

NEW JERSEY GOING GREEN

A DEMAND-SUPPLY ANALYSIS OF CURRENT AND POTENTIAL GREEN JOBS AND GREEN SKILLS



Prepared for:
NEW JERSEY STATE ENERGY SECTOR
PARTNERSHIP COUNCIL

Prepared by:
DIVISION OF LABOR MARKET AND DEMOGRAPHIC RESEARCH
NEW JERSEY DEPARTMENT OF LABOR AND WORKFORCE DEVELOPMENT

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INTRODUCTION

“Going Green” is one of the highest priorities of this current administration and for the State of New Jersey. From renewable energy standards in law or State policy, to the need to clean up older industrial sites and numerous Super Fund sites; from the movement to local sustainable agriculture and to the tremendous need for weatherizing older housing stock in the State, there is a strong and growing demand for “green.” In October 2008, New Jersey’s Energy Master Plan (EMP) was created to guide the development of green energy infrastructure in New Jersey. There are also comprehensive statewide and national initiatives to redirect the workforce system in support of this new and emerging industry. The EMP targets a 20 percent decrease in energy consumption by 2020. It also projects the creation of approximately 20,000 jobs during the same period, due in large part to a \$33 billion infrastructure investment. At the national level, the American Recovery and Reinvestment Act (ARRA) includes \$500 million for training related to careers in the energy efficiency and renewable energy industries. These important measures mean that it is crucial to have an accurate profile of the green industry in New Jersey today.

The purpose of this report is to provide an overview of the current status of green industries in New Jersey and outline opportunities for the state as it works to create more innovative and forward-looking strategies for the green energy workforce. Profiled are “potentially green” industries or industries with a significant proportion of activities related to the green economy. Next, a regional analysis was conducted, assessing the competitiveness of green industries in New Jersey’s three regions. For each of these regions, the core occupations skills required by its most competitive green industry(ies) are highlighted. This skill-demand analysis will be evaluated vis-à-vis the current supply of training programs provided by New Jersey’s county colleges and vocational schools. The current and potential skills supply will also be assessed vis-à-vis training program needs identified by previous research. Finally, and in an effort to provide pathways for development for dislocated workers as well as workers who just entered the labor market, various “green career pathways” are outlined.

It is important to note that findings from this research are based in large part on the application of green industry definitions and skills requirement identified in other research. However, the

composition and profile of green industry varies significantly from one region and state to another. This is why further research is needed to better profile the green industry in New Jersey and to identify the staffing patterns of these industries that are specific to this state. Accordingly, the New Jersey Department of Labor and Workforce Development (LWD) has applied for two federal grants to improve labor market information related to green jobs. Specifically, these two grants seek to 1) define the green industry, 2) assess its growth potential, 3) analyze current and projected green job vacancies, and 4) provide a thorough analysis of the skills required for these types of jobs in New Jersey.

Data Sources and Methodology

This research is based on a synthesis and application of the most widely accepted green industry definitions. The green industry definition is based primarily on three well-regarded studies conducted by other state labor market information divisions: Oregon,¹ Colorado,² and Washington.³ The studies were chosen based on their breadth of research and because they included specific green energy industry definitions. The industry definitions were adapted using state-specific information. Using data from the Quarterly Census of Employment and Wages, this synthesized definition was applied to assess the current and potential size of the industry. The staffing patterns of these industries were also determined using Occupational Employment Survey data.

Another source of data used is a survey on county colleges and vocational schools inventorying the training programs they offered that were related to “green skills.” (We have plan to expand the scope of this survey to include other private and proprietary schools in the future.)

The final source of data used in this report was research conducted by other states on the types of training required to fill specific green jobs. We conducted a detailed literature review, and

¹Oregon Employment Department, “Oregon’s Energy Efficiency and Renewable Energy Workforce,” State of Oregon, April 24, 2008: http://www.qualityinfo.org/pubs/single/green_energy.pdf

² Department of Labor & Employment, “Powering a Brighter Tomorrow,” State of Colorado: <http://lmigateway.coworkforce.com/lmigateway/admin/gsipub/htmlarea/uploads/EnergyResearchers.pdf>

³ E2SHB Implementation Team, “Initial Washington Green Economy Industry List,” State of Washington, July 15, 2008: <http://www.labormarketinfo.edd.ca.gov/contentpub/GreenDigest/WA-NAICS-Industry-List.pdf>

synthesized and adapted much of the information and methodologies used in these reports so that it was applicable to New Jersey.

Green Incentives

New Jersey provides a wide range of financial incentives to encourage the development and growth of the state's green economy. To support the goals of Governor Corzine's Energy Master Plan strategy, the New Jersey Economic Development Authority launched the Clean Energy Solutions product portfolio, which encompasses a comprehensive suite of financing programs, including interest-free loans and grants to ensure that commercial, industrial and institutional entities have the resources they need to grow and prosper while simultaneously reducing New Jersey's carbon footprint. Among these programs are the Clean Energy Solutions Capital Investment (CESCI), the Combined Heat and Power (CHP) program, and the Clean Energy Manufacturing Fund (CEMF). These three programs are designed to promote the purchase and installation of clean/green technologies that reduce energy consumption and/or generate energy through recycling production wastes.

The New Jersey Department of Labor and Workforce Development (LWD) has also developed several training initiatives designed to ensure the availability of the necessary talent pool for supporting the growth of the green economy. Supported in part by a \$300,000 grant from the Conserve to Preserve Foundation of the New Jersey Resources Corporation, LWD has implemented a unique collaboration called the Green Job Training Partnership (GJTP) Program. The GJTP Program is designed to provide a pipeline of entry-level workers for the new jobs that will be created as a result of Governor Corzine's Economic Recovery and Assistance Plan (introduced in October 2008) and the Energy Master Plan. The program will provide crucial training to traditionally underserved urban men, women, and youth, as well as re-training for incumbent workers seeking to upgrade their skills.

NEW JERSEY'S GREEN INDUSTRY

There is a vast body of literature on the green industry today. This study started with an extensive review of the literature related to green energy, with a focus on studies that provided definitions of green industries and occupations. We have adapted the industry definitions provided in two seminal green studies developed by the Oregon and Washington State Labor Market Information divisions. In this report, green industries are grouped into four major industry sectors: 1) energy efficiency, 2) renewable energy, 3) waste reduction and management, and 4) transportation.

Energy efficiency includes industries that build and/or install systems designed to reduce energy consumption at the residential, commercial and industrial levels. Some of the industries in this group are concerned with retrofitting current residential, commercial, and industrial buildings to make them more efficient. Others are engaged in constructing new “green buildings.” Also included in this sector are industries that install renewable energy devices, such as solar panels or geothermal heating systems at residential, commercial, and industrial sites.

Renewable energy includes industries that design and manufacture renewable energy technologies, such as solar energy, wind energy, photovoltaic technologies, wind turbines, fuel cells, geothermal technologies, cogeneration, wave or tidal action, biofuels and bio-mass. The industries in this sector are mainly in the manufacturing and professional & technical services sectors.

The third sector, **environmental remediation**, includes industries related to recycled goods, waste reduction, and water treatment. The industries are mostly administrative support and waste management and remediation services; however, there are also two wholesale industries in this group.

Transportation encompasses mass transit systems. This industry is included for three reasons. First, an increase in demand for mass transit will result in less energy consumption and carbon emissions by personal cars. Second, many of the transit systems across the nation are involved in

major developmental projects to implement more clean energy technologies. For example, the Port Authority of New York and New Jersey has implemented an aggressive environmental plan to help improve air quality for the 18 million residents in the metropolitan region through the expansion of the fleet of clean fuel vehicles and the replacement of current engines with lower emission engines. Also, through several federal grants from the U.S. Environmental Protection Agency, all pre-1994 trucks at various ports, which produce 10 to 30 percent of various types of pollutants, will be replaced with cleaner engine trucks. Third, many of the ports are ideal sites for the installation of shore power systems.

Employment in the Green Industry

There are 20,764 companies in New Jersey that are either already performing green functions or may “turn green” whether through the implementation of clean/green technologies or through producing green technologies. Combined, these industries employ almost 192,000 workers, which is five percent of New Jersey’s total employment. (Table 1) Some of these companies are producers of green/clean energy, while others are major current/potential consumers of green industry. It should be noted, however, that green economy involves extensive transformation in building and production models across all industries. Moving forward, more industries will become green. It is important, therefore, to design broad incentives that are available for all New Jersey’s companies that develop ways to become more energy efficient.

Table 1. Employment in New Jersey's Green Industries
Average Annual Employment, 2009

Green Industry		Number Of Firms	Average Annual Employment	Share Of Total Green Employment
Energy Efficiency	Building Installation	8,735	60,857	30.4%
	Residential Construction	7,268	24,905	12.4%
	Commercial And Industrial Construction	1,138	12,712	6.3%
	Building And Equipment Manufacturing	122	3,885	1.9%
	Total, Energy Efficiency	17,263	102,359	55.3%
Renewable Energy	Biofuel Energy	158	7,082	3.5%
	Solar Energy	453	14,247	7.1%
	Wind	439	12,501	6.2%
	Thermal, Hydraulic And Other Renewable Energy	1,127	30,550	15.2%
	Total, Renewable Energy	2,177	64,381	32.1%
Environmental Remediation		1,250	17,428	8.7%
Transportation		75	7,713	3.8%
Total, All Green Industries		20,764	191,888	100%

Energy efficiency accounts for more than half of the employment in New Jersey's green industries, or over 102,000 jobs. Retrofitting existing buildings to become energy efficient and adding solar panels is currently the biggest subcomponent in the energy efficiency sector. Fifty-nine percent of the energy efficiency employment (over 60,000 jobs) is in the building installation industry. The 37,000 jobs in the residential and nonresidential construction industries are either currently green or will become green in the near future. This will require that the manufacturing of the materials used in the construction of these buildings conform to new green standards. Another important green element is related to the manufacturing of greener, more energy-efficient equipment, including refrigerators, laundry equipment, etc. A significant proportion of the 3,900 manufacturing jobs is also expected to become green in the near future. Both the construction and manufacturing industries have been hard hit by the recession.

Almost one-third of employment in New Jersey's green industries in renewable energy; over half of this (almost 34,000) is distributed among biofuels, solar, and wind-related manufacturing. The production of other renewable resources (e.g., thermal, hydraulic) is a small but significant component in the green industry, currently employing about 31,000 workers, or 15 percent of total green employment in New Jersey. The comprehensive incentives designed in support of the Governor's Energy Master Plan are expected to boost employment in these jobs significantly.

Figure 1. Distribution of Employment in Green Industries in New Jersey

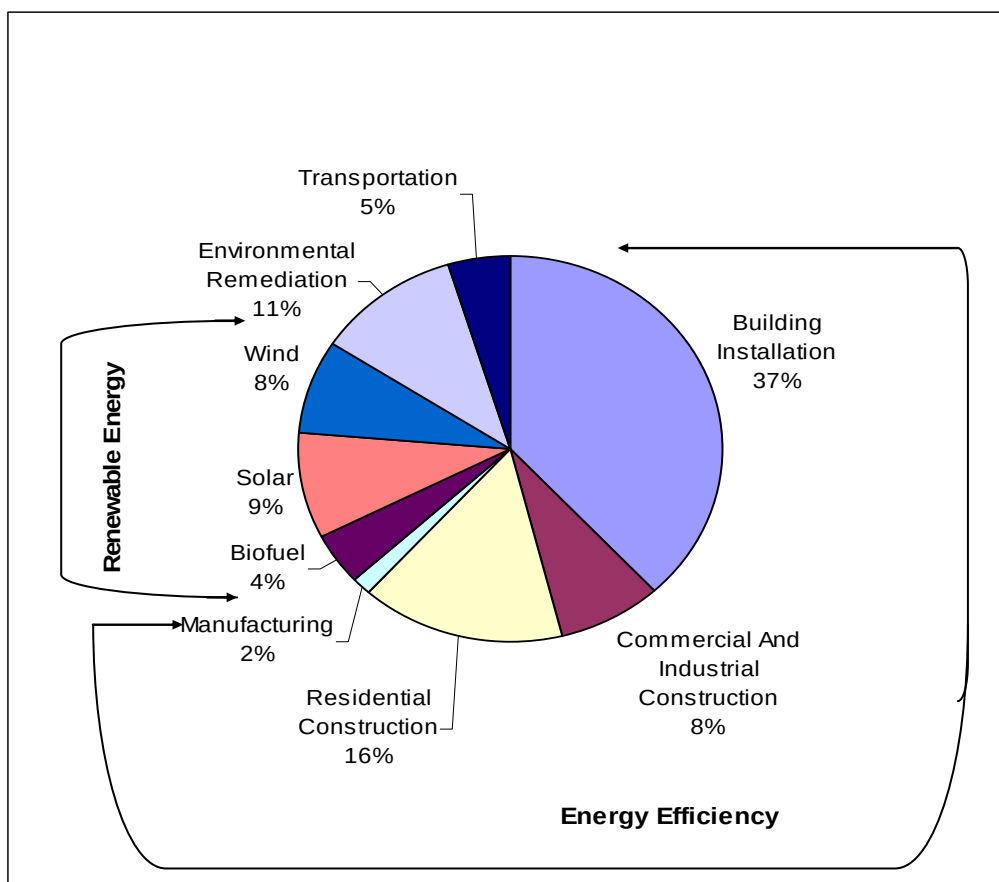
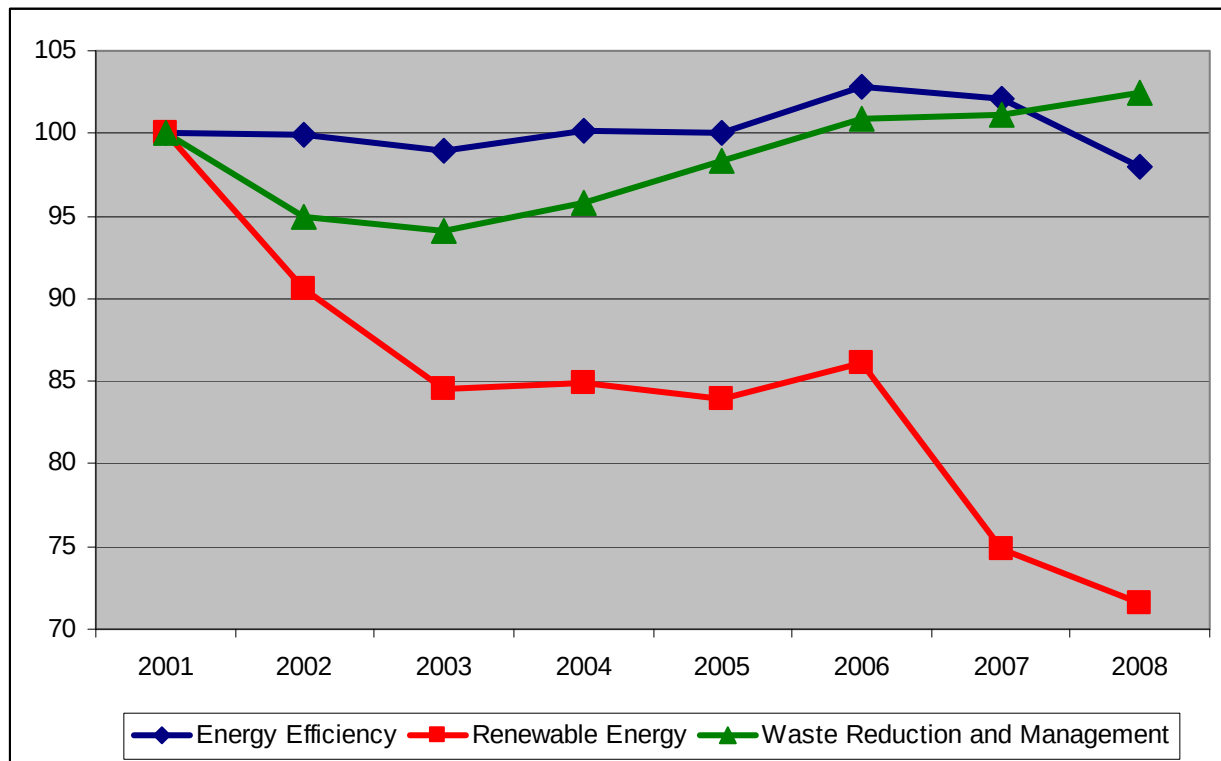


