration with the State of Hawaii Department of Labor and Industrial Relations (DLIR) as part of their Hawaii Green Jobs Initiative.[1] The green jobs portion of that program was funded through a U.S. Department of Labor Employment and Training Administration grant under the American Recovery & Reinvestment Act (ARRA) federal stimulus bill. The improvements to the labor force data made possible by the grant are intended to expand the monitoring of industries and occupations that are increasing green jobs in the State, providing useful information for policymakers and agencies involved with the Hawaii Clean Energy Initiative.

Green job short-term projections for 2011 and long-term projections for 2018 were established to coincide with the time horizons of official total industry and occupation projections published by the DLIR.[2] Greater data availability for industry sectors permitted UHERO to generate projections for intervening two-year intervals: 2012, 2014, and 2016. We use a flexible approach, generating a range of potential outcomes. High growth and low growth scenarios are presented to emphasize the diverse possibilities in future green jobs creation.

The first two sections of this report summarize the green jobs projections, first by industry sectors and then by occupations. This is followed by a brief explanation of the job growth concepts modeled and the methodology used in creating the projections. A discussion of the larger policy context of changes in green jobs in Hawaii concludes.

1. www.GreenJobsHawaii.org
2. These DLIR reports and data are available online at DLIR's Hawaii Workforce Informer web site: https://www.hiwi.org

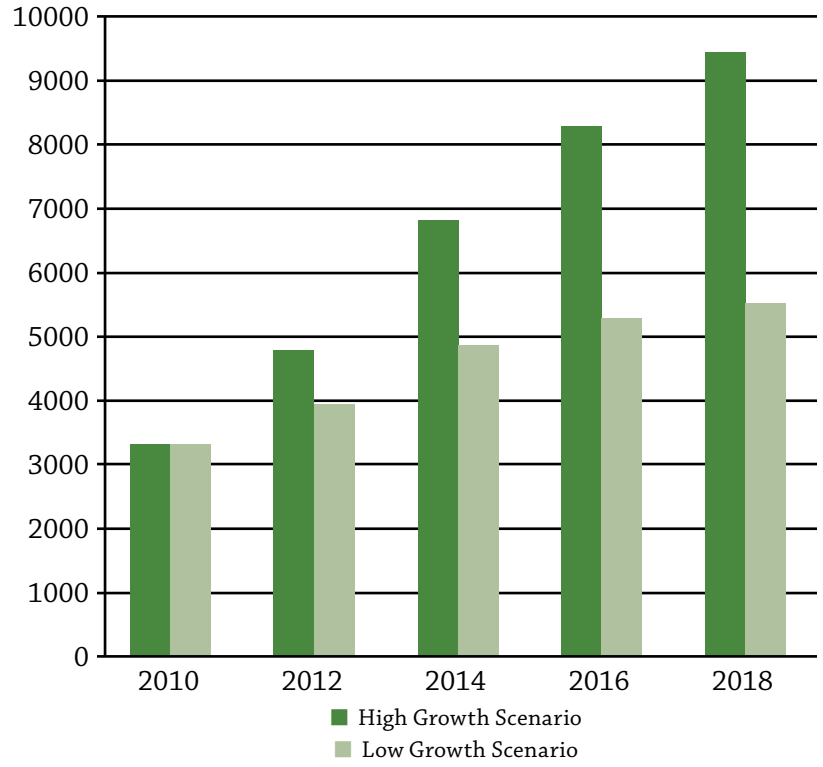
Projected Job Growth by Industry Sector

Hawaii's green jobs over the next seven years will continue to be primarily in the **Construction and Mining** sector. From a current value of 3,300 in early 2010, according to the DLIR green jobs survey, the number of green workers employed in the sector should expand between two to three fold by 2018. The high scenario projects more than 6,000 new green Construction and Mining jobs by 2018 if the industry recovers as expected. Even the low scenario's conservative assumptions project more than 2,000 new green jobs by that time.

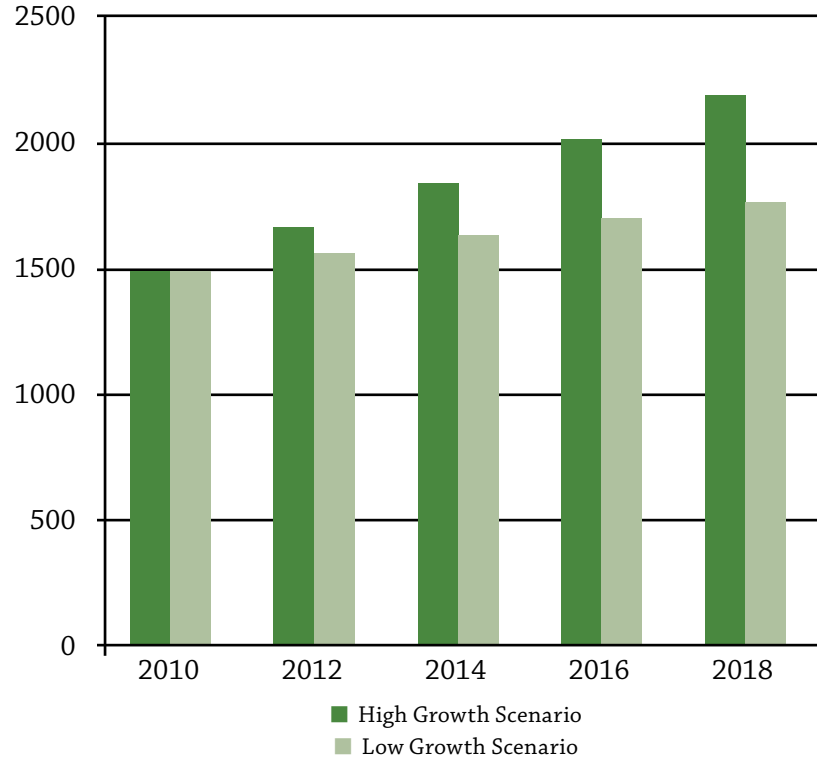
Expansion of green jobs opportunities will also occur in the broad **Other Services** sector, which adds between 1,500 and 3,500 new green jobs by 2018. This is not surprising, given the presence of two important component industries within this group: Administrative and Support and Waste Management and Remediation Services, along with Professional, Scientific, and Technical Services. Waste management and facilities management are areas where there is significant potential for an environmental focus. This is also true for the scientific and technical services side, which includes engineering and design services as well as many research functions. In the high scenario, the green jobs tally in the Other Services group nearly doubles in eight years (up 72%).

The number of green workers employed in the Construction and Mining sector should expand between two to three fold by 2018.

Green Job Scenarios: Construction & Mining



Green Job Scenarios: Retail & Wholesale Trade

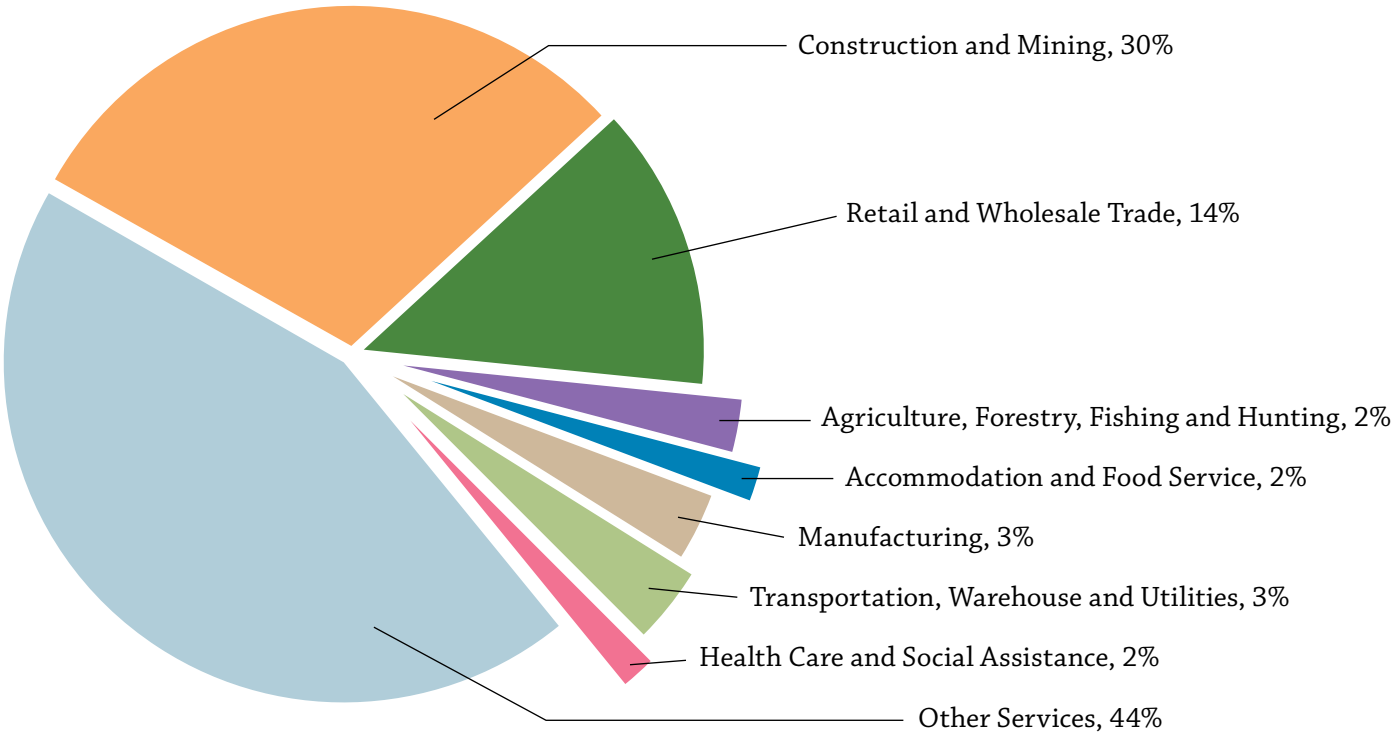


The Construction and Mining, Other Services, and Retail and Wholesale Trade industry groups contributed 87% of the green jobs in the 2010 DLIR survey.

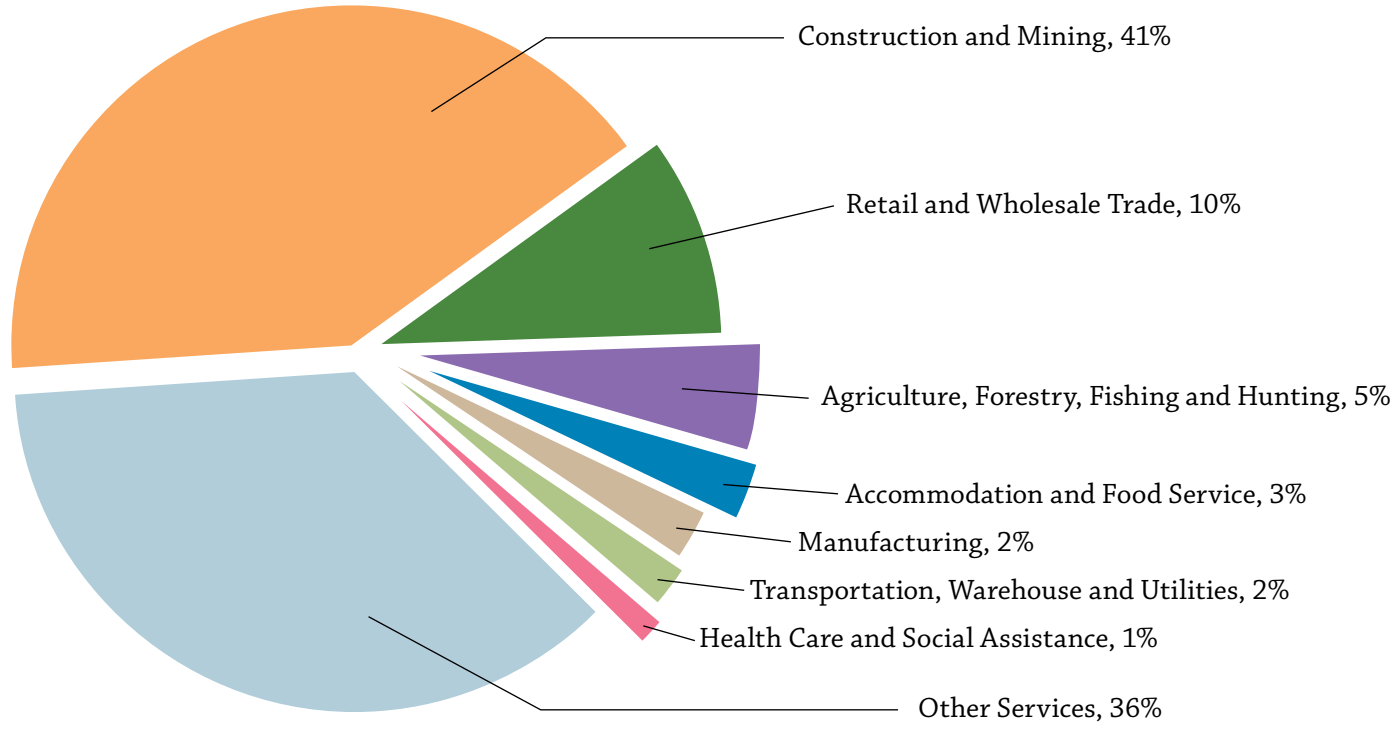
The third largest industry group by total number of projected green jobs is **Retail and Wholesale Trade.** These industries are notable for the relatively low variance in the projected 2018 totals for the two scenarios, ranging between 1,800 and 2,200. This implies that retail and wholesale trade should be a reliable source of green jobs in the state economy with slow but steady growth.

Overall, our projections do not point to any significant change in the industrial distribution of green jobs in Hawaii. When the Construction and Mining, Other Services, and Retail and Wholesale Trade industry groups are combined, they contributed 87% of the green jobs in the 2010 DLIR survey. Our projections incorporating economic recovery and current information about structural shifts place the 2018 share of green jobs for these three groups at 88% in the high scenario and 96% in the low scenario. As the Hawaii Clean Energy Initiative, other major policy shifts, and unanticipated new technological advances take effect, these expectations may change.

2010 Green Jobs by Industry

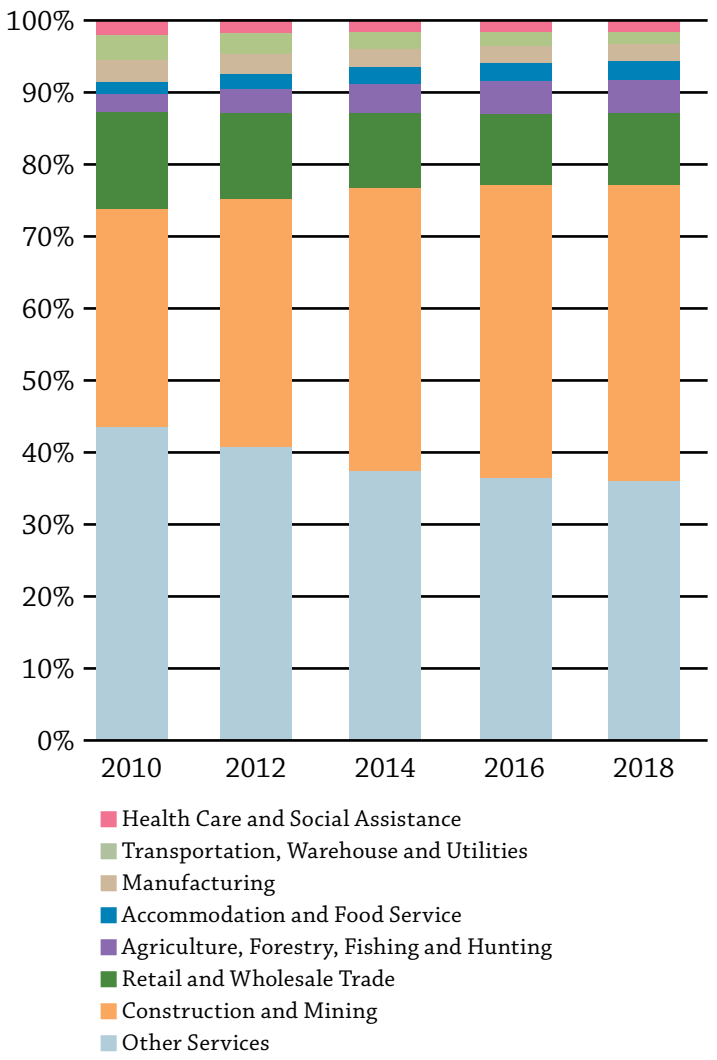


2018 Green Jobs by Industry: High Growth Scenario



One industry group that bears mentioning is the **Agriculture, Forestry, Fishing & Hunting** group. The expected percentage gains in green jobs in this sector are very large in magnitude, actually exceeding the growth rate in the Construction and Mining sector in the high scenario. The limiting factor for the green jobs outlook in Agriculture is the small overall size of the sector, which begins in 2010 with just 278 green jobs according to the DLIR survey. Although the high scenario has this sector more than tripling its total green jobs by 2018, it would still have fewer than retail and wholesale trade, owing to the fact that the trade sector is roughly thirteen times larger by overall employment.

Green Jobs Distribution by Industry and Year: High Scenario



Projected Job Growth by Occupation Code

Nearly all of the occupations producing large[3] increases in green jobs through 2018 have direct and obvious ties to construction, facilities maintenance, or trade. Of the occupations adding at least 300 jobs in the high scenario, three out of ten are construction occupations: carpenters, electricians, and first line construction supervisors (typically construction site foremen). The number one fastest growing occupation by sheer volume was electricians, which could add up to 1,208 jobs and is likely to at least double its green jobs by 2018. Tile and marble setters and general construction laborers are also projected to add at least 100 green jobs within seven years.

Related to construction are the facilities maintenance occupations, which entail upkeep and upgrades to establishments' land and buildings. Many of these occupations are involved in weatherization or other retrofits to wiring or cooling systems for energy efficiency. Janitors and cleaners, heating and air conditioning mechanics and installers, and landscaping and groundskeeping workers and their first line landscaping and groundskeeping supervisors are all expected to add 300 or more green jobs in the high scenario. General maintenance and repair workers, plumbers, and painters (construction and maintenance) are all expected to add 140 or more green jobs by 2018.

Retail and wholesale trade occupations could grow as qualified salespersons for environmentally-conscious or energy-efficient goods and services increase. Reworking of handling and movement of goods along the supply

3. See the Methodology section for details.

The number one fastest growing occupation by sheer volume was electricians, which could add up to 1,208 jobs and is likely to at least double its green jobs by 2018.

chain creates opportunities for specific green jobs within logistics networks. While only a small percentage of retail salespersons will be considered green jobs, it is the single largest occupation for the retail and wholesale trade industry group, and projects to double its green numbers—increasing from 219 jobs in 2010 to 576 in 2018 in the higher scenario. Laborers and freight, stock, and material movers, who are largely involved in wholesale trade and distribution, will increase between 76 and 265 jobs by 2018 in the two scenarios considered here.

Of the remaining high growth occupations, first line supervisors of production and operating workers are probably indicative of a redirection of positions within manufacturing, energy, and administrative/waste management fields as green occupations. Environmental scientists are likely to double in number by 2018, while solar energy systems engineers will go from 10 green jobs in 2010 to between 53 and 184 at the end of the projection. Public relations specialists will have a role in disseminating information about various green topics such as energy conservation. The one surprising SOC code that does not seem to have a ready explanation is high green jobs growth in computer support specialists (increase of 408 in the high scenario).

Like the aforementioned recycling and reclamation workers, many of these occupations will have not only more green jobs but increasingly larger shares of their workers classified as green. By 2018, in both the high and low scenarios, more than half of all HVAC repairers and installers will be considered green jobs. Green electricians will rise from roughly 15% of all electricians in 2010 to nearly 25% green in the low scenario and almost 50% in the high scenario. The green share of first line supervisors of production and operating workers will increase from 3.5% in 2010 to more than triple that percentage, possibly rising as high as 31% of all such supervisors being classified green eight years later.

For the most part, the projected high growth occupations have clear links to industries identified as being high growth green jobs industries. Occupations with large shifts in job mix toward relatively more green jobs in later years match the conventional expectations about fields with obvious energy or environmental roles.[4]

Many of these occupations will have not only more green jobs but increasingly larger shares of their workers classified as green.

Sources of Change in Green Jobs Counts

We considered two major reasons why the number of green jobs in Hawaii could change over time. First, there are changes in the size of particular industries or occupations. Suppose a hypothetical industry grows from 1000 to 2000 jobs over time, but with no change in technology or methods of production. If 10% of the jobs in that industry are classified as green jobs, the number of green jobs in that industry would grow from 100 to 200 jobs over that period. This effect is particularly pronounced for industries and occupations that are already strongly identified with green and sustainable technologies and objectives.

Changes to the methods and technologies used in various industries are the second way green job counts could change. An industry or occupation could convert existing or future jobs to engage in economic activities that make a positive impact on the environment or energy sustainability when those jobs would not have done so prior to the change. This does not require the total number of jobs in the industry or occupation to vary because it affects the mix of jobs that make up the industry or occupation category. Consider a hypothetical industry with 1000 workers using methods and technologies that classify 10% of the jobs as green jobs. New job duties and methods could be implemented so 20% of the jobs are now considered green jobs. Even if no new jobs are

4. Some occupations, like solar photovoltaic installers, could not be projected reliably due to data limitations. See the Methodology section for details.

created, the number of green jobs increased from 100 to 200. This second effect is important because it indicates greater sustainability awareness and activity in existing economic activity.

Both effects happen simultaneously, so it is difficult to isolate which is relatively more important in changing green job counts. The industries and occupations where green jobs are likely to expand the fastest are those with both increasing overall employment and increasingly adopting objectives and methods that significantly contribute to environmental protection or preservation.

Changes to the methods and technologies used in various industries indicates greater sustainability awareness and activity.

Methodology: Industry Projections

Industry-based projections of green jobs through 2018 were modeled using the two concepts outlined above: changes in the size of an industry could change the job counts, and changes in the mix of jobs within an industry could change the job counts. The UHERO private industry projections[5] were mainly performed at the 2-digit NAICS sector level,[6] mirroring the industry structure used by UHERO in its regular economic forecasts of the State of Hawaii. A combination of Quarterly Census of Employment and Wages (QCEW) data from the State Department of Labor and Industrial Relations (DLIR) and UHERO's custom macroeconomic employment models produced jobs series for each of these 2-digit sectors.

UHERO's dynamic macroeconomic model incorporates data from multiple State and National level sources to forecast, among other things, job growth at the sector level in Hawaii. Growth rates determined by the UHERO whole-economy model were applied to the baseline 2010 QCEW industry job counts to forecast job counts in later years on a consistent basis.

DLIR's data from their December 2010 report for green job estimates in 2010 and 2012 were then incorporated into the modeling process to add the effect of job mix changes over time. Due to data limitations, precise estimates are difficult to generate. We used the available information to generate conservative upper and lower bound estimates on hiring patterns within each sector. These are presented as high and low scenario outcomes. For the high scenario, we extrapolated the growth in the green share of jobs in a sector from the DLIR survey out to 2018 in a linear fashion. This optimistic scenario assumes employers will convert conventional jobs to green jobs at the same rate they are converting them today.[7] The conservative scenario assumes the full conversion in 2012 will be slower than expected and will instead not be completed until 2018. This gives a range of outcomes intended to encompass the possible paths of green jobs over the next seven years.

A limitation of this approach is that it cannot account for the interaction between the changing mix of jobs and overall industry growth rates. In other words, does the greening of an industry accelerate, slow down, or not affect the overall (green as well as non-green) growth rate of each particular sector job count? Such analysis would require more data than is available, but should be considered in the future.

Methodology: Occupation Projections

Projections for occupation-specific green jobs changes over time were created in a similar fashion by using the

5. Public sector establishments were not part of the DLIR survey, so generating Government projections was not possible.
6. The North American Industry Classification System (NAICS) index of industry and sector listings is available online at http://www.census.gov/eos/www/naics/ from the U.S. Census Bureau. Our NAICS definitions comply with the 2007 NAICS standards.
7. This is unlikely, because the easiest and lowest cost conversions are available for employers to execute now. As the most profitable conversions are done early on, fewer obvious candidates for conversion will remain in the future. But it is possible that advances in technology or policy, which we cannot anticipate today, could affect the calculus of employers to keep conversion rates high even through 2018.

Launched in 2008, the Hawaii Clean Energy Initiative (HCEI) aims to achieve a 70% clean energy economy by 2030.

official U.S. Bureau of Labor Statistics (BLS) and DLIR occupation job projections as the basis for forward-looking counts. The Occupational Employment Statistics (OES) program at BLS produces survey-based estimates of job counts by specific Standard Occupational Classification (SOC) code.[8] In cooperation with the State of Hawaii DLIR, projections at the one[9] and eight[10] year intervals are produced each autumn.

Similar to the process that merged QCEW data and the UHERO forecast for sector job counts, we combine OES data and DLIR occupation projections to generate a SOC code-specific growth path for each occupation code. Each SOC code for which official OES and DLIR data are available was mapped to a growth path from 2010 out to 2011 and 2018. DLIR's green jobs survey data for 2010 and 2012 were used to add the effect of changing job mix, this time within each individual occupation code. Again due to data limitations, UHERO produced high and low scenarios. The high scenario extrapolates the surveyed growth rate from 2010 to 2012 out to 2018.

DLIR data from the *Hawaii's Green Workforce: A Baseline Assessment* and prior reports such as the Workforce Development Council's *Green Workforce Report* did not use standard SOC coding, but instead implemented O*Net SOC codes which further subdivided official SOC code occupations into component sub-occupations. For example, SOC 45-2092 is officially "Farmworker and Laborers, Crop, Nursery, and Greenhouse." O*Net's system and the various State reports instead produce estimates for the component sub-occupations 45-2092.01 "Nursery Workers" and 45-2092.02 "Farmworkers and Laborers, Crop." It is not clear from the official reports whether the basis for the component estimates sum to the total. This discrepancy between estimation by DLIR using O*Net and official OES SOC systems in the different reports may have introduced some error.[11] We attempted to minimize this by adhering strictly to official OES and BLS definitions of SOC occupations, suppressing projections for any occupation code where it appeared large discrepancies were introduced.

Green Jobs and Hawaii's Clean Energy Inititiative

In January 2008, the Hawaii Clean Energy Initiative (HCEI) was launched between the U.S. Department of Energy and the State of Hawaii. HCEI aims to achieve a 70% clean energy economy by 2030. To help achieve this goal, in 2009 the State Legislature increased the Renewable Portfolio Standard (RPS) to 40% by 2030. RPSs are amongst the most powerful policy instruments that states have to help ensure a minimum amount of renewable electricity penetration and, ultimately, reduce greenhouse gas emissions and reliance on fossil fuels. Notably, starting in 2015 the updated RPS no longer includes energy efficiency. As such, an Energy Efficiency

8. The official SOC system description and index can be accessed online at http://www.bls.gov/soc.
9. *Employment Forecasts for the Short-Term Future 2009-2011* from September 2010 is the newest short-term report. Because the baseline year the report is generated against is one year prior to the report issue date, it projects one year forward rather than two. The report is available online from the DLIR at: https://www.hiwi.org/admin/gsipub/htmlarea/uploads/Short-Term%20Forecasts%202009-2011.pdf.
10. *Employment Projections for Industries and Occupations 2008-2018* from September 2010 is the newest long-term report. Because the baseline year the report is generated against is two years prior to the report's issue date, it projects eight years forward rather than ten. The report is available online from DLIR at https://www.hiwi.org/admin/gsipub/htmlarea/uploads/Long-Term%20Projections%202008-18%20State.pdf
11. Solar Photovoltaic Installers, O*Net SOC 47-4099.01 is a good example of this. The December 2010 *Hawaii's Green Workforce: A Baseline Assessment* report indicates that 237 green jobs in that code existed at the time of the survey in early 2010 (Appendix C, page 65). However, the official OES estimate for the entire 47-4099 SOC code, of which Solar Photovoltaic Installers is a component sub-occupation, was 130 in 2009. DLIR's short-term forecast from September 2010 projects no growth in that SOC code through 2011, and the long-term forecast projects an increase only to 170 by 2018 for the entire 47-4099 SOC code. The December 2010 green jobs report, on the other hand, suggests the green jobs portion of the sub-component 47-4099.01 will more than double by 2012 to 684 (see page 35 of the report). Occupations with data anomalies like this have been suppressed.

