

Green Jobs in New Jersey's Energy Sector:

Strategies for Building a World-Class Workforce for the State's
Renewable Energy and Energy Efficiency Industries

A Report of New Jersey's *Ready for the Job* Initiative

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New Jersey's Ready for the Job Initiative: Aligning Workforce Preparation with the Skill Needs of Key Industries

Economic growth in New Jersey requires a highly skilled workforce prepared to meet the evolving demands of the state's global economy. *Ready for the Job* is a key component of Governor Jon S. Corzine's Economic Growth Strategy for New Jersey. The initiative began in 2002 to collect and disseminate information on the workforce challenges and skill needs of the state's key industries and to identify education and training strategies to address those needs. *Ready for the Job* is a partnership among several state agencies and departments led by the State Employment and Training Commission and the New Jersey Department of Labor and Workforce Development.

Five *Ready for the Job* reports were released in 2008-2009, including reports on the life sciences, green jobs in the energy sector, finance, the rise of remote work in New Jersey, and a report on emerging skills that identifies cross-cutting workplace trends and skill needs affecting employers throughout the innovation economy. Including these 5 reports, there have been a total of 17 reports. Past reports focused on the following industries:

Construction	Manufacturing
Emerging Industries	Port Newark/Elizabeth
Finance	Public Health/Disaster Management
Health Care	Retail
Hospitality and Tourism	Transportation
Information Technology	Utilities/Infrastructure

Information provided in the *Ready for the Job* reports is derived from an Industry Workforce Advisory Council for each industry, interviews with key employers and policymakers, focus groups of educational institutions and other stakeholders, a review of available labor market information, and background research on industry trends. Employer feedback collected in this and other *Ready for the Job* reports will be used to inform efforts to prepare individuals for industry jobs, including workforce development initiatives, K-12 education, higher education, and vocational training programs.

Results and reports from the *Ready for the Job* initiative are distributed through the NJNextStop website (www.njnextstop.org). NJNextStop is the State of New Jersey's primary career guidance Internet portal for high school students, counselors, teachers, and parents.

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Executive Summary

- Green Jobs in the Renewable Energy and Energy Efficiency Industries
- Growth of Green Jobs in New Jersey
- Priority Workforce Skill Needs of Renewable Energy and Energy Efficiency Employers
- Strategies in Place to Address Industry Workforce Skill Needs
- Suggested Next Steps



This report highlights the priority workforce skill needs of New Jersey's renewable energy and energy efficiency industries and presents a statewide action plan to better align education and training with these needs.

The news media is flooded with reports about the expected growth of “green jobs” in response to growing concerns about climate change, volatile energy prices, the United States’ need for energy independence, and the potential for economic stimulus. Although the actual job opportunities and growth potential of the green economy are still emerging, state policymakers, agencies, and educational institutions can take important steps to develop their capacity to respond to employer demand for “green workers” as jobs grow.

This *Ready for the Job* report, an initiative of Governor Corzine’s Economic Growth Strategy for the State of New Jersey, identifies the key skills workers need to fill green jobs in the renewable energy and energy efficiency (RE/EE) sectors. It also proposes instituting an industry-specific talent network, and provides recommendations for state agencies, workforce and community groups, and educational institutions seeking to build a flexible pipeline of skilled green workers to meet employer demand. The report’s analysis is based on national and state reports and feedback from more than 75 employers, educators, and other stakeholders who participated in two Industry Workforce Advisory Councils convened by the New Jersey Department of Labor and Workforce Development in spring 2008. (For a full list, see Appendix A.)

Green Jobs in the Renewable Energy and Energy Efficiency Industries

While there is no standard definition of green jobs, this report focuses on occupations associated with the renewable energy and energy efficiency sectors. These are the jobs most likely to increase in order to meet the challenges of global warming, and to promote the state’s transition to a green economy based on the efficient use of energy and a reduction in harmful emissions.

The American Solar Energy Society estimates that the RE/EE sectors comprised 2% of all jobs nationwide in 2007.¹ Because green jobs are found within many traditional industries and occupations, however, it is difficult to count the exact number of these jobs in New Jersey using available public data.