Figure 2. Indexed Employment in Green Energy Industries

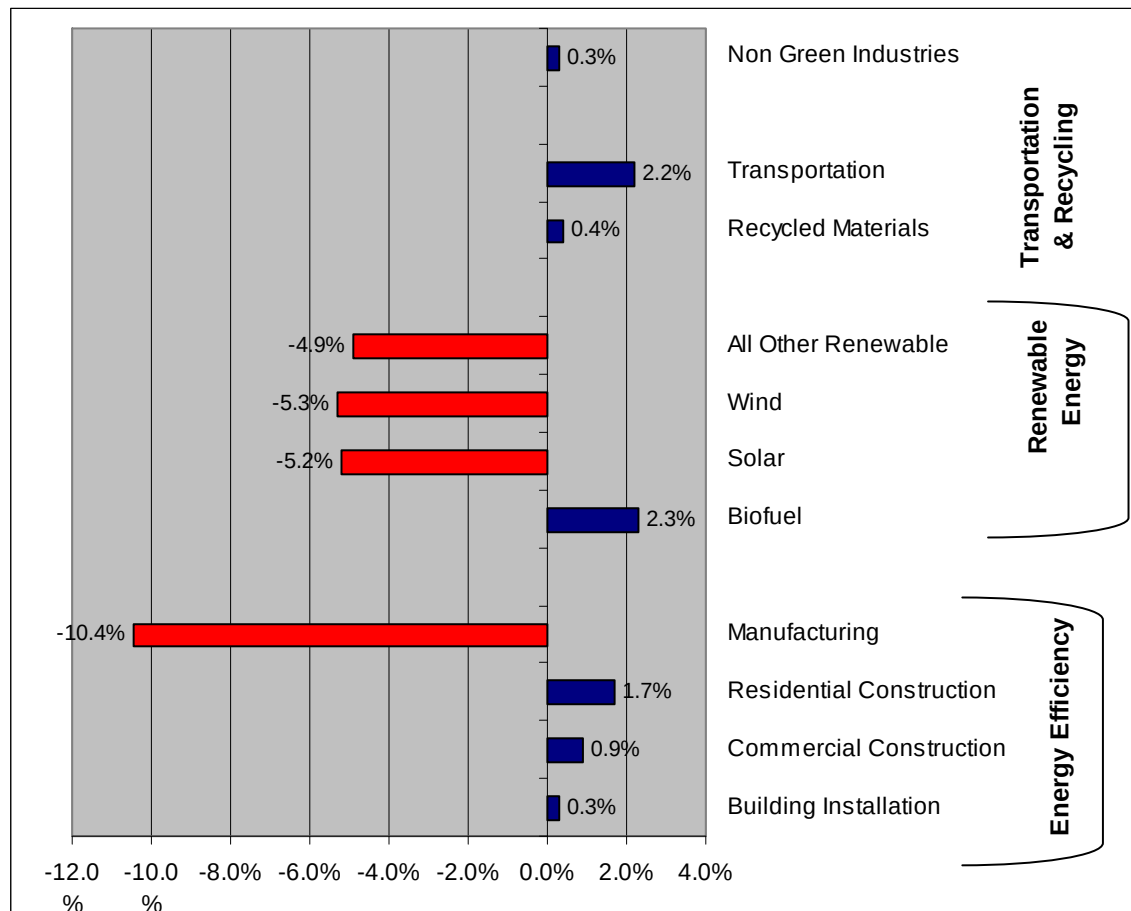


Employment in the energy efficiency industry remained stable between 2001 and 2006 (Figure 2). The current recession, however, had a great impact on the construction industry. Between December 2007 and July 2009, the construction industry lost 18.3 percent of its total employment. Employment in the energy efficiency sector, therefore, dropped by 4.1 percent between 2007 and 2008.

Most of the companies in the renewable energy sector are manufacturing companies producing products that are currently not green, such as plastics material, glass, copper wire, metal manufacturing, industrial fans, etc. Manufacturing employment has been on a decade's long downward trend, but that pace has accelerated over the course of the recession. The green economy, however, will create new opportunities for rejuvenating the manufacturing industry in New Jersey. Many of these companies will be incorporated into the extensive supply chain of the wind, solar, and biofuels energy.

Figure 3 depicts data on the average annual growth in the various green sectors between 2001 and 2008 and compares these growth patterns with that in all other industries. Significant growth was recorded in the biofuels and transportation sectors. Residential and commercial construction have also been growing. While infrastructure construction has been declining, this industry is expected to be targeted by both the state and federal recovery investments, which in turn should increase employment in this sector by thousands of jobs over the next five to ten years.

Figure 3. New Jersey Average Annual Employment Growth, 2001 to 2008



Geographic Sector Analysis

This section identifies the geographic concentrations of green industries around which the state energy strategies should revolve. Through the use of mapping techniques, we identify geographic concentrations of the various green sectors defined above. We provide an analysis of the specific industry strengths of various regions. (Appendix A includes eight maps which graphically depict the distribution of firms in four energy efficiency subsectors and four renewable energy subsectors.)

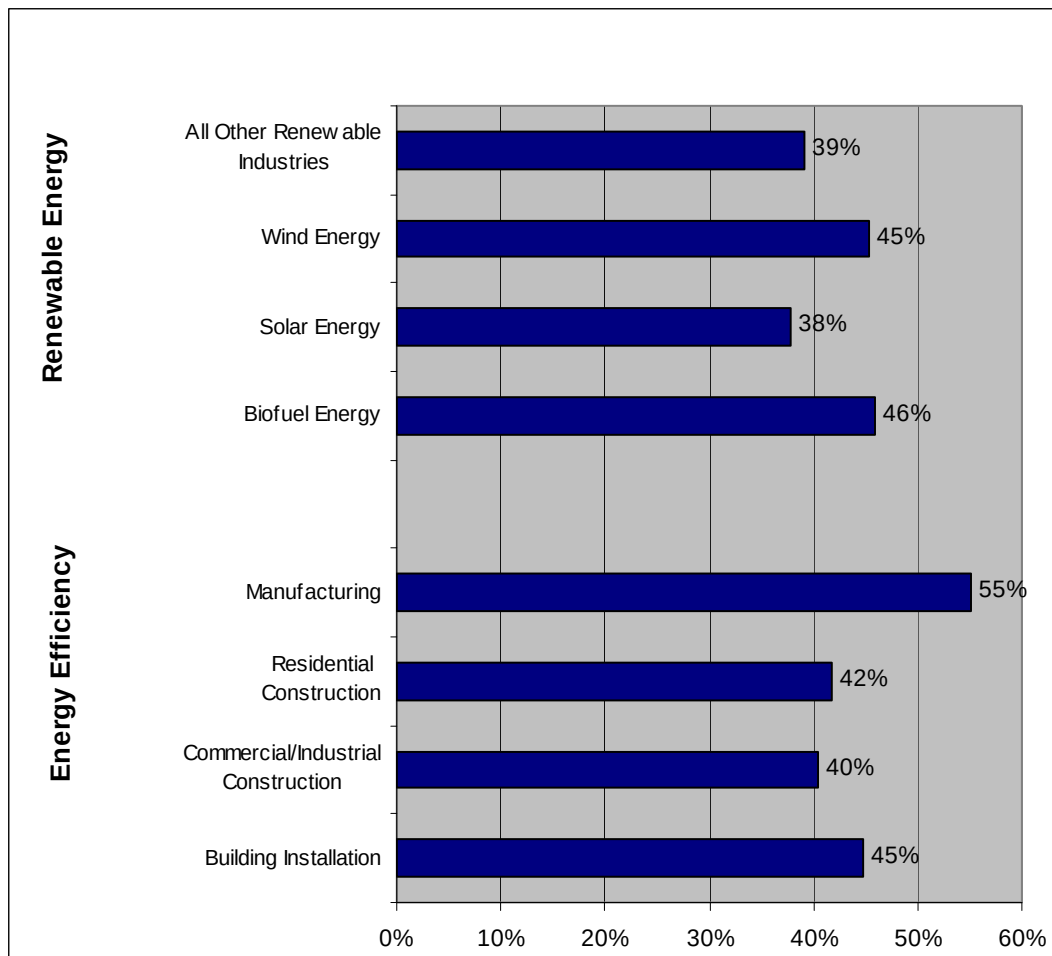
The analysis compares regional employment concentration to statewide concentration levels. This technique, known as location quotient (LQ) analysis, is a measure of the relative industry strengths in the region. A location quotient less than one (1) implies that the area has a less than proportionate share of employment in a particular industry, and a location quotient greater than one (1) implies a greater than proportionate concentration of employment.

For this analysis, we divided New Jersey into three regions, North, Central, and South Jersey. The Northern Region includes Warren, Sussex, Morris, Bergen, Passaic, Essex, Hudson, and Union counties. The Central Region includes Ocean, Monmouth, Somerset, Hunterdon, Middlesex, and Mercer counties. Lastly, the Southern Region includes Atlantic, Cape May, Salem, Cumberland, Gloucester, Camden, and Burlington counties.

Northern Region

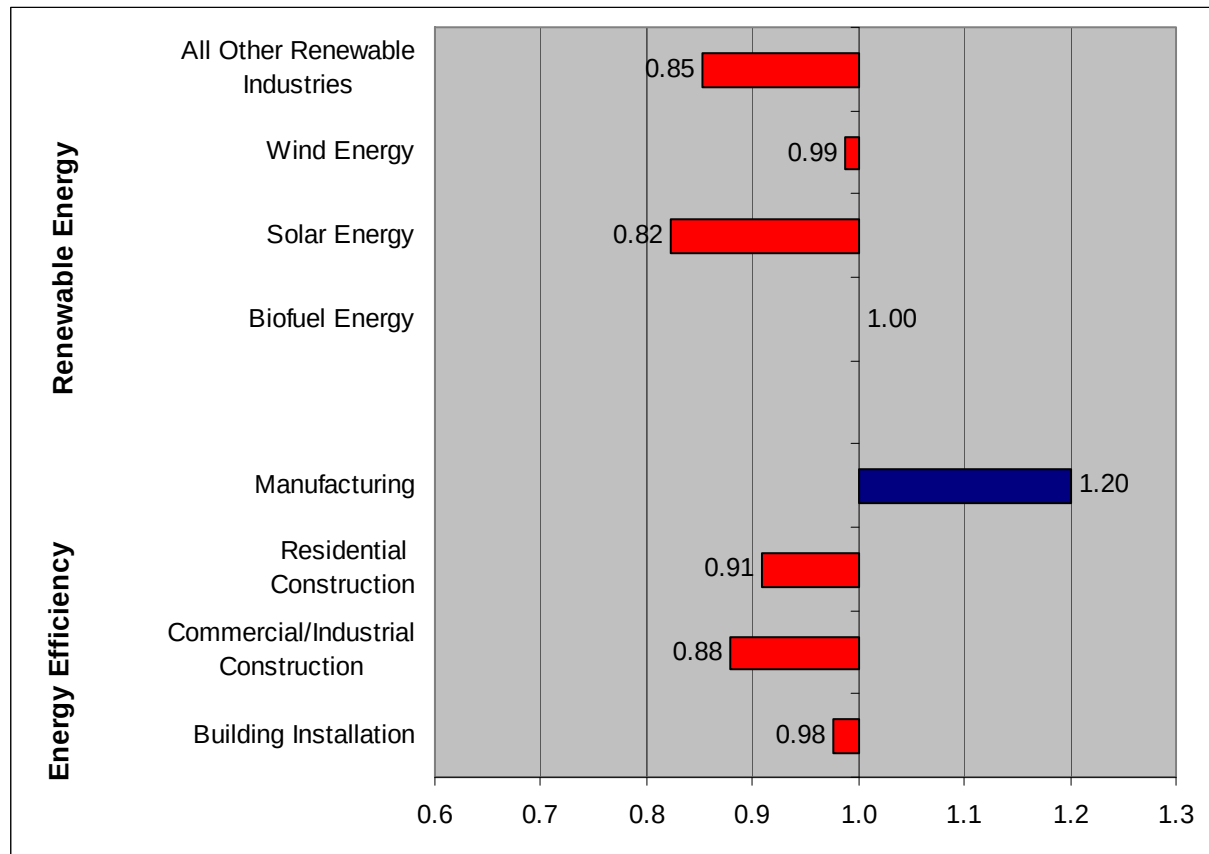
Almost one-half of the state's total employment (46 percent) is in the Northern Region. The region's employment distribution in the green energy sectors was overrepresented in the manufacturing of energy efficiency products (55 percent) and was most underrepresented in all other renewable industries and solar energy (39 and 38 percent, respectively). (See Figure 4)

Figure 4. Northern Region Employment in Green Industries as a Share of Statewide Green Employment



The region also has a strong energy efficiency manufacturing sector, as measured by the location quotient. (Figure 5) There are about 63 companies employing over 2,000 workers in the eight northern counties that manufacture building products or equipment for houses that consume a large amount of energy (light bulbs, refrigerators, laundry equipment) and which will become green(er) as the products they manufacture become more energy efficient. The concentration of building and equipment manufacturing relative to total employment in the northern region is 20 percent higher than in the state. The Northern Region has the same share of employment in the building installation sector as the rest of the state. All other sectors showed a lower relative concentration in the northern region, which means that the region was not more specialized in other sectors when compared to the rest of the state.

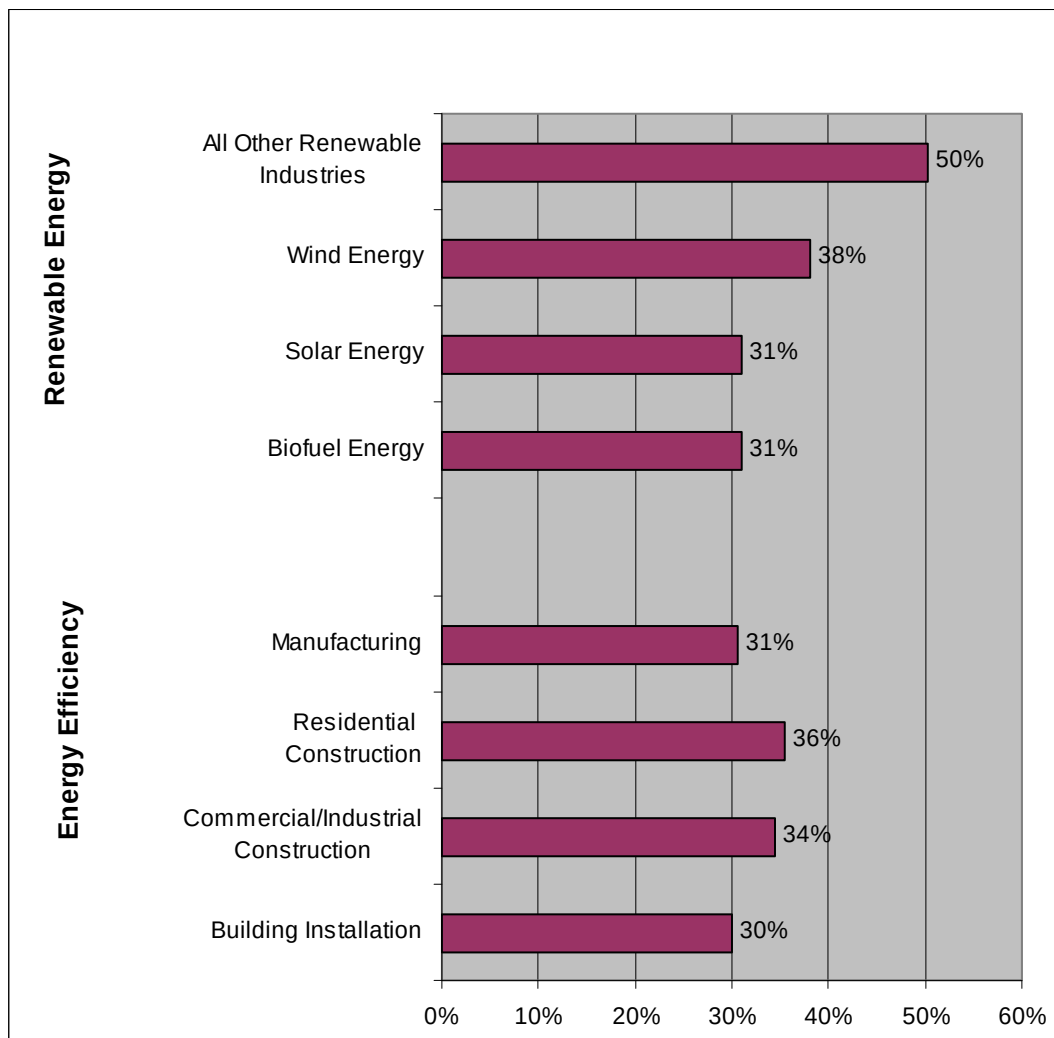
Figure 5. Northern Region Location Quotients, Green Industry Sectors