Portfolio Standard was created to achieve 30% energy efficiency based on projected electricity demand by 2030. The separation of renewable energy from efficiency is an important one in terms of making the RPS a more stringent target.

The Public Utilities Commission has recently approved a docket in regards to a feed-in-tariff, which sets specific rates for utility purchase of various renewable energies including wind and solar photovoltaic. This mechanism, along with rising world oil prices, will make renewable energy sources for electricity more economically attractive within the State.

Hawaii is currently overwhelmingly dependent on oil for its energy needs—meeting nearly 80% of its electricity demand through petroleum-burning. The challenges to increasing renewable sources of electricity include are both economic and physical. Although intermittent energy sources such as wind, solar, and ocean are abundant in Hawaii, there is difficulty in accepting these fluctuating energy types within a small grid system. Thus, although the Renewable Portfolio Standard was recently codified into law, there remains great uncertainty and debate as to the appropriate mix, and scale, of various renewable energies.

The State and Hawaiian Electric Company have entered into a voluntary agreement. Although there is a wide range of renewable energy types identified within the agreement, the dominant indigenous energy source included is the installation of large wind farms. Notably, up to 450 megawatts of wind turbines are sited for Lanai and Molokai, and the State is currently in the planning stages to bring the power to Oahu via an undersea cable.

The project's potential impacts are currently being studied. The Environmental Impact Statement is currently in the planning process, and studies are being conducted regarding the potential costs. The costs for the undersea cable are quite uncertain (generally posited as a $1 billion infrastructure investment)—and financing mechanisms are similarly unclear. Questions remain regarding whether the cable will be financed by taxpayers, ratepayers, privately, or otherwise. Clearly these distinct mechanisms will have differing impacts on residents of Hawaii and the overall economy.

There is little precise data on the current and projected labor impacts of renewable energy within the State. For example, the Kaheawa Wind Farm has four employees associated with its 30 MW of power.[12] This likely does not include additional contractors, such as electricians. In addition, there is clearly much higher employment associated with the construction phase of wind installation. For the undersea cable, on the other hand, while it is a large construction project, very few companies worldwide are capable of installing this type of cable and thus the labor is likely to be imported.

Up to 450 megawatts of wind turbines are sited for Lanai and Molokai, and the State is currently in the planning stages to bring the power to Oahu via an undersea cable.

Oahu is likely to have more potential for solar photovoltaic, given the extensive rooftop real estate. To foster the development of solar projects, the State provides a 35% tax credit, in addition to the federal subsidy of 30%, for the cost and installation of the unit.

As such, as highlighted in the report, solar photovoltaic is amongst the fastest growing renewable energy industries. Employment in the solar photovoltaic industry ranges from installers and electricians to marketing and sales. Once installed, there is little maintenance costs or labor needs. In addition, there is a net metering cap that will limit the overall growth of solar units. There is a limit of 1% of utility peak demand for HECO and KIUC and 3% for HELCO and MECO. Thus, the rapid job increase is not likely to continue at the same rate without improved grid-management technologies and supportive policies.

One of the largest challenges in integrating renewable energy sources within the electric grid is managing in-

12. http://www.hoovers.com/search/company-search-results/100003765-1.html?type=company&term=Kaheawa

termittent energy sources, such as wind and solar power. This is one of the reasons that biofuels, in the form of bio-oil and/or biodiesel, are appealing. Biofuels are a firm and easily-transportable energy source that can be burned in existing generators. Thus, biomass-based fuels are highly substitutable with oil. In addition, locally-grown biofuels offer the potential to revitalize currently fallow agricultural lands. Labor is both a potential benefit of a local biofuel industry as well as a potential barrier. For example, in regards to ethanol production from sugarcane, Coffman (2009) estimated that there are 8 jobs per million dollars of ethanol output. This is in contrast to 0.2 jobs per million dollars of petroleum manufacturing. In addition, labor compensation comprised 44% of the value of sugarcane production, by far the most costly input.[13] The cost of labor is among the reasons for the decline of large-scale agriculture in Hawaii and will certainly be a challenge for the biofuel industry in the future.

While there are a number of planned projects and newly-built renewable energy projects, such as the wind farm recently installed on Oahu, the full trajectory of renewable energy technologies to meet the RPS requirement in 2030 is yet unknown. The RPS could be met, for example, through the installation of large-scale wind farms, distributed and utility-scale solar photovoltaic, locally grown biomass, or imported biomass. The labor impact between these technologies is quite distinct and, of course, is only one consideration amongst many in the move to Hawaii's clean energy future.

13. http://www.hnei.hawaii.edu/bmpp/documents/stakeholders/masterplan/20091215/Vol_II_HBMP_2.8_Economic_Impacts.pdf

Appendix A:
Green Jobs by Industry

	Current Jobs		Forecasted Green Jobs				Forecasted Green Jobs				2010-2018 Overall Growth			
			2012		2014		2016		2018		High Growth Scenario		Low Growth Scenario	
Industry	**Green Jobs**	**Total Jobs**	**High Growth**	**Low Growth**	**High Growth**	**Low Growth**	**High Growth**	**Low Growth**	**High Growth**	**Low Growth**	**Green Jobs**	**Percent Change**	**Green Jobs**	**Percent Change**
Agriculture, Forestry, Fishing, & Hunting	278	6,482	495	331	707	382	919	434	1,129	485	851	306.0%	207	74.6%
Construction and Mining	3,330	29,653	4,796	3,950	6,825	4,874	8,280	5,298	9,450	5,538	6,120	183.8%	2,208	66.3%
Manufacturing	347	13,498	398	366	443	378	487	388	529	398	182	52.4%	51	14.7%
Transportation, Warehousing, & Utilities	389	26,311	401	412	420	442	426	462	425	475	36	9.3%	86	22.1%
Retail and Wholesale Trade	1,494	84,885	1,661	1,561	1,838	1,633	2,014	1,701	2,186	1,761	692	46.3%	267	17.9%
Finance, Insurance, and Real Estate	98	27,476	*	*	*	*	*	*	*	*	*	*	*	*
Health Care and Social Assistance Services	183	59,895	202	192	225	204	249	216	272	226	88	48.2%	43	23.6%
Accommodations and Food Services	174	88,978	276	204	384	236	496	267	611	299	437	251.4%	125	45.3%
Other Services	4,854	128,656	5,717	5,271	6,617	5,680	7,506	6,050	8,347	6,359	3,493	72.0%	1,506	26.3%
Total Private Industry	**11,145**	**465,834**	**14,048**	**12,188**	**16,933**	**13,349**	**19,885**	**14,353**	**22,766**	**14,253**	**11,621**	**104.3%**	**3,108**	**27.9%**

* The number of additional jobs is greater than zero but less than ten.

Appendix B:
Green Jobs by Occupation

		2009	2010			2011			2012	2018					2010–2018 Green Jobs Change	
										High Growth		Low Growth		Total Jobs		
SOC Code	Occupational Title	Total Jobs	Green Jobs	Total Jobs	Share	Green Jobs	Total Jobs	Share	Green Jobs	Green Jobs	Share	Green Jobs	Share		High Growth	Low Growth
37-2011.00	**Janitors and Cleaners, except Maids and Housekeeping Cleaners**	13250	1197	13285	9.0%	1,223	13320	9.2%	1,248	1,497	10.4%	1,351	9.3%	14450	300	154
19-4093.00	**Forest and Conservation Technicians**	130	601	*	*	*	130	*	622	*	*	*	*	140	*	*
33-9032.00	**Security Guards**	10250	552	10390	5.3%	552	10530	5.2%	552	578	4.7%	629	5.2%	12170	26	77
47-2111.00	**Electricians**	2900	438	2855	15.3%	542	2810	19.3%	647	1,646	47.0%	814	23.3%	3500	1,208	376
49-9021.01	**Heating and Air Conditioning Mechanics and Installers**	800	348	800	43.5%	376	800	47.0%	403	690	71.1%	489	50.4%	970	342	141
47-2031.01	**Construction Carpenters**	8630	306	8430	3.6%	326	8230	4.0%	345	692	6.2%	475	4.3%	11080	386	169
47-2131.00	**Insulation Workers—Floor, Ceiling, and Wall**	**	277	**	**	307	**	**	337	**	**	**	**	**	**	**
37-3011.00	**Landscaping and Groundskeeping Workers**	9520	276	9600	2.9%	306	9680	3.2%	336	584	5.2%	390	3.4%	11310	308	114
47-4099.01	**Solar Photovoltaic Installers**	130	237	*	*	*	130	*	684	*	*	*	*	170	*	*
41-2031.00	**Retail Salespersons**	23890	219	24055	0.9%	255	24220	1.1%	290	576	2.0%	337	1.2%	28270	357	118
19-4091.00	**Environmental Science and Protection Technicians, including Health**	180	196	*	*	*	180	*	215	*	*	*	*	200	*	*
51-9199.01	**Recycling and Reclamation Workers**	290	194	290	66.9%	209	290	72.2%	225	*	*	*	*	350	*	*
47-4099.02	**Solar Thermal Installers and Technicians**	130	194	*	*	*	130	*	297	297	*	*	*	170	*	*
53-7062.00	**Laborers and Freight, Stock, and Material Movers—Hand**	8390	191	8325	2.3%	219	8260	2.6%	247	456	5.1%	267	3.0%	8890	265	76
47-2132.00	**Insulation Workers—Mechanical**	**	184	**	**	241	**	**	297	**	**	**	**	**	**	**
47-2061.00	**Construction Laborers**	5410	173	5325	3.2%	173	5240	3.3%	173	274	3.7%	249	3.4%	7420	101	76
47-1011.00	**First-Line Supervisors / Managers of Construction Trades and Extraction Workers**	2410	167	2365	7.1%	191	2320	8.2%	214	499	16.3%	287	9.4%	3060	332	120

Chart continues through page 32

* Data is suppressed for consistency concerns.
** Data is not available.

		2009	2010			2011			2012	2018					2010–2018 Green Jobs Change	
										High Growth		Low Growth		Total Jobs		
SOC Code	Occupational Title	Total Jobs	Green Jobs	Total Jobs	Share	Green Jobs	Total Jobs	Share	Green Jobs	Green Jobs	Share	Green Jobs	Share		High Growth	Low Growth
47-2152.02	**Plumbers**	2790	167	2755	6.1%	176	2720	6.5%	185	315	9.3%	232	6.9%	3380	148	65
47-4041.00	**Hazardous Materials Removal Workers**	290	160	290	55.2%	160	290	55.3%	161	169	56.3%	166	55.5%	300	9	6
49-9042.00	**Maintenance and Repair Workers—General**	6410	159	6490	2.4%	176	6570	2.7%	194	327	4.3%	221	2.9%	7560	168	62
17-2051.00	**Civil Engineers**	1910	152	1900	8.0%	160	1890	8.5%	169	249	11.9%	188	9.0%	2090	97	36
17-2071.00	**Electrical Engineers**	630	140	635	22.0%	145	640	22.7%	150	172	26.9%	149	23.3%	640	32	9
41-3099.00	**Sales Representative Services—All Other**	2910	126	2915	4.3%	134	2920	4.6%	142	213	6.5%	160	4.9%	3290	87	34
53-6099.00	**Transportation Workers—All Other**	1000	121	1010	12.0%	121	1020	11.9%	122	136	11.4%	141	11.8%	1190	15	20
27-3031.00	**Public Relations Specialists**	1400	121	1420	8.5%	138	1440	9.6%	154	291	16.8%	183	10.6%	1730	170	62
51-9061.00	**Inspectors, Testers, Sorters, Samplers, and Weighers**	570	117	565	20.7%	122	560	21.7%	126	181	28.7%	143	22.7%	630	64	26
19-2041.00	**Environmental Scientists and Specialists, including Health**	810	114	815	14.0%	130	820	15.8%	145	259	28.5%	160	17.6%	910	145	46
49-9099.00	**Installation Maintenance and Repair Workers—All Other**	1140	114	1150	9.9%	115	1160	9.9%	135	206	16.4%	144	11.5%	1250	92	30
45-2092.02	**Farmworkers and Laborers—Crop**	3300	106	3290	3.2%	106	3280	3.2%	106	126	3.3%	123	3.2%	3770	20	17
37-1012.00	**First-Line Supervisors/Managers of Landscaping, Lawn Service, and Groundskeeping Workers**	1430	103	1440	7.2%	141	1450	9.7%	179	459	27.7%	204	12.3%	1660	356	101
41-2011.00	**Cashiers**	14430	103	14555	0.7%	*	14680	*	74	*	*	*	*	15550	*	*
49-3023.02	**Automotive Specialty Technicians**	2610	95	2605	3.6%	99	2600	3.8%	102	149	4.8%	122	3.9%	3080	54	27
41-1011.00	**First-Line Supervisors / Managers of Retail Sales Workers**	8880	89	8925	1.0%	89	8970	1.0%	89	98	1.0%	100	1.0%	10100	9	11
53-3032.00	**Truck Drivers—Heavy and Tractor-Trailer**	3870	84	3865	2.2%	90	3860	2.3%	96	163	3.4%	118	2.5%	4740	79	34
45-4011.00	**Forest and Conservation Workers**	**	82	**	**	82	**	**	82	**	**	**	**	**	**	**
41-4011.00	**Sales Representatives—Wholesale and Manufacturing—Technical and Scientific Products**	560	80	555	14.4%	86	550	15.7%	92	151	24.4%	105	16.9%	620	71	25
45-2041.00	**Graders and Sorters—Agricultural Products**	**	79	**	**	130	**	**	181	**	**	**	**	**	**	**

		2009	2010			2011			2012	2018					2010–2018 Green Jobs Change	
										High Growth		Low Growth		Total Jobs		
SOC Code	Occupational Title	Total Jobs	Green Jobs	Total Jobs	Share	Green Jobs	Total Jobs	Share	Green Jobs	Green Jobs	Share	Green Jobs	Share		High Growth	Low Growth
15-1041.00	**Computer Support Specialists**	1270	76	1270	6.0%	121	1270	9.6%	167	484	34.6%	184	13.1%	1400	408	108
11-9012.00	**Farmers and Ranchers**	4990	75	4970	1.5%	75	4950	1.5%	75	77	1.6%	76	1.5%	4980	2	1
43-3031.00	**Bookkeeping, Accounting, and Auditing Clerks**	7970	73	7970	0.9%	75	7970	0.9%	76	97	1.1%	86	1.0%	9010	24	13
27-1025.00	**Interior Designers**	150	69	150	46.0%	76	150	50.7%	83	134	83.7%	89	55.4%	160	65	20
11-1021.00	**General and Operations Managers**	9450	69	9365	0.7%	70	9280	0.8%	72	90	0.9%	78	0.8%	9960	21	9
41-9041.00	**Telemarketers**	450	66	440	15.0%	66	430	15.4%	67	75	18.3%	65	15.8%	410	9	(1)
47-2044.00	**Tile and Marble Setters**	790	64	775	8.3%	81	760	10.6%	98	283	27.2%	135	13.0%	1040	219	71
51-6093.00	**Upholsterers**	**	64	**	**	137	**	**	209	**	**	**	**	**	**	**
17-1011.00	**Architects, except Landscape and Naval**	740	62	735	8.4%	64	730	8.8%	67	82	11.4%	66	9.2%	720	20	4
49-1011.00	**First-Line Supervisors / Managers of Mechanics, Installers, and Repairers**	2170	61	2185	2.8%	63	2200	2.9%	65	81	3.4%	71	2.9%	2420	20	10
13-1199.05	**Sustainability Specialists**	5720	61	5810	1.0%	69	5900	1.2%	78	124	2.0%	79	1.3%	6050	63	18
43-9061.00	**Office Clerks—General**	14700	58	14685	0.4%	62	14670	0.4%	67	106	0.6%	76	0.5%	16650	48	18
17-2141.00	**Mechanical Engineers**	520	57	525	10.9%	62	530	11.7%	67	90	17.4%	65	12.5%	520	33	8
13-1023.00	**Purchasing Agents, except Wholesale, Retail, and Farm Products**	1050	55	1070	5.1%	56	1090	5.1%	57	63	5.0%	64	5.1%	1260	8	9
47-4021.00	**Elevator Installers and Repairers**	240	54	235	23.0%	54	230	23.7%	55	83	28.5%	71	24.4%	290	29	17
47-2041.00	**Carpet Installers**	410	54	395	13.7%	54	380	14.2%	54	86	18.2%	70	14.8%	470	32	16
47-2073.00	**Operating Engineers and Other Construction Equipment Operators**	1800	53	1765	3.0%	53	1730	3.1%	54	81	3.6%	71	3.2%	2250	28	18
17-2199.03	**Energy Engineers**	740	53	750	7.1%	63	760	8.4%	74	127	17.4%	70	9.6%	730	74	17
41-4012.00	**Sales Representatives—Wholesale and Manufacturing, except Technical and Scientific PR**	4890	53	4865	1.1%	55	4840	1.1%	56	79	1.4%	66	1.2%	5700	26	13
11-9041.00	**Engineering Managers**	530	48	530	9.1%	50	530	9.4%	51	67	11.5%	56	9.7%	580	19	8
51-1011.00	**First-Line Supervisors / Managers of Production and Operating Workers**	1360	48	1355	3.5%	95	1350	7.0%	141	470	31.3%	157	10.5%	1500	422	109

		2009	2010			2011			2012	2018					2010–2018 Green Jobs Change	
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SOC Code	Occupational Title	Total Jobs	Green Jobs	Total Jobs	Share	Green Jobs	Total Jobs	Share	Green Jobs	Green Jobs	Share	Green Jobs	Share		High Growth	Low Growth
41-9031.00	**Sales Engineers**	**	46	**	**	156	**	**	267	**	**	**	**	**	**	**
49-9092.00	**Commercial Divers**	70	45	70	64.3%	45	70	64.5%	45	53	66.3%	52	64.8%	80	8	7
37-3013.00	**Tree Trimmers and Pruners**	600	42	610	6.9%	46	620	7.5%	51	91	11.6%	63	8.1%	780	49	21
37-2021.00	**Pest Control Workers**	**	42	**	**	47	**	**	51	**	**	**	**	**	**	**
53-3033.00	**Truck Drivers—Light or Delivery Services**	4350	42	4335	1.0%	46	4320	1.1%	50	86	1.7%	58	1.1%	5080	44	16
51-9023.00	**Mixing and Blending Machine Setters, Operators, and Tenders**	100	37	100	37.0%	39	100	39.2%	41	71	54.5%	54	41.4%	130	34	17
13-1051.00	**Cost Estimators**	660	37	650	5.7%	40	640	6.3%	43	99	10.3%	66	6.8%	960	62	29
45-2092.01	**Nursery Workers**	3300	37	3290	1.1%	37	3280	1.1%	37	44	1.2%	43	1.1%	3770	7	6
45-2093.00	**Farmworkers, Farm and Ranch Animals**	520	36	510	7.1%	36	500	7.3%	37	47	8.9%	40	7.5%	530	11	4
49-2092.00	**Electric Motor, Power Tool, and Related Repairers**	**	36	**	**	53	**	**	70	**	**	**	**	**	**	**
51-7011.00	**Cabinetmakers and Bench Carpenters**	280	35	275	12.7%	*	270	*	30	*	*	*	*	350	*	*
51-8013.00	**Power Plant Operators**	320	34	330	10.3%	35	340	10.4%	37	41	11.1%	39	10.5%	370	7	5
49-9098.00	**Helpers—Installation, Maintenance, and Repair Workers**	680	34	680	5.0%	34	680	5.1%	35	44	5.5%	41	5.1%	810	10	7
51-5023.00	**Printing Machine Operators**	450	34	435	7.8%	34	420	8.1%	34	53	10.3%	43	8.4%	510	19	9
41-4011.07	**Solar Sales Representatives and Assessors**	560	33	555	5.9%	37	550	6.8%	42	80	12.9%	48	7.7%	620	47	15
47-1011.03	**Solar Energy Installation Managers**	2410	32	2365	1.4%	34	2320	1.5%	36	68	2.2%	48	1.6%	3060	36	16
39-6021.00	**Tour Guides and Escorts**	2220	29	2210	1.3%	29	2200	1.3%	30	36	1.5%	33	1.4%	2410	7	4
29-9011.00	**Occupational Health and Safety Specialists**	370	29	375	7.7%	38	380	9.9%	46	98	25.2%	47	12.1%	390	69	18
47-4099.03	**Weatherization Installers and Technicians**	130	28	130	21.5%	31	130	23.7%	33	65	38.4%	44	25.8%	170	37	16
51-9121.00	**Coating, Painting, and Spraying Machine Setters, Operators, and Tenders**	**	28	**	**	32	**	**	36	**	**	**	**	**	**	**
19-3051.00	**Urban and Regional Planners**	360	27	360	7.5%	34	360	9.5%	41	91	23.4%	45	11.5%	390	64	18

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51-9199.00	**Production Workers—All Other**	290	27	290	9.3%	27	290	9.4%	27	34	9.7%	33	9.4%	350	7	6
11-9151.00	**Social and Community Service Managers**	660	26	660	3.9%	28	660	4.2%	30	45	6.1%	33	4.5%	730	19	7
15-1099.11	**Information Technology Project Managers**	1350	26	1385	1.9%	32	1420	2.3%	39	69	5.2%	36	2.7%	1340	43	10
11-1011.00	**Chief Executives**	1670	26	1650	1.6%	26	1630	1.6%	26	31	1.8%	28	1.6%	1740	5	2
41-2021.00	**Counter and Rental Clerks**	1670	25	1680	1.5%	27	1690	1.6%	30	48	2.6%	33	1.8%	1890	23	8
47-5021.00	**Earth Drillers, except Oil and Gas**	100	25	100	25.0%	28	100	28.3%	32	62	51.5%	38	31.6%	120	37	13
47-2141.00	**Painters—Construction and Maintenance**	3180	24	3135	0.8%	43	3090	1.4%	62	214	5.8%	75	2.0%	3710	190	51
51-9032.00	**Cutting and Slicing Machine Setters, Operators, and Tenders**	80	24	80	30.0%	24	80	30.1%	24	24	30.4%	24	30.1%	80	0	0
47-2211.00	**Sheet Metal Workers**	790	23	775	3.0%	24	760	3.1%	24	39	4.2%	30	3.3%	930	16	7
25-3099.00	**Teachers and Instructors—All Other**	2180	22	2205	1.0%	26	2230	1.2%	30	60	2.3%	35	1.3%	2660	38	13
51-9197.00	**Tire Builders**	**	22	**	**	26	**	**	31	**	**	**	**	**	**	**
19-1031.01	**Soil and Water Conservationists**	140	22	145	15.2%	22	150	14.8%	22	17	11.9%	20	14.4%	140	(5)	(2)
43-5021.00	**Couriers and Messengers**	490	21	485	4.3%	21	480	4.5%	22	27	5.4%	23	4.6%	500	6	2
23-1011.00	**Lawyers**	2900	20	2880	0.7%	20	2860	0.7%	20	22	0.8%	21	0.7%	2950	2	1
19-4011.01	**Agricultural Technicians**	380	19	380	5.0%	22	380	5.7%	25	45	10.9%	27	6.5%	410	26	8
53-7061.00	**Cleaners of Vehicles and Equipment**	1530	19	1535	1.2%	20	1540	1.3%	21	29	1.7%	24	1.3%	1760	10	5
11-9021.00	**Construction Managers**	2350	19	2290	0.8%	19	2230	0.9%	20	36	1.2%	29	0.9%	3120	17	10
17-2081.00	**Environmental Engineers**	230	19	235	8.1%	19	240	7.9%	19	16	6.7%	19	7.8%	240	(3)	(0)
51-6052.00	**Tailors, Dressmakers, and Custom Sewers**	200	19	200	9.5%	26	200	13.2%	34	**	**	**	17.0%	**	**	**
51-4121.06	**Welders Cutters and Welder Fitters**	600	18	610	3.0%	18	620	2.9%	18	17	2.7%	18	2.9%	640	(1)	0
43-6011.00	**Executive Secretaries and Administrative Assistants**	5090	17	5090	0.3%	24	5090	0.5%	31	82	1.4%	35	0.6%	5870	65	18
11-2021.00	**Marketing Managers**	600	17	600	2.8%	24	600	3.9%	30	80	11.7%	34	5.1%	680	63	17

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13-1073.00	**Training and Development Specialists**	570	16	575	2.8%	16	580	2.8%	17	22	3.0%	20	2.8%	710	6	4
25-2032.00	**Vocational Education Teachers—Secondary School**	**	16	**	**	19	**	**	22	**	**	**	**	**	**	**
19-2042.00	**Geoscientists, except Hydrologists and Geographers**	210	15	210	7.1%	15	210	7.4%	16	20	8.9%	17	7.6%	230	5	2
39-1021.00	**First-line Supervisors/Personal Service Workers**	1670	15	1685	0.9%	15	1700	0.9%	16	21	1.0%	19	0.9%	2060	6	4
17-3022.00	**Civil Engineering Technicians**	150	14	145	9.7%	16	140	11.7%	19	38	25.6%	20	13.6%	150	24	6
11-9199.11	**Brownfield Redevelopment Specialists and Site Managers**	3650	14	3660	0.4%	14	3670	0.4%	14	15	0.4%	15	0.4%	3990	1	1
47-2181.00	**Roofers**	610	13	585	2.2%	20	560	3.7%	28	96	13.7%	36	5.1%	700	83	23
17-3027.00	**Mechanical Engineering Technicians**	**	13	**	**	13	**	**	13	**	**	**	**	**	**	**
17-3012.02	**Electrical Drafters**	190	13	185	7.0%	13	180	7.3%	13	17	9.2%	14	7.6%	180	4	1
19-2031.00	**Chemists**	180	13	180	7.2%	13	180	7.3%	13	14	7.8%	13	7.4%	180	1	0
19-4099.01	**Quality Control Analysts**	430	12	430	2.8%	12	430	2.9%	13	16	3.6%	13	3.0%	430	4	1
51-5022.00	**Prepress Technicians and Workers**	60	12	60	20.0%	11	60	19.1%	11	8	13.0%	11	18.2%	60	(4)	(1)
11-3051.04	**Biomass Production Managers**	170	11	165	6.7%	11	160	7.2%	12	20	10.6%	15	7.6%	190	9	4
47-4099.00	**Construction and Related Workers—All Other**	130	11	130	8.5%	12	130	9.5%	14	29	17.0%	18	10.6%	170	18	7
43-5081.03	**Stock Clerks—Stockroom, Warehouse, or Storage Yard**	7550	11	7645	0.1%	10	7740	0.1%	9	3	0.0%	10	0.1%	8530	(8)	(1)
43-1011.00	**First-Line Supervisors / Managers of Office and Administrative Support Workers**	6920	10	6930	0.1%	19	6940	0.3%	28	95	1.2%	32	0.4%	7900	85	22
13-1199.01	**Energy Auditors**	5720	10	5810	0.2%	12	5900	0.2%	15	28	0.5%	15	0.2%	6050	18	5
45-1011.07	**First-Line Supervisors/Managers of Agricultural Crop and Horticultural Workers**	**	10	**	**	10	**	**	11	**	**	**	**	**	**	**
17-2199.11	**Solar Energy Systems Engineers**	740	10	750	1.3%	33	760	4.3%	56	184	25.3%	53	7.3%	730	174	43
17-1012.00	**Landscape Architects**	120	10	120	8.3%	10	120	8.4%	10	11	9.2%	10	8.6%	120	1	0