Green jobs in the energy efficiency and renewable energy sectors consist largely of **existing occupations that include a new, “green” layer of skills and knowledge** about environmentally responsible technologies and practices. Jobs are available at all skill and education levels and within many traditional industries and occupations. Common job areas where green jobs are likely to be prominent include:

- Construction, Installation, Repair, and Maintenance
- Architecture, Engineering, and Project Management
- Research and Development

- Manufacturing/Production
- Corporate Administration/Business/Financial/Sales and Marketing/Information Technology

Examples of traditional occupations that are morphing into green jobs in the RE/EE sectors include cost estimators (raters) who estimate the cost of installing new renewable energy or energy efficiency products; certified Energy Insulation Appraisers for residential, commercial, and industrial buildings and structures; heating/air conditioning installers who retrofit residential or commercial heating systems to use less fuel; manufacturing workers who produce parts for solar panels; and scientists and engineers who research and develop alternative energy technologies. Many more examples exist, but as this report discusses, public policy, current employment patterns, and other key factors are important determinants of the direction and pace of growth for particular types of green jobs.

Growth of Green Jobs in New Jersey

The expected boom in green jobs and the types of new skills that are likely to be in demand in a green economy will be influenced by several factors. Understanding these drivers and being able to track their effects as they develop are key to building a responsive — and effective — mechanism for educating new and incumbent workers to fill green jobs. Factors to consider include:

- **Public policy is, and will continue to be, a key driver of job growth in the RE/EE sectors, along with economic conditions and technological advancements.**

The federal economic stimulus plan is designed to promote growth and support training in the RE/EE sectors. The American Reinvestment and

A Definition of the Renewable Energy and Energy Efficiency Industries

While no standard definition of the RE/EE industries or green jobs currently exists, the industries are defined as follows for the purposes of this report:

Renewable Energy

- Solar
- Wind
- Biomass
- Hydropower
- Solar Thermal
- Hydrogen

Energy Efficiency

- “Green Building” Construction
- Building Retrofits
- Energy Use Controls
- Energy Efficient Products
- Corporate Energy Use Management

Recovery Act, passed in early 2009, authorizes \$11 billion to modernize the nation's electric grid, \$6.3 billion in energy-related grants to states, \$5 billion to weatherize homes of moderate-income families, and \$4.5 billion to retrofit federal buildings. An additional \$500 million will be made available through competitive grants to train workers for green-collar jobs. These investments will incentivize hiring in a range of industries.

In New Jersey, the Center for Energy, Environmental, and Economic Policy at Rutgers University estimates that the state's new Energy Master Plan (EMP) has the potential to generate over 20,000 jobs by 2015.² The exact impact that the federal stimulus investments will have on jobs is not yet clear. The state's Energy Master Plan calls for statewide energy reduction of 20% by 2020 and sharp reductions in peak power usage. The plan also supports one of the most robust renewable energy portfolios in the nation, calling for 30% of all power to come from renewable sources by 2020. Other provisions call for development of 1,500 megawatts (MW) of cogeneration and 3,000 MW of wind power by 2020. Governor Corzine's Economic Assistance and Recovery Plan offers several major incentives for extensive building retrofits, clean energy manufacturing, and other projects.³

Besides energy policy, factors such as the condition of the American economy, energy prices, and the pace of technological breakthroughs in RE/EE industries affect future job demand. A faltering economy and volatile energy prices may make homeowners and businesses less able to afford the upfront investments that installing existing RE/EE technologies often requires. The emerging nature of many competing RE/EE-related technologies makes it difficult to predict which technologies, if any, will dominate future markets and create the largest numbers of jobs.

- **Based on current employment and policy trends, most green jobs are likely to be in New Jersey's energy efficiency sector.**

Over 95% of the estimated 3.7 million current direct jobs in RE/EE nationwide were EE related, according to a report by the American Solar Energy Society.⁴ Energy efficiency is the cheapest "alternative" fuel — that is, every kilowatt of electricity or gallon of gas **not** used represents money not spent and carbon not emitted. Energy efficiency is generally the initial investment made by most commercial and industrial businesses, before they decide to invest in renewable energy sources.