Central Region

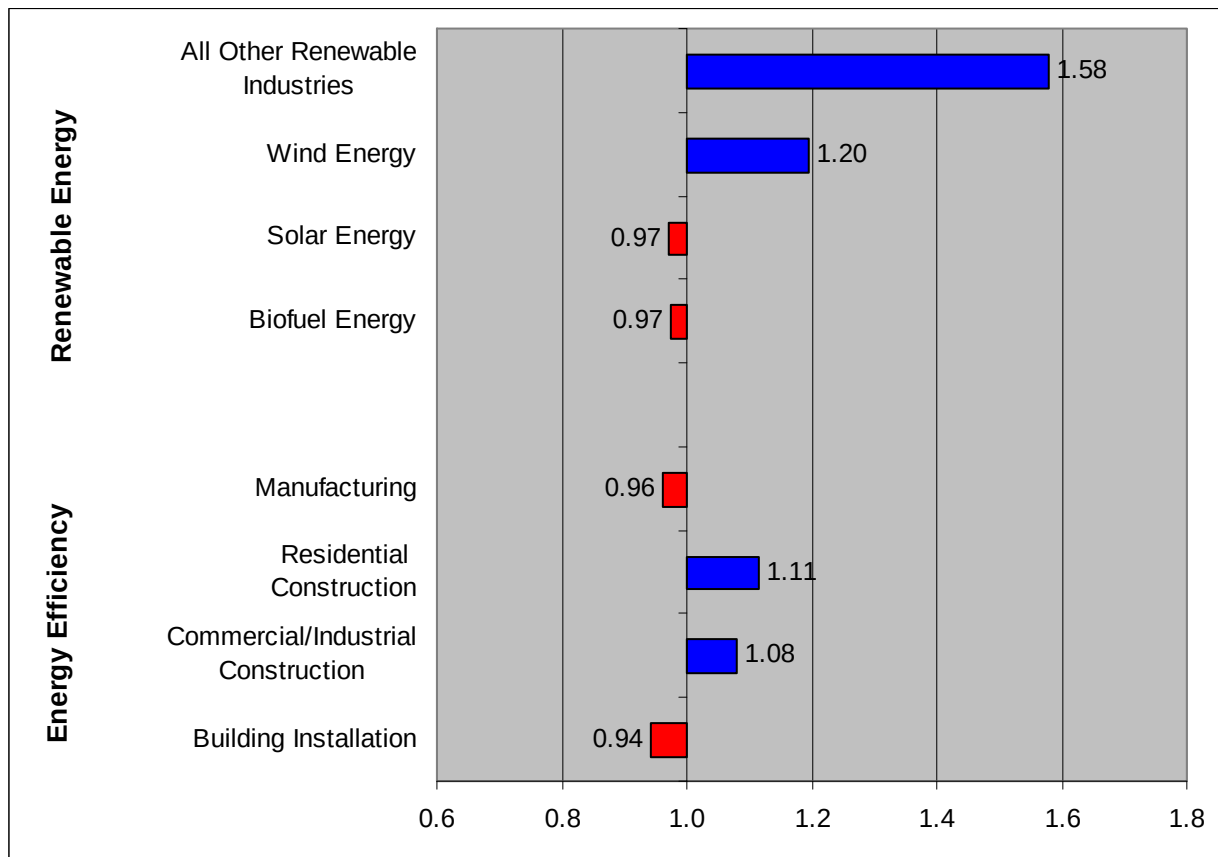
The Central Region accounts for slightly less than one-third of the state's total employment. Its share of employment in every subsector was generally similar to the region's overall total except in the manufacturing of other renewable energy. (Figure 6, below) These include hydroelectric power generation, geothermal energy production, as well as industries involved in the cogeneration of industries. More than half of the state's employment in this subsector (15,385 of 30,550) is located in the Central Region.

Figure 6. Central Region Employment in Green Industries as a Share of Statewide Green Employment



The region's employment pattern demonstrates a high level of specialization in the renewable energy sector overall. The sector size is 27,000 jobs, which is 42 percent of the state's renewable energy sector employment.

Figure 7. Central Region Location Quotients, Green Industry Sectors

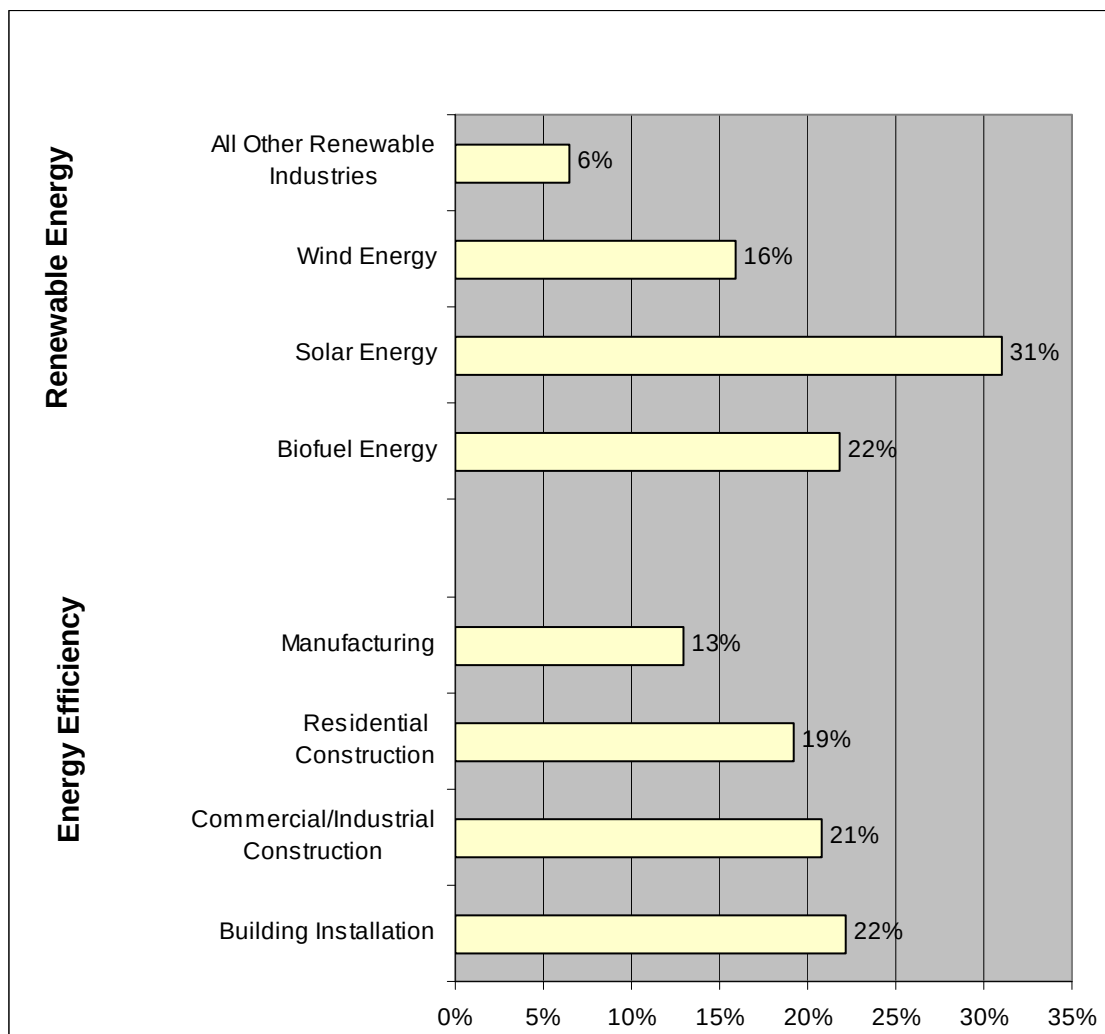


Based on the location quotient analysis, specific strengths were demonstrated in the wind subsector (relative employment share is 20 percent higher than the state). (Figure 7) Although making up only one-percent of total employment, the share of thermal, hydraulic, and other renewable energy industries in the central region's total employment was 60 percent higher than the state. All these industries depend heavily on research and development, which is among the region's greatest strengths given the high concentration of research institutions.

Southern Region

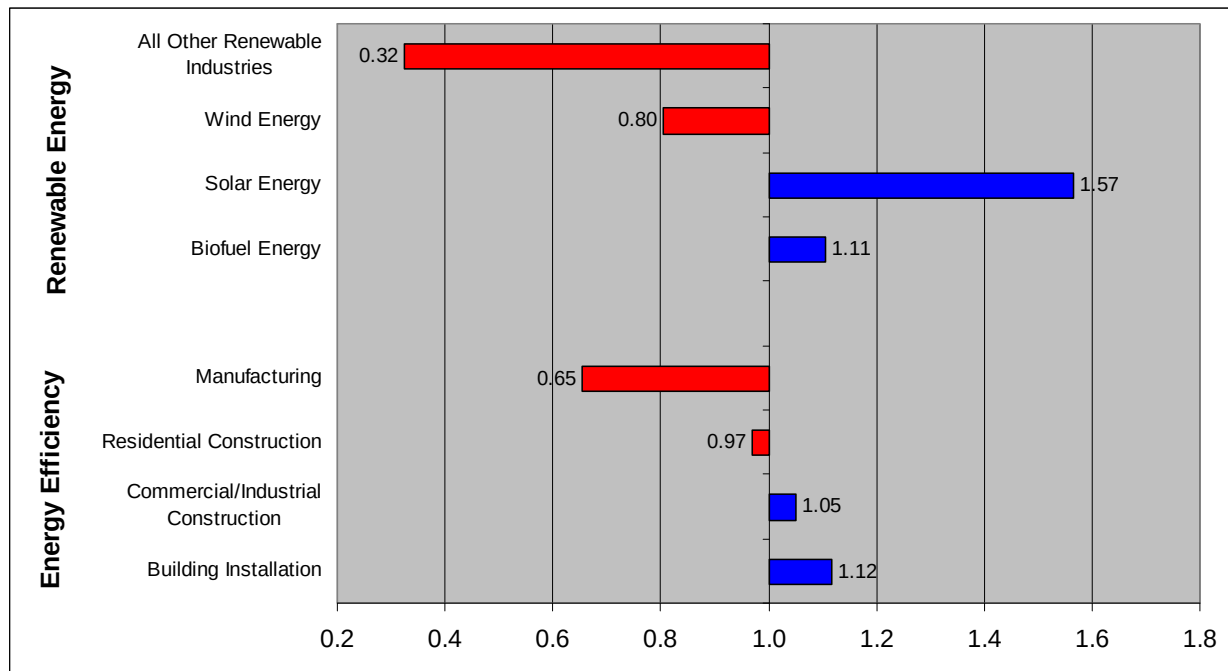
The Southern Region holds less than one-fifth of the state's total employment. This region has a large relative employment share in the solar energy subsector, for which the Southern Region accounts for almost one-third of the total state employment (Figure 8). The region's employment was underrepresented in residential construction, the manufacturing of energy-efficient products, wind energy, and other renewable energy production.

Figure 8. Southern Region Employment in Green Industries as a Share of Statewide Green Employment



Location quotient analysis demonstrates significant regional specialization in both solar manufacturing and in the biofuels industry. Biofuels includes ecosystems and agricultural products, which have received some attention from the Southern Region’s workforce system. Among the energy efficiency subsectors, building installation and commercial/industrial construction also have specialization in the region.

Figure 9. Southern Region Location Quotients, Green Industry Sectors



RECOMMENDED INDUSTRY SECTOR STRATEGY

The maps discussed above (see Appendix A) illustrate that the geographic concentrations of the green energy subsectors cross county and regional boundaries. Many of the industries are clustered around the NJ-Turnpike and Route-1 Corridor. There seem to be strong linkages between the New York and Philadelphia metro areas. A strict regional approach is therefore not recommended given these geographic patterns. That said, it is also important to capitalize on the specific strengths and policy infrastructure that were developed by the various local areas without ignoring the existing strengths in other areas.

It should also be noted that the subsectors identified above overlap in many cases. Some of the inputs in the solar energy subsector are also inputs in other renewable energy industries. Furthermore, each of the energy sectors identified in the analysis have production and consumption sites that are interdependent. There is, therefore, a strong need to focus on the supply chain in each sector that connects the producer to the consumer at every stage.

These two findings suggest the need for an innovative strategic energy plan that 1) finds a middle ground between local strengths and inter-regional connectivity and 2) works to build and enhance the linkages between the various stages of production. We propose the creation of three energy sector “hubs” in the state:

- 1) manufacturing,
- 2) building, installation and maintenance, and
- 3) environmental remediation.

These hubs should be situated locally, but the strategy development and deployment generated by each hub must have a statewide scope. Given the importance of the supply chain in this vision, it is essential to recognize that three hubs are not mutually exclusive. For example, the manufacturing of solar panels and other solar energy products are strongly connected to the installation of the pieces, both in terms of skills requirements and policy needs.

Within each hub, several project teams will be created as needed. The project teams will be tasked with the following:

- a) Identify initial organizations (e.g., industries, higher education institution, and the workforce system) that the team should partner with to identify the skills and policy needs within each sector.
- b) Conduct a supply chain analysis and expand the project as needed to engage the various parts of production.
- c) Respond to current priority skill gaps in the industry as identified by the strategic plan.
- d) Develop a process through which emerging skills and policy needs will be detected and responded to.

Hub Locations

Manufacturing Hub: Given the high concentration of manufacturing firms in the northeast region of the state, we recommend that a manufacturing hub be located in that area. At least two project teams should be created within this hub: building material construction and equipment manufacturing. There may emerge a need to organize the project teams around various products, including building material, solar energy parts, wind parts, and the biofuels energy manufacturing. The team locations may vary to take advantage of local strengths. The southern region, for example, is especially equipped to develop a project team around the biofuels industry.

Building and Installation Hub: Given the recent developmental projects that were implemented in the south, and the high relative concentration of employment in this industry in the south, it is recommended that this hub be hosted in the Southern Region.

Environmental Remediation and Cogeneration Hub: There are a large number of refineries in the Central Region that will be targeted for the implementation of clean technology. Also these refineries are perfect sites for the cogeneration of thermal and carbon industry into other renewable energy. The availability of research institutions in the Central Region makes it particularly competitive to host the hub.

The next section analyzes actual current demand for green jobs in New Jersey. The analysis builds on New Jersey's Real Time Jobs in Demand model⁴ which focuses on actual job openings posted by companies and organizations.

⁴ For more information on Real Time Jobs in Demand, go to <http://lwd.dol.state.nj.us/labor/lpa/content/RealTimeJobsinDemand.html>.

CURRENT DEMAND: WHERE ARE THE GREEN JOB OPENINGS IN NEW JERSEY TODAY?

The analysis of the green industries evaluated the current state New Jersey's green economy by considering the relative size of the various subsectors and regional specialization. A subsequent section looks specifically at the distribution of green jobs by industry, however it is also critical to consider the types of duties performed by specific occupations. Unfortunately, the current parameters of the Standard Occupation Code (SOC) classification system do not include an overlay to specify green jobs. These limitations have created difficulties in the Labor Market Information community as we try to describe aspects of the new green economy using these rigid definitions. Instead of providing a static snapshot, this section provides a dynamic analysis by using data from actual job openings.

Using New Jersey's Real Time Jobs in Demand tool we can move beyond the limitations of the current classification system and identify current jobs in the green economy. Analysis of the data over time also enables us to track which occupations are becoming more prominent. The data in Real Time Jobs in Demand is collected through spidering software. This technology queries thousands of private and government job boards and websites, newspaper classified postings and other media outlets, corporate job boards and websites, and community sites for employment opportunities.