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51-3092.00	**Food Batchmakers**	650	8	650	1.2%	11	650	1.7%	15	41	5.4%	17	2.3%	770	33	9
51-9021.00	**Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders**	60	8	60	13.3%	11	60	17.8%	13	34	48.8%	16	22.2%	70	26	8
27-1011.00	**Art Directors**	180	8	175	4.6%	8	170	4.7%	8	12	5.9%	10	4.9%	210	4	2
13-1041.01	**Environmental Compliance Inspectors**	3000	8	3110	0.3%	8	3220	0.2%	8	7	0.2%	9	0.2%	3610	(1)	1
43-6014.00	**Secretaries, except Legal, Medical, and Executive**	7410	7	7355	0.1%	7	7300	0.1%	8	10	0.1%	8	0.1%	7740	3	1
43-4171.00	**Receptionists and Information Clerks**	3950	7	3955	0.2%	8	3960	0.2%	9	16	0.4%	10	0.2%	4370	9	3
11-2022.00	**Sales Managers**	1710	7	1725	0.4%	7	1740	0.4%	7	10	0.5%	9	0.4%	2120	3	2
49-9094.00	**Locksmiths and Safe Repairers**	30	7	30	23.3%	7	30	24.0%	7	9	29.0%	7	24.8%	30	2	0
15-1099.02	**Computer Systems Engineers / Architects**	1350	7	1385	0.5%	7	1420	0.5%	7	6	0.4%	7	0.5%	1340	(1)	(0)
11-3021.00	**Computer and Information Systems Managers**	520	6	520	1.2%	6	520	1.2%	7	11	1.8%	8	1.3%	590	5	2
11-3051.01	**Quality Control Systems Managers**	170	6	165	3.6%	8	160	5.0%	10	27	14.3%	12	6.3%	190	21	6
49-9041.00	**Industrial Machinery Mechanics**	630	6	645	0.9%	6	660	1.0%	7	10	1.3%	7	1.0%	730	4	1
11-3071.02	**Storage and Distribution Managers**	490	6	485	1.2%	6	480	1.3%	7	9	1.8%	7	1.4%	480	3	1
51-3022.00	**Meat, Poultry, and Fish Cutters and Trimmers**	430	6	435	1.4%	8	440	1.9%	11	27	5.5%	12	2.4%	480	21	6
53-7064.00	**Packers and Packagers—Hand**	2840	6	2820	0.2%	6	2800	0.2%	6	7	0.2%	6	0.2%	2840	1	0
17-1021.00	**Cartographers and Photogrammetrists**	70	6	70	8.6%	6	70	8.6%	6	7	9.0%	7	8.7%	80	1	1
19-2041.02	**Environmental Restoration Planners**	810	6	815	0.7%	8	820	1.0%	10	25	2.8%	11	1.2%	910	19	5
19-3091.02	**Archeologists**	230	6	235	2.6%	6	240	2.5%	6	6	2.3%	6	2.5%	250	(0)	0
13-1111.00	**Management Analysts**	2130	5	2145	0.2%	5	2160	0.3%	6	8	0.4%	6	0.3%	2150	3	1
49-9044.00	**Millwrights**	**	5	**	**	6	**	**	7	**	**	**	**	**	**	**
53-5021.01	**Ship and Boat Captains**	490	5	500	1.0%	5	510	1.1%	6	10	1.5%	8	1.1%	660	5	3
11-3031.01	**Treasurers and Controllers**	2160	5	2150	0.2%	5	2140	0.2%	6	9	0.4%	6	0.3%	2390	4	1

		2009	2010			2011			2012	2018					2010–2018 Green Jobs Change	
										High Growth		Low Growth		Total Jobs		
SOC Code	Occupational Title	Total Jobs	Green Jobs	Total Jobs	Share	Green Jobs	Total Jobs	Share	Green Jobs	Green Jobs	Share	Green Jobs	Share		High Growth	Low Growth
21-1099.00	**Community and Social Service Specialists—All Other**	1140	5	1135	0.4%	6	1130	0.5%	7	15	1.1%	8	0.6%	1300	10	3
51-6011.00	**Laundry and Dry-Cleaning Workers**	1370	5	1370	0.4%	5	1370	0.4%	6	8	0.5%	6	0.4%	1450	3	1
17-3026.00	**Industrial Engineering Technicians**	**	5	**	**	5	**	**	5	**	**	**	**	**	**	**
21-1093.00	**Social and Human Service Assistants**	2880	5	2915	0.2%	5	2950	0.2%	5	7	0.2%	6	0.2%	3490	2	1
31-1012.00	**Nursing Aides, Orderlies, and Attendants**	4990	5	5085	0.1%	5	5180	0.1%	5	5	0.1%	6	0.1%	6160	(0)	1
17-3023.03	**Electrical Engineering Technicians**	560	4	570	0.7%	4	580	0.8%	5	7	1.2%	4	0.8%	540	3	0
35-9011.00	**Dining Room and Cafeteria Attendants and Bartender Helpers**	3630	4	3680	0.1%	4	3730	0.1%	5	8	0.2%	5	0.1%	3980	4	1
37-1011.00	**First-Line Supervisors / Managers of Housekeeping and Janitorial Workers**	1560	4	1575	0.3%	4	1590	0.3%	5	8	0.5%	5	0.3%	1720	4	1
27-1019.00	**Artists and Related Workers—All Other**	**	4	**	**	4	**	**	5	**	**	**	**	**	**	**
49-3031.00	**Bus and Truck Mechanics and Diesel Engine Specialists**	700	4	700	0.6%	4	700	0.6%	5	8	1.1%	6	0.7%	800	4	2
11-9032.00	**Education Administrators—Elementary and Secondary School**	940	4	940	0.4%	4	940	0.5%	5	9	0.8%	6	0.5%	1120	5	2
27-1027.00	**Set and Exhibit Designers**	**	4	**	**	4	**	**	5	**	**	**	**	**	**	**
17-3029.00	**Engineering Technicians, except Drafter—All Other**	640	4	650	0.6%	7	660	1.1%	10	27	4.3%	10	1.5%	640	23	6
19-1032.00	**Foresters**	20	4	20	20.0%	4	20	21.5%	5	6	32.2%	5	23.1%	20	2	1
17-2021.00	**Agricultural Engineers**	**	4	**	**	4	**	**	5	**	**	**	**	**	**	**
25-9021.00	**Farm and Home Management Advisors**	**	4	**	**	4	**	**	4	**	**	**	**	**	**	**
11-3040.00	**Human Resources Managers**	**	4	**	**	4	**	**	4	**	**	**	**	**	**	**
45-2091.00	**Agricultural Equipment Operators**	120	4	115	3.5%	4	110	3.8%	4	7	5.7%	5	4.0%	130	3	1
19-1031.00	**Conservation Scientists**	140	4	145	2.8%	4	150	2.8%	4	4	2.7%	4	2.7%	140	(0)	(0)
19-1031.02	**Range Managers**	140	4	145	2.8%	4	150	2.7%	4	3	2.2%	4	2.6%	140	(1)	(0)

		2009	2010			2011			2012	2018					2010–2018 Green Jobs Change	
										High Growth		Low Growth		Total Jobs		
SOC Code	Occupational Title	Total Jobs	Green Jobs	Total Jobs	Share	Green Jobs	Total Jobs	Share	Green Jobs	Green Jobs	Share	Green Jobs	Share		High Growth	Low Growth
41-1012.00	First-Line Supervisors / Managers of Non-Retail Sales Workers	2160	4	2155	0.2%	4	2150	0.2%	4	5	0.2%	5	0.2%	2460	1	1
11-1011.03	Chief Sustainability Officers	1670	3	1650	0.2%	3	1630	0.2%	4	7	0.4%	4	0.2%	1740	4	1
15-1032.00	Computer Software Engineers—Systems Software	480	3	485	0.6%	3	490	0.7%	4	8	1.3%	5	0.8%	600	5	2
47-2021.00	Brickmasons and Blockmasons	390	3	380	0.8%	3	370	0.9%	4	9	1.9%	5	1.1%	480	6	2
51-8099.00	Plant and System Operators—All Other	**	3	**	**	3	**	**	4	**	**	**	**	**	**	**
49-3042.00	Mobile Heavy Equipment Mechanics, except Engines	400	3	400	0.8%	3	400	0.9%	4	7	1.6%	4	1.0%	430	4	1
23-2011.00	Paralegals and Legal Assistants	990	3	990	0.3%	3	990	0.3%	4	7	0.6%	4	0.4%	1060	4	1
43-5071.00	Shipping, Receiving, and Traffic Clerks	2130	3	2120	0.1%	4	2110	0.2%	5	13	0.6%	6	0.3%	2200	10	3
11-9199.00	Managers—All Other	3650	3	3660	0.1%	3	3670	0.1%	3	5	0.1%	4	0.1%	3990	2	1
51-8031.00	Water and Liquid Waste Treatment Plant and System Operators	360	3	365	0.8%	6	370	1.5%	8	27	6.2%	9	2.2%	430	24	6
27-1021.00	Commercial and Industrial Designers	60	3	60	5.0%	3	60	5.4%	3	6	7.9%	4	5.7%	70	3	1
13-1072.00	Compensation, Benefits, and Job Analysis Specialists	330	3	335	0.9%	3	340	0.9%	3	5	1.2%	4	1.0%	420	2	1
13-2011.01	Accountants	5430	3	5455	0.1%	3	5480	0.1%	3	5	0.1%	4	0.1%	6390	2	1
15-1099.10	Business Intelligence Analysts	1350	3	1385	0.2%	3	1420	0.2%	3	4	0.3%	3	0.2%	1340	1	0
43-4051.00	Customer Service Representatives	6650	3	6715	0.0%	3	6780	0.0%	3	5	0.1%	4	0.0%	8000	2	1
25-1194.00	Vocational Education Teachers—Postsecondary	840	3	845	0.4%	3	850	0.4%	3	5	0.5%	4	0.4%	1060	2	1
27-1024.00	Graphic Designers	680	3	665	0.5%	3	650	0.5%	3	6	0.7%	4	0.5%	770	3	1
51-9198.00	Helpers—Production Workers	860	3	860	0.3%	3	860	0.4%	3	5	0.5%	4	0.4%	940	2	1
37-2012.00	Maids and Housekeeping Cleaners	9890	3	10040	0.0%	4	10190	0.0%	5	10	0.1%	5	0.0%	10900	7	2
47-2071.00	Paving, Surfacing, and Tamping Equipment Operators	230	3	225	1.3%	3	220	1.4%	3	6	1.9%	4	1.5%	300	3	1

		2009	2010			2011			2012	2018					2010–2018 Green Jobs Change	
										High Growth		Low Growth		Total Jobs		
SOC Code	Occupational Title	Total Jobs	Green Jobs	Total Jobs	Share	Green Jobs	Total Jobs	Share	Green Jobs	Green Jobs	Share	Green Jobs	Share		High Growth	Low Growth
51-9195.03	**Stone Cutters and Carvers—Manufacturing**	60	3	60	5.0%	3	60	5.2%	3	5	6.3%	4	5.3%	80	2	1
53-1021.01	**Recycling Coordinators**	760	3	755	0.4%	4	750	0.6%	6	17	1.9%	7	0.8%	870	14	4
11-9199.10	**Wind Energy Project Managers**	3650	3	3660	0.1%	3	3670	0.1%	3	4	0.1%	3	0.1%	3990	1	0
11-3042.00	**Training and Development Managers**	120	2	120	1.7%	2	120	2.0%	3	6	4.7%	3	2.4%	130	4	1
11-3051.03	**Biofuels Production Managers**	170	2	165	1.2%	2	160	1.5%	3	7	3.8%	4	1.9%	190	5	2
11-9041.01	**Biofuels / Biodiesel Technology and Product Development Managers**	530	2	530	0.4%	2	530	0.5%	3	6	1.1%	3	0.5%	580	4	1
13-1199.00	**Business Operations Specialists—All Other**	5720	2	5810	0.0%	2	5900	0.0%	3	6	0.1%	3	0.0%	6050	4	1
13-2099.00	**Financial Specialists—All Other**	720	2	730	0.3%	2	740	0.3%	3	5	0.7%	3	0.4%	740	3	1
15-1031.00	**Computer Software Engineers, Applications**	800	2	805	0.2%	3	810	0.4%	4	12	1.2%	5	0.5%	1060	10	3
17-2111.01	**Industrial Safety and Health Engineers**	120	2	120	1.7%	3	120	2.5%	4	11	8.0%	5	3.3%	140	9	3
25-1041.00	**Agricultural Science Teachers—Postsecondary**	**	2	**	**	2	**	**	3	**	**	**	**	**	**	**
49-2094.00	**Electrical and Electronics Repairers—Commercial and Industrial Equipment**	420	2	430	0.5%	2	440	0.6%	3	5	1.2%	3	0.6%	450	3	1
49-9021.02	**Refrigeration Mechanics and Installers**	800	2	800	0.3%	3	800	0.4%	4	12	1.2%	5	0.5%	970	10	3
51-8012.00	**Power Distributors and Dispatchers**	**	2	**	**	2	**	**	3	**	**	**	**	**	**	**
53-7051.00	**Industrial Truck and Tractor Operators**	1200	2	1205	0.2%	2	1210	0.2%	3	7	0.5%	3	0.2%	1420	5	1
11-2011.01	**Green Marketers**	230	1	230	0.4%	6	230	2.6%	11	41	17.8%	11	4.8%	230	40	10
19-1023.00	**Zoologists and Wildlife Biologists**	160	1	160	0.6%	3	160	1.8%	5	16	10.1%	5	3.0%	160	15	4
25-9031.00	**Instructional Coordinators**	710	1	725	0.1%	3	740	0.4%	5	21	2.2%	6	0.6%	970	20	5
39-2021.00	**Nonfarm Animal Caretakers**	360	1	355	0.3%	4	350	1.2%	8	32	8.0%	9	2.2%	400	31	8
43-4161.00	**Human Resources Assistants, except Payroll and Timekeeping**	1150	1	1145	0.1%	1	1140	0.1%	2	4	0.4%	2	0.2%	1080	3	1

SOURCE: *Hawaii Green Jobs Survey*, Department of Labor & Industrial Relations, Research & Statistics Office, 2010.

* Suppressed for data consistency concerns
** Data not available

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Foreword

In 2009, the U.S. Department of Labor Employment and Training Administration awarded the State of Hawai'i a $1.2 million Labor Market Information Improvement Grant to help Hawai'i's Labor Market Information entity become a more effective partner in the state's transformation from the most oil-dependent state in the country to a state that will develop clean energy options for 70% of its energy needs by 2030.

In 2010, the State Department of Labor and Industrial Relations Research and Statistics Office, as the state's Labor Market Information entity, led the completion of a comprehensive green jobs survey. The results were published in a report entitled *Hawai'i's Green Workforce: A Baseline Assessment*. The report offers a baseline estimate for green jobs in Hawai'i and a prognosis about the growth of green jobs in 2012. The survey's design was aligned with the rigorous requirements of the U.S. Bureau of Labor Statistics.

In early 2011, the data was deployed for employment projection purposes. The University of Hawai'i Economic Research Organization used the baseline data to project the growth of green jobs in Hawai'i for 2011 and 2018. These projections were made to coincide with the time horizons of traditional DLIR R&S projections for all industries and occupations. The project was renamed the "Hawai'i Green Jobs Initiative" in time for the dissemination and outreach phase of the project.

This training gap assessment builds on the new green labor market information. It is a cursory one that is designed to lay out the logic framework for future assessments. It is guided by the sector approach to workforce development, an innovation in workforce development that focuses on a single industry and the transition of individuals from low-wage, low-skill employment to higher wage, higher-skilled jobs.

It embraces the best practices for nascent industry conditions, where workforce development intelligence is derived from historical labor market information along with insightful information from industry, education, and workforce development leaders and experts.

There are several ways to use the results responsibly, such as:

- to gain foundational information about the green construction industry and its skills and training requirements;
- to increase transparency about green training opportunities and gaps; and
- to elicit methods and analysis for future assessments.

While we have made every effort to validate the accuracy of data in this publication, the State of Hawaii and Department of Labor & Industrial Relations provide this assessment for educational and informational purposes only. References to specific products, services or companies are for illustrative purposes only, and do not reflect an endorsement by the State of Hawaii, DLIR or its affiliated agencies.

Executive Summary

This report is a green jobs training gap assessment. Its purpose is to provide an overview of the skills and education requirements for green jobs given current and projected labor force demands, alongside the training resources required to fulfill this need. It builds on green jobs data obtained from *Hawai'i's Green Workforce: A Baseline Assessment* and traditional labor market information. Data and insights from education and training providers, industry leaders and employers, and workforce development professionals were critical parts of the results and process. The report focuses on green construction-related occupations.

KEY FINDINGS INCLUDE:

- The vast majority of green jobs are and will be current occupations whose core skills will remain the same; the jobs will require workers to enhance their skills and knowledge as green products and services become increasingly commonplace. The supply of labor for these green jobs will come from two sources: current workers and new entrants to the occupation.

- The path to a green job depends on the employment stage of an individual. Apprenticeships and classroom instruction from community colleges or trade schools are key paths for new entrants. For veteran journey workers, trade, seminars, classes, and online training modules are pathways toward becoming a green worker. Currently, industry associations, unions, employers, educational institutions, and product vendors offer a variety of opportunities.

- The partnership between the State Department of Education, UH, and Workforce Development was productive during the 2009–2010 learning year. The Construction Academy (pre-apprenticeship) had over 2,000 enrollees; registered apprenticeship programs had 395 completers and 7,000 active apprentices; UH Community Colleges awarded over 400 associate's degrees and certificates in several construction-related programs; UH Manoa awarded 27 doctorates in architecture and 150 bachelor's degrees in engineering (civil and environmental, mechanical, and electrical).

- Future workers in the construction industry will benefit from green-layered programs. Recent graduates, incumbent workers, and the unemployed currently do not have such opportunities. The information gap facing workers or those seeking employment can be considerable.

- Innovation needs to account for the cyclical nature of the construction industry, holistic elements of sustainability, cross-occupational competencies, and maturing green economic activities. Labor market participants need to be pipelined into green re-tooling (e.g., solar panel installers should be equipped with multi-disciplinary construction skills when the demand for solar project work matures and starts to downturn).

- Future training gap assessments can hone in on the local level, pursuing systematic improvements in green jobs data collection and the development of estimation models.

Part I.
Training Gap Assessment Approach

In a region, state, or local area's workforce development system, the interest of a training gap assessment will vary among groups of stakeholders. Broadly speaking, a training gap assessment is a desired starting point to effect change because of

- current job-performance needs or problems;
- the introduction of new technology, systems, and tasks; and
- a desire to benefit from new economic growth opportunities.

A candidate for training can be:

- a new worker or new hire;
- an incumbent worker in the same job or a new job;
- someone already in training or in the talent pipeline;
- a dislocated or unemployed worker; or
- a worker returning from military deployment or retirement.

With this in mind, a training gap assessment can be:

- an individual training needs assessment, that covers an individual's job performance and his or her future career goals;
- an organization's training gap assessment, that accounts for individual goals but also covers overall workplace operations, targets, and leadership succession plans; or
- an industry or workforce system's training gap assessment, that covers present and future industry and multi-industry needs.

This report focuses primarily on the last type of training gap assessment for the three cited reasons and all types of potential trainees.

There is no single way to conduct a training gap assessment. It proceeds in stages, with the findings of one stage shaping the next. Studies and reports by workforce development professionals across the globe use the following terms interchangeably: training gaps or needs, skills gaps or needs, and workforce needs. For the purposes of this report, a training gap assessment refers to a broader concept than a skills gap or training needs. To illustrate, an industry may have several skills gaps, but skills training opportunities that address those gaps may already exist. In this situation, there is a skill gap and a training need but there is no training gap. Conceptually, a training gap assessment is one step beyond the assessment of skills needs, skills gaps, and training needs. Consider Chart 1 below:

Chart 1 **Training Gap Assessment Model**

Skills Demanded by Present and Future Jobs **–** **Skills of Present and Future Labor Force** **=** **Skills Gap or Surplus**

If there's a gap, determine if TRAINING is the solution.

Training Demanded – Available Training = Training Gap or Surplus

When there is a training gap, several questions can be explored. For example, is there also a curriculum gap? If there is no curriculum gap, then a broader question can be posed about potential curriculum implementation gaps and training infrastructures.

This report uses the training gap assessment model as an outline for organizing and presenting information that has been analyzed to date.

Part II.
Greening of the Construction Industry

The products of the construction industry include public buildings, commercial buildings, homes, and infrastructure, such as roads and harbors. All have a major impact on the economy and the environment. More recently, those in the construction industry also talk about wind turbine projects and residential grid-tied photovoltaic systems (Valles: April 2011). Construction work may include new work, additions, alterations, or maintenance and repairs. Construction establishments in this sector are usually specified either in contracts with the owners of construction projects (general contracts), or in contracts with other construction establishments (subcontracts). For statistical purposes, the industry is coded 23 in the North American Industry Classification System ("NAICS"), the standard that is used for labor market information data collection and analysis. Most construction occupations, but not all, are listed under the family of construction and extraction occupations, or the 47-0000 series, in the Standard Occupations Classification. (BLS: 2011)

The greening of the present-day construction industry can be traced back to technological development after the oil crisis of the 1970s (Nakamura: April 2011). The crisis exposed the country's vulnerability to oil-exporting countries and Americans argued for the development and shift to new energy sources and energy-saving technologies. For example, research in the 1970s at the Lawrence Berkeley National Laboratory led to low-emissivity window coatings that were good at keeping heat inside building structures during the winter and keeping heat out during the summer. (Lawrence Berkeley National Lab: 2011)

Overarching Standards

Innovation is ongoing. In the United States, three separate but complementary "green" rating systems serve as overarching standards for work requirements. The current systems are:

- **ENERGY STAR RATING.** Buildings earn an "Energy Star" rating or certification by meeting strict guidelines for energy efficiency. For example, an Energy Star-qualified home uses at least 15% less energy than standard homes built to the 2004 International Residential Code. The tasks to achieve an Energy Star rating usually include properly installed insulation, high performance windows, tight construction and ducts, energy efficient cooling and heating systems, and Energy Star-qualified appliances, lighting and water heaters. (www.energystar.gov)

- **LEED RATING.** LEED stands for Leadership in Energy and Environmental Design and is an internationally recognized green building rating system. It was developed by the U.S. Green Building Council ("USGBC") and serves a framework for identifying and implementing practical and measureable green building design, construction, operations and maintenance solutions. It is holistic in approach and covers all areas from site selection to building maintenance. Projects are awarded certified, silver, gold or platinum certification based on points earned. (www.usgbc.com)

- **NGBS RATING.** National Green Building Standard ("NGBS") was developed by the National Association of Home Builders ("NAHB"). NGBS is similar to LEED but is specifically designed for residential buildings. Falling under this category are homes, high-rise multifamily buildings, home remodeling and additions, hotels and motels, and the site upon which green homes are located. NGBS gives bronze, silver, gold or emerald rating. (www.nahb.org)

Actual participants are finding out that sustainability, or "going green," requires the same foundational competencies that have always been required of construction industry workers. It requires awareness,

learning, and honing sustainability or green[1] skills at work. Because of the holistic nature of sustainability, the alignment of occupation-specific standards with overarching system standards like the above will become increasingly complex. As one national stakeholder puts it, "Crafts should not become silos," given that work will impact each other as products change and installation procedures are revised to encompass green technologies. (DOLETA: June 2009)

It was not too long ago that there was confusion about the proper installation of solar energy systems. The industry eventually sorted out that a photovoltaic type of system required a licensed electrician, while a solar hot water heating or thermal one required a licensed plumber. The industry, through the State's licensing office, now differentiates solar energy system installers and has three separate specialty licenses for contractors of solar power systems, solar energy systems, and solar heating and cooling systems.

Policies, Incentives, and Regulations

Across the world, countries are responding to global climate change and stimulating their respective economies with policies that are designed to increase green activities, including the demand for more Energy Star-rated or green-rated buildings. In the U.S., federal tax credits have been or are currently available for biomass stoves, HVAC (heating, ventilation, and air-conditioning), insulation, roofing, water heaters, and windows and doors. State or local incentives include corporate solar and wind energy credits; loan programs for residential solar water heating systems; feed-in-tariff incentives for the generation of renewable energy affecting residential and industrial construction; property tax-exemption for alternative energy improvement involving building, lands and other properties; and more.[2]

Investments

The public sector has been a force in expanding green or sustainable construction. Hawai'i is one of the states benefiting from the American Recovery and Reinvestment Act that invested more than $25 billion in sustainable buildings. The Government Services Administration ("GSA") requires all federal government agencies to meet sustainability goals, including increasing water and energy efficiency and diverting waste and construction materials from landfills. The GSA requires that all new federal construction projects and substantial renovations must acquire LEED Silver certification. The United States Department of Housing and Urban Development announced that LEED for Neighborhood Development applied to the evaluation process in awarding $3.25 billion in sustainability communities planning grant funds. (Vieira:2010)

The investing public has also been trending toward sustainable tastes and preferences. For example, the Omidyar K-1 Neighborhood project of Punahou School aimed for highest LEED rating (Platinum), after the benefactors, Pierre and Pam Omidyar, offered a $6 million challenge if a Platinum rating was pursued instead of the Gold level. To gain insight about work requirements, some of the new construction practices that could lead to a Platinum rating are the recycling of materials that normally would have gone to a landfill; incorporation of sufficient quantities of Forest Stewardship Council wood; and incorporation of low-emitting materials under the subcategories "adhesives and sealants," "paints and coatings," "carpet flooring" and "complete wood and agri-fiber products." (Building Industry Hawai'i and Guam: 2010)

The number of registered Energy Star-certified buildings in Hawai'i grew from zero in 2001 to 44

1. Broadly defined, sustainability is about the notion of "meeting the needs of the present without compromising the ability of future generations to meet their own needs." This definition is attributed to the 1987 United Nations Brundlandt Report. Green relates to "production that benefit[s] the environment or conserve[s] natural resources as well as processes that are environmentally friendly or use fewer natural resources." This notion is adopted by the Bureau of Labor Statistics. Visit www.bls.gov/green for more information.

2. Data was retrieved on April 15, 2011 from www.energystar.gov/index.cfm?c=tax_credits.tx_index

in 2011 (www.energystar.gov). In 2009, Hawai'i had 584 Energy Star-qualified new homes out of 1,980 one-housing unit permits—a 29% market penetration. No data was retrieved for NGBS-rated homes, but Hawaii has at least 30 LEED-certified structures and 264 more that have registered for LEED certification. Based on the diversity in location, rating and purpose of existing LEED-certified buildings, the preference for green or sustainable buildings is shared by many kinds of groups and ultimate clients. (USGBC: 2011)

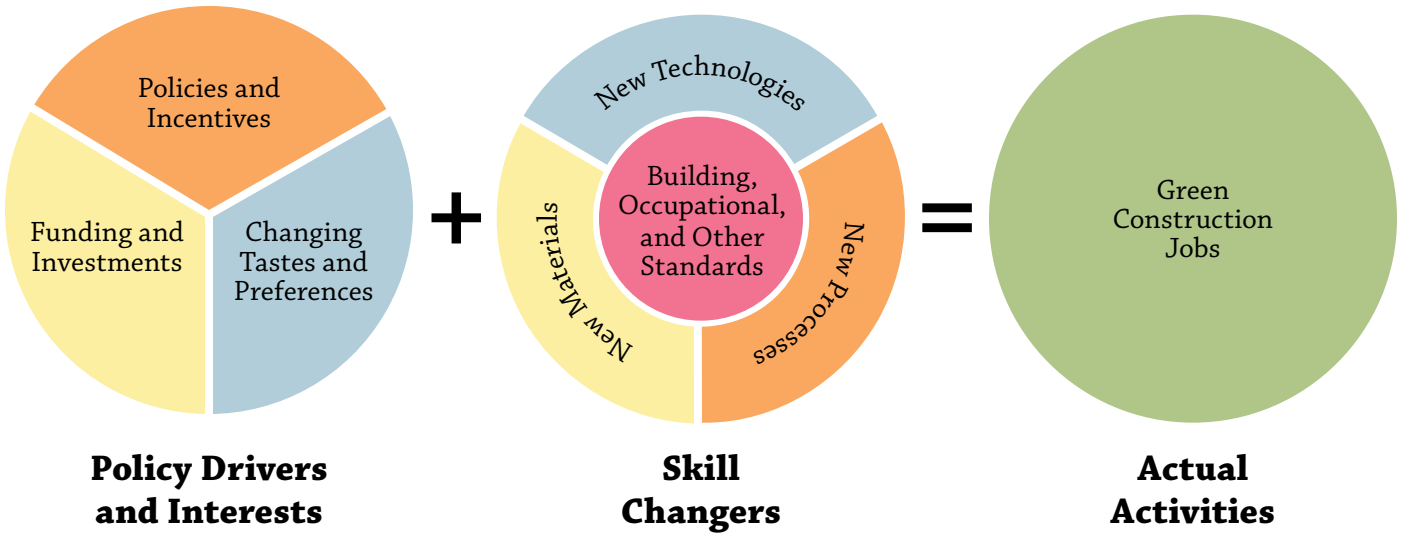
Prospects

While the construction industry continues to be sluggish during this period of economic recovery, and while it can also be challenging to certify a project for LEED certification, there is consensus from all who were interviewed for this project that the industry has no other option but to become "greener." Contractors are presently engaged in learning about green standards and work requirements. It is believed that the ability to practice sustainable construction processes will increasingly be profitable and will be a competitive edge in bidding for all kinds of future construction projects (Nakamura: April 2011). Many of the jobs now and in the future are in military housing and federal building and infrastructure. These are areas of opportunity for the construction and green jobs sector.