In addition to providing replacement job opportunities, the energy efficiency sector is likely to grow in response to federal and state policies and investments. New Jersey's Energy Master Plan sets aggressive conservation goals including building code updates and an energy savings contracting program for state and local government buildings and schools. For example, the Governor's Economic Assistance and Recovery Plan proposes a several hundred million dollar energy efficiency program that partners with New Jersey's electric and gas utilities to encourage retrofitting of commercial, industrial, and residential buildings. These policies will increase demand for jobs in energy efficiency and corresponding skills, many of which are

related to the current construction and building trades industries and their training programs. This investment supplements existing funds in the state's clean energy program, which provides incentives for energy-saving upgrades to commercial and residential structures.

- **Direction and pace of growth in the *renewable* energy sector is influenced by the state's public policies, geography, infrastructure, and natural resources.**

While the energy efficiency sector will provide the largest number of jobs, renewable energy jobs are growing rapidly and are likely to continue to grow in response to state and federal incentives.⁵ The renewable energy sector, however, has a more diverse set of jobs than the energy efficiency sector. Energy efficiency involves large numbers of similar jobs related to building retrofits, while building and maintaining wind turbines will require more mechanical and heavy equipment skills than installing and maintaining solar panels, which involves more electrical labor. The certifications needed in renewable subsectors also vary. These variations have large implications for green jobs workforce and education programs.

Federal policies are still under development. New Jersey policymakers, however, made a serious commitment to increasing the solar energy supply in 2002, helping to make the state home to the second largest number of solar panel installers in the nation, ranking only behind California.⁶ The Energy Master Plan directs 2,120 GWh to come from solar energy by 2020, continuing the trajectory of future solar system installations in the state. The Energy Master Plan also calls for 1,000 MW of offshore wind energy to be installed by 2012, and 3,200 of onshore and offshore wind by 2020. Hydroelectric, biofuel, and other sources of renewable energy do exist in the state, but at a vastly smaller scale.

This mix of renewable energy sectors, each of which has its own skill and certification requirements, is also influenced by the state's infrastructure, geographic features, and natural resources. For example, many midwestern states with large areas of farmland are better suited to develop the biofuel, ethanol. In New Jersey, strong offshore winds enable the implementation of large wind farms at sea and the abundance of flat roofs on the state's warehouses enable solar collection.

- **Workforce training needs for green occupations are influenced by the standards set for green projects.**

Whether they are set by state regulatory agencies, labor unions, or employers, the standards that are — or are not — adopted for energy efficiency and renewable energy projects have an effect on the skill and training requirements for green jobs. For example, green building projects that must meet nationally accepted Leadership in Energy and Environmental Design (LEED) standards, require that building professionals be LEED trained and certified. Building and construction standards established by organized labor are taught within their apprenticeship programs. These programs run from

two to five years, depending on the trade. Additional standards are imposed through annual training, retraining, and certifications. For over 100 years, the union building trades training has traditionally evolved and modernized for governmental, economical, technological, and additional purposes that were necessary to meet workforce demands and challenges. Training curricula have advanced and received input from lead area professionals and various employers. Union training programs are governed by Joint Apprenticeship Committees, labor management committees that have representation from labor and contractors. All training efforts are incorporated into standards that are approved and registered with the U.S. Department of Labor's Office of Apprenticeship. New Jersey is currently considering the adoption of standards for solar panel installation and other projects, which may affect the type of training and certification workers will need.

Priority Workforce Skill Needs of RE/EE Industry Employers

To meet the future workforce needs of the RE/EE industries, employers will need workers who have the core basic skills, training, and credentials associated with the traditional occupations often involved in energy efficiency and renewable energy projects. In some cases, workers also require a new layer of green skills knowledge, while still others require specialized certifications associated with particular types of projects and standards set for RE/EE projects.

While not every job available in the near future will require the "green layer," employers agree that, as New Jersey continues its transition to a clean economy, certain broad skill sets will become increasingly important for workers at many levels to acquire. Companies that participated in the Industry Workforce Advisory Councils convened by the New Jersey Department of Labor and Workforce Development identified the following core green skill and knowledge areas:

- **Energy Conservation and Sustainability Knowledge**

Workers of all types in the RE/EE industries need basic knowledge of energy conservation and sustainability concepts, including energy management, recycling and waste reduction, and data collection and reporting. Broad knowledge of the policies and practices that are emerging in response to global warming, the need for energy independence, and the economics of energy supply and demand is also a valuable asset.