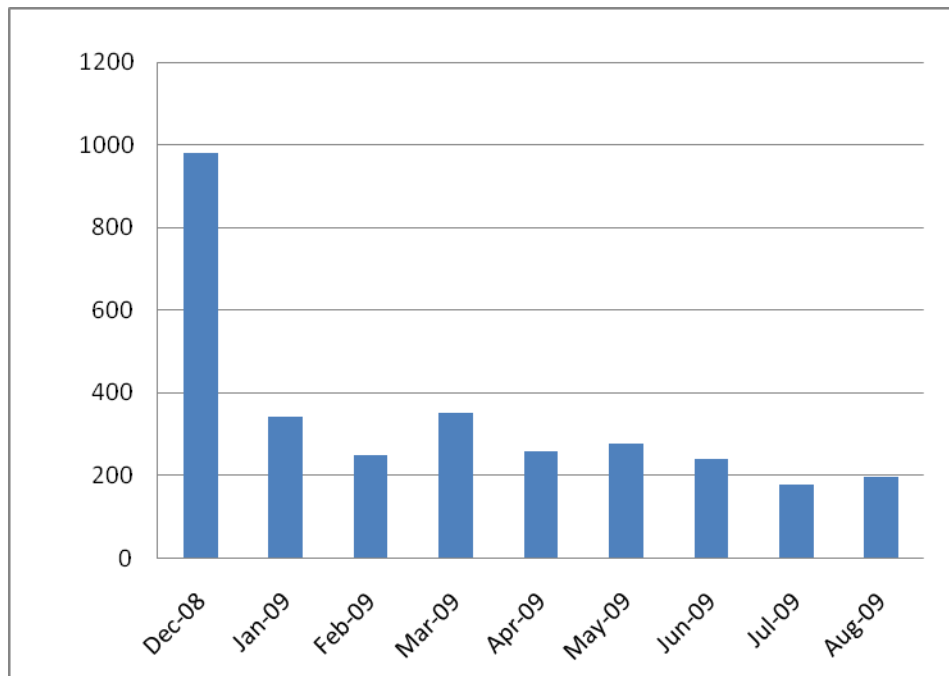
LWD researchers have developed a methodology to estimate the number of green jobs available using the Real Time Jobs in Demand database, which is updated monthly. Instead of looking for what we think a green job is (e.g., relying primarily on the opening's SOC classification), we follow the company's leads by indexing and coding words in job titles and descriptions of jobs with green-related keywords. The list is very adaptable and may change as the industry evolves. Examples of current words used for coding include: solar, wind, energy efficiency, biofuel, renewable energy, and retrofitting. Positions were indexed into broad categories.

- Awareness/Education: Environmental educators
- Business/Finance: energy forecasting, energy analysts, project/program management, energy managers, environmental underwriting
- Green Collar: Building and Utilities

- Legal/Regulation: environmental lawyers/attorneys, environmental protection
- Recycling: waste control, recycling coordinators
- Sales
- Scientists, Engineers, and Technicians: all solar, environmental, and energy engineers and technicians.

Our analysis found that the concentration of current job openings may not match perceptions of green job availability. As Figure 10 illustrates, between 178 and 980 green jobs were posted on various job boards between December 2008 and August 2009. The demand is still seasonal. There was a great spike in demand for green jobs in December (no data is available prior to December) and the demand was mostly in community outreach types of jobs. However, excluding the month of December, there are 260 new green job openings posted every month. If this demand continues, we expect between 3,000 and 4,000 new green job openings on an annual basis.

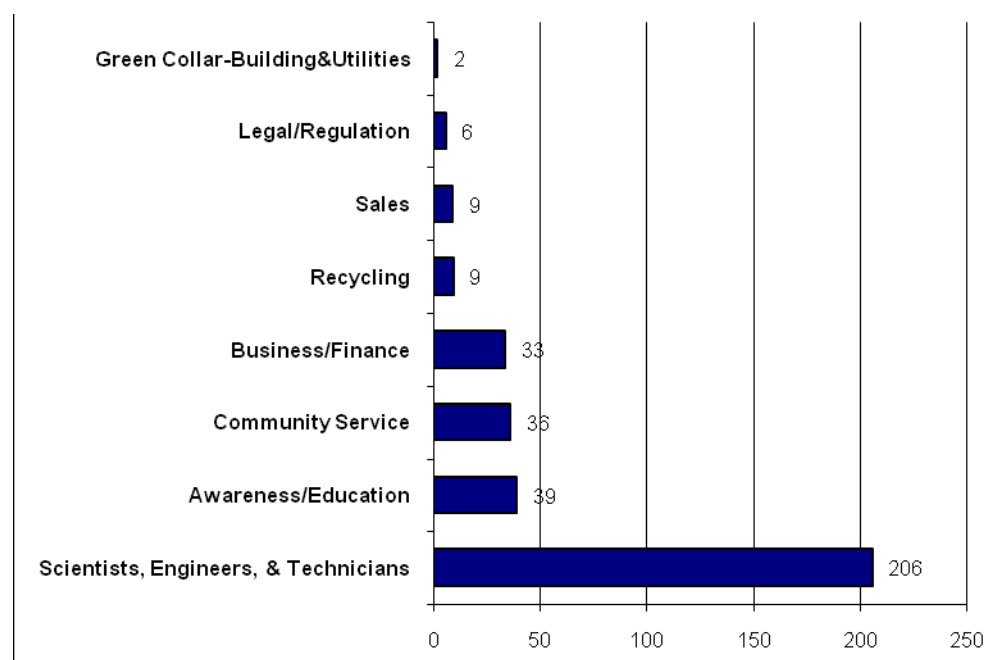
Figure 10. Trends in Green Job Openings: December 2008 to August 2009



The majority of job openings have been concentrated in two occupational groups: scientific, engineering, and technical occupations and business/finance occupations (Figure 11). About 60

percent of openings were in science and engineering jobs. Business finance jobs account for another ten percent of the jobs. December saw a great spike in community service and outreach types of jobs, but the demand did not persist in the following months.

Figure 11. Average Monthly Green Jobs Openings by Occupation Category, December 2008 to August 2009

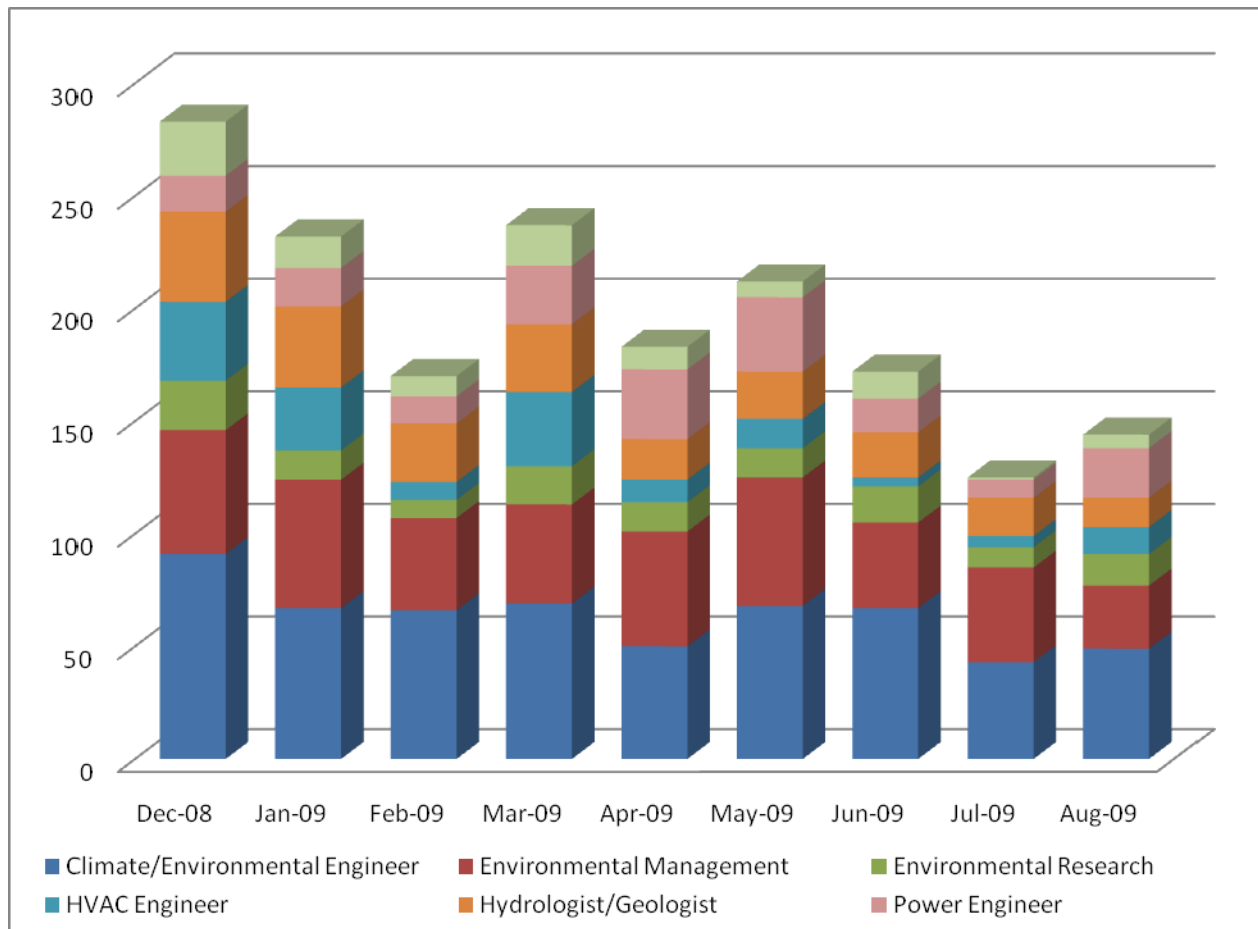


There were few openings for green collar occupations such as solar panel installers. The limited number of postings runs counter to initial expectations; however there a number of potential explanations for the lack of demand. It is possible that projects from federal and state stimulus money are still in early stages and have not created a jump in openings. Furthermore, the non-stimulus openings could be direct hires that do not appear on the sites used to calculate job demand. However, ARRA-funded projects are required to post positions publicly, so this problem should decrease and we expect to see more postings over time.

**Table 2. Green Job Openings in New Jersey by Occupational Group.
December 2008-August 2009**

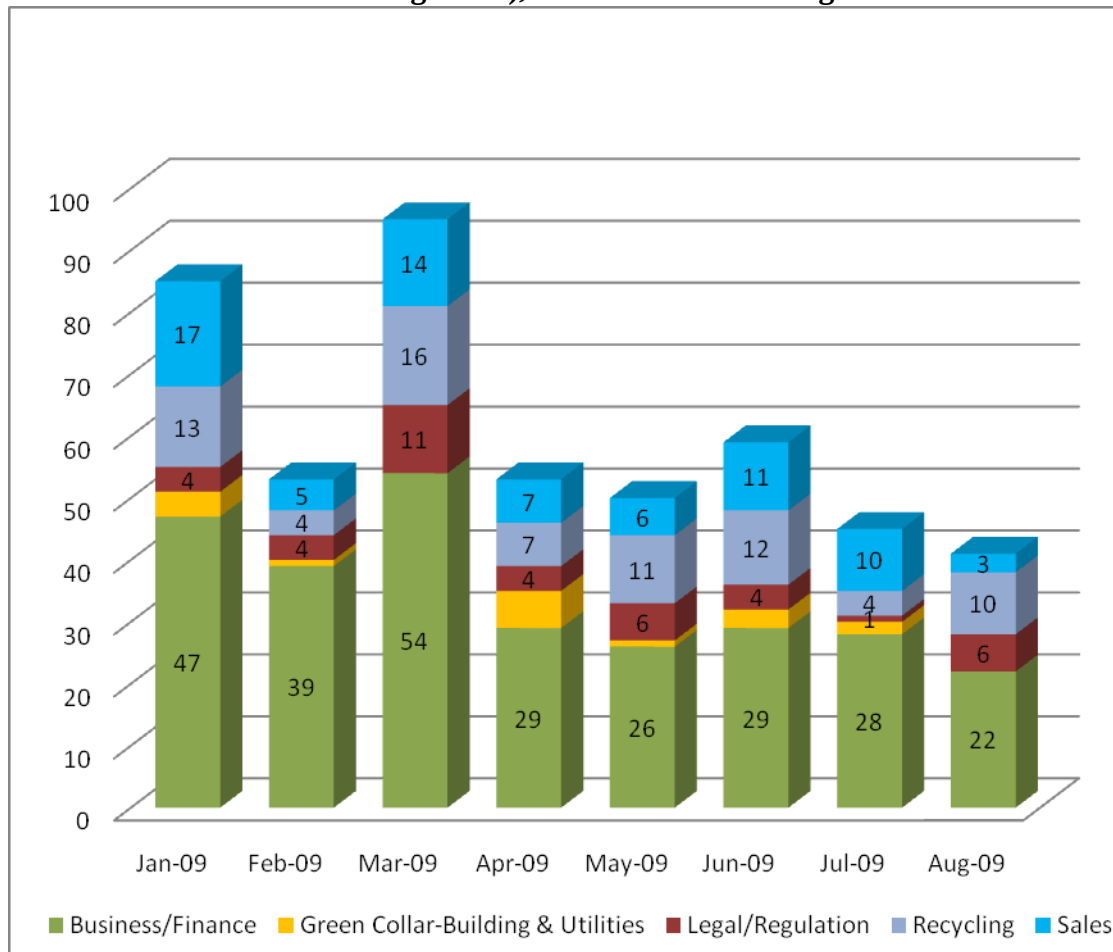
Occupational Group	Types of Jobs	Total # of Openings Dec 08 to Aug 09
Awareness/Education	Environmental Educator	353
Business/Finance	Energy Audit	20
	Energy Business Development	22
	Energy Management/Analysis	181
	Energy-Accounting/Billing	15
	Project/Program Management	61
	Outreach Services	326
Green Collar-Building & Utilities	Building/Installation	12
	Utilities	6
Legal/Regulation	Environmental Law	51
	Environmental Protection	1
Recycling	Waste Engineering/Management	84
Sales	Sales	82
Scientists, Engineers, & Technicians	Climate/Environmental Engineer	570
	Environmental Management	413
	Environmental Research	125
	Environmental Safety	26
	HVAC Engineer	148
	Hydrologist/Geologist	221
	Photonics	23
	Power Engineer	180
	Renewable-Biochemical	101
	Renewable-Bioenergy	4
	Renewable-Solar	15
	Renewable-Thermal Energy	6
	Power Technician	18
Total, All categories		3,064

Figure 12. Trends in Green Science and Engineering Job Openings, December 2008 – August 2009



There has been significant and stable demand for climate and environmental engineers and managers in New Jersey (Figure 12). On average, about 100 jobs were posted in these areas every month between December 2008 and August 2009. There are has been also demand for various types of green scientists including hydrologists, geologists, biochemists, and environmental researchers.

Figure 13. Trends in Demand for Green Jobs by Occupational Group (Excluding Scientists and Engineers), December 2008 – August 2009



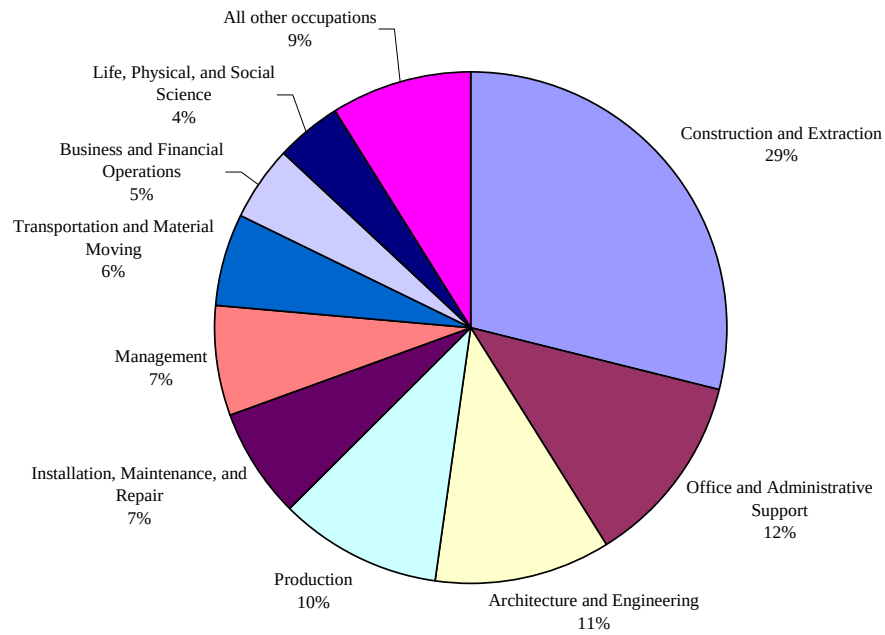
As Figure 13 illustrates, there has been continuous demand for green business/finance jobs, although the numbers have fluctuated over the first eight months of the year. These are the jobs related to energy management, analysis and forecasting. There are also many sales-related jobs, but these types of jobs seem to be impacted more by seasonality.