For the near term (2011–2012), industry observers point out that both green and non-green construction will continue to be sluggish. Construction will be buoyed by government and retrofit/renovation projects, a list of which can be found in the 2011 forecast of the General Contractors' Association. Department of Business, Economic Development and Tourism representatives are positive that a number of these projects will incorporate energy efficiency and other "green" specifications. State of Hawai'i statutes require LEED Silver-level certification and benchmarking for state facilities using Energy Star Portfolio Manager for projects over 5,000 square feet (DBEDT: April 2011).

The growth and nature of green jobs will be shaped by the interplay of policies and incentives, investments and actual expenditures, new building and efficiency standards, and increasing consumer preferences for sustainable products and lifestyles.

Chart 2 **Determinants of Green Jobs**



Part III. Required Competencies—Knowledge, Skills, and Abilities

The competence of workers and a client's ultimate ability to save energy and money are inextricable. The new sets of competencies[3] required of construction workers are summarized in two models: residential and commercial/industrial. Layered within these competencies are two sets of "green" competencies—sustainable practices and green building practices.[4]

3. A "competency" is the ability to apply or use a set of related knowledge, skills, and abilities in order to successfully perform "critical work functions" or tasks in a defined work setting. Elaboration is available from www.careeronestop.org/competencymodel/LearnCM_whatCM.aspx
4. Only the pyramid model of competencies for commercial construction includes sustainability practices.

SUSTAINABLE PRACTICES are in the same category as other transferable workplace skills like teamwork, problem-solving, and craftsmanship. Sustainable practice skills include the ability to "learn how to learn" and "adapt" to advances in science and technology that upgrade levels of efficiency and environmental protection.

GREEN BUILDING PRACTICES refer to industry sector-specific technical skills similar to specialty skills like carpeting, laying tiles, and others. For example, a "green" roofer will know how to incorporate plants on roofs. Roofers are usually responsible for making sure the roof is watertight and can withstand the weight and water needs of the plants.

Chart 3 Commercial & Industrial Construction Industry Competency Model

Management Competencies							Occupation-Specific Requirements
Industry-Sector Technical Competencies							
Construction of Commercial / Industrial Buildings	Materials and Installation	Heavy Equipment Operations	Customer Service and Contractual Relationships	Green Building Practices			
Industry-Wide Technical Competencies							
Building and Construction Design	Material Resources	Operation, Installation, & Repair	Regulations and Quality Assurance	Health, Safety, and Security			
Workplace Competencies							
Teamwork	Following Directions	Following Plans and Schedules	Problem-Solving and Decision-Making	Working with Tools and Technology	Checking, Examining, and Recording	Crafts-manship	Sustainable Practices
Academic Competencies							
Reading	Writing	Mathematics	Science	Communication: Visual and Verbal	Basic Computer Skills		
Personal Effectiveness Competencies							
Interpersonal Skills	Integrity	Professionalism	Initiative	Dependability and Reliability	Willingness to Learn		

SOURCE: Recreated from the chart found at http://careeronestop.org/competencymodel/pyramid.aspx?CONC=Y

Chart 4 Residential Construction Industry Competency Model

Management Competencies				Occupation-Specific Requirements		
Industry-Sector Technical Competencies						
Construction of Specific Home Components	Specialty Skills	Business Fundamentals	Customer Service and Homeowner Relations	Green Building Practices		
Industry-Wide Technical Competencies						
Building and Construction Design	Material Resources	Operation, Installation, & Repair	Regulations and Quality Assurance	Health, Safety, and Security		
Workplace Competencies						
Teamwork	Following Directions	Planning and Scheduling	Problem-Solving and Decision-Making	Working with Tools and Technology	Checking, Examining, & Recording	Craftsman-ship
Academic Competencies						
Reading	Writing	Mathematics	Science	Communication: Visual and Verbal	Basic Computer Skills	
Personal Effectiveness Competencies						
Interpersonal Skills	Integrity	Professionalism	Initiative	Dependability and Reliability	Willingness to Learn	

SOURCE: Recreated from the chart found at http://careeronestop.org/competencymodel/pyramid.aspx?CONR=Y

Green Skills Required by Different Occupations

Table 1 (on page 17) lists the top construction-related occupations[5] in Hawai'i and summarizes how and when an occupation is designated as "green." Though much of the concept of what constitutes green may be thought to be discretionary, there are numerous measurable standards for a variety of construction disciplines already in place, and more continue to emerge and evolve. In the construction industry, the skills required of an occupation can often be specifically identified, whether it be in the design, in the building/maintenance process, or in the materials used. For analytical purposes, the occupations can be sorted into three types,[6] as follows:

GREEN INCREASED DEMAND OCCUPATIONS: The construction design, process, or materials do not entail significant changes in work and worker requirements, but the work's context may change. The impact of the green economy activities and technology is that there is an increase in demand for jobs.

GREEN ENHANCED SKILLS OCCUPATIONS: The impact of green economy remains the same, but tasks, skills, and knowledge have been altered. The design, process, or materials result in a significant change to the work and worker requirements of an existing job.

5. The report's use of the term "occupation" is equivalent to "Broad Group Occupation" under the Bureau of Labor Statistics' NAIC SOC system. Its use of the term "jobs" is closer to the notion of "detailed occupations." To illustrate, "Electrician" is a broad SOC category that can include master electricians, solar photovoltaic electricians, electrical wirers, and others. See www.bls.gov/soc for more discussion. The top 20 ranking is based on the total number of workers in an occupation. To illustrate, "Electricians" is the top green construction-related occupation because it has the highest number of workers in 2010.

6. DLIR R&S's classification is consistent with O*NET except for "Electricians," which the former lists under "Green Enhanced Skills Occupations" while the latter lists it under "Green Increased Demand Occupations." See taxonomy at www.onetonline.org

GREEN NEW AND EMERGING OCCUPATIONS: The impact of green economy is sufficient to the need for unique work and worker requirements, which results in the creation of a new occupation in the O*NET taxonomy of occupations.

There are green jobs in all phases of construction projects, from marketing, design, and planning to construction, operation, and maintenance. Those selling the idea of green construction projects need to have a basic understanding of all aspects of a green project. For example, to be ethical and to protect consumers, photovoltaic ("PV") salespeople need to have an accurate understanding of the right photovoltaic installation for different buildings and settings. The design and planning stages for construction projects are generally in the hands of the engineers and architects. Everything from the project design, the building methodologies, and the choice of materials is determined in the planning stage, and there are definite green choices and decisions that can be implemented. Currently, the most widely recognized green building standard is the LEED, or Leadership in Energy and Environmental Design, standard. Each LEED certification requires a specific LEED examination. The USGBC offers a variety of educational media, indcluding in-person workshops, online training, and approved third-party education provider courses. These will be outlined in more detail in a later section.

With the "white collar professionals" planning a "green framework" for a project, it follows that the "blue collar" workers who implement and build green structures using green materials are deemed "green" as well. For instance, skilled trade workers like carpenters, electricians, and HVAC installers and mechanics follow blueprints that are eco-friendly in design while using eco-friendly materials and fixtures as specified. Of course, skilled trade workers themselves can use their knowledge and expertise in being green, such as electricians, plumbers, and HVAC workers who service residences and commercial buildings advising clients toward the optimal cost effectiveness in installing green fixtures. For an example of how current skilled occupations have become green from new, emerging green industries (enhanced skills resulting from the green movement), electricians and plumbers are required to connect the PV and solar thermal units to the power and water supplies respectively. These tasks cannot be performed by unlicensed workers, who are, in this example, exclusively PV and solar thermal installers.

Some construction jobs have been impacted by the green movement primarily in the materials and/or fixtures used in their profession. While the occupation of insulation worker may be inherently green on the basis of its energy-efficiency outcomes, the industry also has specific green material and green workmanship standards. The National Association of Home Builders collaborated with the International Code Council to develop an American National Standards Institute ("ANSI") standard for green building practices.[7] Known as the National Green Building Standard, it provides a system for certifying homes as green buildings, and awarding points to homes based on the design and materials choices made in constructing the home. Among the sections in the NGBS are guidelines for insulation in terms of recycled content, energy conservation effectiveness, and emission levels, among others.

Two other examples of workers becoming green as a result of the evolution of materials are carpet installers and tile and marble setters. Carpeting and tile products are being manufactured and subsequently marketed as green that have product features such as recycled content and low volatile organic compounds (VOCs) and emissions.

Finally, in the instance of an elevator installer and repairer, there are elevator manufacturers producing "green elevators," which have markedly improved energy efficiency and thus are worthy of earning LEED points toward a certified green building.

National stakeholders noted that individual trades and crafts impact each other as products change and tasks are revised to encompass green technologies. There

7. www.dovetailinc.org/files/DovetailGrnBldg0410.pdf

Table 1 Summary of How and When Jobs Become Green for the Top 20 Green Occupations in the Construction Industry, 2010

Green Increased Demand Occupations	**Construction Carpenters**	Constructing structures with eco-friendly design, use of renewable and sustainable building materials, use of energy-saving tools, and proper on-site waste management through gathering excess materials and salvaging.
	Insulation Workers—Floor, Ceiling, and Wall	Insulation focuses on weatherization, energy efficiency, and greenhouse gas reduction. There are NAHB green standards for insulation and emission levels.
	Insulation Workers—Mechanical	Insulation focuses on weatherization, energy efficiency, and greenhouse gas reduction. There are NAHB green standards for insulation and emission levels.
Green Enhanced Skills Occupations	**Electricians**	Installation, maintenance, and repair of energy-efficient electrical systems and fixtures. A licensed electrician is required to connect PV systems to the power grid. Some electricians install PV systems.
	Heating and Air Conditioning Mechanics and Installers	Installation, maintenance, and repair of energy-efficient heating and cooling systems.
	Construction Laborers	Provide manual labor for construction projects that are eco-friendly in design, construction methodology, and materials.
	First-Line Supervisors / Managers of Construction Trades and Extraction Workers	Provide supervision for construction workers on projects/tasks that are eco-friendly in design, construction methodology, and materials.
	Plumbers	Installation, maintenance, and repair of plumbing systems and fixtures that use water conservation techniques and technology. A licensed plumber is required to connect solar water heating systems to the water supply. Some plumbers install solar water heaters.
	Hazardous Materials Removal Workers	Identify, remove, pack, transport, or dispose of hazardous materials, including asbestos, lead-based paint, waste oil, fuel, transmission fluid, radioactive materials, contaminated soil, etc.
	Maintenance and Repair Workers—General	Maintenance and repair of structures, systems, and fixtures that employ eco-friendly methods and materials.
	Civil Engineers	Plan, design, and oversee construction and maintenance of building structures and facilities that are eco-friendly in design, building methodologies, and materials.
	Electrical Engineers	Design, develop, test, or supervise the manufacturing and installation of energy-efficient electrical equipment, components, and systems.
	Installation, Maintenance, and Repair Workers—All Other	Installation, maintenance and repair of structures, systems, and fixtures that employ eco-friendly methods and materials.

Table continues on the next page

Table continued from previous page

Green Enhanced Skills Occupations	**Tile and Marble Setters**	Employ setting systems that offer low volatile organic compound options and use care and maintenance products that are less harmful to indoor air quality. Recycle or reuse materials from other tiles or industrial products with a nod to an environmentally-conscious manufacturing process.
	Architects, except Landscape and Naval	Plan and design structures using eco-friendly building materials, construction practices, and plumbing, heating, cooling, and energy systems.
	Mechanical Engineers	Apply principals of green design to plan and develop tools, engines, machines, and other mechanically-functioning equipment that, for example, may result in optimizing energy and water conservation.
	Elevator Installers and Repairers	Install and repair energy-efficient elevators that typically use less energy and produce less heat than conventional elevators.
	Carpet Installers	Installation of carpet, carpet pads and carpet adhesives that help reduce volatile organic compounds (VOCs) and emissions. Use of recycled content for building materials.
Green New and Emerging Demand Occupations		
	Solar Photovoltaic Installers	Installation of clean energy equipment.
	Solar Thermal Installers and Technicians	Installation of clean energy equipment.

NOTES: Based on occupational job duties categorized as "green," as given by respondents to the Hawai'i Green Jobs Survey. These descriptions were vetted according to the following definition: A green job engages in at least one of five core areas: 1) it generates clean, renewable, sustainable energy; 2) it reduces pollution and waste, conserves natural resources, recycles; 3) it is energy efficient; 4) it educates, trains, and supports a green workforce; and 5) it involves natural, environmentally-friendly production.

is increasingly a call not to work so much in silos but to begin understanding others' tasks and discovering where the areas of alignment are. (DOLETA: June 2009)

Knowledge, Skills, and Abilities ("KSA")

Charts 3 and 4 outlined the competencies from a broad industry perspective. Table 2 looks at each of the top 20 growing occupations and summarizes the major worker requirements for each occupation in terms of knowledge, skills, and abilities (O*NET: April 2011). In the "knowledge" category, the most frequently cited includes "Mathematics," and naturally for the construction sector, "Mechanical" and "Building and Construction." In terms of "skills," while most of the positions were of the blue-collar variety, "everyday basic skills" in communication and rational thinking appeared most often. Of note in the "abilities" category is that many abilities listed are physical attributes involving strength, flexibility, coordination, and dexterity. Appendix A provides general definitions of each of the knowledge, skills, and abilities listed.

Table 2 The Most Important Knowledge, Skills, and Abilities for the Top 20 Green Occupations in the Construction Industry, 2010

		Knowledge	Skills	Abilities
Green Increased Demand Occupations	**Construction Carpenters**	Building and Construction, Mathematics, Design	Mathematics, Time Management, Critical Thinking	Arm–Hand Steadiness, Multilimb Coordination, Trunk Strength
	Insulation Workers—Floor, Ceiling, and Wall	Building and Construction, English Language, Transportation	Installation, Active Listening, Speaking	Extent Flexibility, Multilimb Coordination, Trunk Strength
	Insulation Workers—Mechanical	Mathematics, Mechanical, Building and Construction	Installation, Active Listening, Coordination	Arm–Hand Steadiness, Oral Comprehension, Oral Expression
Green Enhanced Skills Occupations	**Electricians**	Mechanical, Building and Construction, Mathematics	Critical Thinking, Active Listening, Complex Problem Solving	Arm–Hand Steadiness, Oral Comprehension, Finger Dexterity
	Heating and Air Conditioning Mechanics and Installers	Mechanical, Customer and Personal Service, Engineering and Technology	Troubleshooting, Repairing, Active Listening	Extent Flexibility, Finger Dexterity, Problem Sensitivity
	Construction Laborers	Building and Construction, Design, Mathematics	Active Listening, Coordination, Equipment Selection	Manual Dexterity, Arm–Hand Steadiness, Static Strengh
	First-Line Supervisors / Managers of Construction Trades and Extraction Workers	Building and Construction, Administration and Management, Mathematics	Time Management, Coordination, Instructing	Oral Comprehension, Problem Sensitivity, Oral Expression
	Plumbers	Building and Construction, Mechanical, Mathematics	Critical Thinking, Installation, Complex Problem Solving	Arm–Hand Steadiness, Near Vision, Finger Dexterity
	Hazardous Materials Removal Workers	Chemistry, Mechanical, Education and Training	Operation Monitoring, Active Listening, Critical Thinking	Problem Sensitivity, Control Precision, Deductive Reasoning
	Maintenance and Repair Workers—General	Mechanical, Building and Construction, Public Safety and Security	Equipment Maintenance, Repairing, Troubleshooting	Problem Sensitivity, Information Ordering, Manual Dexterity
	Civil Engineers	Engineering and Technology, Design, Building and Construction	Reading Comprehension, Complex Problem Solving, Critical Thinking	Oral Expression, Written Comprehension, Oral Comprehension

Table continues on the next page

Table continued from previous page

		Knowledge	Skills	Abilities
Green Enhanced Skills Occupations	**Electrical Engineers**	Engineering and Technology, Computer and Electronics, Mathematics	Active Listening, Troubleshooting, Critical Thinking	Deductive Reasoning, Near Vision, Problem Sensitivity
	Installation, Maintenance, and Repair Workers—All Other	Mechanical, Public Safety and Security, Mathematics	Equipment Maintenance, Active Listening, Repairing	Arm-Hand Steadiness, Problem Sensitivity, Near Vision
	Tile and Marble Setters	Building and Construction, Administration and Management, Customer and Personal Service	Mathematics, Coordination, Active Listening	Visualization, Arm–Hand Steadiness, Multilimb Coordination
	Architects, except Landscape and Naval	Building and Construction, Design, Engineering and Construction	Active Listening, Critical Thinking, Complex Problem Solving	Oral Comprehension, Oral Expression, Problem Sensitivity
	Mechanical Engineers	Engineering and Technology, Mechanical, Design	Mathematics, Complex Problem Solving, Critical Thinking	Oral Comprehension, Written Comprehension, Oral Expression
	Elevator Installers and Repairers	Mechanical, Customer and Personal Service, Building and Construction	Equipment Maintenance, Equipment Selection, Troubleshooting	Problem Sensitivity, Oral Comprehension, Deductive Reasoning
	Carpet Installers	Customer and Personal Service, Mathematics, Public Safety and Security	Mathematics, Installation, Time Management	Extent Flexibility, Near Vision, Static Strength
Green New and Emerging Demand Occupations	**Solar Photovoltaic Installers**	Mechanical, Building and Construction, Mathematics	Critical Thinking, Active Listening, Complex Problem Solving	Arm–Hand Steadiness, Oral Comprehension, Finger Dexterity
	Solar Thermal Installers and Technicians	Building and Construc-tion, Mechanical, Mathematics	Critical Thinking, Installation, Complex Problem Solving	Arm–Hand Steadiness, Near Vision, Finger Dexterity

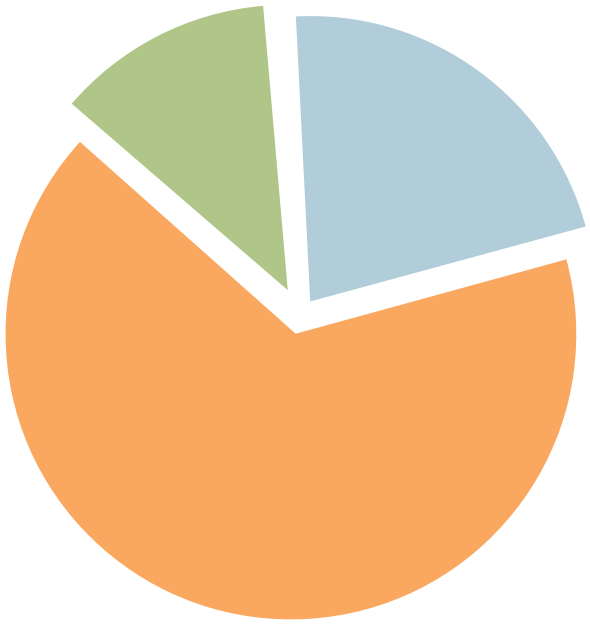
Part IV.
Demand for Skills and Workers

It is a major misconception that all green jobs are new jobs (Valles: April 2011). In fact, most of the green jobs in the construction industry are jobs that have long been part of the construction industry. Most green jobs simply require upgrading or enhancing construction skills that workers already have. For example, sixty-six percent (66%) of workers in the top 20 occupations are in jobs that can be described as "green enhanced skills jobs." Twenty-two percent (22%) are in jobs where existing know-how will be used in more green projects (see Chart 5). Jobs in two occupations—Solar Photovoltaic Installers and Solar Thermal Installers and Technicians—make up the 12% that can be classified as "new and emerging demand occupations."

Although the last two are identified as new occupations, the tasks require the traditional competencies of electricians, plumbers, insulators, and roofers. As this has become more widely understood, more experienced construction-industry workers have been willing to find work with solar energy system employers (Duda: April 2011).

Projections for 2018 create an expectation that the growth rate for green jobs will greatly outpace that of the industry as a whole. In 2010, about 11% of

Chart 5 **Distribution of the Top 20 Green Occupations Based on O*NET Taxonomy**



NOTE: This is a DLIR R&S classification guided by the O*NET Green Economy Sector.

Table 3 **2010 Actual and 2018 Projected Green Jobs in the Construction Industry and Total Economy**

	2010	Low Projection 2018	High Projection 2018	Average Projection 2018	% Increase (Low)	% Increase (High)	% Increase (Avg)
Green Jobs	3,327	5,538	9,450	7,494	66%	184%	125%
All Construction	29,307	40,440	40,440	40,440	38%	38%	38%
% of Green to Total	11%	14%	23%	n/a	n/a	n/a	n/a

NOTE: Private sector jobs only. **SOURCE:** DLIR R&S, September 2010, December 2010, May 2011

construction jobs were classified as green. By 2018, the share of green jobs in the industry is expected to be between 14% and 23% of all construction jobs. Green jobs are expected to increase 125% over their 2010 size while the industry as a whole is expected to grow by 38%. All told, green employment in construction over an eight-year span is anticipated to increase by between 2,000 and 6,000 jobs (see Table 3 on the previous page).

Top 20 Green Occupations in the Construction Industry

The dramatic increase of 125% can be explained more by a re-accounting of existing jobs and less by the emergence of new jobs. As shown in Table 4 on the opposite page, the largest number of green workers in Hawai'i are electricians, heating and air conditioning mechanics and installers, construction carpenters, and solar photovoltaic installers. The survey-based projections for 2012 and the model-based projections for 2018 both show that green jobs will grow. For example, the need for electricians, first-line supervisors (e.g. foremen and superintendents), and tile and marble setters is higher by over 100%.

The increase in green workers includes an "unquantified" need for replacing current construction workers who will be retiring or leaving in the coming years. In its 2008–2018 projection for all occupations, the DLIR R&S projects a replacement need of 130 per year for construction workers, 80 per year for electricians, and 50 each per year for supervisors and plumbers (see Table 5 on page 24 for other occupational replacement projections). It is likely that everyone entering the construction workforce and lined up to replace retiring workers will need to be competent in green building practices.

Median Wages and Entry Requirements

Most of the current construction jobs pay well and therefore are among the desirable jobs that the state envisions for its residents. The average of median hourly wages for the top 20 occupations is $29.20, which is higher than the estimate of $21.65 for all jobs. Only three of the top 20 occupations pay below the average median wage.[8] Most of the jobs require skills that can be acquired from more education and training. Table 6 on page 25 summarizes the entry-level requirements for the different occupations. More than half of the trade jobs require apprenticeship or classroom instruction. The more technical, skill-trade jobs typically require some classroom training (from a community college, union, or trade association) before going on with more apprenticeship-like work experience. Labor market information statistics show that four of the top 20 occupations require at least a four-year college degree; these are the architectural and engineering occupations. On the other end, two occupations, namely construction laborer and carpet installer, require minimal "on-the-job" training only.

Professional and Vocational License Requirements

A current license can indicate one's competence in the latest industry standards and expectations. Professional or vocational licenses are required for architects, engineers, electricians, and plumbers. Many contractors also need licenses depending on their areas of specialty (see Appendix C). For example, Hawai'i now requires specialty licenses for different solar contractors—solar power systems, solar energy systems, and solar heating and cooling systems.

Electricians have seven levels of licenses, while plumbers have two (see Appendix C). Electricians are tested every time they renew their license because of the constancy of technological change. In 2006, the Hawai'i House of Representatives passed Act 127, which requires all plumbers renewing their licenses in the State of Hawai'i to take an updated code exam or attend a class approved by the Honolulu Community College. Plumbers in the State of Hawai'i are aware of the current uniform plumbing code, which is increasingly going green. (McDermott: April 2011)

8. These are statistics for all construction workers, whether green or not. Additional research will be required to collect data and estimate wages for green workers only (e.g. the wage of an electrician or plumber versus a green electrician or plumber).

Table 4 Estimates and Projections for the Top 20 Green Occupations in the Construction Industry, State of Hawai'i 2010–2018

	Green Count 2010	Green Vacancy 2010	Green Projected 2012	Green Projected 2018	Green Growth 2010–2018	Green Growth Percent
Green Increased Demand Occupations (GID):						
Construction Carpenters	306	0	345	584	278	91%
Insulation Workers—Floor, Ceiling, and Wall	277	0	337	*	n/a	n/a
Insulation Workers—Mechanical	184	0	297	*	n/a	n/a
Green Enhanced Skills Occupations (GES):						
Electricians	438	30	647	1,230	792	181%
Heating and Air Conditioning Mechanics and Installers	348	7	403	590	242	70%
Construction Laborers	173	0	173	262	89	50%
First Line Supervisors / Managers—Construction Trades	167	10	214	393	226	1.35%
Plumbers	167	0	185	274	107	64%
Hazardous Materials Removal Workers	160	0	161	168	8	50%
Maintenance and Repair Workers—All Other	159	11	194	274	115	72%
Civil Engineers	152	4	169	219	67	44%
Electrical Engineers	140	4	150	161	21	15%
Installation Maintenance and Repair Workers—All Other	114	0	135	175	61	54%
Tile and Marble Setters	64	14	98	209	145	2.27%
Architects, except Landscape and Naval	62	2	67	74	12	19%
Mechanical Engineers	57	6	67	78	21	37%
Elevator Installers and Repairers	54	0	55	77	23	43%
Carpet Installers	54	0	54	78	24	44%
Green New and Emerging Demand Occupations (GNE):						
Solar Photovoltaic Installers	237	82	684	*	n/a	n/a
Solar Thermal Installers and Technicians	194	2	297	*	n/a	n/a

* Not projected. **NOTES:** Data covers private sector employment only. The 2018 projection is extrapolated from actual projections. Occupations are classified as GID, GES, and GNE based on O*Net classifications except for Electricians. **SOURCE:** DLIR R&S December 2010, May 2011

Table 5 Projected Growth and Replacement Levels in Selected Occupations in the Construction Industry, 2008–2018

	2008	2018	Change	Percent Change	Average Annual Openings		
					Due to Growth	Due to Replacement	Total
Green Increased Demand Occupations							
Construction Carpenters	10,430	11,080	650	6%	70	130	200
Insulation Workers—Floor, Ceiling, and Wall	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Insulation Workers—Mechanical	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Green Enhanced Skills Occupations							
Electricians	3,360	3,500	140	4%	10	80	100
Heating and Air Conditioning Mechanics and Installers	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Construction Laborers	6,510	7,420	910	14%	90	40	140
First-Line Supervisors/ Managers of Construction Trades and Extraction Workers	2,810	3,060	250	9%	30	50	80
Plumbers*	3,200	3,380	180	6%	20	70	80
Hazardous Materials Removal Workers	280	300	20	7%	<10	10	10
Maintenance and Repair Workers General	6,830	7,560	730	11%	70	110	180
Civil Engineers	2,000	2,090	90	5%	10	30	40
Electrical Engineers	640	640	0	0%	0	20	20
Installation Maintenance and Repair Workers All Other	1,190	1,250	60	5%	10	20	20
Tile and Marble Setters	970	1,040	70	7%	10	30	30
Architects, Except Landscape and Naval	770	720	–50	–6%	0	10	10
Mechanical Engineers	530	520	–10	–2%	0	10	10
Elevator Installers and Repairers	300	290	–10	–3%	0	10	10
Carpet Installers	510	470	–40	–8%	0	10	10
Green New and Emerging Demand Occupations							
Solar Photovoltaic Installers	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Solar Thermal Installer and Technicians	n/a	n/a	n/a	n/a	n/a	n/a	n/a

NOTE: This is from the DLIR R&S 2008–2018 Employment Projections, which cover all occupations, not green occupations per se.
* Includes Plumbers, Pipefitters, and Steamfitters

Table 6 2018 Projections, 2010 Median Wages, and Entry Level Requirements for the Top 20 Green Occupations in the Construction Industry

	Green Projected 2018*	Median Wage per Hour, 2010	Typical Entry Requirements**
Green Increased Demand Occupations			
Construction Carpenters	584	$31.65	Apprenticeship
Insulation Workers—Floor, Ceiling, and Wall	***	$22.96	Apprenticeship
Insulation Workers—Mechanical	***	$26.28	Apprenticeship
Green Enhanced Skills Occupations			
Electricians	1,230	$31.49	Trade Class Instructions
Heating and Air Conditioning Mechanics and Installers	590	$24.19	Trade Class Instructions
Construction Laborers	262	$22.93	On-the-Job Training
First Line Supervisors / Managers—Construction Trades	393	$35.33	Skilled Trade Experience
Plumbers	274	$27.34	On-the-Job Training
Hazardous Materials Removal Workers	168	$19.08	Trade Class Instructions
Maintenance and Repair Workers—All Other	274	$18.45	Trade Class Instructions
Civil Engineers	219	$36.64	Bachelor's Degree
Electrical Engineers	161	$40.91	Bachelor's Degree
Installation Maintenance and Repair Workers—All Other	175	$15.44	Trade Class Instructions
Tile and Marble Setters	209	$28.77	Trade Class Instructions
Architects, except Landscape and Naval	74	$34.95	Bachelor's Degree
Mechanical Engineers	78	$39.21	Bachelor's Degree
Elevator Installers and Repairers	77	$39.64	Trade Class Instructions
Carpet Installers	78	$18.50	On-the-Job Training
Green New and Emerging Demand Occupations			
Solar Photovoltaic Installers	***	$19.30	Apprenticeship
Solar Thermal Installers and Technicians	***	$19.30	Apprenticeship

* This is an extrapolated average from DLIR R&S Projections, May 2011. ** Typical entry requirements information is extracted from O*NET occupational descriptors with modifications by DLIR R&S analysts. *** Not projected.