- **Knowledge of Alternative Energy Technologies and Common Standards**

A critical knowledge area that applies across a range of jobs and disciplines involves knowledge of alternative energy technologies, as well as nationally recognized standards for RE/EE projects. This includes understanding the broad array of existing and emerging renewable energy technologies, from

photovoltaics to biomass to geothermal power. Another important category of information includes knowledge of the emerging systems of **financing** alternative energy technologies — from carbon credits and solar renewable energy credits to corporate and residential financing schemes designed to reduce the capital costs of consumers purchasing alternative energy technologies for homes, schools, and businesses. Depending on the type of job, workers may need specific knowledge, skills, and/or certification to install, inspect, or manufacture particular technologies. It also involves understanding the national standards that are associated with the type of RE/EE work being performed. For a list of common standard-setting bodies in RE/EE, see Appendix B

▪ **Life Cycle Analysis Skills**

Another growing area of knowledge that is important to varying degrees in many types of green jobs is life cycle analysis, which involves understanding the costs of products over the long term, as well as the impacts of technologies on the environment and energy use, based on the entire industrial process involved in creating a product. From extraction of materials through manufacture and continued use, life cycle analysis allows workers to calculate the true costs and benefits of various RE/EE products. At a minimum, life cycle analysis allows workers at various levels to communicate the benefits of RE/EE projects to potential customers.

Strategies in Place to Address Industry Workforce Skill Needs

Several initiatives are under way in New Jersey to support the development of a qualified workforce for employers in the RE/EE industries. Training and education programs are under development in both the public and private sectors. Efforts include those spearheaded by state agencies, building and construction trades, organized labor, employers, public and private educational institutions and training establishments, and community-based organizations.

The **Innovation Partnership Institute** (IPI) grants allow consortia of educational institutions, employers, and other stakeholders to develop and distribute curricula to address skill gaps in key New Jersey industries. Funded by the New Jersey Commission on Higher Education, two IPIs are addressing priority skill needs in the RE/EE industries, including one led by Essex County College that is focused on addressing gaps in the area of construction and facilities management, and another at the New Jersey Institute of Technology focused on nuclear energy.

The New Jersey Department of Labor and Workforce Development (NJLWD) convened several **Industry Workforce Advisory Councils** to advise state policymakers and educational institutions on the emerging skill and certification needs of RE/EE employers. These groups included senior hu-

man resource managers from some of the state's key RE/EE companies and were instrumental in developing this report. NJLWD has also developed the **Green Job Training Partnership Program** and a **Youth Transitions to Work** program designed to link energy efficiency, environmental remediation, and training with internships and employment. Finally, NJLWD has made \$500,000 available through its **Regional Economic Development Initiative** program, which promotes coordination of green job development efforts and provides training to workforce system staff on the skill and education requirements of green energy jobs.

The New Jersey Department of Education issued a grant to The College of New Jersey to develop a sustainability and green jobs awareness curriculum for high schools to use. That curriculum will help New Jersey high school students to learn the basics of environmental sustainability and energy conservation principles.

In addition, the state benefits from the continued efforts of the building and construction trades. Organized labor and their memberships are almost always on the cutting edge of training in new technologies. The majority of the New Jersey building trades have already explored green technologies and have built training modules for both apprentices and journey worker training. In some instances, international unions are still working and planning with their local apprenticeship programs to finalize training efforts. The overall goal of the building and construction trades is to prepare their memberships with the most current skills, knowledge, and abilities to enable them to be prepared for work in green industries.

Finally, the cities of Trenton and Newark, in partnership with state agencies, community-based organizations, and others, are planning city-wide green jobs efforts that will include job creation and job training efforts. In addition, several colleges, universities, high schools, vocational schools, labor unions, employers, and private training providers are developing training and education programs that address key employer skill needs in the RE/EE sectors. For example, the International Brotherhood of Electrical Workers has developed a solar technology curriculum, PSEG is adding a green module to the energy training program that it developed in partnership with several of the state's community colleges and high schools, and Salem Community College recently received a large federal grant to develop training for the energy industry.

Suggested Next Steps

If New Jersey is to continue to attract and retain quality RE/EE jobs, state agencies must work with manufacturers, contractors, educational institutions, organized labor, and community organizations to ensure the development of the correct types of training and education to meet the changing demands of this dynamic industry. New Jersey policymakers and educational institutions should consider taking three key steps:

Step 1: Support and expand current efforts to build capacity in priority cross-occupational skill areas throughout the K-16+ curricula.