OCCUPATIONAL DISTRIBUTION IN NEW JERSEY'S GREEN INDUSTRIES

In New Jersey, a green job is one where the primary responsibilities are related to promoting energy efficiency, renewable energy, building retrofitting and other areas related to improving the environment and conserving energy. The specific industries where green jobs are found were discussed in the previous section. This section analyzes the current distribution of occupations in these industries. It should be noted, however, that not every worker in these occupations is in a green job. Therefore, the estimates should be viewed as the maximum, not as the exact number. Plans are underway to conduct a survey of companies in green industries to determine more precisely which occupations are engaged in green activities. Note that these figures do not include potential increases due to changes in funding, policies, or training programs. Each industry section also includes details on available training and education programs, focusing on those offered by county colleges and vocational-technical schools.

Our analysis found over 254,000 workers in New Jersey's are currently performing some type of green or potentially green function. Over 90 percent of the occupations are concentrated in just nine occupational classifications (Figure 1). Construction and extraction occupations comprised almost 30 percent of the positions. The next three occupational groups (office and administrative support, architecture and engineering, and production) averaged between ten and twelve percent each. It is important to keep in mind the current economic climate in the state and the country when evaluating the composition of green industries. Additional analysis presented later in this report will include a discussion of the implications of job losses sustained in the recession which began December 2007.

Figure 14. Green Occupations by SOC Classification



The next section describes the occupational distribution in each industry in detail.

Energy Efficiency Industries

Not all these jobs will require training. Some may require intensive training, others may need to just add a “green layer” to their skills set, while others may not require any training. In the energy efficiency sector, few green specialized skills were identified in previous research.

Energy Efficiency: Construction

Staffing Pattern

The occupational distribution for residential and commercial/industrial construction is generally similar, so they are discussed together in this section (however when applicable they will be discussed separately in the credentials and training, below). As expected, 60 percent of the occupations in this industry are in construction and extraction, and over 75 percent of construction jobs fall into just three categories: carpenters, construction laborers, and construction supervisors and managers. For the industry as a whole, the next two leading occupational categories were office and administrative support (15 percent) and management (nine percent). Table 3, below provides a detailed staffing distribution for the construction industry. These 20 positions represent 78 percent of the occupations in the industry and have an average wage of about \$25.

Table 3. Energy Efficiency: Construction (Residential and Commercial/Industrial)_

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
47-2031	Carpenters	9,828	23%	\$23.53	Long-term on-the-job training
47-2061	Construction laborers	5,804	14%	\$20.42	Moderate-term on-the-job training
47-1011	First-line supervisors/managers of construction trades and extraction workers	3,968	9%	\$32.82	Work experience in a related field
11-9021	Construction managers	2,225	5%	\$46.99	Bachelor's degree
43-6014	Secretaries, except legal, medical, and executive	1,698	4%	\$15.56	Moderate-term on-the-job training
43-9061	Office clerks, general	1,210	3%	\$11.69	Short-term on-the-job training
47-3012	Helpers, carpenters	1,180	3%	\$12.28	Short-term on-the-job training
43-3031	Bookkeeping, accounting, and auditing clerks	1,173	3%	\$16.61	Moderate-term on-the-job training
13-1051	Cost estimators	984	2%	\$29.62	Work experience in a related field
11-1021	General and operations managers	658	2%	\$59.59	Degree plus work experience

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
47-2051	Cement masons and concrete finishers	658	2%	\$23.74	Moderate-term on-the-job training
43-6011	Executive secretaries and administrative assistants	598	1%	\$20.48	Moderate-term on-the-job training
47-2221	Structural iron and steel workers	530	1%	\$25.80	Long-term on-the-job training
47-2141	Painters, construction and maintenance	488	1%	\$18.00	Moderate-term on-the-job training
49-9042	Maintenance and repair workers, general	457	1%	\$17.30	Moderate-term on-the-job training
41-3099	Sales representatives, services, all other	420	1%	\$28.75	Moderate-term on-the-job training
47-2073	Operating engineers and other construction equipment operators	401	1%	\$27.07	Moderate-term on-the-job training
13-2011	Accountants and auditors	395	1%	\$30.94	Bachelor's degree
47-2152	Plumbers, pipefitters, and steamfitters	395	1%	\$27.92	Long-term on-the-job training
47-2021	Brickmasons and blockmasons	387	1%	\$29.39	Long-term on-the-job training

Certifications

The energy efficiency industry has well-established national certifications that are applicable to a range of professionals.

Leadership in Energy and Environmental Design (LEED) was developed by the U.S. Green Building Council and is a program that both certifies buildings and credentials professionals. These programs are administered by the Green Building Certification Institute. There are two credential programs targeted towards different types of professionals in the industry.

- *LEED Green Associate (GA)* credential is for professionals who do not have technical knowledge, but want to show green building expertise. The credential indicates that the holder has basic knowledge of green design, construction, and operations. In order to be eligible to sit for the exam, candidates must demonstrate experience through involvement in a LEED-registered project, (previous) employment in the sustainability field, or engagement in/completion of a green building education program. Continuing education is also required to maintain the credential.

<http://www.gbci.org/DisplayPage.aspx?CMSPageID=83>

- *LEED Accredited Professional (AP)* credential was recently changed so that holders have specialties reflecting their area of focus. The credential requires a two-part exam. The first part is identical to the exam required for the Green Associate credential. The second part depends on the specialty designation (Operations and Maintenance, Homes, Building Design+Construction, Interior Design+Construction, Neighborhood Development [available 2010]). LEED AP candidates also must meet eligibility requirements by documenting experience working on a LEED project in the last three years. Continuing education is also required to maintain the credential.

<http://www.gbci.org/DisplayPage.aspx?CMSPageID=84>

Green Advantage Certification is a program that targets professionals in the construction industry. There are three certifications: Commercial, Residential, and Commercial/Residential. In order to become certified, applicants must pass an exam that covers fundamental knowledge, comprehension, application, and the ability to analyze green construction concepts, materials, and practices. The specific topics include: rationale and basic understanding of sustainability and green building, site and land use, water, energy and atmosphere, materials, and indoor air quality. A score of at least 75 percent is considered passing.

<http://www.greenadvantage.org/GAExamOverview.php>

Training opportunities

There are a wide variety of training opportunities related to green construction throughout the state. While at least 11 are specifically targeted at the LEED credentials described above, there are also nine general courses aimed at providing an overview of green building. Green Advantage certification courses are offered or proposed at two county colleges.

North Jersey

Green Advantage Certification courses are still in the planning stages at **Union** County College. LEED courses are in the proposal stage at **Essex** and **Union** county colleges; **Hudson** also has a LEED course. The colleges' survey responses did not specify whether the material would include both LEED GA and AP.

In addition to these certification-related programs and courses, other county college offerings include:

- o Overview/principles of green building (**Essex, Morris and Union**)
- o Courses in green facilities management (**Essex**)

New Jersey Institute of Technology (NJIT) is a four year institution in the region offering certificate programs relevant to construction. These include a Sustainable Design certificate with the NJ School of Architecture and a Construction Management program.

Central Jersey

Four county colleges in the region provide some sort of LEED certification-related coursework.

Brookdale currently offers a 36-hour course for Green Associate (GA) certification and plans to provide a LEED-AP course in 2010. **Mercer** does not have a course that focuses exclusively on LEED; however they note that their five-course Green Future Management certificate program includes content for the LEED GA certification. **Middlesex** County College has 20-hour courses for both LEED AP and GA. Lastly, **Raritan Valley** also provides a 15-hour LEED exam review relevant for AP and GA.

In addition to these certification-related programs and courses, other county college offerings in the central region include:

- o Overview/principles of green building (**Mercer, Raritan Valley**)

South Jersey

Just two county colleges in the region offer or plan to offer LEED related course. **Atlantic Cape** Community College has a 10-week preparation course for LEED AP certification and **Cumberland** has a similar course in the development stages. **Atlantic Cape** is also one of the two institutions statewide which has a course on Green Advantage certification. It is for the commercial building program.

The region's vocational schools also provide classes or courses that are relevant for energy efficiency/construction. Some of the courses listed on the survey include:

- Green construction contracting (proposed in **Camden** and **Cape May**)

- Building construction/technology (**Atlantic, Camden**)
- Construction trades (**Cumberland, Gloucester**)
- Carpentry (**Cape May, Cumberland**)

Energy Efficiency: Building Installation

Staffing Pattern

Building installation has occupations that are similar to those in construction, however the distribution is different so the industries are analyzed separately. The majority of the occupations (58 percent) in this industry are in construction and extraction, and half of construction jobs fall into just two categories: electricians, and plumbers, pipefitters, and steamfitters. For the industry as a whole, the next two leading occupational categories were office and admin installations, maintenance, and repair (16 percent) and office and administrative support (11 percent); these three categories include 85 percent of the building installation occupations. Table 4 provides a detailed staffing distribution for the building installation component of the energy efficiency industry. These 30 positions represent 86 percent of the occupations in the industry and have an average wage of about \$24.70.

The U.S. Department of Labor's Employment and Training Administration has identified "new and emerging" occupations in this industry that are not captured by the current Occupational Information Network (ONET) coding system. They are: energy auditors, energy engineers, testing and balancing (TAB) technicians, and weatherization installers and technicians.

Table 4. Energy Efficiency: Building Installation

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
47-2111	Electricians	12,643	19%	\$28.71	Long-term on-the-job training
47-2152	Plumbers, pipefitters, and steamfitters	8,053	12%	\$27.92	Long-term on-the-job training
49-9021	Heating, air conditioning, and refrigeration mechanics and installers	6,455	10%	\$23.06	Long-term on-the-job training
47-2211	Sheet metal workers	3,022	4%	\$23.68	Long-term on-the-job training
47-1011	First-line supervisors/managers of construction trades and extraction workers	2,779	4%	\$32.82	Work experience in a related field
47-2031	Carpenters	2,017	3%	\$23.53	Long-term on-the-job training
43-6014	Secretaries, except legal, medical, and executive	1,996	3%	\$15.56	Moderate-term on-the-job training
47-2181	Roofers	1,761	3%	\$18.67	Moderate-term on-the-job training
47-3013	Helpers, electricians	1,740	3%	\$14.31	Short-term on-the-job training
43-9061	Office clerks, general	1,638	2%	\$11.69	Short-term on-the-job training

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
43-3031	Bookkeeping, accounting, and auditing clerks	1,510	2%	\$16.61	Moderate-term on-the-job training
47-2061	Construction laborers	1,465	2%	\$20.42	Moderate-term on-the-job training
47-2081	Drywall and ceiling tile installers	1,438	2%	\$20.58	Moderate-term on-the-job training
13-1051	Cost estimators	1,248	2%	\$29.62	Work experience in a related field
47-3015	Helpers, pipelayers, plumbers, pipefitters, and steamfitters	984	1%	\$14.07	Short-term on-the-job training
11-9021	Construction managers	940	1%	\$46.99	Bachelor's degree
11-1021	General and operations managers	918	1%	\$59.59	Degree plus work experience
41-2031	Retail salespersons	831	1%	\$9.74	Short-term on-the-job training
49-1011	First-line supervisors/managers of mechanics, installers, and repairers	789	1%	\$30.55	Work experience in a related field
53-7062	Laborers and freight, stock, and material movers, hand	765	1%	\$11.17	Short-term on-the-job training
49-9052	Telecommunications line installers and repairers	668	1%	\$28.98	Long-term on-the-job training
49-2022	Telecommunications equipment installers and repairers, except line installers	632	1%	\$28.44	Long-term on-the-job training
41-4012	Sales representatives, wholesale and manufacturing, except technical and scientific products	595	1%	\$27.78	Moderate-term on-the-job training
47-3016	Helpers, roofers	564	1%	\$13.42	Short-term on-the-job training
49-9098	Helpers--Installation, maintenance, and repair workers	550	1%	\$12.92	Short-term on-the-job training
41-3099	Sales representatives, services, all other	516	1%	\$28.75	Moderate-term on-the-job training
49-2098	Security and fire alarm systems installers	507	1%	\$18.27	Postsecondary vocational award
37-3011	Landscaping and groundskeeping workers	499	1%	\$11.82	Short-term on-the-job training
47-2131	Insulation workers, floor, ceiling, and wall	475	1%	\$22.24	Moderate-term on-the-job training
43-4171	Receptionists and information clerks	463	1%	\$11.72	Short-term on-the-job training

Certifications

The certifications for building installations occupations are for jobs not currently assigned SOC codes. Included in building installation are solar panel installers who were discussed separately in the solar manufacturing section. This **section** focuses on certification of energy auditors and weatherization technicians (**need tech cert info from Maureen**).

The *Building Performance Institute (BPI)* offers training, certification, and accreditation in the building industry. Energy auditors are certified under their Building Performance Analyst program which focuses on small homes (less than five units) building. There are also small home certifications for envelope, heating, and A/C and heat pump professionals. BPI has a multifamily (five or more units) certification that includes Building Analysts, Building Operations Specialists, Hydronic Heating System Design, and Advanced Heating. Candidates must score at least 70 percent on an exam for certification. Both individuals and firms (typically contractors) can become certified. Training is not necessary to pass but is recommended, as is experience in the field. Recertification requires continuing education and/or additional examinations.

The *Residential Energy Services Network (RESNET)* certifies home energy raters who perform energy audits. Certification requires passing a 50-question online exam with 75 percent correct answers.

The *Association of Energy Engineers (AAE)* is a professional organization that offers certifications primarily to engineers (or architects) who are registered Professional Engineers and/or have a college degree or extensive work experience. Some of the certifications offered by AAE include:

- Certified Energy Manager (CEM) a type of high-level auditor
- Energy Manager in Training (EMIT) for professionals with the technical knowledge to pass the CEM exam but who are still pursuing the necessary credentials
- Certified Energy Auditor

There are also national green training certifications for insulators. In New Jersey, these programs are offered through *Insulators Local 32*.

- Insulation Energy Appraisal Program (IEAP) sponsored by National Insulation Association. Apprentice Coordinator receive the training capability to train engineers, contractors and key personnel to conduct an energy audit, 3E-Plus.
- Green Awareness in the Mechanical Insulation Industry certificate issued from the International Association of Heat and Frost Insulators and Allied Workers and the US Green Building Council. A green layer training course designed in conjunction with the Insulators Training Program or a stand-alone training program. The 16-hour course reviews data received from the 3E-Plus program and corrective actions needed to correct any Energy Efficient/Renewable Energy (EE/RE) concerns. The course will also cover the effectiveness of a well-insulated system, future cost and environmental savings with proper mechanical insulation, as well as the need and marketing of well insulated systems.

Training opportunities

North Jersey

County colleges and vocational-technical programs both provide numerous courses for energy auditors and weatherization technicians. **Hudson** County Community College has a four-week energy audit certificate course; however they did not specify eligibility to sit for national certification. **Morris** County College has a similar program, however no certificate is offered. Lastly, **Union** County College's proposed audit program prepares participants for the BPI or RESNET exams. **Union** County College has also proposed a home weatherization specialist program.

Four vocational-technical schools in northern New Jersey offer energy auditor courses (**Union**) or have them in the planning stages (**Bergen, Essex, Passaic**). **Bergen** has also proposed a weatherization technician course and **Passaic** plans to train energy retrofitters.

Other programs mentioned by northern vocational-technical schools on the survey include:

- o HVAC (**Bergen, Essex, Passaic, Union**)
- o Electrician Apprenticeship (**Bergen**)
- o Plumbing (**Bergen, Passaic**)

Central Jersey

Two colleges in the region offer courses in BPI certification. **Brookdale's** 40-hour course and **Ocean** County College's 80-hour course both include field training and prepare participants for the Building Analyst 1 level BPI exam.

Mercer County offers a 60-hour energy auditing and weatherization course as part of their new Solar/Energy Technology Certificate Program. **Raritan Valley** has two non-credit courses that prepare for RESNET certification: Energy Auditing and In-Home Energy Survey Professional.

Only **Ocean** County's vocational school reported energy auditor and energy retrofitter programs, however they are still in the planning stages.

Other programs mentioned by central vocational-technical schools on the survey include:

- o HVAC (**Hunterdon, Mercer, Middlesex, Ocean, Somerset**)
- o Plumbing (**Hunterdon, Middlesex, Monmouth, Somerset**)

South Jersey

The southern region offers a limited number of courses in building installation. BPI certification is planned for **Cumberland** County College and offered at **Burlington** County College. No community colleges in the area offer weatherization courses.