SOURCES: DLIR R&S April 2011; EMSI 2010; O*NET online

Some license programs require that applicants have the minimum credit hours of continuing education. Architects require sixteen (16) credit hours of continuing education ("CE"). Courses in green building practices can meet part of these CE requirements.

Licensure exams are also required for general engineering, general building contractors, and specialty contractors. In the case of specialty contractors, the State requires applicants to have four years of full-time supervisory work experience as a journeyman, supervisor, foreman or contractor within the last ten years. The State allows the use of board-approved training for up to one (1) year of work experience.

As of April 2011, Hawai'i has 2,280 registered licensed architects; 5,841 engineers (various); 2,928 active electricians (at 7 license levels); and 1,089 journeymen and master plumbers. (DCCA: 2011)

The holistic nature of sustainability is bound to make the industry look at the interplay of the different tasks and results of different occupations. It can come to a point where the trades need to be more aligned with each other and licenses will be required for more trades, not just electricians and plumbers (McDermott: April 2011). San Francisco's low-flush toilet rebate program is a widely-publicized case that can dramatize the need for a more holistic vantage. Encouraged by a government-funded rebate, San Francisco residents embraced low-flow toilets that successfully cut annual water consumption by 20 million gallons. The collective action though caused sludge to back up in the pipelines, causing bacteria to multiply and emit a "rotten egg" smell in some parts of the city. The pipelines are older and were installed with high-flush toilet flow assumptions. To counter the smell, the city proposes to spend $14 million worth of concentrated bleach to disinfect wastewater before it goes into the bay. (Matier and Ross: 2011)

Part V.
Potential Green Workers

The State Workforce Development Council ("WDC") and four county workforce investment boards—bodies that are responsible for multi-year workforce development strategic plans—assert that Hawai'i is facing a long-term labor shortage because of an aging workforce, a skills gap, and a high cost of living. To meet future needs, strategies have been directed toward equipping everyone who can work with employable skills. "Everyone" includes both incumbent workers and those in the talent pipeline. It also includes the hard-to-employ or never-employed, the underemployed and new immigrants, and retirees. (WDC: 2009)

Meanwhile, leaders and representatives from the industry, unions, and construction establishments are now facing a sluggish and uncertain economy. Actual jobs are their foremost concern, especially because so many construction workers are "on the bench." The construction industry is particularly affected by the slow economic recovery. The January 2011 statistics show that out of 15,126 insured unemployed, a total of 4,877 were laid off by the construction industry. There were far more males than females. Most were between the ages of 25 and 54 and from Oahu. Appendix B offers a more detailed profile of unemployed construction workers who filed claims for regular UI benefits in January 2011. (DLIR R&S: March 2011)

Broadly speaking, the universe of potential trainees can therefore cover almost everyone in Hawai'i. They can be from:

- the talent pipeline, usually meaning those who are still in school;
- the current labor force, usually meaning able-bodied individuals 16 years and older who may be employed or looking for a job; and
- the retired and others who are not actively looking for work.

The construction industry is a highly unionized industry[9] and recruitment for needed workers is different from most industries. Major employers (mostly contractors) have agreements with labor unions to recruit needed workers through the hiring hall system. Unions with hiring halls include the Hawai'i Carpenters Union, Hawai'i Electrical Workers, Plumbers and Fitters, International Heat and Frost Insulators and Allied Union, Elevator Constructors Union, and others. As union members, many construction workers who are laid-off need to report to their respective labor union hiring halls. They are not required to register with HireNet-Hawaii, Hawai'i's virtual one stop job center system (DLIR UI: 2011). Hence, not all job openings in the construction industry are posted on online job boards. The construction industry is unique when it comes to the recruitment process, and online job boards or job aggregators are likely underestimating or under-representing available construction work.[10]

In the talent pipeline are students attending public and private schools, including those in charter schools and home schools. There were over 178,000 public school students and over 34,000 private school students during the 2009–2010 school year. (DOE: 2011)

The labor force is made up of people who are currently working or actively looking for work. In January 2011, there were a little more than 590,000 workers who were gainfully or partially employed. For that month,

9. For example, the Hawai'i Building and Construction Trades Council, AFL-CIO covers 17 construction unions and claims to have over 26,000 members.
10. One stop centers and labor unions have started working together in recruiting apprentices. In the industry, apprenticeships are a gateway to employment.

it was estimated that Hawai'i had a total of 39,000 unemployed workers. A total of 15,126 partially or totally unemployed filed claims for unemployment insurance benefits. The largest bulk of UI claimants came from the construction, retail trade, administrative/waste services, and accommodation and food services industries. (DLIR R&S: March 2011)

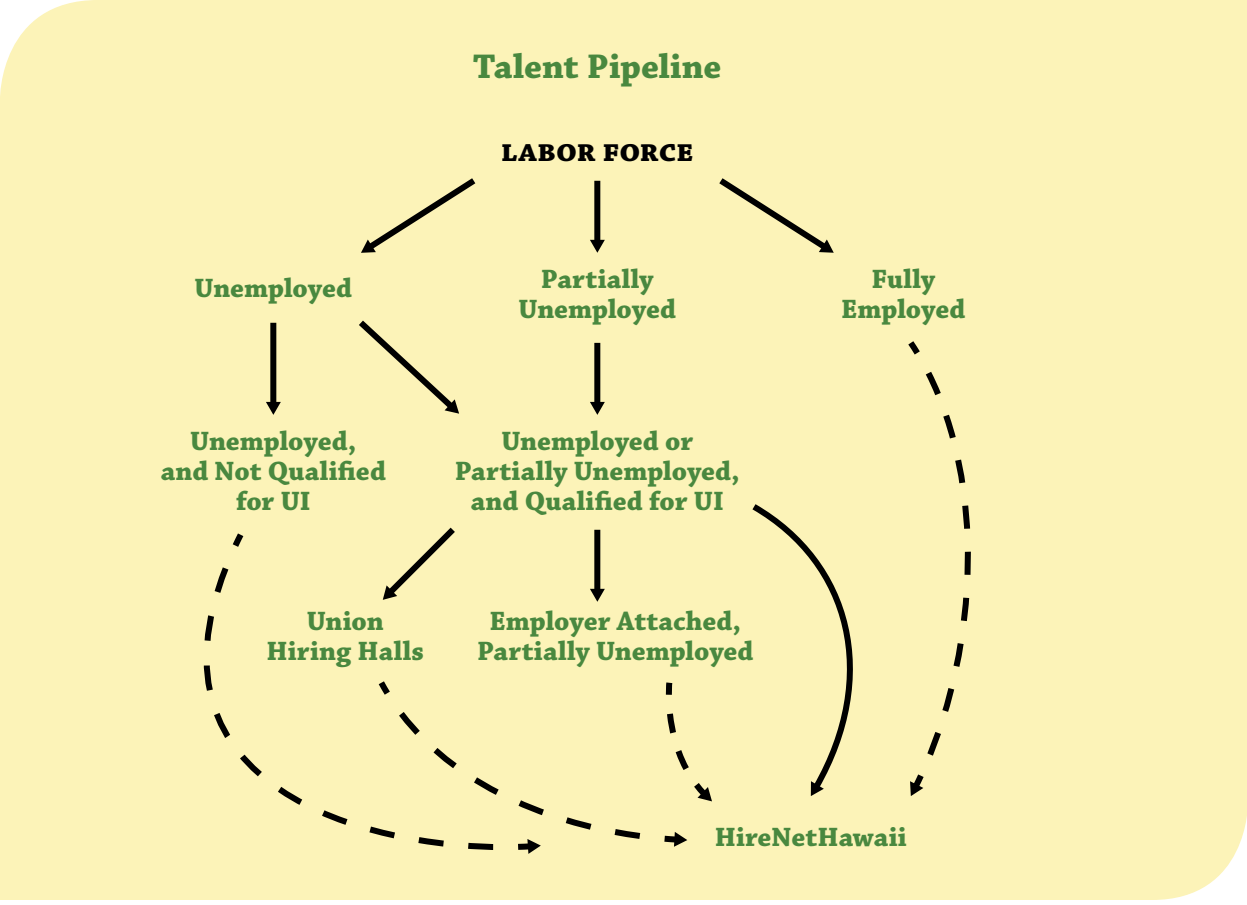
The workers who receive UI benefits include: a) the unemployed, who are required to report to hiring halls by virtue of their union membership; b) the partially employed (technically classified as employer-attached), which may include union members who are working part-time; and c) the unemployed, who are required to register with HireNetHawaii in order to receive their UI benefits.

For the year ending December 2010, HireNetHawaii reported more than 77,000 registered participants, of which slightly over 70,000 were unemployed. HireNetHawaii participants include over 7,700 who are still in school; 5,800 high school dropouts; 32,700 high school graduates; and 20,000 with secondary degrees or certifications. All HireNetHawaii participants can receive basic or core employment services. (DOLETA: January 2011)

The January 2011 list of HireNetHawaii participants includes over 4,000 individuals who recently lost their jobs and were selected by the UI office to go through more intensive reemployment assistance (Ogawa: April 2011). Military veterans and other "program-eligible" individuals are prioritized for more intensive workforce development services and training funds. Program-eligible individuals usually are the low-income and socioeconomically disadvantaged.

The flow of potential trainees within the State's unemployment and workforce development services system is summarized in Chart 6 below.

Chart 6 **Potential Trainees in the Workforce Development System**



Part VI.
Green Training

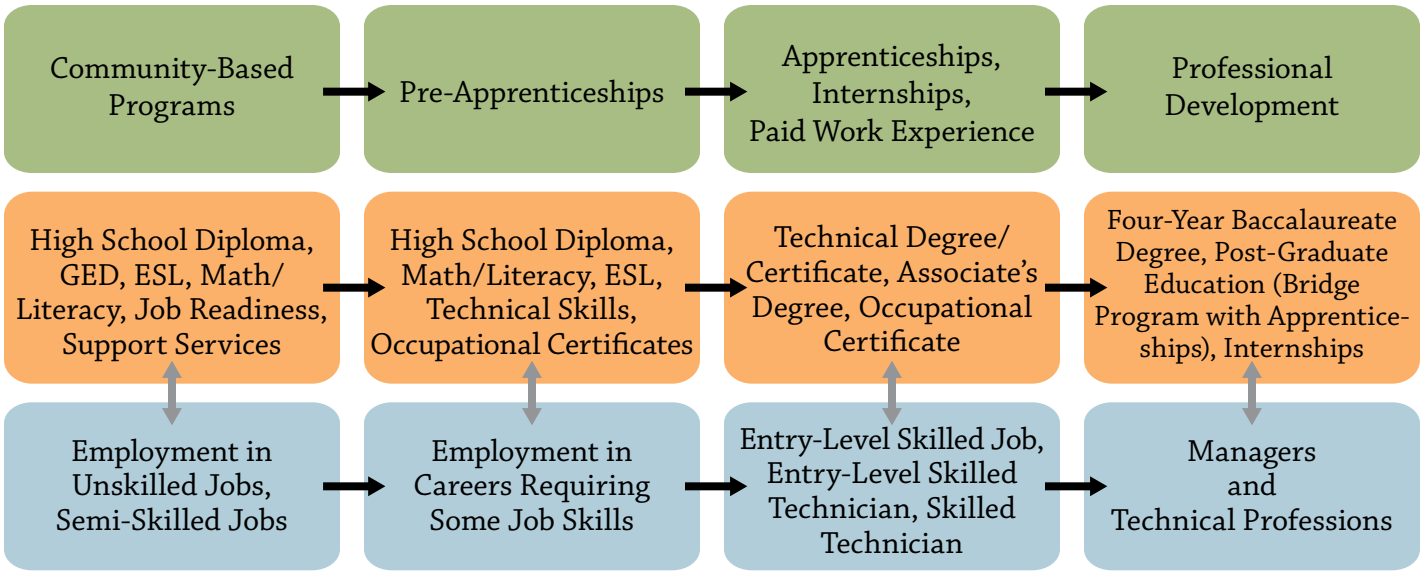
For this report, "training" refers broadly to the acquisition of knowledge, skills, and competencies as a result of teaching, instruction, and practice. Green training programs, courses, classes, or curricula for the construction sector and other green sectors are evolving across the islands. Various partnerships and training providers are catching up with emerging standards, curricula, new providers, and new ways of delivering training. The Workforce Development Council's Hawai'i Green Careers Pathways Initiative Logic Model (see Chart 7 below) provides a framework for analyzing information that has been collected from rapid appraisal. The logic model reflects longstanding assumptions about the state of workforce development in Hawai'i. First, a great number of current and future workers need to develop work readiness skills. Second, not everyone graduating from high school has the foundational academic skills for post-secondary education. Third, a high school diploma is no longer sufficient for most jobs. Post-secondary education and work-based experiences are valued by employers. Finally, education for work purposes requires continuing education or ongoing professional development. (WDC: 2009)

Community-Based Programs

Urban Corps is an example of a community-based and context-based job readiness program. Launched in January 2011, Urban Corps is a cooperative effort between KUPU, a non-profit organization, and Sunetric. The program targets under-resourced young adults and offers an intensive five-month job training and service learning program. Participants have a chance to earn their GEDs, discover the different jobs involved in a solar panel installation business, and learn green skills through hands-on community solar panel installation projects. (Matthews: April 2011)

The State Workforce Development Council and the University of Hawai'i Community Colleges are also collaborating to train the unemployed to become "green-collar" workers. The proposed partnership

Chart 7 **Hawai'i Career Pathways Initiative Logic Model**



NOTE: This chart was extracted from an unpublished document, *Hawai'i Workforce Development Council*, April 2011.

will be funded by a State Energy Sector Partnership ("SESP") grant and will have a job readiness component. (Hardway: April 2011)

Pre-Apprenticeship Programs

The University of Hawai'i Community Colleges Construction Academy (also referred to as Pre-Apprenticeship) began in 2004 with a $1.4 million grant from the U.S. DOLETA. A $5.4 million appropriation by the 2006 Senate Legislature expanded the project to all counties. The fund supports Pre-Apprentice program and Apprentice program classroom instruction. The Pre-Apprenticeship component has grown from 200 students at 8 pilot schools during the 2005–2006 school year to over 2,000 students in 35 high schools statewide in Fall 2010. The Pre-Apprenticeship program offers a hands-on approach to learning and requires students to apply skills in math, communication, construction technology, problem solving, and teamwork. (UH: November 2010)

This school year, the Construction Academy introduced Honolulu Community College's Carpentry 43 (Sustainable Building Practices) course into the high school's building and construction. The curriculum, Green Building Fundamentals for Pre-Apprentices and Apprentices, was developed with the Building Industry Association of Hawai'i ("BIAH") and O-Brien and Company.[11] The BIAH makes the curriculum available online for free. This course was developed with the support of DLIR Employment Training Fund. Construction academy teachers also received training in photovoltaic systems and Carpentry 43.

In Maui, renewable and sustainable energy practices like solar thermal hot water, photovoltaic energy, and wind power were incorporated into all aspects of the Pre-Apprenticeship program. Instructors introduced aspects of green building to students, focusing on the requirements contained in the National Green Building Standards as well as LEED requirements.

11. The development of the curriculum is discussed further online, at buildingcapacity.typepad.com/blog.

Registered Apprenticeship Programs

There are currently thirty-nine (39) registered apprenticeship programs in the construction industry.[12] Thirty-two (32) apprenticeship programs are sponsored and operated by labor unions. The Associated Builders and Contractors Hawai'i Chapter, an organization of non-union employers, operates five (5) apprenticeship programs. Two (2) individual employers—Kawika's Painting and Color Dynamics, Inc.—have apprenticeship programs for painters. The Carpenters apprenticeship program, operated by the United Brotherhood of Carpenters and Joiners of America, Local 745, has the largest number with 1,794 apprentices. The Roofers apprenticeship program, operated by the United Union of Roofers, Waterproofers and Allied Workers, Local 221, is second in number of apprentices with 846 registered apprentices. There are currently 6,631 registered apprentices in programs for the construction industry. The largest apprenticeship programs are for carpenters, electricians, and plumbers (see Table 7 on the opposite page). The apprentices are in various stages of their programs, but there were 395 completers and 7,000 active apprentices between June 1, 2009 and June 30, 2010. (DLIR WDD: April 2011)

The length of training of apprenticeship programs varies depending on the trade or occupation. Some programs, such as the Construction Craft Laborers apprenticeship program, only require 4,000 hours or two (2) years of on-the-job learning, while the Electrician apprenticeship program requires 10,000 hours or 5 years of on-the-job learning. Also, the related instruction hours vary with a minimum of 144 hours per year of apprenticeship. The related instruction curriculum must be approved by the community college system, University of Hawai'i before this can be used by the sponsor. Because of new and evolving technology there were revisions in the related instruction curriculum that includes "greening" or "green layering" in some of the courses. Also, some revisions in the related instruction curriculum were

12. This count excludes the Pearl Harbor Naval Shipyard Apprenticeship Program.

Table 7 Registered Apprenticeship Programs for the Construction Industry and the Number of Apprentices by Operator and Program Type as of March 31, 2011

Program Types	Operators		Private Employers	Total
	Unions	ABC		
Boilermaker	11	-	-	11
Bricklayer	47	-	-	47
Carpenter	1,794	95	-	1,889
Cement Finisher	87	-	-	87
Construction Craft Laborer	128	-	-	128
Construction Equipment Operators	66	-	-	66
Drywall	467	-	-	467
Electricians (Various)	393	219	-	612
Elevator Constructor	151	-	-	151
Fire Sprinkler Fitter	31	-	-	31
Floor Layer	45	-	-	45
Glazier	62	-	-	62
Heat and Frost Asbestos Insulator	47	-	-	47
Heavy Duty Repairman and Welder	16	-	-	16
Iron Worker (Fabricator, Reinforcer, or Structural)	370	-	-	370
Painter	380	135	52	567
Plasterer	80	-	-	80
Plumber	266	66	-	332
Pointer–Caulker–Weatherproofer	3	-	-	3
Refrigerator and Air Conditioning	145	-	-	145
Roofer	846	16	-	862
Sheet Metal Worker	242	-	-	242
Steamfitter / Welder	25	-	-	25
Stone Mason	17	-	-	17
Taper	205	-	-	205
Telecommunications Installer Technician	69	-	-	69
Tile Setter	55	-	-	55
Truck Operator and Driver	-	-	-	-
Total	6,048	531	52	6,631

NOTE: "ABC" is Associated Builders and Contractors Hawai'i. **SOURCE:** DLIR WDD, April 2011

based on nationally-approved curricula for the trades or occupations. When the number of construction projects decreases because of the economy, the number of apprentice work sites decreases, too. This change in capacity keeps apprentices "on the bench," resulting in delays in meeting work hour requirements. Apprenticeship program coordinators who were interviewed reported some decline in the number of apprentices participating in apprenticeship programs. At least two programs were estimated to have somewhere between 45–55% less attendance than last year.

The "greening" or "green layering" of apprenticeship programs is taking place. Brief conversations with five apprenticeship program coordinators indicated that the different apprenticeship programs will infuse green building practices as they see fit (April 2011). Some of the considerations are, not surprisingly, parallel to those expressed by stakeholders at the national level (DOLETA: June 2009). For example:

- Whether to incorporate a green curriculum and change existing apprenticeship program curricula, or keep a stand-alone course where completers can earn a specific "green" credit. A change in an existing and approved curriculum can be a longer process but it also means that apprentices are required to cover the subject matter of green skills. A stand-alone course does not need any approval but it becomes an optional course. An apprentice can also have distinct "green" credentials.

- Whether to implement a curriculum for both apprentices and incumbent workers. While both incoming and current workers need green skills, highly experienced workers may need a different curriculum or style of presentation from apprentices.

- For jobs that hardly changed in terms of tasks, whether instructional training is the answer when the acquisition of competencies will be from exposure to as many kinds of real work applications.

- Whether to train workers in technologies that have emerged when "related supporting industry" is not in place. This applies in the specific case of saving excess materials in construction sites for the purpose of manufacturing them back into new building materials.

- Availability of instructors who have real field experience and have demonstrated credibility to teach construction workers. This does not apply only to topics that cover emerging green skills, but apprenticeship instruction in general.

- Balance in stressing personal initiative as a way to become the worker that employers will want to hire, even in hard economic times.

- Supporting training for workers in occupations that are not identified in the Top 20 occupations. Sustainability design and construction is holistic, where green ratings are earned, not only by the efforts of those in the top 20 occupations but by workers who are tasked to complete the various parts of a structure or project. For example, painting may not be one of the largest occupations but painters are critical in helping a project earn LEED points.

Bachelor's Degrees (Four-Year College Degrees)

The University of Hawai'i at Mānoa ("UHM") offers bachelor's, or four-year, degree programs that meet the entry-level requirements of four top green occupations. UHM offers bachelor's, master's, and doctoral degrees in civil and environmental engineering, electrical engineering, and mechanical engineering. Since October 2007, UHM has also offered a doctorate in Architecture, though only when the entry point is a bachelor's degree in International Studies.

The UH School of Architecture has an Environment Research and Design Lab that is dedicated to expanding the experiences of students and faculty members with new building designs that promote sustainability and contribute to the reduction of

Table 8 **Selected Degrees Earned from the University of Hawai'i at Mānoa in FY2010 (June 2009–July 2010)**

	B.S.	M.S.	Ph.D.	DArch
College of Engineering	150	33	8	-
— Civil Engineering	61	14	1	-
— Electrical Engineering	49	10	5	-
— Mechanical Engineering	40	9	2	-
School of Architecture	-	-	-	27

NOTES: Bachelor's of Architecture (BArch) and Master's of Architecture (MArch) degrees were replaced by the Architecture Doctorate (ArchD) program in July 1999. The ArchD is the first professional degree with a BA exit point in Interdisciplinary Studies. The degree's title was changed from ArchD to DArch and approved by the UH President effective October 2007. **SOURCE:** UH Institutional Research and Analysis Office, 2011

greenhouse gas emissions. Actual design projects, supported through public and private funds, provide immediate ground-level benefits while equipping students with the skills needed to understand the larger perspective required to design sustainable buildings and communities, develop measuring tools, and increase solutions. (Meder: April 2011)

Engineers routinely address efficiency and thus one hundred percent (100%) of traditional curricula can be described as "green." To increase sensitivity to the subject and to be more explicit, students will be required to enroll in an introductory sustainability course starting Fall 2011. Faculty members are directly involved in real-world developments and they bring these real-world engineering challenges (e.g. disaster-related challenges) to the classroom for students to learn from. The University of Hawai'i Hilo ("UHH") provides instructions in the same areas but does not award degrees.

The number of civil engineering graduates last year is an increase from five years ago and is consistent with cyclical patterns exhibited since the 1990s. An estimated 80% of graduates find local employment. (Papacostas: April 2011)

Associate's Degrees and Other Community College Certificates

A community college on each island is offering a combination of construction-related coursework. There is only one program that is distinctly designed for green construction: the Sustainability Construction Technology program in Maui. Honolulu Community College offers associate's degrees in applied trades (about 60 credit hours) to all successful completers of federally-approved and registered apprenticeship programs. There are at least 14 education and training programs that can lead to an associate's degree (see Table 9 on the next page).

Four community colleges offer several other types of recognition—associate's degree level (about 60+ credit hours), certificates of achievement (about 30 credit hours), certificates of completion (around 10 to 20 credit hours), certificates of competence (less than 10 credit hours), and general instruction. They awarded a total of 261 associate's degrees and 139 certificates in several construction-related fields (see Table 10 on page 35). Next steps for completers can be more education, apprenticeship, or employment.

Table 9 **Construction-Related Associate's Degree and Certification Programs at the University of Hawai'i Community Colleges, April 2011**

Community College Program*	Target of Preparation	Associate's Degree	Various Certificates or Instruction
Applied Trades	All Apprentices, Various Occupations	H	-
Architecture and Engineering CAD	Technician, Prep for 4-year Degree	H, Ha	H
Building Maintenance	Building Technician, 2 Skills Trade	-	M
Carpentry Technology	Carpenter	H, Ha, M	H, Ha, M, K
Construction Technology: Sustainable Technology	Construction Worker, Technician, Others	M	M
Drafting Technology	Architectural, Engineering Technician	-	M
Electrical Installation & Maintenance	Electrician, Maintenance Worker	H, Ha	H, Ha, K
Facilities Engineering Technology	Multiple Maintenance Competencies	-	K
Industrial Education	Education/Teaching—Industrial Arts	H	-
Liberal Arts—Pre-Engineering	Welding, Sheet Metal, Machine Technology	Ha	Ha
Refrigeration and Air Conditioning Technology	Technician, Repair, Installer	H	H
Sheet Metal and Plastic Technology	Pre-Apprenticeship, Technician, Designer	H	H
Sustainable Construction Technology	Construction Worker, Technician	M	M
Welding Technology	Welder	H, M	M, H

* Programs have been aggregated from community colleges so specific names may be different.
LEGEND: H: Honolulu Community College; Ha: Hawai'i; M: Maui; K: Kaua'i. **SOURCE:** These programs were extracted from uhcc.hawaii.edu/programs on April 24, 2011, using the filter "Industrial and Engineering Technology."

Green content is or will be nested in the various certificate and degree programs. For example, to reinforce green concepts, students in the carpentry program are currently required to complete a one-credit course in sustainability. Efforts are also currently underway to incorporate this course into the other construction-related programs. (Niino: April 2011)

Green Training for Emerging and Incumbent Workers

A rapid environmental scan led to eight distinct entities and nine sets of credentials. The entities are the Associated Builders and Contractors Hawai'i ("ABC"), Building Engineers Association of Hawai'i ("BEAH"), Building Industry Association of Hawai'i ("BIA HI or BIAH"), International Union of Painters and Allied Trades ("IUPAT"), Pacific Center for Advanced Technology Training ("PCATT"), Sustainable Living Institute of Maui ("SLIM"), United States Green Building Council Hawaii ("USGBC HI"), and the General Contractors Association of Hawai'i ("GCA HI").

The nine distinct tracks are the USGBC LEED Green Associate and Professional Track (including

a GreenAdvantage certificate), National Association for Homebuilders Green Professional Track ("NAHB"), National Association Board of Certified Energy Professionals Sales or Installation for PV and Thermal Systems set of credentials ("NABCEP"), Residential Energy Services Network Home Energy Rater set of credentials ("RESNET"), EPA WaterSense Certification Inspectors Training, American Institute of Architects ("AIA Hawai'i") continuing education credits, Building Operators Certification ("BOC"), CTC Green Building Curriculum for Pre-Apprenticeship and Journey Workers, and Painters' Green Construction/HazLead Courses.