State agencies can ensure that core priority employer skill needs in the RE/EE sectors are addressed through current and future efforts to address green skills in the K-12 system. Potential strategies include using the IPIs to ensure priority cross-occupational skills are infused into all levels of education appropriately, expanding Department of Education efforts to create green jobs/sustain curricula for high schools by ensuring they align with priority employer skill needs and transfer knowledge to the K-8 level, and improving the delivery of green jobs career information in multiple settings using technology.

Step 2: Track and disseminate real-time information about employer demand for workers and training.

New Jersey requires a mechanism to obtain real-time information on how policy is affecting “boots on the ground” — the development of actual jobs. In addition, education and training institutions need to know which areas of training and which types of credentials employers demand. Three strategies will assist New Jersey to do this:

Strategy 1: Institutionalize the Green Energy Industry Workforce Advisory Council. In spring 2008, NJLWD convened two meetings of stakeholders to provide input on the industry’s evolving hiring and skill needs. This Industry Workforce Advisory Council should be convened on a regular basis as a partner with the state in improving and creating training programs and helping to inform curriculum and workforce policy. The IWAC should be expanded to include representatives from the building and construction trades.

Strategy 2: Establish a mechanism to track the effects that federal and state policy are having on jobs. Using up-to-date information on policy developments and economic analysis, state agencies should coordinate efforts to understand and document the effect that policy is having on job creation. This information should be disseminated to a range of stakeholders, including education, training, and workforce providers.

Strategy 3: Research existing green occupations and related training activities, as compared to future demand, and plan to develop programs to meet the gap as needed.

Step 3: Create a Green Energy Talent Network to promote coordination of green jobs workforce and economic development programs in the state and maximize resources.

A Green Energy Talent Network can achieve broad statewide alignment of workforce education with priority employer needs, providing flexibility and momentum to support the state’s emerging RE/EE industries.

To ensure the success of the Green Jobs Talent Network, state agencies should consider the following strategies:

Strategy 1: Assign a Green Jobs Talent Network coordinator to organize network activities and to act as a liaison between network members, the IWAC, organized labor, and individual green employers.

Strategy 2: Establish a Green Energy State Leadership Council, potentially as a subcommittee of the State Employment and Training Commission. The council should consist of state agency administrators and a representative of the building and construction trades. The council can guide the efforts of the larger Talent Network and strategize on ways to combine funding streams, where feasible, and implement strategies to avoid the duplication of training efforts.

Strategy 3: Map existing green jobs education assets and develop a state-wide green jobs action plan to prioritize investments in green jobs workforce education efforts.

Possible initiatives of the Green Jobs Talent Network and/or its members could include:

- Develop a Green Energy Training Center to offer hands-on training with RE/EE technologies and expert career advising. Florida has created such a center in a partnership with the University of Central Florida and key employers. In New Jersey, the center could be coordinated with labor unions and the Energy Institute of New Jersey, the entity proposed by the Energy Master Plan to oversee basic and applied energy research efforts at the colleges and universities in the state.
- Build green jobs career pathways by creating “stackable” credentials that allow workers to earn nationally recognized skill certificates and apply the training and/or on-the-job experience toward more advanced training or college credit. Efforts should include consultation with major industry credentialing bodies, some of which may have developed curricula as well as certification standards. (See Appendix B for a list of major credentialing bodies in the RE/EE sectors.)
- Enhance existing and create new partnerships with organized labor, the U.S. Department of Labor’s Office of Apprenticeship, and other members of the State Employment and Training Commission’s Apprenticeship Pathway Committee. The focus could be on creating new apprenticeable occupations within the RE/EE sectors, developing best practices for workforce training within these sectors, and ensuring New Jersey has a qualified pool of workers within green industry jobs.

Introduction

- Purpose
- Methods



This report provides a roadmap to understanding and addressing the emerging skill needs of employers in New Jersey's renewable energy and energy efficiency industries.

Overview of Report

This report identifies:

- Broad trends affecting workforce skill needs in the RE/EE industries,
- Priority skill needs of employers,
- Current state and regional efforts to address critical industry skill needs, and
- Strategies state departments and other stakeholders should consider to more fully address these skill needs statewide.