Among the area's vocational schools, **Atlantic** is planning a Building Analyst course, and **Cape May** and **Cumberland** counties have energy auditor programs, although the former is still in the planning stages. A weatherization technician program is proposed in **Atlantic**, while **Cumberland's** program is already underway.

Other programs mentioned by south Jersey vocational-technical schools on the survey include:

- o HVAC (**Atlantic, Camden, Cape May, Cumberland, Gloucester**)
- o Plumbing (**Cape May, Cumberland**)

Rowan University offers two 30-hour instructor led online courses in Performing Comprehensive Building Assessments (which prepares auditors) and the Principles of Green Buildings.

Renewable Energy Industries

Renewable Energy: Biofuels manufacturing

Staffing pattern

Occupations in biofuels manufacturing are similar to traditional chemical manufacturing jobs. Most positions (40 percent) are in production. Another third of the jobs are in four occupational groups: installation, maintenance and repair (ten percent) transportation and material moving (nine percent), life and physical sciences (eight percent), and architecture and engineering (seven percent). Many workers are chemists and chemical technicians or engineers in chemical or petroleum engineering. Table 5 below provides a detailed staffing distribution for the potential biofuels manufacturing industry. These 20 positions represent 62 percent of the occupations in the industry and have an average wage of almost \$23, which is about the same as the average for the entire industry sector.

It is important to note that the USDOL Employment and Training Administration has identified “new and emerging” occupations in this industry that are not captured by the current ONET coding system. They are: biofuels/biodiesel technology and product development managers, biofuels production managers, and biofuels processing technicians. Additional occupations not included on this list include biofuels plant field and operations engineers.

Table 5. Biofuels Staffing Pattern

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
51-8093	Petroleum pump system operators, refinery operators, and gaugers	579	8%	\$27.58	Long-term on-the-job training
51-9023	Mixing and blending machine setters, operators, and tenders	440	6%	\$13.86	Moderate-term on-the-job training
51-1011	First-line supervisors/managers of production and operating workers	340	5%	\$25.50	Work experience in a related field
51-8091	Chemical plant and system operators	329	5%	\$26.00	Long-term on-the-job training
19-4031	Chemical technicians	327	5%	\$20.38	Associate's degree
51-9011	Chemical equipment operators and tenders	245	3%	\$21.28	Moderate-term on-the-job training

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
49-9041	Industrial machinery mechanics	240	3%	\$20.73	Long-term on-the-job training
51-9111	Packaging and filling machine operators and tenders	232	3%	\$10.19	Short-term on-the-job training
49-9042	Maintenance and repair workers, general	223	3%	\$17.30	Moderate-term on-the-job training
19-2031	Chemists	213	3%	\$31.85	Bachelor's degree
17-2041	Chemical engineers	168	2%	\$43.90	Bachelor's degree
53-3032	Truck drivers, heavy and tractor-trailer	161	2%	\$19.29	Moderate-term on-the-job training
17-2171	Petroleum engineers	131	2%	\$39.41	Bachelor's degree
51-9061	Inspectors, testers, sorters, samplers, and weighers	130	2%	\$14.44	Moderate-term on-the-job training
11-3051	Industrial production managers	127	2%	\$41.85	Work experience in a related field
53-7062	Laborers and freight, stock, and material movers, hand	117	2%	\$11.17	Short-term on-the-job training
43-5071	Shipping, receiving, and traffic clerks	103	1%	\$13.68	Short-term on-the-job training
49-1011	First-line supervisors/managers of mechanics, installers, and repairers	101	1%	\$30.55	Work experience in a related field

Certifications

There are no national certifications for workers specific to the biofuels industry. Some engineers may require professional licensure through the state of New Jersey's Division of Consumer Affairs, State Board of Professional Engineers and Land Surveyors. In addition, there are general Certified Manufacturing Technologist and Certified Manufacturing Engineer certifications through the Society of Manufacturing Engineers which may be relevant for some occupations.

Training opportunities

Currently, there are few courses or programs specifically dedicated to the biofuels industry. The applicable options are described below, including relevant coursework applicable to chemical manufacturing in general.

North Jersey

Sussex County Community College offers one three-hour course in biofuels as part of their clean energy certificate program. **Essex** County College has a new certificate program in Energy Efficiency and Renewable Energy which will include biofuels as a topic. For chemical manufacturing more broadly, County College of **Morris** has an AAS in Chemical Technology, including an environmental option.

Central Jersey

None of the central region's county colleges or technical schools in the survey reported coursework relevant to biofuels manufacturing.

South Jersey

Recall that the industry analysis noted that the southern region has significant specialization in biofuels manufacturing. **Cumberland** County has a new AAS program in Renewable Energy Technology, however the only specific concentrations noted on the survey were solar, geothermal and wind. In addition, the college has a proposed certificate program in Renewable Energy and it is likely that biofuels will be a theme or course available for study.

Salem Community College has a new AAS degree program in Sustainable Energy Technology which will prepare technicians in various energy fields, including biofuels.

Renewable Energy: Wind manufacturing

Staffing Pattern

Wind turbine manufacturing occupations are similar to traditional manufacturing positions and include titles such as team assemblers, machinists, and packers/packagegers. By far, the majority of positions (55 percent) are in production. There are nine percent of occupations in both transportation and material moving and office and administrative support. Table 6, below provides a detailed staffing distribution for the potential wind turbine manufacturing industry. These 20 positions represent about half of the occupations in the industry and have an average wage of close to \$14.40, however the average wage for the entire industry sector is about four dollars higher.

The USDOL Employment and Training Administration has identified “new and emerging” occupations in this industry that are not captured by the current ONET coding system. They are: wind energy operations managers, wind energy project managers, wind energy engineers, and wind turbine service technicians.

Table 6. Wind Sector – Occupational distribution

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
51-2092	Team assemblers	634	4%	\$11.83	Moderate-term on-the-job training
51-1011	First-line supervisors/managers of production and operating workers	597	4%	\$25.50	Work experience in a related field
51-4072	Molding, coremaking, and casting machine setters, operators, and tenders, metal and plastic	564	4%	\$11.45	Moderate-term on-the-job training
53-7064	Packers and packagers, hand	551	4%	\$8.59	Short-term on-the-job training
51-4021	Extruding and drawing machine setters, operators, and tenders, metal and plastic	527	4%	\$13.41	Moderate-term on-the-job training
51-2022	Electrical and electronic equipment assemblers	513	3%	\$12.80	Short-term on-the-job training
51-9061	Inspectors, testers, sorters, samplers, and weighers	441	3%	\$14.44	Moderate-term on-the-job training
51-9198	Helpers--Production workers	401	3%	\$9.16	Short-term on-the-job training
53-7062	Laborers and freight, stock, and material movers, hand	336	2%	\$11.17	Short-term on-the-job training
49-9042	Maintenance and repair workers, general	297	2%	\$17.30	Moderate-term on-the-job training

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
51-9111	Packaging and filling machine operators and tenders	270	2%	\$10.19	Short-term on-the-job training
53-7051	Industrial truck and tractor operators	256	2%	\$14.39	Short-term on-the-job training
51-4031	Cutting, punching, and press machine setters, operators, and tenders, metal and plastic	247	2%	\$13.03	Moderate-term on-the-job training
51-4041	Machinists	247	2%	\$19.15	Long-term on-the-job training
43-5071	Shipping, receiving, and traffic clerks	241	2%	\$13.68	Short-term on-the-job training
51-4081	Multiple machine tool setters, operators, and tenders, metal and plastic	239	2%	\$14.48	Moderate-term on-the-job training
51-2023	Electromechanical equipment assemblers	234	2%	\$13.60	Short-term on-the-job training
51-2099	Assemblers and fabricators, all other	217	1%	\$14.89	Moderate-term on-the-job training
49-9041	Industrial machinery mechanics	214	1%	\$20.73	Long-term on-the-job training
41-4012	Sales representatives, wholesale and manufacturing, except technical and scientific products	213	1%	\$27.78	Moderate-term on-the-job training

Certifications

There are no national certifications for workers specific to the wind turbine industry. The North American Board of Certified Energy Practitioners has completed a task analysis for small wind installers, which is considered the first step in the process of creating a certification system. In addition, there are general Certified Manufacturing Technologist and Certified Manufacturing Engineer certifications through the Society of Manufacturing Engineers which may be relevant for some occupations.

Training opportunities

There are currently few courses or programs specifically dedicated to the wind turbine industry.

North Jersey

Sussex County Community College offers one three-hour course in wind power as part of their clean energy certificate program.

Central Jersey

The industry analysis showed that the Central Region is competitive in wind manufacturing.

Brookdale Community College has proposed a wind turbine technician certificate program.

South Jersey

Cumberland has proposed a certificate program for wind turbine technicians. In addition, their new AAS program in Renewable Energy Technology includes a concentration in wind. The college's proposed certificate program in Renewable Energy could also include wind as a theme or course available for study, however it was not specifically noted on the survey.

Salem Community College has a new AAS degree program in Sustainable Energy Technology which will prepare technicians in various energy fields, including wind.

Renewable Energy: Solar Manufacturing

Staffing Pattern

Occupations in solar manufacturing are largely similar to traditional manufacturing jobs. Most positions (50 percent) are in production, primarily assemblers electrical/electronic and team), packers, and their supervisors. Transportation and material moving occupations are a distant second at just under ten percent. Table 7, below provides a detailed staffing distribution for the potential solar manufacturing industry. These 20 positions represent 45 percent of the occupations in the industry and have an average wage of about \$15.60. This is slightly lower than the average for all occupations in the industry, about \$19.

The USDOL Employment and Training Administration has identified “new and emerging” occupations in this industry that are not captured by the current ONET coding system. They are: solar energy installation managers, solar photovoltaic installers, solar power plant technicians, solar sales representatives and assessors, solar energy systems engineers, solar thermal installers and technicians, and solar thermoelectric plant/concentrating thermal power plant operators.

Table 7. Solar Staffing Pattern

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
51-2022	Electrical and electronic equipment assemblers	640	4%	\$12.80	Short-term on-the-job training
51-1011	First-line supervisors/managers of production and operating workers	593	4%	\$25.50	Work experience in a related field
51-2092	Team assemblers	579	4%	\$11.83	Moderate-term on-the-job training
53-7064	Packers and packagers, hand	482	3%	\$8.59	Short-term on-the-job training
51-9061	Inspectors, testers, sorters, samplers, and weighers	443	3%	\$14.44	Moderate-term on-the-job training
51-9198	Helpers--Production workers	389	3%	\$9.16	Short-term on-the-job training
53-7062	Laborers and freight, stock, and material movers, hand	326	2%	\$11.17	Short-term on-the-job training
49-9042	Maintenance and repair workers, general	310	2%	\$17.30	Moderate-term on-the-job training
51-4021	Extruding and drawing machine setters, operators, and tenders, metal and plastic	287	2%	\$13.41	Moderate-term on-the-job training
51-9041	Extruding, forming, pressing, and compacting machine setters, operators, and tenders	262	2%	\$11.46	Moderate-term on-the-job training

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
51-4031	Cutting, punching, and press machine setters, operators, and tenders, metal and plastic	254	2%	\$13.03	Moderate-term on-the-job training
53-7051	Industrial truck and tractor operators	245	2%	\$14.39	Short-term on-the-job training
51-2041	Structural metal fabricators and fitters	244	2%	\$16.30	Moderate-term on-the-job training
49-9041	Industrial machinery mechanics	233	2%	\$20.73	Long-term on-the-job training
51-4121	Welders, cutters, solderers, and brazers	231	2%	\$17.58	Long-term on-the-job training
51-9111	Packaging and filling machine operators and tenders	225	2%	\$10.19	Short-term on-the-job training
11-3051	Industrial production managers	224	2%	\$41.85	Work experience in a related field
43-5071	Shipping, receiving, and traffic clerks	217	1%	\$13.68	Short-term on-the-job training
51-2023	Electromechanical equipment assemblers	214	1%	\$13.60	Short-term on-the-job training
41-4012	Sales representatives, wholesale and manufacturing, except technical and scientific products	211	1%	\$27.78	Moderate-term on-the-job training

Certifications

For solar manufacturing it might be applicable for some workers to pursue the general Certified Manufacturing Technologist and Certified Manufacturing Engineer certifications through the Society of Manufacturing Engineers discussed above.

Currently there are no mandatory certifications for solar contractors or installers. However, it is possible to receive a voluntary certification through the North American Board of Certified Energy Practitioners (NABCEP). The NABCEP offers the following programs:

- *Entry Level Certificate of Knowledge* This program is geared towards people new to the solar/photovoltaic industry. The certificate shows that holders have basic knowledge, comprehension, and application of key terms and concepts in photovoltaic systems operations. Students must take a class through an approved provider and pass a national exam. As of 7/21/2009 there were no approved providers in New Jersey listed on the NABCEP website. <http://www.nabcep.org/wp-content/uploads/2009/01/Approved-Providers072109.pdf>

- *Photovoltaic (PV) Installer Certification and Solar Thermal Installer Certification* These certifications are designed for the person responsible for installing PV or solar thermal systems (e.g., contractor, foreman, supervisor, journeyman). Certified installers must meet education and experience requirements:

<http://www.nabcep.org/certification/pv-installer-certification/pv-requirementseducation>)

<http://www.nabcep.org/certification/solar-thermal-installer-certification/requirementseducation>

There are different entry tracks to certification, which include work experience, apprentice programs, degree programs, etc. Training is encouraged, but not necessary for certification. Documentation of employment, experience, education, and systems installations must be provided.

Training opportunities

Courses and programs related to opportunities in the solar energy industry are proposed or in place through the state. There are four to six offerings in each of the three regions, although some are still in the planning stages. These courses are offered almost exclusively through the community colleges and include introductory courses as well as certification in solar energy technology. There are also courses for the less technical aspects of the industry in the arena of estimation, sales, and customer service. A unique course is offered at **Ocean** County College, it provides an overview of job opportunities in the solar industry. These are all discussed in more detail, below.

Only **Atlantic Cape** Community College specifically noted that participants would be prepared to take the NABCEP Certificate of Knowledge exam upon completion. All programs should provide some sort of accompanying certification in order to build confidence in this labor force.

North Jersey

Bergen and **Union** Community Colleges have proposed new courses related to the solar industry. **Bergen** (BCC) offers “Solar and Renewable Energy for Everyone,” an 18-hour course taught over eight days. The overview includes the basics of solar technology and site selection,

as well as cost, financing, and tax incentives. The other BCC course, “Photovoltaic Systems,” is for licensed electricians or their apprentices. This 45-hour course teaches the technology and skills necessary for installation. The course satisfies continuing education hours for the NJ State Board of Electrical Contractors. Lastly, a Photovoltaic Systems Technology course is in development.

Union County College has two proposed non-credit courses. The “Solar Technology Specialist” course would focus on the basic components of solar panel technology, including installation and maintenance. “Solar Sales” would teach solar basics so that students would know the fundamentals necessary to sell residential solar components. They would also learn how to estimate the cost of solar projects.

Essex County College is launching an Energy Efficiency/Renewable Energy Technology certificate program in fall 2009. It is probable that this program will include elements relevant to the solar industry.

Sussex County Community College will offer a one session, three-hour Solar Energy class in Fall and Spring 2009-2010 that will present the basics of solar energy and include hands-on activities. Students who complete this course and three others (Introduction to Clean Energy, Biofuels, Wind Power) will complete their new Clean Energy certificate program.

New Jersey City University is a four-year institution in the region offering solar/photovoltaic training. The weekend course includes four sessions over four full weekend days. Topics include design and installation, basics of electricity, systems components, site analysis, cost studies, and safety issues.

Central Jersey

One credit-based certificate program, one non-credit certificate course, and two individual courses are offered across four county colleges in the central region of the state. There is also one course that provides an overview of the types of jobs available in the solar industry. **Mercer** County Community College is introducing a 31-credit Solar/Energy Certificate program in fall 2009. The program includes courses in electronics fundamentals, alternative energy

certification, building construction fundamentals, energy auditing/weatherization, and solar installation technology.

Middlesex County College's new Introduction to Solar Electric Systems course will begin in September 2009. The 20-hour one-week course is aimed towards mechanics and contractor's assistants.