BIA Hawai'i's Green Jobs curriculum is a localized curriculum for those who have to familiarize themselves with construction industry lingo and for those who are more experienced. It is an online course that can be learned at one's own pace and convenience. It is a general curriculum for contractors, workers, suppliers, and other stakeholders. The courses are: Green Building Fundamentals, Green Building for Contractors, Green Building for Carpenters, Green Building for Masons, and Green Building for Laborers/Operating Engineers. (Nakamura: April 2011)

The painter's Green Construction/HazLead course is an example of occupation-specific training for incumbent workers. This is designed to train workers and help them understand the role of their work in achieving different LEED rating levels. To date, 143 painters, 11 tapers, and 2 floor layers (a total of 156 District Council 50 members) have successfully completed the training. (WDC: April 2011)

Some training opportunities can also be counted as continuing education credits that satisfy requirements to maintain professional licenses or certification. For example, architects need four (4) hours of sustainable design credits. LEED Associates and Accredited Professionals need between 15 and 30 hours of continuing education credits every two years in order to be up-to-date with their certification. (AIA Hawai'i: April 2011)

Table 10 Selected Degrees and Certificates Earned at the University of Hawai'i Community Colleges in FY2010 (June 2009–July 2010)

	Associate's Degree	Certificates
Applied Trades	127	-
Architecture and Engineering CAD	35	1
Carpentry Technology	19	3
Electrical Installation/ Maintenance Technology	32	3
Facilities Engineering Technology	-	14
Machine, Welding, and Industrial Mechanics Tech	11	25
Refrigeration and Air Conditioning Technology	19	3
Sheet Metal and Plastics Technology	3	14
Sustainable Construction Technology	2	69
Welding Technology	13	7
Total	261	139

NOTES: (1.) The Building Maintenance program at Kaua'i Community College is inactive. (2.) The Electrical Installation & Maintenance program at Kaua'i Community College is inactive. (3.) The program in Sustainable Construction Technology at Maui College consolidates programs in Drafting, Building Maintenance, Welding and Sustainable Technology. The change was approved by the UH Board of Regents in July 2007, effective Spring 2008.
SOURCE: UH Institutional Research and Analysis Office, 2011

There are other opportunities for top management, including general contractors. For example, the General Contractors' Association of Hawai'i has prepared 60 individuals in LEED Green Associates and 28 individuals in LEED AP. (WDC: April 2011)

Most of the training opportunities are open to people holding different but related jobs. Some are designed for jobs that are not in the Top 20 growth occupations in the construction industry, such as home energy raters and water sense inspectors.

Growing Opportunities

Opportunities for developing green skills are evolving. On April 27, 2011, the University of Hawai'i announced the approval of a new bachelor of applied science in sustainable science management at the University of Hawai'i Maui College. It is an interdisciplinary program that integrates topics including the built environment. It is envisioned to provide workforce development in Maui's emerging green industry. (Bonilla and Char: April 2011)

As mentioned earlier, Hawai'i's State Energy Sector Partnership ("SESP") is funding some of the existing training opportunities. The SESP is a $6 million grant from DOLETA through the American Recovery and Reinvestment Act ("ARRA"). As of March 31, the SESP has supported training opportunities by the Associated Builders and Contractors, Building Industry Association of Hawai'i, and the International Union of Painters and Allied Trades. Through the SESP, interim credentials are also being explored as a viable approach for aligning apprenticeship programs and other federally-funded Workforce Investment Act programs. A major part of the SESP grant will be for the University of Hawai'i Community Colleges System to create and implement a renewable and energy-efficiency training infrastructure statewide. This has resulted in the creation of 13 industry-recognized certificate programs.[13] (Hardway: April 2011)

Under the SESP program, several trade and industry associations were given grants of $87,500 to $194,000 each to deliver incumbent workers training. These associations evaluated and decided for themselves what green (energy efficiency and renewable energy) skills workers need. Each organization identified different levels of job training that were needed.[14]

SESP results are and will be recorded in a Recovery Act Database ("RAD"); there were 280 participants as of January 2011 and WDC expects to eventually have 600 participants. (Hardway: April 2011)

Overall, the Green Building Curriculum for Pre-Apprenticeship and Journey Workers appears to be a friendly curriculum. It is an industry-driven, introductory curriculum that the BIAH modified to fit local conditions. It is a free and on-demand online course that is available by contacting the BIAH. The curriculum has been adapted by the Construction Academy, and three community colleges (Honolulu, Hawai'i, and Maui) have committed to using it. It remains a challenge to get the thousands of general contractors and journey workers to view the course. At the moment, most construction-industry clients are not requiring or demanding that projects be completed by construction workers with green credentials.

Employer-Sponsored Training

Opportunities for incumbent workers include an undetermined number of employer-based programs. For example, the Hawaiian Dredging Construction Company has 30 LEED AP professionals and 25 of them have LEED AP specialty area credentials. The company is also growing its pool of workers with LEED Green Associate credentials. It has a Green 'Ohana committee that organizes brown bag lunch learning sessions, which include reviews for LEED certification exams. The seamless shift to sustainability is likened to the industry's adjustment to ADA (American Disabilities Act) requirements a few years ago; everyone eventually learned their tasks through awareness and best practices in actual jobsites. (Lee: April 2011)

13. The 13 include NABCEP, LEED, CBEM, SBEM, and RESNET certifications that are reflected in Table 11. It also includes programs for Pervious Cement, Facilities Engineering, and Process technology.
14. The $6 million SESP covers construction and non-construction industries. In addition to BIAH, GCA, and IUPAT, the other partners are Hawaiian Electric Company (HECO), Pacific Resource Partnership-Hawaii Carpenters Union (PRP HCU), Kauai Island Utility Cooperative (KIUC), and Hawaii Farm Federation Bureau (HFFB).

Table 11 List of Publicized Training Programs and Credentials in Hawai'i, April 2011

Certifying Entity, Credentials, Courses	Providers/ Lead	Relevant Occupations	Maintaining Credentials
USGBC			
LEED Green Associate	-	All supporting LEED	15 hours of continuing education every 2 years
Introduction to Green Building and Energy Management	PCATT	-	-
Introduction to Green Building and LEED Exam Prep	SLIM	-	-
LEED Green Associate Exam Workshop	USGBC HI	-	-
LEED AP without specialty	ABC, USGBC	Various professionals	30 hours of continuing education every 2 years
LEED AP Specialty Areas O+M (Operations and Maintenance)			
Intermediate Green Building	SLIM	-	-
LEED AP Homes	USGBC HI	-	30 hours of continuing education every 2 years
LEED AP BD+C (Building Design and Construction)	USGBC HI	-	30 hours of continuing education every 2 years
LEED AP ID+C (Interior Design and Construction)	USGBC HI	-	30 hours of continuing education every 2 years
LEED AP ND (Neighborhood Development)	USGBC HI	-	30 hours of continuing education every 2 years
Green Advantage			
Commercial / Residential Certificate	-	-	-
***Green Advantage Certification for LEED Innovation Credit**	PCATT-Green Advantage Training Program	-	-
NAHB			
CGP (Certified Green Professional)	BIA HI	All professionals involved, from sales to engineers	12 hours of continuing education every 2 years
MCGP (Master Certified Green Professional)	-	At least 5 years of experience as a builder or remodeler	-
NABCEP			
PV Technical Sales Certification	-	-	-
Online Course PV Technical Sales	SLIM, ABC	-	-
PV Installer Certification	-	-	-
PV Entry Level PV Design and Installation	SLIM, ABC	Entry-level PV installers	-
Advanced PV Design and Installation	SLIM, ABC	-	-

Table continues on the next page

Table continued from previous page

Certifying Entity, Credentials, Courses	Providers/ Lead	Relevant Occupations	Maintaining Credentials
Solar Thermal Installer Certification	-	-	-
Solar Hot Water Design and Installation, Entry Level	SLIM	Entry-level thermal installers	-
RESNET	-	Home energy raters (recognized by the mortgage industry)	-
CHER (Certified Home Energy Rater)	-	-	-
Home Energy Survey Professional (HESP) Class	SLIM	-	-
EPA WaterSense Certification			
WaterSense Inspector Training	SLIM	EPA WaterSense Inspector	-
AIA CES (4 hour requirement for continuing education on sustainable design)	-	Architects	-
Sustainable Design Topics	-	-	-
Building Operators Certification for Energy Efficiency	-	Engineers	-
BOC Level 1 (an 8-day course, BOC 101 to 107)	SLIM, BEAH	-	-
BOC Level 2 (a 7-day course, BOC 201 to 216)	-	-	-
BIA Hawaii	BIA Partners	Pre-apprentices, journeyworkers	-
CTC's Green Building Curriculum for Pre-Apprentices and Journeyworkers	-	-	-
International Union of Painters & Allied Trades	IUPAT	Painters, floor layers, tapers	-
Green Construction / HazLead Classes	-	-	-

NOTE: Data has been aggregated from several internet sources.

Part VII.
Training Gap Assessment

Program Completion and Job Growth Data

The cursory assessment shows an encouraging state of workforce preparation. The latest numbers of enrollees or graduates of foundational programs are close to projected annual openings. With a groundwork laid out, future workers have the ability to upgrade and develop their green skills.

Current participants and future completers will likely be trained in programs that have been layered with green curricula. There is less certainty about whether or not recent graduates or completers and incumbent workers are receiving or will receive green training.

Determining Gaps from Educational Attainment

Labor market information analysts have relied on educational attainment to indicate skills.[15] Most construction workers in Hawai'i aged 25 to 44 years old in the different occupations have a high school diploma or more (see Chart 8 on the next page). This indicates that foundational academic skills should not be a major barrier to learning green skills.

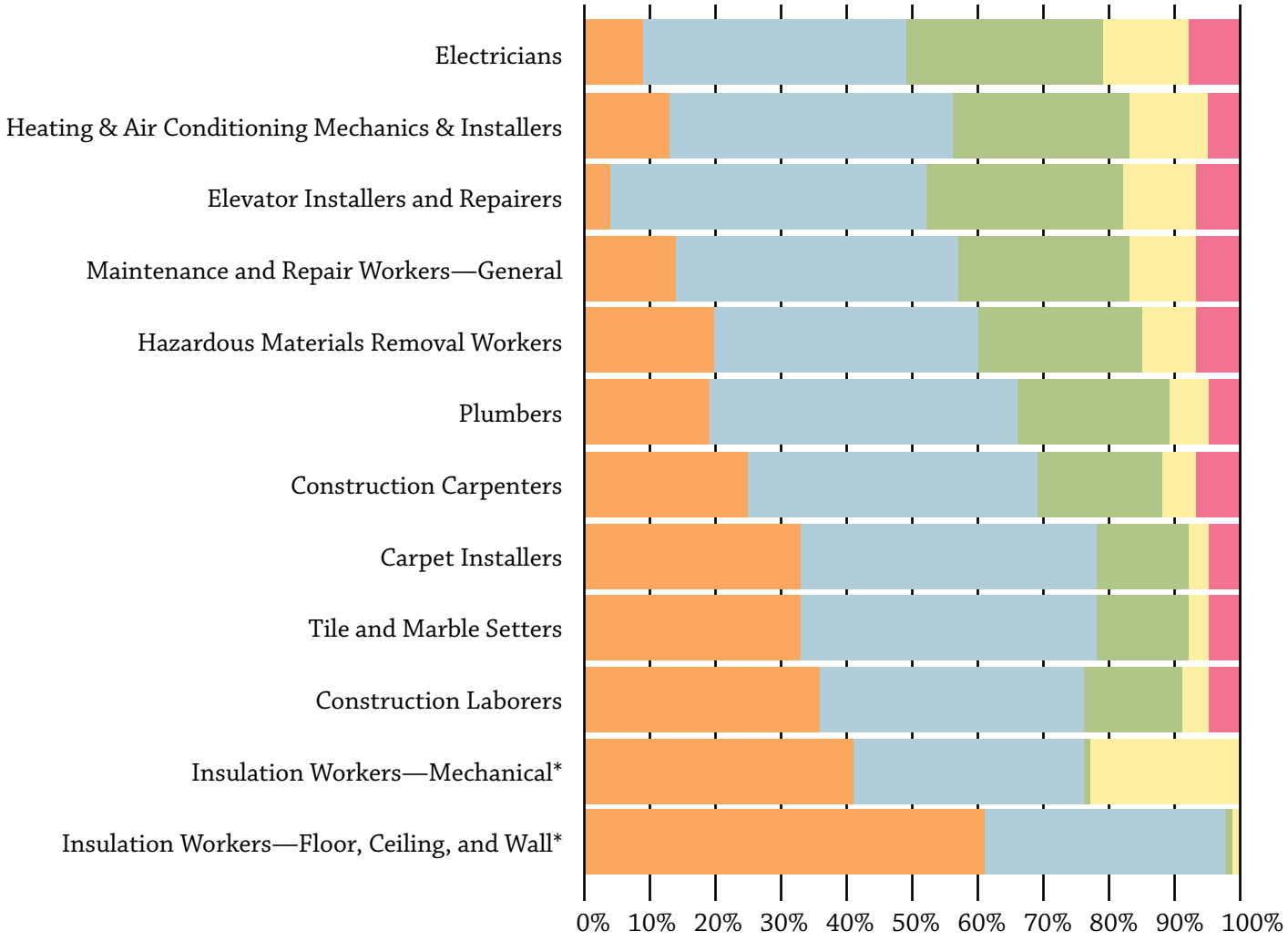
15. For example, a high school dropout is a proxy measure for low skills, a high school graduate with some college is a proxy measure for medium skills, and an individual with a college degree is a proxy measure for high skills. Generally speaking, it is assumed that someone with at least a post-secondary education has a better capacity to cope with 21st-century work skills than someone who is a high school dropout.

Table 12 2009–2010 Program Completions and Enrollment Data vs. 2008–2018 Projected Annual Openings

Program	Number of Completers (2009–10)	Occupation	Projected Annual Average Openings (2008–2018)
DOE Construction Academy / Pre-Apprenticeship Program Enrollees	2,000+ Enrollees	Broad Construction and Extraction Occupations	1,030
UHCC Associate's Degrees / Certificates in Construction Fields	400 Graduates	Signals Preparedness for Higher Education, Apprenticeship Programs, or Employment Requiring Medium-Level Skills	
Registered Apprenticeship Programs	395 Graduates, 7,000 Active Apprentices	Sub-Group of Broad Construction and Extraction Occupations	840
UH-Manoa Bachelor of Science Engineering Graduates (Civil, Electrical, and Mechanical)	150 Graduates	Civil, Electrical, and Mechanical Engineers	70
UH-Manoa Doctorate in Architecture Graduates	27 Graduates	Architects, Surveyors, and Cartographers	30

NOTE: Data has been aggregated from tables and information in this report. **SOURCE:** DLIR WDD, DLIR R&S

Chart 8 Highest Educational Attainment of Workers 25–44 Years Old in Hawai'i Construction Occupations—Selected Trades Only



SOURCE: www.onetonline.org

There are only four occupations where higher percentages of workers are without a high school diploma. There was no local data for insulation workers, but nationwide data shows that a large percentage of insulation workers have not completed high school, with three out of five (floor, ceiling, and wall) and two out of five (mechanical) workers not receiving a high school diploma. Nearly one-quarter of mechanical insulation workers have earned a post-secondary certificate, perhaps as a reflection of companies ensuring the strong industry standards of the National Insulation Association. Three other occupations that have a high percentage of workers without high school diplomas are construction laborers, tile and marble setters, and carpet installers—about one in three of these workers have not finished school. This is not surprising for laborer positions, as the job is considered unskilled, with short-term on-the-job training sufficient for most jobs. As for tile and marble setters and carpet installers, these occupations can be filled by workers with no post-secondary training, with the bulk of skills and knowledge learned on-the-job.

The remainder of the top occupations is more of the "skilled trade" variety. Education levels for these nine occupations average out in the following way:

- An average of 43% of workers (a 40%-48% range) have completed their high school education;
- An average of 26% (a 19%-30% range) have completed some college; and
- An average of 9% (a 5%-13% range) have received associate's degrees.

These three levels of education cover over three-quarters of the educational outcomes for these workers. For skilled trade occupations, a high school diploma or its equivalent is essential in today's job market, with some college coursework quite helpful, but apprenticeships still play the most critical role in the skilled labor supply.

Determining Gaps from Occupational Knowledge, Skills, and Abilities

Workforce development systems across the nation have shifted to web-based analytics for mining labor market information and automating analysis. Some of these web-based analytics provide intelligence to determine competency gaps and/or training gaps.[16]

The results from the various analytics are only as good as the data used for analysis. At writing time, the tools that have been introduced to Hawai'i are not robust enough yet to produce intelligence about green skills gaps or green training gaps.[17] Tools will help identify usual KSA gaps, but they cannot identify green skills training gaps as of yet.

16. For example, EMSI uses a compatibility index while TORQ uses a transferability index. They do not have the same algorithm but both are dependent on O*NET information. Visit www.torqworks.com and www.economicmodeling.com to learn more.
17. Tools rely on the information power of the O*NET database which has yet to embed the green occupation descriptors, especially Knowledge, Skills, and Abilities. O*NET version 15 added new and emerging green occupations in 2010. O*NET version 16 will have green tasks and skills added. Hawai'i is collecting and incorporating green training program and provider information as part of the Workforce Investment Act training providers list (a.k.a. the Consumer Report Card System at www.hawaiicrcs.org).

To illustrate, some construction jobs are projected to decline and therefore workers will need to prepare for other kinds of jobs. TORQ analytics shed light on the training requirements of workers in different declining occupations.[18] The workers' occupational knowledge, skills, and abilities are compared with the KSAs of construction carpenters, electricians, and construction laborers. TORQ transferability index scores summarize the comparison as follows. (Hartz: April 2011)

TORQ 90–100
- Chances for a successful transition are very high.
- May be able to make transition immediately or with short training/education investment.

TORQ 80–89
- Transition is probably still possible.
- Larger KSA gaps or general differences in occupations may require more intensive training.

TORQ 75–80
- Transition may still be possible.
- One or more major KSA gaps may severely hinder transfer or require substantial training/education.

TORQ <75
- In most cases, this transition is probably impractical.

Based on data from DLIR R&S, TORQ analytics identified seven construction occupations that will decline in the years to come. Table 13 on the next page presents the results of TORQ analytics and indicates that sheet metal workers and elevator installers have the best shot at becoming construction carpenters and/or construction laborers. Roofers can become construction laborers but TORQ scores indicate the need for intensive training. For reference, Appendix D presents a breakdown of TORQ scores into more specific gap areas.

18. These are occupations with negative average annual growth in the DLIR Long Term Occupational Projections for 2008 to 2018 (www.hiwi.org).

Table 13 TORQ Scores of Declining Construction Occupations When Targeting Three Selected Construction Occupations

TORQ Score Ranges	Target Occupation: Construction Carpenters	Target Occupation: Electricians	Target Occupation: Construction Laborers
	Source Occupations:	**Source Occupations:**	**Source Occupations:**
90–100	Sheet Metal Workers	-	Elevator Installers and Repairers; Sheet Metal Workers
80–89	Elevator Installers and Repairers	-	Roofers
70–79	Carpet Installers; Roofers	Elevator Installers and Repairers; Sheet Metal Workers	Carpet Installers; Floor Layers except Carpet, Wood and Hard Tile
60–69	Floor Layers except Carpet, Wood and Hard Tile	-	Plasterers and Stucco Masons
50–59	Plasterers and Stucco Masons	Roofers; Carpet Installers; Floor Layers except Carpet, Wood and Hard Tile	-

NOTE: "Declining Construction Occupation" designations are based on negative employment projection growth rates from 2008 to 2018.
SOURCE: TORQ as of April 29, 2011

Table 14 looks at non-construction industries with the same three construction-related occupations as targets. Specifically, it covers hypothetical workers in lower-paying occupations that are projected to decline in the next seven years. TORQ score results are similar to Table 13; that is, the chances of transitioning from most jobs to the three selected occupations will require major training and investments.

Table 14 TORQ Scores of Lower Wage and Declining Non-Construction Occupations When Targeting Three Selected Construction Occupations

TORQ Score Ranges	Target Occupation: Construction Carpenters	Target Occupation: Electricians	Target Occupation: Construction Laborers
	Source Occupations:	**Source Occupations:**	**Source Occupations:**
90–100	-	-	Conveyor Operators and Tenders
80–89	Conveyor Operators and Tenders	-	Farmworkers—Farm and Ranch Animals
70–79	Computer, Automated Teller, and Office Machine Repairers; Carpet Installers; and Farmworkers—Farm and Ranch Animals	Conveyor Operators and Tenders	Computer, Automated Teller, and Office Machine Repairers; Laborers and Freight, Stock, and Material Movers; Machine Feeders and Offbearers; Carpet Installers; Printing Machine Operators; Office Machine Operators, except Computers; Photographic Process Workers; and Shipping, Receiving, and Traffic Clerks

Table continues on the next page

Table continued from previous page

TORQ Score Ranges	Target Occupation: Construction Carpenters	Target Occupation: Electricians	Target Occupation: Construction Laborers
	Source Occupations:	**Source Occupations:**	**Source Occupations:**
60–69	Printing Machine Operators; Photographic Process Workers; Textile Cutting Machine Setters, Operators, and Tenders; Machine Feeders and Offbearers; Laborers and Freight, Stock, and Material Movers; Wholesale and Retail Buyers, except Farm Products; Shipping, Receiving, and Traffic Clerks; and Service Station Attendants	Computer, Automated Teller, and Office Machine Repairers	Veterinary Assistance and Laboratory Animal Caretakers; Photographers; Cooks—Short Order; Photographic Processing Machine Operators; and Floral Designers
50–59	Veterinary Assistants and Laboratory Animal Caretakers; Cooks—Short Order; Photographers; Floral Designers; Photographic Processing Machine Operators; Historians; Order Clerks; and Dispatchers, except Police, Fire, and Ambulance	Photographic Process Workers; Wholesale and Retail Buyers, except Farm Products; Carpet Installers; Farmworkers—Farm and Ranch Animals; Office Machine Operators, except Computers; Textile Cutting Machine Setters, Operators, and Tenders; Machine Feeders and Offbearers; Photographers; Laborers and Freight, Stock, and Material Movers; Veterinary Assistants and Laboratory Animal Caretakers; Service Station Attendants; and Shipping, Receiving, and Traffic Clerks	Couriers and Messengers; Pharmacy Aides; Historians; Order Clerks; Sewing Machine Operators; Dispatcher Except Police, Fire and Ambulance; Mail Clerks and Mail Machine Operators Except Postal Services; Radio and Television Announcers; Data Entry Keyers; Credit Authorizers; Demonstrators and Product Promoters

NOTE: "Lower Wage" occupations in this context include all occupations that did not have more than $40,000 in annual median wages. "Declining Non-Construction" occupations include occupations with negative projected employment growth rates from 2008 to 2018.
SOURCE: TORQ as of April 29, 2011

Part VIII. Career Pathways and the Green Jobs Portal

Career pathway information can reduce the confusion about skills, training, and needed credentials. A career pathway is defined as "a series of articulated education and training programs and services that enable individuals, often while working, to advance over time to successively higher levels of education and employment in a given industry or occupational sector."

Often key in a worker's advancement up the career ladder, particularly in the construction industry, are the apprenticeships and training courses available through labor unions and employer groups. As stated in an earlier section, there are 39 Registered Apprenticeships in the local construction industry, of which 32 are operated by labor unions. The unions are also a major source of continued instruction for journey and supervisory workers. Of course, the community colleges and even the high schools (pre-apprenticeship skills development) also provide a significant portion of the job-ready training for the trade skills that employers demand.

The more specific preparation requirements of a particular occupation were analyzed in the case of the top three (3) green construction-related occupations: Electricians, Solar Photovoltaic Installers/Solar Thermal Installers and Technicians, and Insulation Workers—Mechanical and Floor, Ceiling, and Wall. Three DLIR Green Occupations snapshots can be found in Appendix D. The snapshots elaborate on the labor market conditions for the particular occupations, highlight the three most important KSA (Knowledge, Skills, and Abilities), list earning and career transition potentials, and describe the specific training that needs to be pursued.

On May 5, 2011, the Hawai'i Green Jobs portal[19] was launched to improve access to real-time labor market and training information. This signals the start of making better green information available for various purposes, including career pathways and training gap assessments.

19. www.greenjobshawaii.org

Part IX.
Conclusion and Recommendations

The uniqueness of the construction industry highlights the usefulness of a sector approach in conducting a training gap assessment. The sector approach leads to a better understanding of the economic development drivers and technological underpinnings that are at play in determining the nature and number of green jobs in the industry. It elicits information about the critical role of apprenticeship programs, the strong presence of unions in recruiting and training, and the cyclical nature of employment in the construction industry. It also reveals a partnership network between industry, education, and workforce development that has the ability to develop and deploy curricula and programs for the talent pipeline and other stakeholders. It begins to sort out the specific green credentials that make sense to the industry.

This cursory assessment brings to light the availability of numerous reporting databases, seemingly unrelated information, and speedy web-based data analytics. It also reveals the lack of data in many other areas, especially green occupation descriptors, green training programs, and re-skilling information for both employed and unemployed workers. It exposes the seamlessness among information systems as well as the challenge of quantitatively estimating training gaps.

This cursory assessment has two sets of recommendations—one for the industry and the other for future training gap assessments. The recommended priority action areas for the industry are:

- Re-employment and re-skilling of unemployed construction workers. Those who have been in the industry are more prepared with the foundational skills that are required by the industry.
- Incentives for re-tooling incumbent workers and clarifying the needs of specific occupations and individuals.
- More innovations in training, including solutions that address the cyclical nature of the industry (e.g. retaining apprentices and good construction workers), the holistic nature of sustainability (e.g. multi-occupational programs), and the maturing green economy activities (e.g. the future decline of the solar installation market due to saturation).

The recommended priority action areas for future training gap assessments are:

- Training gap assessments for the other green sectors.
- Data collection and analysis at the local or community levels.
- Multi-stakeholder partnerships that can continue to guide the collection of quality data and the seamless connection of various databases for systematic gap assessments.
- An expanded assessment of the industry that drills down to all occupations.

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NOTE: Any information used in the report that is not cited here was either e-mailed or telephoned. Please see the acknowledgments at the beginning of this report for contributors' names and organizational affiliations.

Appendix A: Descriptions of Knowledge, Skills, and Abilities

Knowledge

ADMINISTRATION AND MANAGEMENT: Knowledge of the business and management principles involved in strategic planning, resource allocation, human resources modeling, leadership technique, production methods, and coordination of people and resources.

BUILDING AND CONSTRUCTION: Knowledge of the materials, methods, and tools involved in the construction or repair of houses, buildings, or other structures such as highways and roads.

CHEMISTRY: Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes the using chemicals and knowing their interactions, danger signs, production techniques, and disposal methods.

COMPUTERS AND ELECTRONICS: Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.

CUSTOMER AND PERSONAL SERVICE: Knowledge of the principles and processes for providing customer and personal services. This includes assessing customer needs, meeting quality standards for services, and evaluating customer satisfaction.

EDUCATION AND TRAINING: Knowledge of the principles and methods for curriculum and training design, individual and group teaching and instruction, and the measurement of training effects.

ENGINEERING AND TECHNOLOGY: Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.

ENGLISH LANGUAGE: Knowledge of the structure and content of the English language, including the meanings and spellings of words and the rules of composition and grammar.

MECHANICAL: Knowledge of machines and tools, including their designs, uses, repair, and maintenance.

PRODUCTION AND PROCESSING: Knowledge of the raw materials, production processes, quality control, costs, and other techniques involved in maximizing the effective manufacture and distribution of goods.

PUBLIC SAFETY AND SECURITY: Knowledge of relevant equipment, policies, procedures, and strategies to promote effective local, state, or national security operations for the protection of people, data, property, and institutions.

TRANSPORTATION: Knowledge of the principles and methods for moving people or goods by air, rail, sea, or road, including their relative costs and benefits.

Skills

ACTIVE LISTENING: Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.

COMPLEX PROBLEM SOLVING: Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.

COORDINATION: Adjusting actions in relation to others' actions.