New Jersey's renewable energy and energy efficiency (RE/EE) industries require ready access to a highly skilled workforce. State agencies, educational institutions, and other stakeholders must work together to ensure that job seekers and workers have access to appropriate training and education options that will prepare them for the emerging needs of green jobs in these innovation-rich sectors.

Purpose

This report provides a roadmap to understanding and addressing the evolving skill needs of employers in New Jersey's RE/EE industries. It describes trends affecting workforce skill requirements in these sectors and identifies the priority skill needs of employers, both as they occur across a variety of occupations (**cross-occupational skill needs**) and as they occur within common green job occupational areas (**occupational skill needs**). Finally, the report identifies current state and regional efforts to address critical industry skill needs in the RE/EE industries and outlines the steps policymakers, state agencies, and other industry stakeholders should take to better address these skill needs statewide.

Methods

This report reflects discussions with more than 75 employers, educators, government officials, and other experts in the RE/EE fields. Two Industry Workforce Advisory Councils met in the spring of 2008 to provide input on industry skill and workforce needs. The councils consisted of senior human resources professionals and other managers from key RE/EE employers, regulatory agencies, educational institutions responsible for industry-related education and training, and other stakeholders. In addition, interviews were conducted with experts in the RE/EE industries. For a full list of individuals who participated in the study, see Appendix A. In addition to employer input, this report draws on data and information from several national reports, articles, and conferences regarding the RE/EE industries. No data on industry jobs were available at the time this report was written.

Profile of the Renewable Energy and Energy Efficiency Industries and Green Jobs in New Jersey

- Understanding the Renewable Energy/ Energy Efficiency Industries in New Jersey
- Key Job Categories for Green Jobs in the Renewable Energy/Energy Efficiency Industries
 - Construction, Installation, Repair, and Maintenance
 - Architecture, Engineering, and Project Management
 - Manufacturing/Production
 - Research and Development
 - Corporate Administration/Business/ Financial/Sales and Marketing/ Information Technology



Green jobs in New Jersey's renewable energy and energy efficiency industries are numerous and poised to grow in response to national and global trends.

New Jersey is a recognized leader in promoting energy efficiency, and in the development and use of clean and renewable energy sources. The state's dense population, and its high economic and environmental costs of generating power from traditional sources, have prompted aggressive policies to reduce energy use and encourage adoption of renewable energy sources such as solar panels and wind turbines.

New Jersey is home to a large number of companies in the energy efficiency (EE) sector, including Honeywell International, Inc., a producer of lighting, heating, and energy efficiency controls; Johnson Controls; and a host of construction and architectural firms dedicated to building and retrofitting energy efficient structures. Utilities that supply power to the state, such as PSEG and JCP&L, have also become partners with the state in instituting energy efficiency measures and have begun to employ EE workers. A wide array of commercial and industrial businesses have begun to employ workers dedicated to managing company energy use and conserving energy resources.

The Garden State's vibrant renewable energy sector is second only to California in the number of solar installation firms in the state.⁷ The worldwide headquarters of EPV Solar, Inc., a large global manufacturer of components for solar panels, is located in New Jersey. A number of jobs also exist in other renewable energy sectors, including wind and biofuels.

Across both the renewable energy and energy efficiency industries, New Jersey has a vigorous research and development sector. The state's economic development policy, technology incubator programs, scientific

One View of RE/EE Industries in the United States

Over 3.7 million direct jobs nationwide:

- Approximately 2% of all U.S. jobs
- Over 95% of jobs in energy efficiency
- 5% of jobs in renewable energy

Key jobs in areas including:

- Construction
- Installation
- Manufacturing
- Research and Development
- Sales

Source: Roger Bezdek, Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century" Management Information Services (MIS) for the American Solar Energy Society, 2007.

entrepreneurs, and higher education institutions have fostered the growth of a variety of research and development operations that research, design, and develop new RE/EE products, from hydrogen batteries, to biofuels made from cooking grease and landfill gas, to new types of building energy use controls.