Ocean County College offers two new solar courses that are unique compared to others in the state. Green Collar Jobs in the Renewable Solar Energy Economy provides an introduction to available jobs and the purpose of each job. It is a one-session, three-hour course. Grid-Tied Solar Energy Systems is a five-hour, two-session course aimed at everyone from contractors to home-owners. It will focus on systems that connect to the local electric utility (grid-tied) and include state and federal incentives, as well as an overview of the technology and terminology.

Lastly, **Raritan Valley** Community College will offer a 40-hour non-credit solar panel installation course. The course includes hands-on labs and lecture and provides information for self-installation and maintenance of residential photovoltaic systems. It also covers taxes, rebates, and other incentives.

South Jersey

The industry analysis found that South Jersey is competitive for solar manufacturing. There are numerous training opportunities currently underway or in the planning stages.

Atlantic Cape County College has four courses related to the solar industry. It offers separate Solar Design and Installation courses: a 48-hour course for construction or electrical workers and a 100-hour course for those with no prior experience. The first focuses on the details of the PV system, while the novice course also includes basic electricity, electronics, math, and job readiness material. Atlantic Cape also provides a course in Solar Customer Service and Sales Training (80 hours) and another in Solar Estimation (hours TBD).

Cumberland County College has both credit and non-credit programs in the proposal stages. A non-credit course in Solar Panel Installation Certification is being developed. Second, an AAS

in Renewable Energy Technology is proposed for 2010 and will include an option in solar energy.

Salem Community College has a new AAS degree program in Sustainable Energy Technology which will prepare technicians in various energy fields, including solar.

Only one technical school in the state has coursework specifically related to the solar industry.

Cape May County Technical School has a proposed program in Solar Panel Technology.

Located in the Adult Division, the course will include eight weeks of training in the design and installation of solar panels.

Additional training opportunities

Green job training opportunities are also listed on the website of the state Clean Energy Program.

Current classes include offerings on photovoltaics ranging from two hours to one-day. All three courses described are approved for credit by the NJ Electrical Contractors Board.

Renewable Energy: All other industries

Staffing Pattern

As discussed in the industry overview, this sector includes those components of renewable energy not discussed in its own category, such as biomass, geothermal, hydraulic, etc. More than one-third of the occupations are in life, physical, and social sciences (19 percent) and architecture and engineering (15 percent) occupations. Three other occupational categories include another 36 percent of the jobs: computer and mathematical, office and administrative support, and management. Less than seven percent are production occupations. Table 8, below provides a detailed staffing distribution for this part of the renewable energy industry. These 30 positions represent 51 percent of the occupations in the industry and have an average wage of about \$34.70. This is slightly higher than the average for all occupations in the industry, about \$31.80.

The USDOL Employment and Training Administration has identified “new and emerging” occupations in this industry that are not captured by the current ONET coding system. They are: Biomass Plant Engineers, Biomass Production Managers, Biomass Plant Technicians, Geothermal Production Managers, Geothermal Technicians, Hydroelectric Plant Technicians, Hydroelectric Production Managers, Methane Capturing System Engineers/Installers/Project Managers, Methane/Landfill Gas Collection System Operators, Methane/Landfill Gas Generation System Technicians.

Table 8. All other renewable energy industries – Occupational distribution

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
19-4031	Chemical technicians	1,274	3%	\$20.38	Associate's degree
15-1032	Computer software engineers, systems software	1,186	3%	\$44.57	Bachelor's degree
19-1042	Medical scientists, except epidemiologists	1,179	3%	\$39.25	Doctoral degree
13-1199	Business operation specialists, all other	1,123	3%	\$29.02	Bachelor's degree
15-1031	Computer software engineers, applications	1,042	2%	\$38.51	Bachelor's degree
43-6014	Secretaries, except legal, medical, and executive	1,007	2%	\$15.56	Moderate-term on-the-job training
11-9121	Natural sciences managers	889	2%	\$64.99	Degree plus work experience
17-2141	Mechanical engineers	849	2%	\$36.96	Bachelor's degree
19-2031	Chemists	827	2%	\$31.85	Bachelor's degree
19-4021	Biological technicians	826	2%	\$22.46	Associate's degree
43-6011	Executive secretaries and administrative assistants	819	2%	\$20.48	Moderate-term on-the-job training
17-2199	Engineers, all other	775	2%	\$44.19	Bachelor's degree
17-2072	Electronics engineers, except computer	764	2%	\$45.99	Bachelor's degree
43-9061	Office clerks, general	753	2%	\$11.69	Short-term on-the-job training
11-1021	General and operations managers	691	2%	\$59.59	Degree plus work experience
15-1051	Computer systems analysts	672	2%	\$36.88	Bachelor's degree
13-1111	Management analysts	570	1%	\$37.18	Degree plus work experience
11-9199	Managers, all other	563	1%	\$43.96	Work experience in a related field
51-9061	Inspectors, testers, sorters, samplers, and weighers	548	1%	\$14.44	Moderate-term on-the-job training
11-9041	Engineering managers	548	1%	\$57.33	Degree plus work experience
15-1021	Computer programmers	525	1%	\$34.72	Bachelor's degree
13-2011	Accountants and auditors	522	1%	\$30.94	Bachelor's degree
19-4099	Life, physical, and social science technicians, all other	506	1%	\$20.08	Associate's degree
11-3021	Computer and information systems managers	504	1%	\$55.36	Degree plus work experience
19-1021	Biochemists and biophysicists	502	1%	\$51.42	Doctoral degree

SOC Code	Description	2006 Jobs	% of Industry	2009 Hourly Wages	Education Level
17-2071	Electrical engineers	498	1%	\$42.10	Bachelor's degree
17-2112	Industrial engineers	467	1%	\$34.10	Bachelor's degree
49-9042	Maintenance and repair workers, general	450	1%	\$17.30	Moderate-term on-the-job training
43-3031	Bookkeeping, accounting, and auditing clerks	419	1%	\$16.61	Moderate-term on-the-job training
17-3023	Electrical and electronic engineering technicians	409	1%	\$24.91	Associate's degree

Certifications

There are no general national certifications for renewable energy.