CRITICAL THINKING: Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

EQUIPMENT MAINTENANCE: Performing routine maintenance on equipment and determining when and what kind of maintenance is needed.

EQUIPMENT SELECTION: Determining the kind of tools and equipment needed to do a job.

INSTALLATION: Installing equipment, machines, wiring, or programs to meet specifications.

INSTRUCTING: Teaching others how to do something.

MATHEMATICS: Using mathematics to solve problems.

OPERATION MONITORING: Watching gauges, dials, or other indicators to make sure a machine is working properly.

READING COMPREHENSION: Understanding written sentences and paragraphs in work-related documents.

REPAIRING: Repairing machines or systems using the needed tools.

SPEAKING: Talking to others to convey information effectively.

TIME MANAGEMENT: Managing one's own time and the time of others.

TROUBLESHOOTING: Determining the causes of operating errors and deciding what to do about them.

Abilities

ARM–HAND STEADINESS: The ability to keep your hand and arm steady while moving your arm or while holding your arm and hand in one position.

CONTROL PRECISION: The ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.

DEDUCTIVE REASONING: The ability to apply general rules to specific problems to produce answers that make sense.

EXTENT FLEXIBILITY: The ability to bend, stretch, twist, or reach with your body, arms, and/or legs.

FINGER DEXTERITY: The ability to make precisely-coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.

INFORMATION ORDERING: The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, or mathematical operations).

MANUAL DEXTERITY: The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.

MULTILIMB COORDINATION: The ability to coordinate two or more limbs (e.g., two arms, two legs, or one leg and one arm) while sitting, standing, or lying down. This does not involve performing the activities while the whole body is in motion.

NEAR VISION: The ability to see details at close range (within a few feet of the observer).

ORAL COMPREHENSION: The ability to listen to and understand information and ideas presented through spoken words and sentences.

ORAL EXPRESSION: The ability to communicate information and ideas in speaking so that others will understand.

PROBLEM SENSITIVITY: The ability to tell when something is wrong or is likely to go wrong. This does not involve solving the problem, only recognizing there is a problem.

STATIC STRENGTH: The ability to exert maximum muscle force to lift, push, pull, or carry objects.

TRUNK STRENGTH: The ability to use your abdominal and lower back muscles to support part of the body repeatedly or continuously over time without "giving out" or fatiguing.

VISUALIZATION: The ability to imagine how something will look after it is moved around or when its parts are moved or rearranged.

WRITTEN COMPREHENSION: The ability to read and understand information and ideas presented in writing.

Appendix B: Characteristics of the Insured Unemployed in Hawaii's Construction Industry, January 2011

		State	Oahu	Maui / Lanai	Hawaii	Kauai	Molokai
Total		4,877	3,041	672	725	412	27
Sex	**Male**	4,684	2,931	640	690	400	23
	Female	193	110	32	35	12	4
	Total	4,877	3,041	672	725	412	27
Age	**Under 22**	34	24	3	4	2	1
	22 to 24	213	149	28	23	13	0
	25 to 34	1,426	921	189	196	115	5
	35 to 44	1,336	814	175	233	103	11
	45 to 54	1,151	718	169	151	108	5
	55 to 64	625	354	101	103	64	3
	65 and Over	92	61	7	15	7	2
	Total	4,877	3,041	672	725	412	27
Duration	**1-4 Weeks**	2,381	1,523	337	284	231	6
	5-14 Weeks	1,575	1,013	203	218	127	14
	15 and Over	921	505	132	223	54	7
	Total	4,877	3,041	672	725	412	27
Occupation	**Management**	79	42	15	16	5	1
	Business/Financial Operations	13	7	2	3	1	0
	Computer/Mathematical	3	1	0	1	1	0
	Architecture/Engineering	13	10	0	1	2	0
	Legal	1	1	0	0	0	0
	Arts/Entertainment/Sports	3	3	0	0	0	0
	Healthcare Support	2	1	1	0	0	0

Table continues on the next page

		State	Oahu	Maui / Lanai	Hawaii	Kauai	Molokai
Occupation	Protective Service	1	1	0	0	0	0
	Food Preparation/Serving	4	3	1	0	0	0
	Building/Grounds Maintenance	12	7	1	3	0	1
	Personal Care/Service	4	2	2	0	0	0
	Sales Related	10	6	2	2	0	0
	Office/Administrative Support	149	52	70	21	3	3
	Farming/Fishing/Forestry	14	6	1	6	1	0
	Construction/Extraction	4,298	2,729	550	626	373	20
	Installation/Maintenance/Repair	82	53	8	15	6	0
	Production	54	38	3	7	6	0
	Transportation/Material Moving	76	44	5	17	9	1
	Information Not Available	59	35	11	7	5	1
	Total	4,877	3,041	672	725	412	27
Race	American Indian	15	9	2	2	1	1
	Chinese	130	87	21	19	3	0
	Filipino	1,116	861	86	88	77	4
	Japanese	468	319	50	55	44	0
	Other Asian	60	47	6	4	3	0
	Black	48	28	6	10	4	0
	Hawaiian	1,313	754	173	248	118	20
	Other Pacific Islander	267	199	29	31	8	0
	White & Latino	933	430	217	171	113	2
	Others	526	306	82	97	41	0
	Information Not Available	1	1	0	0	0	0
	Total	4,877	3,041	672	725	412	27
Education	Less than 12 Years	390	270	39	61	20	0
	12 Years	3,360	2,096	467	506	270	21
	More than 12 Years	1,072	647	158	152	109	6
	Information Not Available	55	28	8	6	13	0
	Total	4,877	3,041	672	725	412	27

SOURCE: DLIR R&S

Appendix C: License Requirements—Electricians, Plumbers, and Other Specialty Areas

Requirements for Different Licenses—Electricians and Plumbers Only

SUPERVISING ELECTRICIAN Four years of experience as a licensed journey worker electrician.

JOURNEY WORKER ELECTRICIAN Five years and not less than 10,000 hours of experience with all aspects of electrical working work, primarily in residential and commercial wiring.

SUPERVISING INDUSTRIAL ELECTRICIAN Four years of experience as a licensed journey worker industrial electrician or equivalent.

JOURNEY WORKER INDUSTRIAL ELECTRICIAN Five years and not less than 10,000 hours of industrial wiring work.

MAINTENANCE ELECTRICIAN One year of electrical maintenance wiring work or two years of electrical trade schooling.

SUPERVISING SPECIALTY ELECTRICIAN Four years of experience as a licensed journey worker specialty electrician or equivalent.

JOURNEY WORKER SPECIALTY ELECTRICIAN Five years of specialty wiring work.

MASTER PLUMBER Two years of experience as a licensed journey worker plumber or equivalent.

JOURNEY WORKER PLUMBER Five years and not less than 10,000 hours of experience with all aspects of plumbing work in compliance with the latest Uniform Plumbing Code.

Specialty Areas Requiring Contractors to Have a License

General Engineering
Painting and Decorating
General Building
Pile Driving, Drilling, Foundation
Acoustical and Insulation
Plastering
Mechanical Insulation
Plumbing
Asphalt Paving and Surfacing
Irrigation and Lawn Sprinkler Systems
Asphalt Concrete Patching, Sealing, Striping
Refrigeration
Boiler, Hot Water Heating, Steam Fitting
Reinforcing Steel
Cabinet, Millwork, Carpentry Remodeling and Repairs
Roofing
Siding Application
Wood Shingles and Shakes
Carpentry Framing
Scaffolding
Carpet Laying
Sewer, Sewage Disposal, Drain, Pipe Laying
Cesspool
Reconditioning, Repairing Pipeline
Drywall
Sheet Metal
Electrical
Structural Steel
Sign Contractor
Swimming Pool
Electronic Systems
Swimming Pool Service
Fire and Burglar Alarm
Concrete and Clay Tile

Elevator
Ventilating, Air Conditioning
Conveyor Systems
Waterproofing
Excavating, Grading, Trenching
Welding
Fire Protection
Well
Dry Chemical Fire Repressant Systems
Pumps Installation
Flooring
Solar Energy Systems
Glazing and Tinting
Solar Hot Water Systems
Gunite
Pole and Line
Landscaping
Stone Masonry
Tree Trimming and Removal
Ornamental, Guardrail, Fencing
Masonry
Cement Concrete
Play Court Surfacing
Garage Door
Asbestos
Glass Tinting
Building Moving and Wrecking
Institutional and Commercial Equipment
Hydro Mulching
Refractory
Tuckpointing and Caulking
Classified Specialist
Wall Coverings
Taping
Surface Treatment
Soil Stabilization
Lathing
Vacuum and Air Systems
Water Chlorination
Treatment and Pumping Facilities
Fuel Dispensing
Post Tensioning
Prefabricated Refrigerator Panels
Aluminum Shingles
Cement and Clay Tile
Urethane Foam
Wood and Vinyl Fencing
Roof Coatings
Gutters
Awnings and Patio Cover
Steel Door
Hot Tub and Pool
Tile
Pole
Cultured Marble
Terrazo
High Voltage Electrical
Solar Power Systems
Injection Well
Solar Heating and Cooling Systems
Sewer and Drain Line
Concrete Cutting, Drilling, Sawing, Coring, and Pressure Grouting

SOURCE: www.contractors-license.org/hi/hawaii.html

Appendix D:
Sample Breakdown of TORQ Scores

TORQ identifies gaps by comparing the KSA requirements of source occupations to those of target occupations. The KSA are based on O*NET description of occupations. A TORQ score has three parts, including knowledge, skills, and abilities. The score breakdown measures gaps in knowledge, skills, and abilities. The importance of a particular knowledge, skill or ability is also measured. An important knowledge, skill, or ability will have a score of 50 and above. A gap score of –10 or lower can likely be solved through training. A gap score of –50 suggests incompatibility of occupations, therefore training alone will likely not address the gap.

Interpreting the Table: From Roofer to Construction Carpenter

In order to help readers interpret the table on the next page, consider the example of roofers as a source occupation. Roofers targeting a new career in construction carpentry have a TORQ transferability score in the 70 to 79 range, which indicates the need for major training. The breakdown of TORQ scores in the table indicates that for construction carpenters, two of the most important knowledge areas are "building and construction" and "mathematics"—their importance ratings are 84.75 and 66.5, respectively. Importance scores for both are above 50, which indicates that they are very important knowledge areas. In those two areas, the gap scores between roofer and construction carpenter are –20.29 and –18.14, respectively. Both scores are higher than 10, which indicates that there is a major knowledge gap. Since it is a knowledge issue, training is a potential solution.

In the skills area, the only identified gap is in "critical thinking." The score of 53.75 indicates that it is a priority area, yet the gap score for roofers is only 1.71, a gap not wide enough to warrant it as a priority training area.

In the ability area, the highest score for importance is 66 for "manual dexterity" but the gap is only –8.85. The next highest scores are for "static strength," "multilimb coordination," and "trunk strength." The gap scores are –19.57, –7, and –3.57, respectively. Hence, static strength is a priority area for improvement but can also be an innate ability. In this case, training might have a limited impact.

TORQ Scores for Declining Construction Industry Occupations When Targeting Construction Carpenter Occupations

Source Occupation/s	KSA Category	KSA Name	Gap	Importance
Roofers	Knowledge	Mechanical	-25.14	62.75
		Building and Construction	-20.29	84.75
		Production and Processing	-18.57	61.5
		Mathematics	-18.14	66.5
		Engineering and Technology	-15.29	50.5
		Public Safety and Security	-11.42	51.75
		Design	-7.86	57.25
		Administration and Management	-5.15	53.75
	Skill	Critical Thinking	-1.71	53
	Ability	Static Strength	-19.57	63
		Visualization	-17.86	56
		Far Vision	-10.57	53
		Manual Dexterity	-8.85	66
		Near Vision	-7.14	60
		Multilimb Coordination	-7	63
		Finger Dexterity	-5.29	60
		Extent Flexibility	-3.57	53
		Trunk Strength	-3.57	63
Plasterers and Stucco Masons	Knowledge	Engineering and Technology	-43.29	50.5
		Mathematics	-42.14	66.5
		Design	-39.29	57.25
		Mechanical	-34.72	62.75
		Administration and Management	-33.29	53.75
		Customer and Personal Service	-26.57	51

Table continued from previous page

Source Occupation/s	KSA Category	KSA Name	Gap	Importance
Plasterers and Stucco Masons	Knowledge	Production and Processing	-26.14	61.5
		Building and Construction	-22.72	84.75
		Public Safety and Security	-4.85	51.75
	Skill	Critical Thinking	-7.14	53
	Ability	Near Vision	-10.71	60
		Deductive Reasoning	-9	56
		Finger Dexterity	-8.86	60
		Visualization	-8.86	56
		Multilimb Coordination	-8.85	63
		Static Strength	-8.85	63
		Trunk Strength	-5.43	63
		Problem Sensitivity	-3.57	63
		Arm-Hand Steadiness	-3.43	56
		Far Vision	-3.42	53
		Information Ordering	-1.71	56
		Manual Dexterity	-1.71	66
Floor Layers, except Carpet, Wood, and Hard Tiles	Knowledge	Engineering and Technology	-18.57	50.5
		Public Safety and Security	-12.14	51.75
		Building and Construction	-8.57	84.75
		Administration and Management	-7.58	53.75
		Design	-6.43	57.25
		Mechanical	-6.43	62.75
		Production and Processing	-4.29	61.5
		Mathematics	-0.71	66.5

Table continues on the next page

Table continued from previous page

Source Occupation/s	KSA Category	KSA Name	Gap	Importance
Floor Layers, except Carpet, Wood, and Hard Tiles	Skill	Critical Thinking	-3.43	53
	Ability	Static Strength	-16	63
		Far Vision	-14.14	53
		Stamina	-12.43	53
		Finger Dexterity	-10.71	60
		Multilimb Coordination	-10.57	63
		Manual Dexterity	-7	66
		Deductive Reasoning	-5.43	56
		Extent Flexibility	-5.43	53
		Trunk Strength	-5.43	63
		Problem Sensitivity	-5.29	63
		Near Vision	-3.57	60
		Visualization	-3.57	56
		Arm-Hand Steadiness	-1.71	56
		Information Ordering	-1.71	56
Elevator Installers and Repairers	Knowledge	Production and Processing	-21	61.5
		Administration and Management	-16.86	53.75
		Mathematics	-4.85	66.5
	Skill	Critical Thinking	-1.71	53
	Ability	Static Strength	-25	63
		Trunk Strength	-14.29	63
		Stamina	-12.43	53
		Far Vision	-12.42	53
		Multilimb Coordination	-8.85	63

Table continues on the next page

Table continued from previous page

Source Occupation/s	KSA Category	KSA Name	Gap	Importance
Elevator Installers and Repairers	Ability	Extent Flexibility	-5.43	53
		Manual Dexterity	-5.28	66
		Visualization	-5.28	56
		Deductive Reasoning	-3.58	56
		Finger Dexterity	-3.57	60
		Near Vision	-1.71	60
Sheet Metal Workers	Knowledge	Public Safety and Security	-11.28	51.75
		Production and Processing	-0.71	61.5
	Skill	Critical Thinking	-1.71	53
	Ability	Static Strength	-14.28	63
		Far Vision	-10.57	53
		Trunk Strength	-9	63
		Finger Dexterity	-8.86	60
		Manual Dexterity	-8.85	66
		Multilimb Coordination	-8.85	63
		Deductive Reasoning	-7.15	56
		Stamina	-7.15	53
		Extent Flexibility	-7.14	53
		Near Vision	-3.57	60
		Problem Sensitivity	-1.72	63
		Arm-Hand Steadiness	-1.71	56

Appendix E: Career Pathways #1 Electricians

OCCUPATIONAL DESCRIPTION: Install, maintain, and repair electrical wiring, equipment, and fixtures. Ensure that work is in accordance with relevant codes. May install or service street lights, intercom systems, or electrical control systems. In 2010, there were 2,640 electricians in the state.

When Is an Electrician Considered "Green"?

A green electrician, at the minimum, periodically does one or more of the following: installs, maintains, or repairs energy efficient fixtures and/or clean energy systems, such as photovoltaic systems. Only a licensed electrician is qualified to connect a PV system to the electrical grid. In relation to the description of GREEN core areas described in the publication *Hawai'i's Green Workforce: A Baseline Assessment*, the electrician's contribution to green generally falls under the G and E categories—Generate clean, renewable, sustainable energy; and Energy efficiency.

Who Employs Green Electricians?

The vast majority of green electricians are employed by electrical contractors. However, other sources of employment include, but are not limited to, other sectors of the construction industry (e.g., plumbing, heating, and air-conditioning contractors), all levels of government (local, state, and federal), industrial manufacturers, building maintenance firms, and hotels.

The Numbers on Green Electricians

- 4th-highest green occupation
- 438 jobs in 2010 (17% of all electricians)
- 30 current vacancies
- 647 projected jobs in 2012
- Annual average openings for all electricians due to growth: 10; due to replacement: 90
- Median hourly wage of all electricians, 2010: $31.49

How the Movement Toward Green Has Affected the Occupation

With the ever-increasing demand for energy efficiency and clean energy, electricians have to keep pace with ever-changing technology (as they have in the past). This requires keeping abreast on the latest job-specific requirements and skills. While the foundation of most electrical projects has evolved rather steadily over time, some of types of work, such as photovoltaic installation, require a higher degree of specific training. This degree of occupational evolution will increasingly require an aspiring electrician to obtain "green enhanced skills" (see figure on next page). In fact, new and emerging occupations, such as solar photovoltaic installers and solar thermal installers and technicians, are already significant in number, and may have in fact drawn from the electrician workforce, who can now specialize in this green job due to the strong demand for clean energy installation.

Important Knowledge

- Mechanical
- Building and Construction
- Mathematics

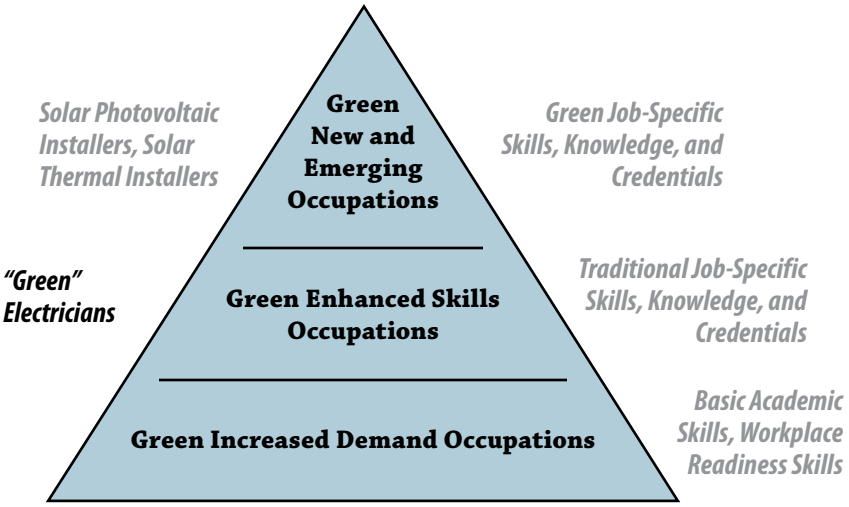
Important Skills

- Critical Thinking
- Active Listening
- Quality Control Analysis

Important Abilities

- Arm–Hand Steadiness
- Oral Comprehension
- Finger Dexterity

Occupations by Skills Sought by Green Job Employers



SOURCE: (OccupatAions) National Center for O*Net Development, 2009; (Skills) John J. Heldrich Center for Workforce, 2009

Potential Job Transitions into Electrician Positions

Jobs with at least 100 workers, making less than electricians (on average), having a compatibility index of at least 90, are identified in the chart below.

Entry to Becoming an Electrician

Apply for an apprenticeship either through the union (IBEW Local 1186) or outside the union (Associated Builders & Contractors, Inc). After securing employment, expect to concurrently be taking coursework through IBEW or ABC throughout your apprenticeship. However, according to Honolulu Community College, there is an advantage to completing the electrical program at community colleges instead of directly applying for an appren-

Job Title	2010 Jobs	2010 Hourly Earnings	Compatibility Index*
Plumbers	2,450	$27.34	94
Automotive Body and Related Repairers	423	$19.27	91
Machinists	362	$26.75	91
Telecommunications Line Installers and Repairers	246	$22.82	91
Surveying Technicians	173	$18.81	91
Maintenance and Repair Workers—General	6,372	$18.95	90
Aircraft Mechanics and Service Technicians	780	$29.50	90
Heating and Air Conditioning Mechanics and Installers	676	$24.19	90
Surveyors	241	$21.40	90
Helpers: Brickmasons, Blockmasons, Stonemasons, and Tile and Marble Setters	165	$18.39	90
Transportation Vehicle, Equipment, and Systems Inspectors, except Aviation	152	$27.12	90
Electronic Home Entertainment Equipment Installers and Repairers	110	$29.46	90

NOTES: Occupation compatibility, or the similarity between two occupation's competencies, is another term that is crucial for interpreting Career Pathways analysis. The compatibility index comparing the skill, knowledge, and ability profiles of two occupations, in terms of both attainment level and importance. An algorithm uses the differences between competency levels, weighted by importance levels, to determine how compatible two occupations are.

ticeship: often the unions, private or government employers may recruit for apprentices through the community colleges, since students already have the basic knowledge and skills needed to perform entry level work.[20]

Apprenticeship via IBEW LOCAL 1186

MINIMUM REQUIREMENTS:

- Age 18+ (with verification documents)
- High school diploma or GED
- Must pass 1 year of high school Algebra (not Pre-Algebra)
- Transcript of high school or post-high school courses
- Must pass industry aptitude test to qualify for oral interview
- Substance abuse test before indenturing
- $25 application fee

RECRUITMENT:

- 2-week period in the first six months of the year

CONTACT:

- Hawai'i Electricians Training Office
  http://hawaiielectricianstraining.org
  phone: (808) 847-0629

Apprenticeship via Associated Builders & Contractors

MINIMUM REQUIREMENTS:

- High school diploma or GED
- Must pass 1 year of high school Algebra (not Pre-Algebra)
- Transcript of high school or post-high school trade courses
- Valid driver's license
- Must pass industry and color-code vision tests
- Must be a U.S. citizen to go on military bases
- Must work for a member company for six or more weeks
- Must be legally able to work under current immigration laws

RECRUITMENT:

- Sponsored by member company

CONTACT:

- Associated Builders & Contractors, Inc.
  http://www.abchawaii.org
  phone: (808) 845-4887

Education

For a more general curriculum for the aspiring electrician, three community college campuses on O'ahu (Honolulu Community College), Kaua'i, and the Big Island offer coursework leading to either an Associate's Degree in Applied Science (63 credits) or in Electrical Installation and Maintenance Technology, or a Certificate of Achievement (47 credits) in Electrical Installation and Maintenance Technology. In addition, Kaua'i Community College has a Certificate of Completion in Electrical Installation and Maintenance Technology (23 credits).

Maui Community College offers two certificates that specifically incorporate green electrical construction principles. Both are under the blanket of the Sustainable Construction Technology Program, namely the Certificate of Competence in Electrical Maintenance (5 credits) and the Certificate of Competence in Energy Production (6 credits), which also helps prepare students to become NABCEP (North American Board of Certified Energy Practitioners) certified. The overall academic program—which leads toward an Associate's Degree in Applied Science (64–67 credits), a Certificate of Achievement (33 credits), or a Certificate of Completion (16 credits) in Sustainable Construction Technology—focuses on the design, retrofit, and maintenance of sustainable construction, including energy-efficient systems, passive cooling, renewable energy for wind, sun, and water, and electricity-saving equipment using such new technology as off-grid systems and computer-controlled consumption. MCC is the only branch of the UH system to offer this program.

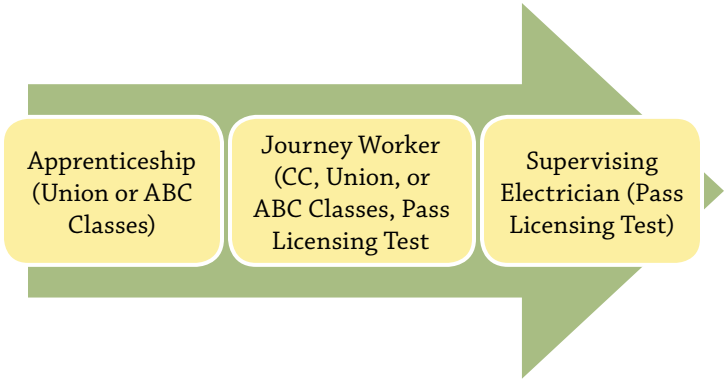
20. http://tech.honolulu.hawaii.edu/eimt/eimtfaq.html#5

Licensing

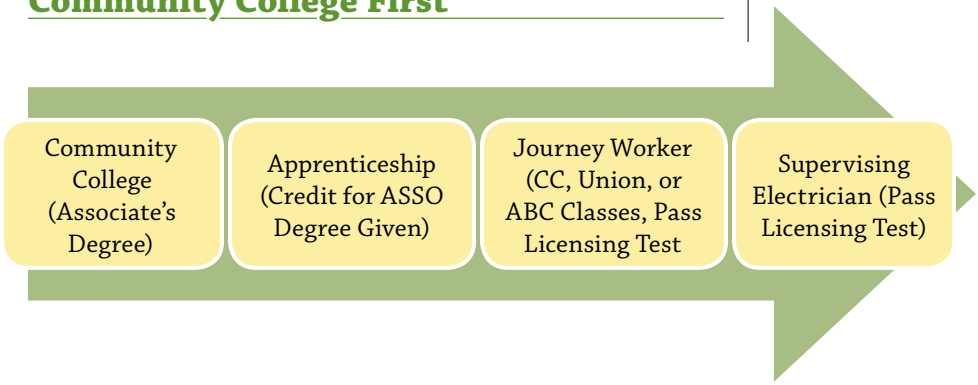
The State of Hawai'i Department of Commerce and Consumer Affairs handles the licensing process for electricians. Here are the work and education requirements, effective July 1, 2013 (along with passing a board examination), which lend themselves to outlining the career pathways of an electrician.[21]

21. http://hawaii.gov/dcca/pvl/faqs/electrician_plumber_faq.pdf

Career Pathway: Straight Into Apprenticeship



Career Pathway: Community College First



JOURNEY WORKER: 5 years and not less than 10,000 hours in residential or commercial wiring (general, EJ license), industrial wiring (industrial, EJI license), or specialty wiring (specialty, EJS license), and satisfactory completion accepted by a University of Hawai'i Community College offering an appropriate program of study of electrical academic coursework (200 hours industrial, 120 hours speciality). The equivalent amount of academic coursework via the union or ABC is also acceptable.

SUPERVISING ELECTRICIAN: 2–4 years of experience as a licensed journey worker electrician—general, ES (4 years); industrial, ESI (3 years); or specialty, ESS (2 years); or equivalent.

MAINTENANCE ELECTRICIAN: 1 year of electrical maintenance wiring and satisfactory completion accepted by a University of Hawai'i Community College offering an appropriate program of study of electrical academic coursework (80 hours), or 2 years of schooling in the trade with not less than 1,000 hours of hands-on lab exercises. The equivalent amount of academic coursework via the union or ABC is also acceptable.

Appendix E: Career Pathways #2 Insulation Workers—Mechanical and Floor, Ceiling, and Wall

Occupational Descriptions

MECHANICAL INSULATION WORKER: Apply insulating materials to pipes or ductwork, or other mechanical systems in order to help control and maintain temperature. Some examples of reported job titles include Insulator, Mechanical Insulator, Insulation Mechanic, Industrial Insulator, Insulation Helper, Insulation Worker, Mechanic Insulator, Commercial Insulator, Heat and Frost Insulator, Insulation Installer.[1]

FLOOR, CEILING, & WALL INSULATION WORKER: Line and cover structures with insulating materials. May work with batt, roll, or blown insulation materials. Some examples of reported job titles include Insulation Installer, Installer, Insulator, Insulation Estimator, Retrofit Installer, Insulation Mechanic, Warehouse Insulation Worker.[2]

When Are These Occupations Considered "Green"?

As the primary purpose of most installation of insulation materials to mechanical systems or building structures is to improve energy efficiency, the insulation worker is largely an inherently green occupation. However, one example of a non-green insulation installation would be for soundproofing (acoustic insulation).

Who Employs Insulation Workers?