Understanding the Renewable Energy/ Energy Efficiency Industries in New Jersey

Occupations within renewable energy and energy efficiency sectors are defined by their focus on clean or renewable energy and energy conservation. These jobs do not fit easily into the traditional definitions used to track industries and occupations in the U.S. economy. Occupations in RE/EE are often located within in a company that has another main business strategy. For example, one EE occupation is the facilities manager of a supermarket chain whose priority is to ensure cost-effective energy usage in all its stores. Other traditional industries, such as construction and architecture, manufacturing, and utilities, are developing entire divisions focused on RE/EE services and products.

Energy efficiency jobs are found across a wide variety of sectors and comprise over 95% of all RE/EE jobs nationally.⁸ In New Jersey, employers estimate that energy efficiency occupations, which are the largest contributor to RE/EE jobs in the state, are heavily concentrated in the building and construction trades. Construction; architecture; electrical work; heating, ventilating, and air conditioning (HVAC); plumbing and pipe fitting companies; and other types of businesses are involved in retrofitting older buildings to conserve energy, as well as designing and building new green buildings.

Energy efficiency jobs are also found within the manufacturing sector, among companies such as Honeywell International and Johnson Controls which develop and market lighting, heating, ventilation, and other building controls designed to reduce energy use. Other manufacturers develop energy efficient lighting, appliances, and products. These companies often provide energy savings services — performing audits, retrofitting, and monitoring energy use in residences, businesses, schools, and government buildings. Demand is rising as well for energy managers, or resource and sustainability officers, who are responsible for controlling energy use and managing resources in a wide range of manufacturing facilities, warehouses, and corporate offices.

The potential growth in New Jersey's renewable energy market can be understood by examining the state's current energy generation and its goals for electricity generation in 2020. New Jersey currently derives more than **half** of its power from nuclear sources, compared to a national average of just 8%. New Jersey ranked 10th among 31 states in the United States for nuclear capacity in 2005. Natural gas made up 26% of the state's electricity market in 2006.⁹ The goals set in New Jersey's Energy Master Plan call for a

Table 1. Current Electricity Market in New Jersey and Energy Master Plan Goals for 2020 Electricity Generation (percent generated by fuel)

Year	Coal	Natural Gas	Nuclear	Wind	Biomass	Onsite (includes combined heat and power)	Solar	Refuse
2006	18%	26%	54%	*	*	*	*	*
2020	15%	15%	36%	13%	6%	13%	2%	1%

Source: U.S. Energy Information Administration and New Jersey Energy Master Plan Electricity Fact Sheet.

*Less than 1%.

substantial change to the state's current energy infrastructure, with 30% of the state's energy to come from renewable sources that currently make up less than 1% of the electricity supply. (See Table 1.)

Although nuclear power and natural gas each create environmental concerns of their own, they will play an important role in New Jersey's future efforts to reduce carbon emissions in electricity production. Both sectors face workforce development issues that will affect future action plans for preparing the state's green energy workforce. Additional research is required to understand the skill needs in these sectors.

Key Job Categories for Green Jobs in the RE/EE Industries

RE/EE occupations fall into five broad functional areas that help define related jobs and career ladders. Identifying jobs in key functional areas — which share some common skill sets or educational requirements — can help job seekers, educators, and workforce professionals to understand how employment is structured in most RE/EE firms.

As one employer noted, "The entire clean energy sector is really an advancement of existing trades."¹⁰ A consistent theme among employers is that few, if any, jobs in the industry are brand-new occupations. Even emerging occupations, such as energy engineer positions, which employ a whole systems approach to designing energy efficient facilities, are modifications of existing jobs with a new set of added competencies. Employers observe that workers need foundational skills and experience in the "root job" (e.g., engineer, electrician, etc.), as well as new knowledge relevant to RE/EE.

Currently, employers, organized labor, and private training providers offer much of this add-on training to their employees, membership, or constituents, and prepare them to acquire nationally recognized credentials and certifications where necessary.

Construction, Installation, Repair, and Maintenance

“Green-collar jobs,” a term that has been widely used in the media and in political campaigns, refers to installation, maintenance, and other technician-level occupations — with an RE/EE or environmental focus — that require various levels of skills. These jobs tend to pay family-supporting wages and are not likely to experience outsourcing. The term is most often used to describe occupations such as insulators, carpenters, plumbers, or pipefitters, that do work involved in constructing “green buildings” or performing energy efficiency building retrofits. Other types of green-collar jobs include energy auditors and weatherization professionals who assess energy use and heat loss in businesses and homes, solar panel installers, electricians, and other skilled workers involved in installing or repairing RE/EE technologies.