APPENDIX A – MAPS OF GEOGRAPHIC DISTRIBUTION OF GREEN INDUSTRIES

Figure I

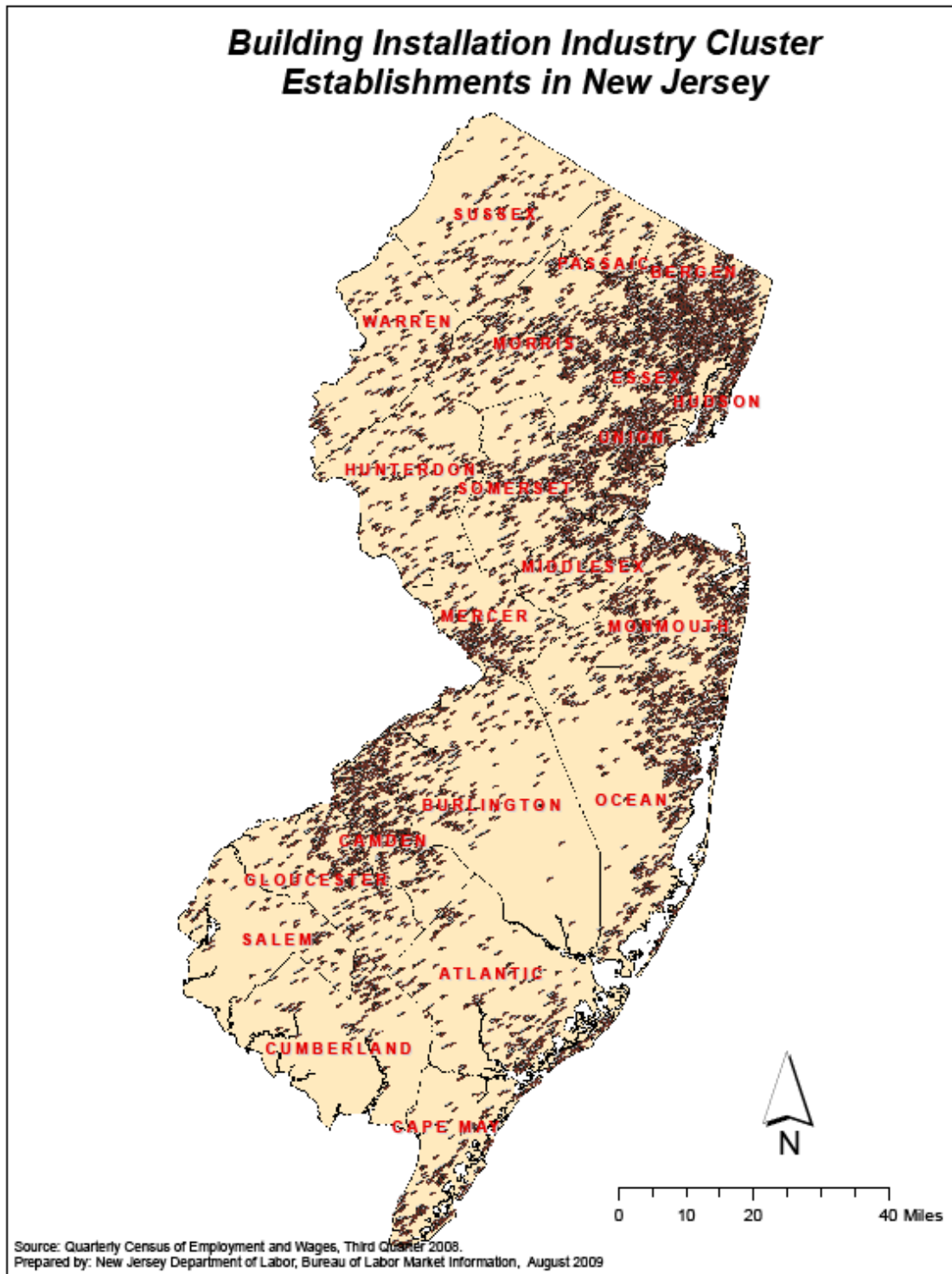


Figure II

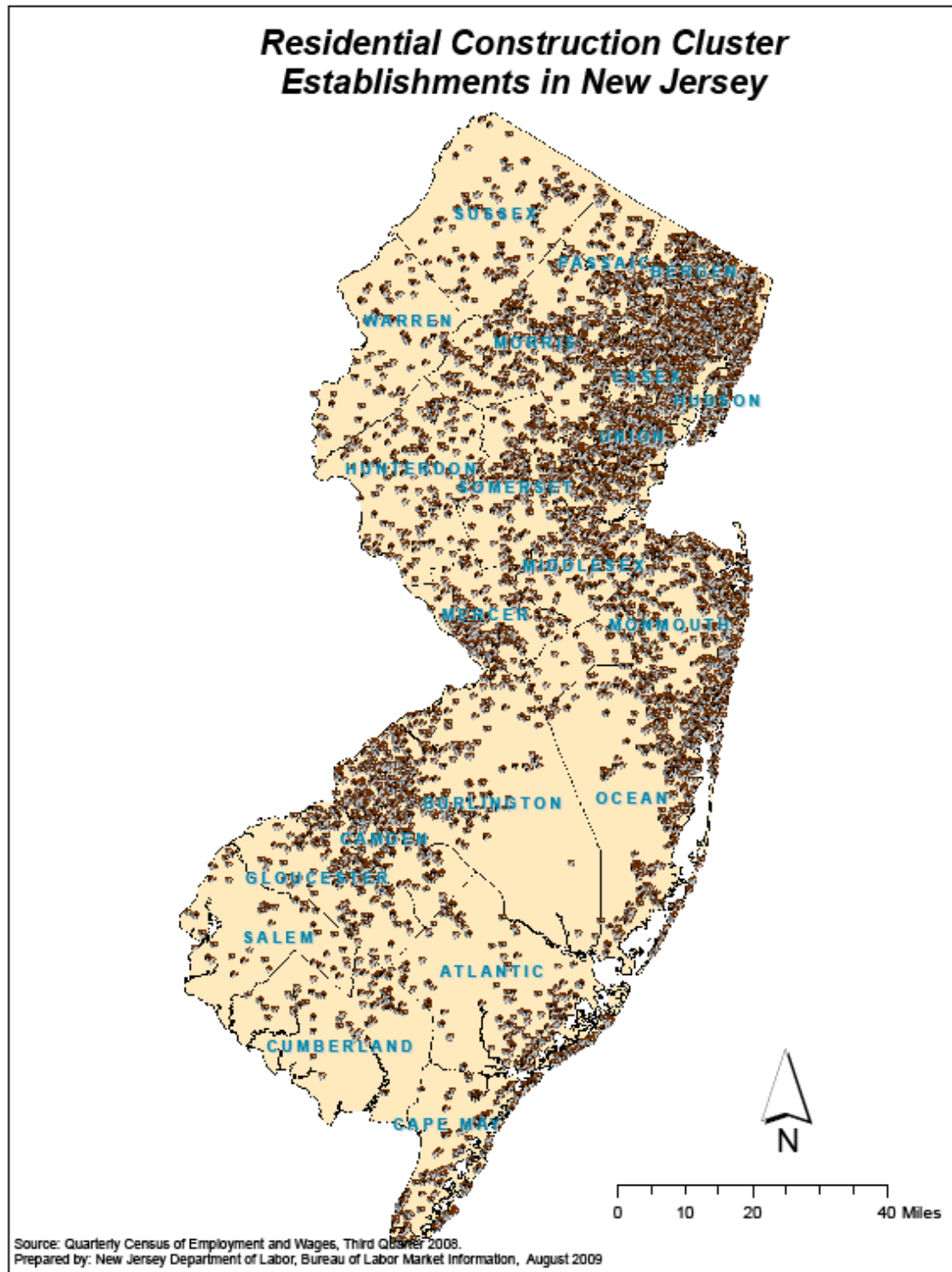


Figure III

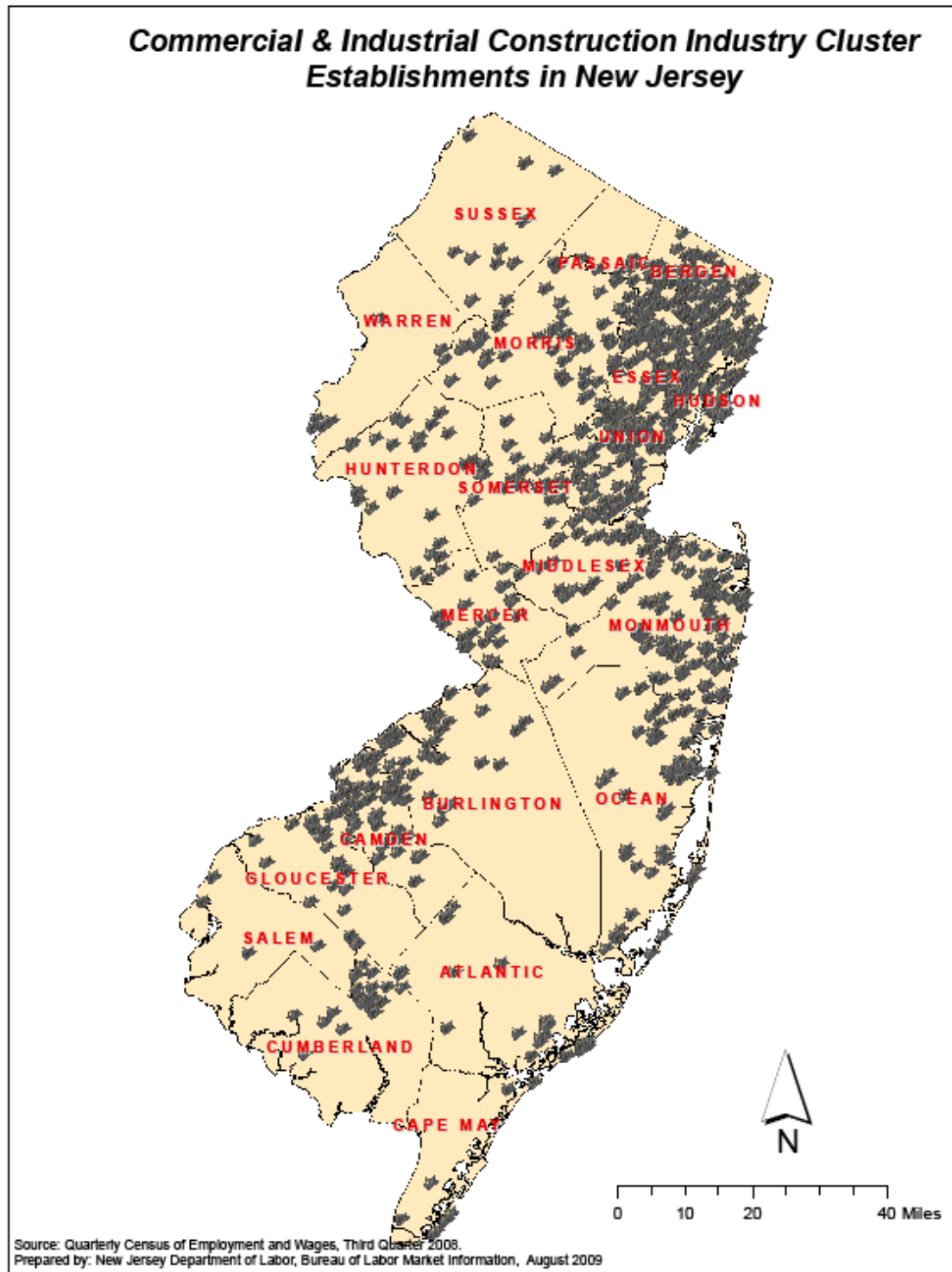


Figure IV

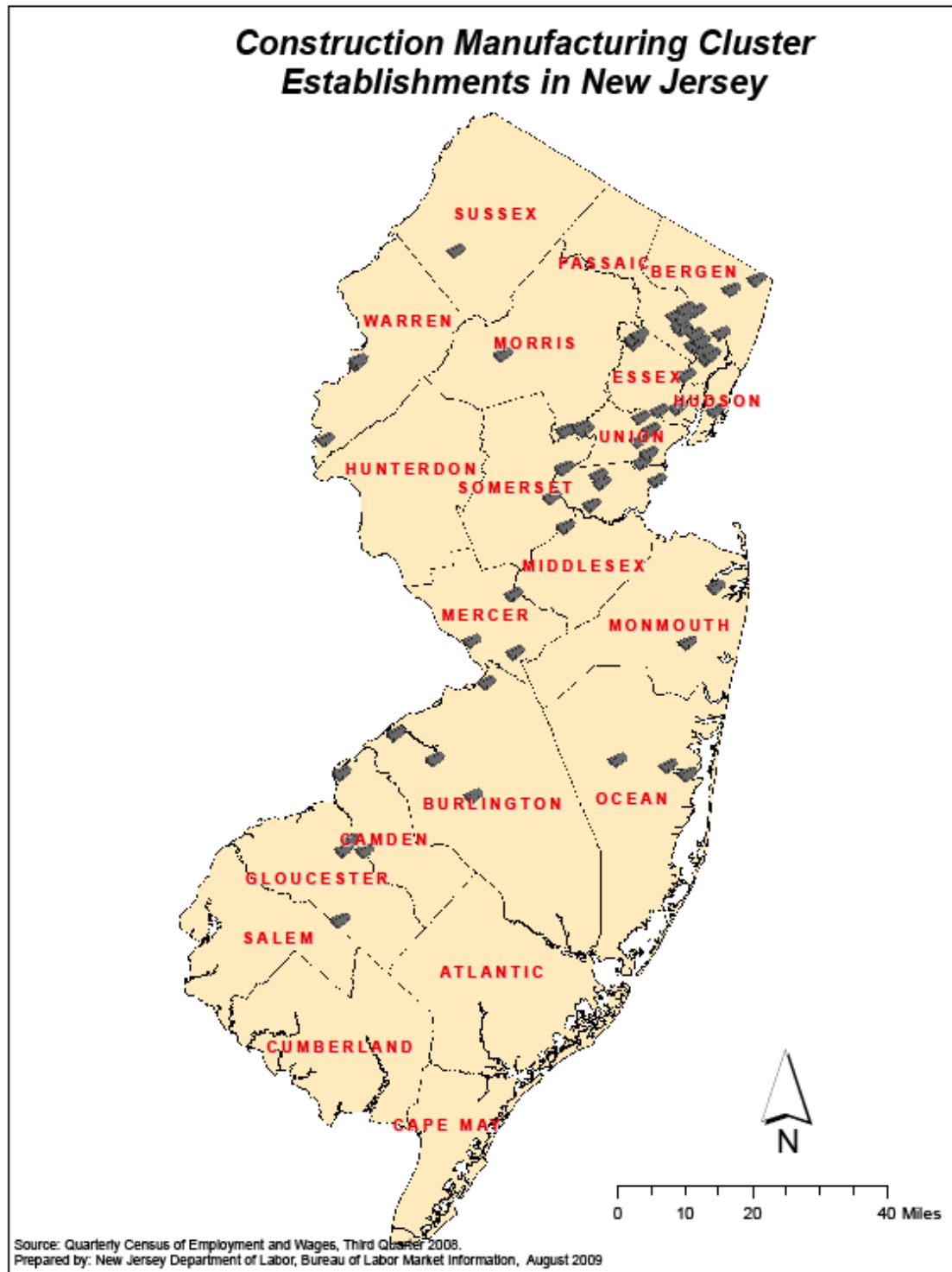


Figure V

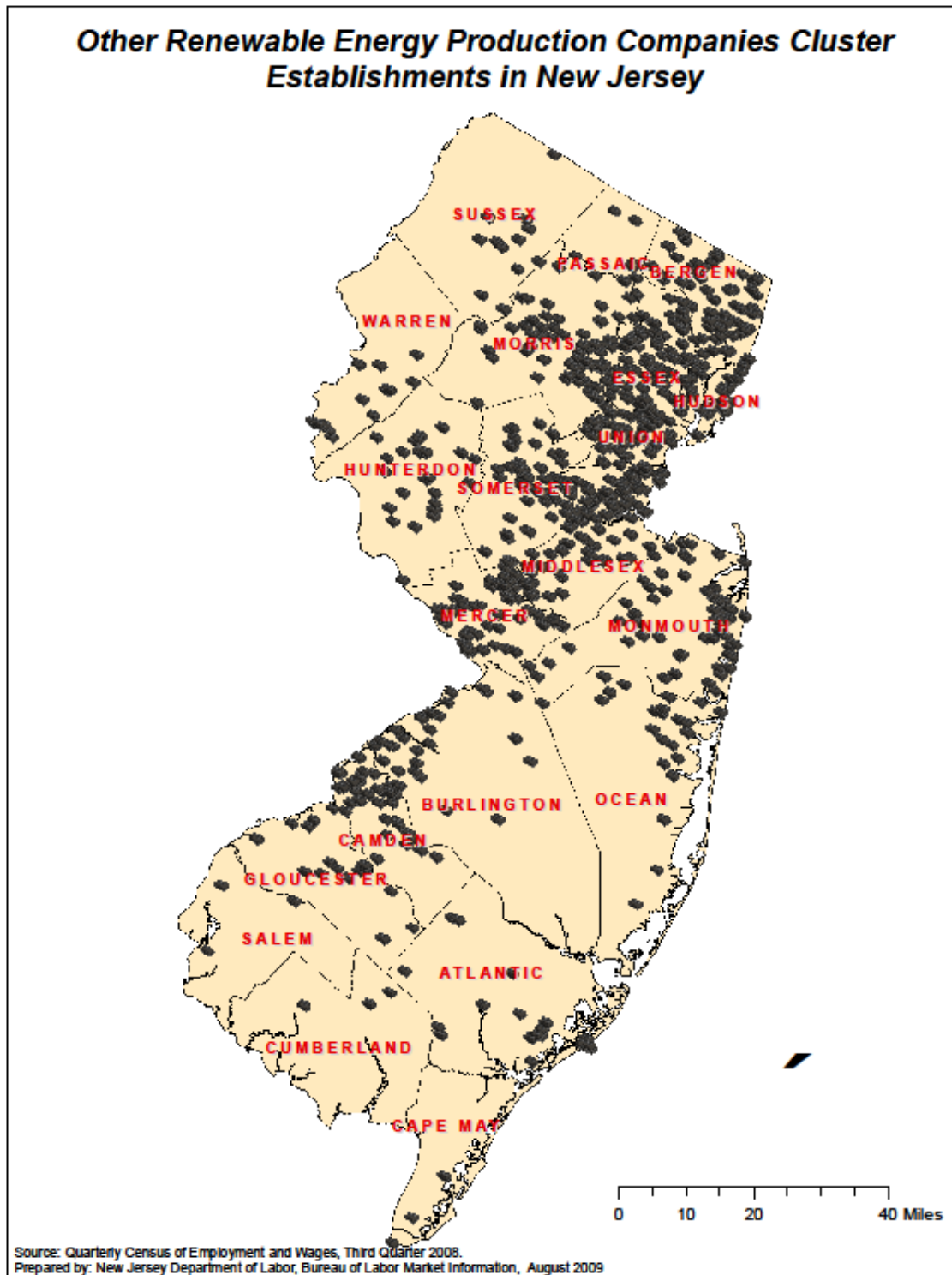


Figure VI

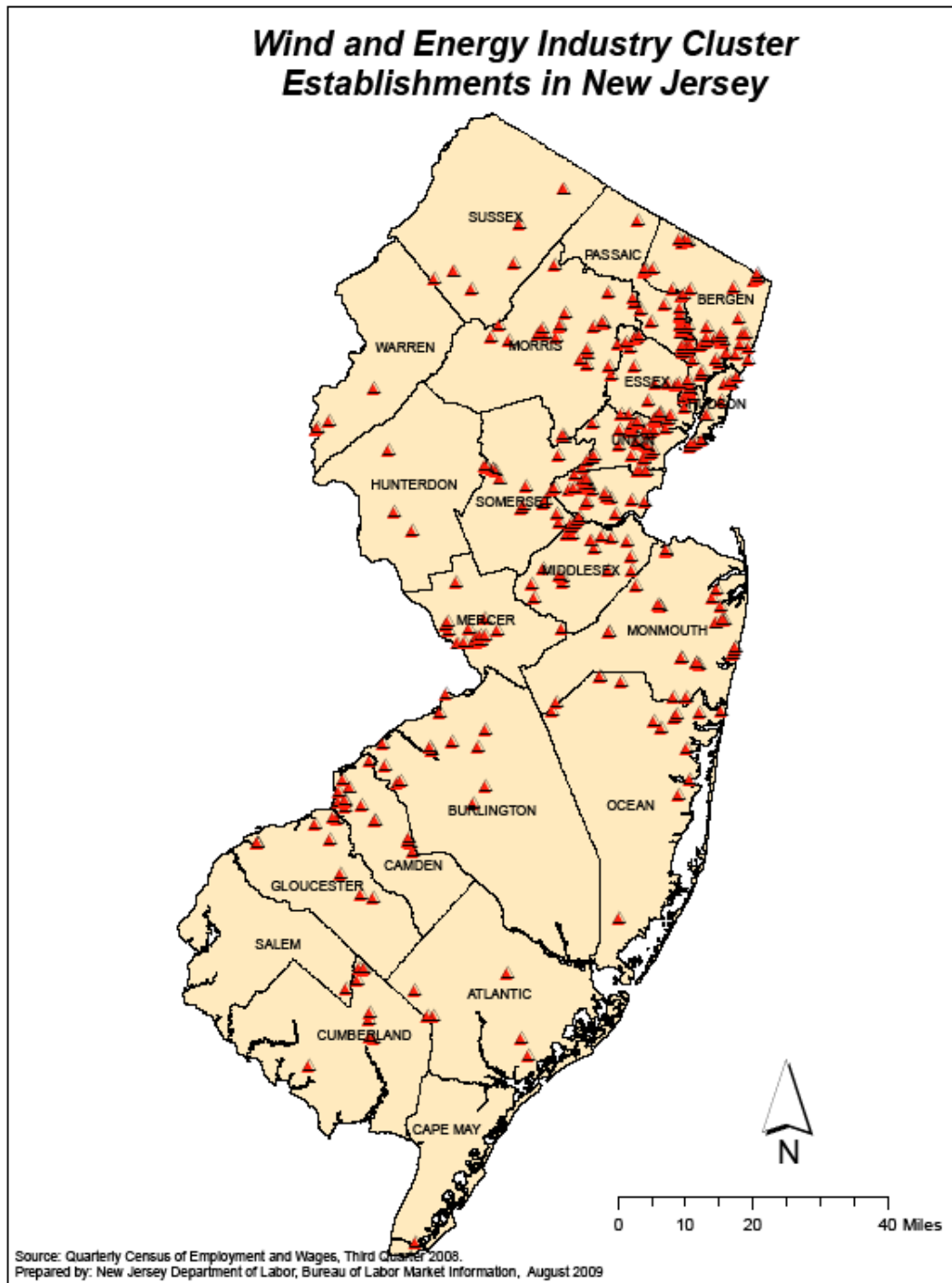


Figure VII

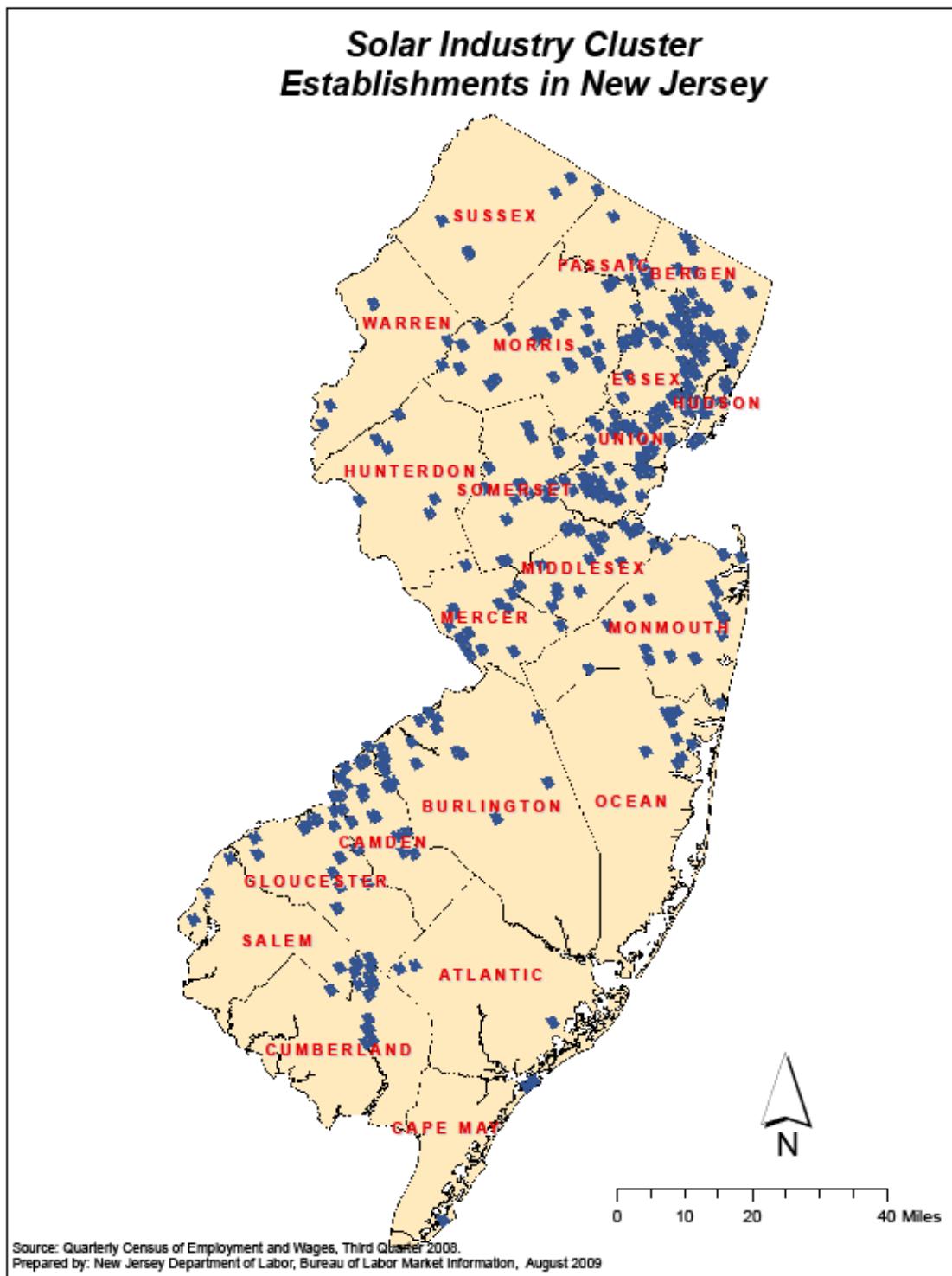


Figure VIII