Mechanical insulation workers generally work for plumbing and heating, ventilation, & air conditioning (HVAC) contractors. Floor, ceiling, & wall insulation workers are generally employed by drywall and roofing contractors.

The Numbers on Mechanical Insulation Workers

- 15th-highest green occupation
- 184 jobs in 2010
- 296 projected jobs in 2012
- Median hourly wage: $27.26

The Numbers on Floor, Ceiling, and Wall Insulation Workers

- 7th-highest green occupation
- 276 jobs in 2010
- 336 projected jobs in 2012
- Median hourly wage: $22.96

How the Movement Toward Green Has Affected the Occupations

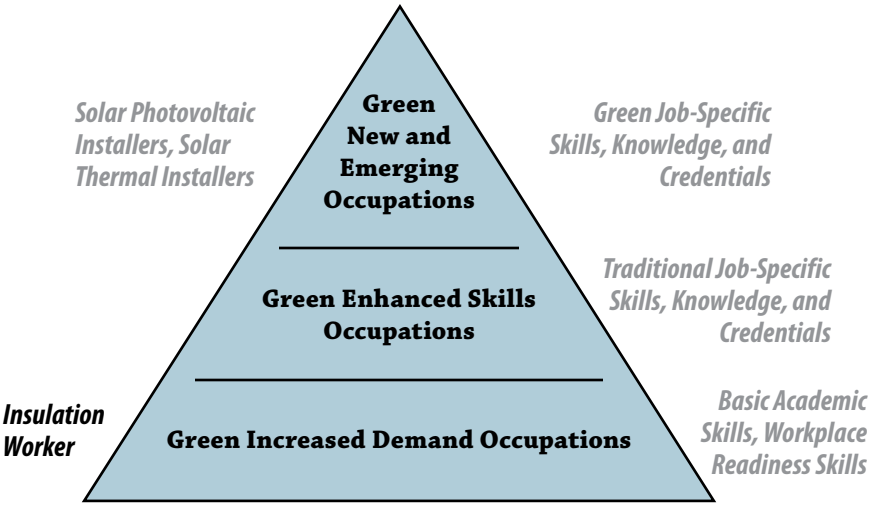
Both types of insulation workers are in the green jobs category of "increased demand" green occupations (see figure on next page). As insulating HVAC or other mechanical systems as well as building structures improves energy efficiency, with consistently rising energy costs, demand for insulation workers is expected to increase at a healthy rate in the next few years.

Important Knowlege for Mechanical Insulation Workers

- Mathematics
- Mechanical
- Building and Construction

1. http://www.onetonline.org/link/summary/47-2132.00
2. http://www.onetonline.org/link/summary/47-2131.00

Occupations by Skills Sought by Green Job Employers



SOURCE: (Occupations) National Center for O*Net Development, 2009; (Skills) John J. Heldrich Center for Workforce, 2009

Important Skills for Mechanical Insulation Workers

- Installation
- Active Listening
- Coordination

Important Abilities for Mechanical Insulation Workers

- Oral Comprehension
- Arm–Hand Steadiness
- Oral Expression

Potential Job Transitions into Mechanical Insulation Worker Positions

Jobs with at least 100 workers, making less than mechanical insulation workers (on average), having compatibility index of at least 92, are identified in the chart below.

Job Title	2010 Jobs	2010 Hourly Earnings	Compatibility Index*
Roofers	498	$24.81	96
Telecommunications Line Installers and Repairers	246	$22.82	95
Helpers—Carpenters	439	$18.05	95
Helpers—Electricians	354	$16.44	94
Construction Laborers	4,462	$22.93	93
Highway Maintenance Workers	319	$22.47	93
Painters—Construction and Maintenance	1,727	$22.31	93
Security and Fire Alarm Systems	173	$19.82	93
Carpet Installers	286	$18.50	93
Helpers: Brickmasons, Blockmasons, Stonemasons, and Tile and Marble Setters	165	$18.39	93
Helpers: Pipelayers, Plumbers, Pipefitters, and Steamfitters	242	$15.38	93
Nursery Workers*	4,014	$12.30	93
Maintenance and Repair Workers—General	6372	$18.95	92
Team Assemblers	502	$13.25	92

* Occupation compatibility, or the similarity between two occupation's competencies, is another term that is crucial for interpreting Career Pathways analysis. The compatibility index comparing the skill, knowledge, and ability profiles of two occupations, in terms of both attainment level and importance. An algorithm uses the differences between competency levels, weighted by importance levels, to determine how compatible two occupations are.

Important Knowledge for Floor, Ceiling, and Wall Insulation Workers

- Mathematics
- Mechanical
- Building and Construction

Important Skills for Floor, Ceiling, and Wall Insulation Workers

- Installation
- Active Listening
- Coordination

Important Abilities for Floor, Ceiling, and Wall Insulation Workers

- Oral Comprehension
- Arm–Hand Steadiness
- Oral Expression

Potential Job Transitions into Floor, Ceiling, and Wall Insulation Worker Positions

Jobs with at least 100 workers, making less than f, c, & w insulation workers (on average), having a compatibility index of at least 90, are identified in the chart below.

Entry to Insulation Worker Positions

In general, employers prefer applicants with at least a high school diploma who are in good physical shape. While most insulation workers learn their trade informally on the job or through formal training via their employer (e.g., spray manufacturer instruction), skills learned in high school elective courses in the industrial arts can provide useful learning experiences. Community college or trade school coursework in the industrial arts may also add value to a potential applicant. In the field, job experience in the construction industry, even in "unskilled" positions such as in a laborer or helper capacity, is also a plus. Finally, if an employer requires an installer to perform asbestos abatement, that worker must receive certification by the Hawai'i Department of Health.[3]

Apprenticeships

The union for insulation workers is the International Association of Heat and Frost Insulators and Allied

3. http://www.asbestos-abatement.com/state-resources/hawaii.html

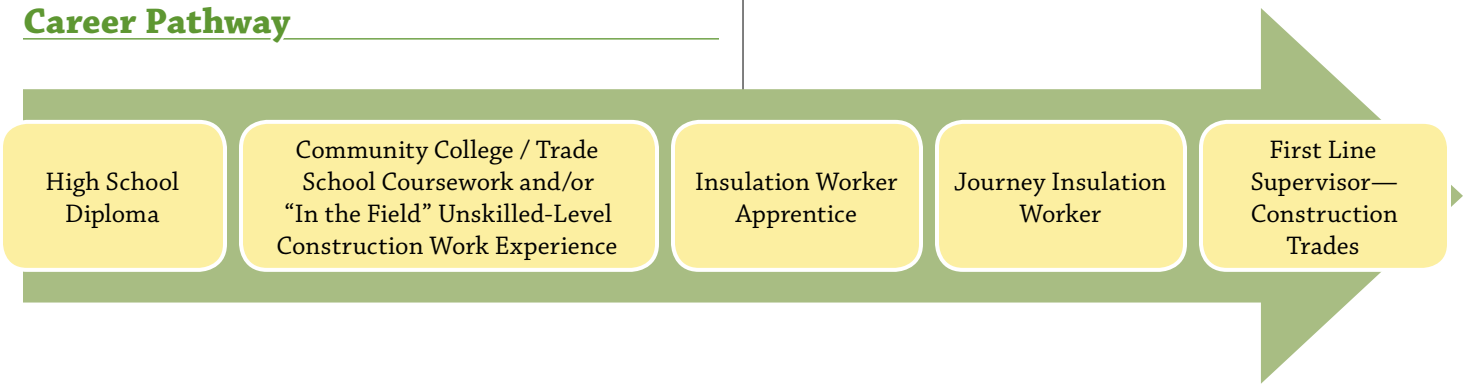
Job Title	2010 Jobs	2010 Hourly Earnings	Compatibility Index*
Helpers: Brickmasons, Blockmasons, Stonemasons, and Tile and Marble Setters	165	$18.39	97
Nursery Workers	4,014	$12.30	95
Construction Laborers	4,462	$22.93	94
Helpers: Carpenters	439	$18.05	94
Painters—Construction and Maintenance	1,727	$22.31	93
Automotive Body and Related Repairers	423	$19.27	93
Telecommunications Line Installers and Repairers	246	$22.82	92
Machine Feeders and Offbearers	370	$10.05	92
Highway Maintenance Workers	319	$22.47	91
Carpet Installers	286	$18.50	91
Tree Trimmers and Pruners	446	$17.81	91
Landscaping and Groundskeeping Workers	7,219	$14.55	91
Cabinetmakers and Bench Carpenters	258	$14.26	91

Workers. Their apprenticeship program is structured for entry-level workers, as well as for insulation workers already employed within the industry who wish to upgrade their skills and to advance to journeyman status.[4] The program emphasizes on-the-job training and classroom instruction, as well as the use of textbooks and other course materials that give participants a thorough knowledge of the trade. Apprentices are assigned to work for an insulation contractor. Upon completion of the apprenticeship, there is an examination, with passage of this test necessary to obtain journeyman status.

LOCAL 132 (HAWAI'I)

707 Alakea Street, Room 206
Honolulu, HI 96813
awl132@insulators.org
(808) 521-6405

Career Pathway



4. http://www.insulators.org/pages/appren.asp

Appendix E: Career Pathways #3 Solar Photovoltaic Installers and Solar Thermal Installers and Technicians

Occupational Descriptions

SOLAR PHOTOVOLTAIC INSTALLER: Assemble, install, or maintain solar photovoltaic (PV) systems on roofs or other structures in compliance with site assessment and schematics. May include measuring, cutting, assembling, and bolting structural framing and solar modules. May perform minor electrical work such as current checks.[1] "Solar photovoltaic systems" refers to a wide variety of solar electricity systems. Solar photovoltaic systems use solar panels made of silicon to convert sunlight into electricity. Solar photovoltaics are used in a number of ways, primarily to power homes that are inter-tied or interconnected with the grid.[2] In 2010, there were 237 solar photovoltaic installers in the state.

SOLAR THERMAL INSTALLERS AND TECHNICIANS: Install or repair solar energy systems designed to collect, store, and circulate solar-heated water for residential, commercial, or industrial use.[3] In 2010, there were 194 solar thermal installers and technicians in the state.

When Are These Occupations Considered "Green"?

As the principal job duty is installation of clean energy fixtures, these occupations as a whole are inherently green. In relation to the description of GREEN core areas described in the publication, *Hawai'i's Green Workforce: A Baseline Assessment*, the contribution to green falls under the G category: Generate clean, renewable, sustainable energy.

1. http://www.onetonline.org/link/summary/47-4099.01
2. http://www.thesolarguide.com/solar-energy-systems/solar-photovoltaic-systems.aspx
3. http://www.onetonline.org/link/summary/47-4099.02

Who Employs Solar Photovoltaic Installers?

The vast majority are employed by electrical contractor and solar energy specialists.

Who Employs Solar Thermal Installers And Technicians?

The vast majority are employed by plumbing contractors and solar energy specialists.

The Numbers on Solar Photovoltaic Installers

- 9th-highest green occupation
- 237 jobs in 2010
- 82 current vacancies
- 684 projected jobs in 2012
- Median hourly wage: n/a

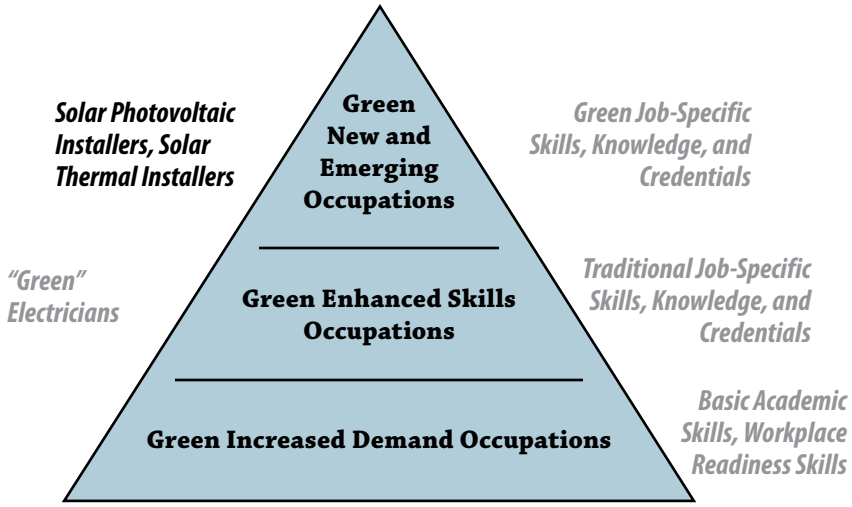
The Numbers on Solar Thermal Installers and Technicians

- 12th (T) highest green occupation
- 194 jobs in 2010
- 2 current vacancies
- 297 projected jobs in 2012
- Median hourly wage: n/a

How the Movement Toward Green Has Affected the Occupation

Both types of solar installers are in the green jobs category of "new and emerging" green occupations (see below). Strong growth is anticipated in these occupations statewide, as Hawai'i government leaders have consistently targeted becoming less reliant on

Occupations by Skills Sought by Green Job Employers



SOURCE: (Occupations) National Center for O*Net Development, 2009; (Skills) John J. Heldrich Center for Workforce, 2009

imported oil to meet energy demands. As a result, tax credits and other government incentives to install solar energy based systems are expected to remain the trend.

Possible Transition Occupations

There are already significant amounts of electricians and plumbers performing solar installation work. It may be considered a natural progression based on business demand that some in these occupations convert to full-time work in the solar energy field. This has in fact already taken place and will continue to, given the current and expected future expansion of the industry. Currently there are 2,640 electricians and 2,450 plumbers in the State of Hawai'i.

Entry to Solar Installation Positions

Most solar installers have a high school diploma and mechanical, electrical (photovoltaic), plumbing (thermal), or related experience. People with construction backgrounds are often well-suited for the work. New workers frequently learn on the job, although specific training in solar installation or solar power is helpful.[4] Some employers prefer to hire applicants who have an associate's degree in an electrical or related field. Paid apprenticeships are also available (see "Apprenticeships" section). However, according to Honolulu Community College, there is an advantage to completing the electrical program at community colleges instead of directly entering the union: often the unions, private or government employers may recruit for apprentices through the community colleges, since students already have the basic knowledge and skills needed to perform entry level work.[5]

Education (Community College)

For an associate's degree most in line with a solar photovoltaic installer, three community college campuses on O'ahu (Honolulu Community College), Kaua'i, and the Big Island offer coursework leading to either an Associate's Degree in Applied Science (63 credits) or in Electrical Installation and Maintenance Technology, or a Certificate of Achievement (47 credits) in Electrical Installation and Maintenance

4. http://www.bls.gov/opub/ooq/2009/fall/yawhat.pdf
5. http://tech.honolulu.hawaii.edu/eimt/eimtfaq.html#5

Technology. In addition, Kaua'i Community College has a Certificate of Completion (23 credits) in Electrical Installation and Maintenance Technology.

Maui Community College offers three certificates that specifically incorporate green principles. All are under the blanket of the Sustainable Construction Technology Program, namely the Certificate of Competence in Electrical Maintenance (5 credits), the Certificate of Competence in Energy Production (6 credits), and the Certificate of Competence in Maintenance Plumbing (4 credits). The overall academic program—which leads toward an Associate's Degree in Applied Science (64–67 credits), a Certificate of Achievement (33 credits), or a Certificate of Completion (16 credits) in Sustainable Construction Technology—focuses on the design, retrofit, and maintenance of sustainable construction, including energy-efficient systems, passive cooling, renewable energy for wind, sun, and water, and electricity-saving equipment using such new technology as off-grid systems and computer-controlled consumption. MCC is the only branch of the UH system to offer this program.

For perhaps a quicker route for a worker with some related experience (skilled trade) to become a solar photovoltaic installer, the Pacific Center for Advanced Technology Training (PCATT) at Honolulu Community College offers "Introduction to Photovoltaic Design." Upon completion of this course, participants will qualify to take the North American Board of Certified Energy Practitioners (NABCEP) PV Entry Level certification exam (see Certification section).[6]

Education (Trade Association Classes)

Another possible route more geared for an experienced worker is a course at the ABC (Associated Builders and Contractors) Hawai'i Training Center in Honolulu. There, the Solar Training Institute (based in San Jose, CA) offers an accredited program which provides professional training for construction professionals seeking employment in the solar industry, as well as licensed contractors who want to get started in the solar PV industry. The goal of this five-day Photovoltaic (PV) design and installation course (PV Design and Installation Certificate) is to provide trainees expertise with the latest techniques that are required to install solar PV systems. This is a performance-based course designed upon job-related tasks a solar installer must perform and prepares workers for entry into the solar field. At the completion of the course students will take a final exam, and upon obtaining a passing grade they will receive a Certificate of Completion from STI. Successful completion of this course also allows students to take the NABCEP PV Entry Level Exam given by STI (see Certification section).

Education (Union Classes)

For persons who join the International Brotherhood of Electrical Workers (IBEW Local 1186), photovoltaic classes are scheduled on a periodic basis for apprentices. For persons who join the Plumbers and Fitters UA Local Union 675, solar thermal training classes are scheduled on a periodic basis for apprentices.

Apprenticeships via the Trade Association

To become an apprentice via the Associated Builders and Contractors, Inc., applicants must meet the following minimum requirements:

- High school diploma or GED
- 1 year of high school Algebra (not Pre-Algebra)
- Transcript of high school courses or post-high school trade courses
- Valid driver's license
- Must pass industry and color-code vision tests
- Must be a U.S. Citizen to go onto military bases
- Must work for a member company for six or more weeks
- Must be legally able to work under current immigration laws

6. http://pcatt.org/pcatt/schedule/viewCategoryAction.do?category=Green Training

RECRUITMENT:
- Sponsored by member company

CONTACT:
- Associated Builders & Contractors, Inc.
  http://www.abchawaii.org
  phone: (808) 845-4887

Apprenticeships via the Union

To become an apprentice via the IBEW Local 1186, applicants must meet the following minimum requirements:

- Must be at least 18 years of age
- Must provide a copy of high school diploma or GED, as well as all applicable official transcripts and records
- Show evidence of successful completion of one full year of high school algebra I or higher math, and/or successfully complete the National Joint Apprenticeship & Training Committee (NJATC) Tech Math Course and provide official transcripts
- Pass the NJATC Aptitude Test with a minimum score established by the JAC.

RECRUITMENT:
- 2 week period in 1st 6 mo of the year

CONTACT:
- Hawai'i Electricians Training Office
  http://hawaiielectricianstraining.org
  phone: (808) 847-0629

Apprenticeship openings via the Plumbers and Fitters UA Local Union 675 depend on the need for apprentices in the plumbing industry. Applications are accepted only during a recruitment period. Applicants who apply must meet minimum entry requirements[7]:

- Must be at least 18 years of age
- Must provide evidence of being a high school graduate or have a General Educational Development (G.E.D.) certificate or equivalent
- Must provide an "official" transcript of high school records and a transcript of trade school courses, if any
- Must show a valid driver's license
- Must be physically fit to perform the duties of the specific trade
- Must take a Math Skills Evaluation test and satisfactorily pass with a minimum score of 70 percent

CONTACT:
- Plumbers and Fitters UA Local Union 675
  http://plumbershawaii.com
  phone: (808) 536-5454

Apprenticeships via Community College

The Sustainable Living Institute of Maui is a partner with the Rural Development Project (RDP) Green Industry Internship Program for 2010–2012. Students that participate in SLIM programs are eligible to apply to the program. This is a paid internship program. Students can intern with solar companies, conduct energy audits, or intern other types of green industries.[8] Applicants can send their resume and cover letter to sliminfo@hawaii.edu.

Certification (NABCEP: National Association Board for Certified Energy Practitioners)

The NABCEP certification (PV and solar thermal) is a voluntary certification that provides a set of national standards by which installers with skills and experience can distinguish themselves from their competition. The target candidate for NABCEP certification is the person responsible for the system installation (e.g., contractor, foreman, supervisor, or journeyman).[9] Here are the qualifying categories for the following certifications exams:

SOLAR PV INSTALLER:
- Experience installing PV systems occurring at some point in the two (2) years prior to submit-

7. http://plumbershawaii.com/apprenticeship.php

8. http://sustainablemaui.org/programs-projects/green-internships
9. http://www.nabcep.org/certification/pv-installer-certification

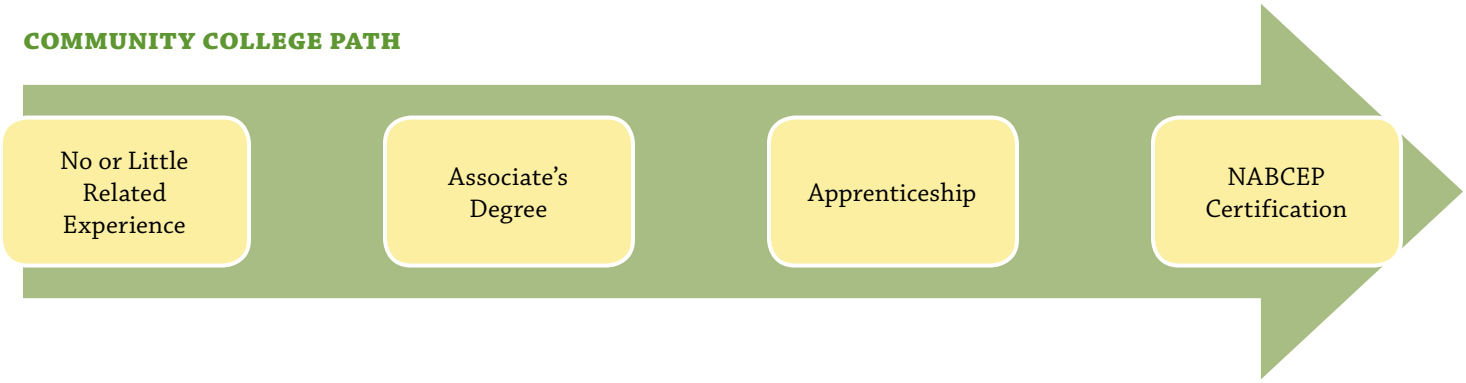
ting an application for the exam, in addition to the completion of 40 hours cumulative of training; OR
- Be an existing licensed contractor in good standing in solar or electrical construction-related areas with experience installing PV systems occurring at some point in the two (2) years prior to submitting an application for the exam, in addition to the completion of 40 hours cumulative of training; OR
- Four (4) years of electrical construction-related experience working for a licensed contractor, including experience installing PV systems occurring at some point in the two (2) years prior to submitting an application for the exam, in addition to the completion of 40 hours cumulative of training; OR
- Three (3) years experience in a U.S. Dept. of Labor-approved electrical construction trade apprentice program, including experience installing PV systems occurring at some point in the two (2) years prior to submitting an application for the exam, in addition to the completion of 40 hours cumulative of training; OR
- Two (2)-year electrical construction-related, or electrical engineering technology, or renewable energy technology/technician degree from an educational institution or four (4)-year construction-related or engineering degree from an educational institution, including experience installing PV systems occurring at some point in the two (2) years prior to submitting an application for the exam.

SOLAR THERMAL INSTALLER:

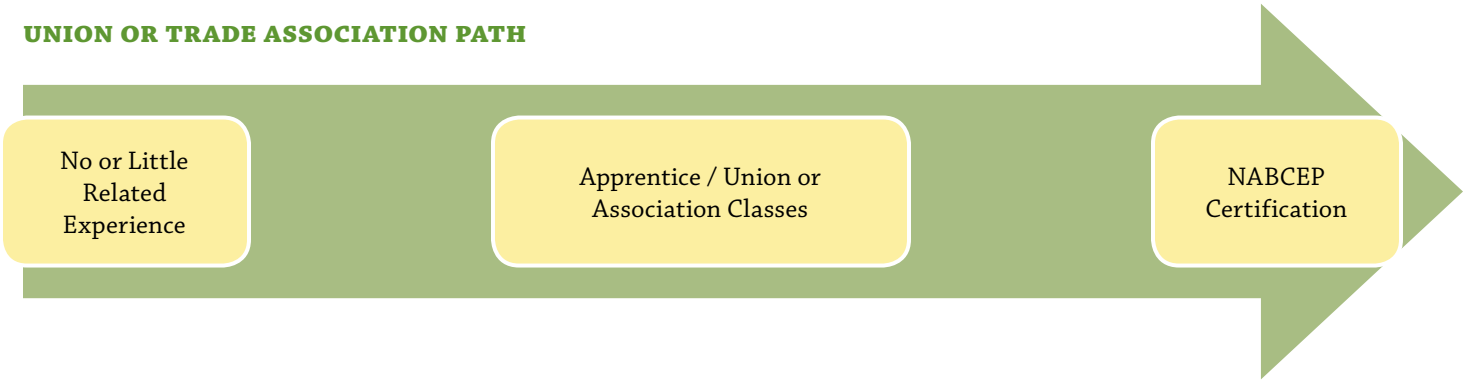
- Four (4) years of experience installing Solar Hot Water Systems; OR
- Two (2) years of experience installing Solar Pool Heating Systems in addition to completion of a board-recognized training program; OR
- Two (2) years of experience installing Solar Thermal Systems, in addition to completion of 40 hours cumulative of training; OR
- Be an existing licensed contractor in good standing in solar or construction-related areas with one (1) year of experience installing Solar Thermal Systems; OR
- Four (4) years of HVAC, mechanical, pipe-fitting, or plumbing-related experience working for a licensed contractor, including one (1) year of experience installing Solar Thermal systems; OR
- Three (3) years of experience in a government/trade union-approved construction trade apprentice program, including one (1) year of experience installing Solar Thermal Systems; OR
- Two (2)-year construction-related, or engineering technology, or renewable energy technology/technician degree from an accredited educational institution, plus one (1) year of experience installing Solar Thermal Systems; OR
- Four (4)-year engineering degree from an accredited educational institution, including (1) year of experience installing Solar Thermal Systems; OR
- NABCEP© Solar PV Installer Certification AND 16 hours of Board-recognized training, AND installation of at least two solar hot water systems. These two systems require a permitting and inspection process by a permitting authority, OR, in the absence of such, an appropriate underwriter authorized to provide an inspection certificate. In regions where neither of these inspection options exist, the Application Review Committee will judge experience based on supplied documentation.

Possible Career Paths For Workers With Little or No Related Skill Trade Experience

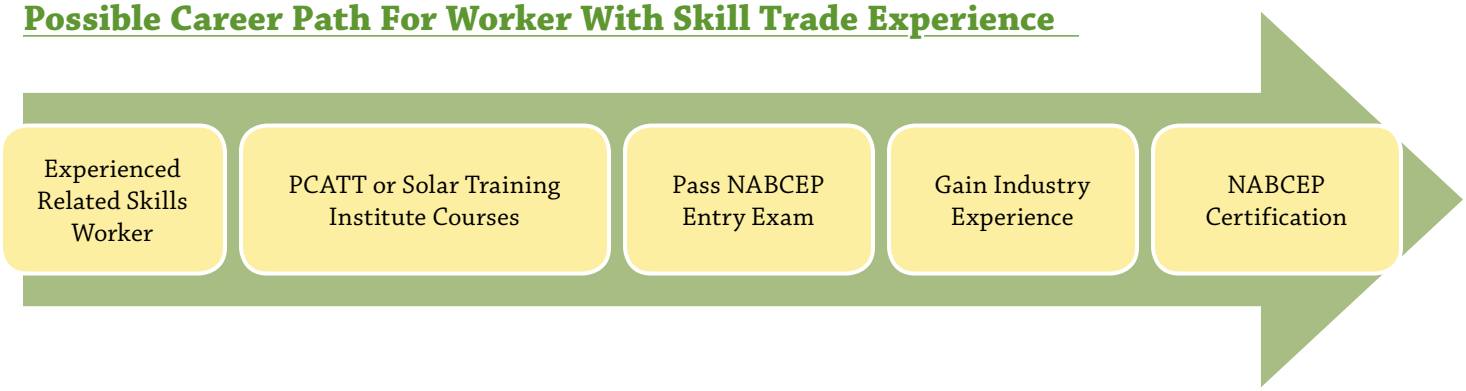
COMMUNITY COLLEGE PATH



UNION OR TRADE ASSOCIATION PATH



Possible Career Path For Worker With Skill Trade Experience





hawai‘i green jobs initiative

Department of Labor and Industrial Relations

Mixed Sources
Product group from well-managed forests and other controlled sources
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