Some groups see green-collar jobs as suitable targets for workforce and economic development efforts, as they can provide viable job and career ladder opportunities for all workers and require a manageable amount of training after high school. Often, green-collar jobs involve a traditional skilled labor set acquired through apprenticeship, additional training, or certification after high school, but usually require less formal education than a college degree.

Architecture, Engineering, and Project Management

Highly skilled workers with advanced degrees design, plan, and manage complex RE/EE projects. Architects design green buildings and engineers with various specialties are needed to design sound project plans for green construction, building retrofits, and energy systems. For example, energy engineers get involved in designing projects that take into account how architecture, construction, and product installation will work together to ensure that the entire building operates in the most energy efficient manner.

Skilled project managers are essential in managing RE/EE-related construction projects. These workers often interface with both customers and technical or scientific staff and are responsible for overseeing the progress of complex green building or EE retrofitting projects. To operate and maintain the more efficient buildings and equipment, facilities managers must also engage in energy use analysis and have technical knowledge of RE/EE technologies and procedures.

Key RE/EE Job Categories

Construction, Installation, Repair, and Maintenance

Skilled trades workers and laborers involved in “green building” construction, building retrofits, and installation/repair/maintenance of RE/EE products, from efficient HVAC systems to solar panels. Sometimes called “green-collar jobs.” Examples:

- Electricians
- Solar Panel (Photovoltaics) Installers
- Insulation Workers
- Construction Laborers
- Wind Turbine Technicians
- Sheet Metal Workers
- Plumbers and Pipefitters
- HVAC Workers

Architecture, Engineering, and Project Management

High-skill jobs involved in the design, engineering, and overall project management of “green building” or energy efficiency retrofits as well as the operation of buildings. Examples:

- “Green Building” Architects
- Energy Engineers, also Electrical, Mechanical, and Construction Engineers
- Construction Project Managers
- Facilities Managers

Manufacturing/Production

Low- to moderate-skill jobs involved in the design and production of RE/EE products, from biofuels to energy efficient washing machines and solar panel components. Examples:

- Production Workers and Laborers
- Chemical Equipment Operators and Tenders

Research and Development

High-skill jobs involved in basic research and development of emerging RE/EE products and technologies. Examples:

- Chemical, Electrical, and Mechanical Engineers
- Chemists, Other Scientists

Corporate Administration, Business, Financial, Sales, Marketing, and Information Technology

Moderate- to high-skill jobs that keep RE/EE businesses functioning from a business perspective. Also includes emerging occupations involved in carbon trading and corporate resource management. Examples:

- Accountants, Financial Analysts
- Carbon Certificate/Solar Renewable Energy Certificate Brokers/Traders
- Energy Managers/Resource Managers
- Solar Panel Salespersons

Manufacturing/Production

Various manufacturing facilities fabricate RE/EE products, including wind turbines, solar panel components, energy efficient vehicles, hydrogen batteries, and energy efficient lighting systems. Manufacturing positions in these facilities are considered part of the RE/EE industries, and include occupations such as production workers, engineers, quality assurance technicians, machine operators, and laborer positions.

Research and Development

RE/EE companies involved in product development and manufacturing need a variety of scientists and researchers to perform the basic research and testing that is required to achieve technological breakthroughs for new and existing products. Engineers design new products or make improvements to RE/EE products. Computer scientists are also sometimes involved in creating modeling programs that assist in the research and development and testing processes.

Given the wide range of technologies used, scientists and researchers with a variety of backgrounds, from chemistry to fluid dynamics to computer science and physics, are needed. Engineers of various types are also required, including electrical and mechanical engineers, chemical engineers, and others.

Corporate Administration/Business/Financial/Sales and Marketing/Information Technology

Like other businesses, companies that specialize in RE/EE products or services need corporate managers, administrative assistants, accountants, sales and marketing workers, and information technology personnel to keep the business running.

Many of these workers need some specialized knowledge of RE/EE concepts. For example, accountants must be aware of unique financing options and tax incentives used in the RE/EE field, such as carbon trading and renewable energy credits.

This category also includes new and emerging occupations in RE/EE, including resource, energy and sustainability managers, carbon traders, and renewable energy credit brokers.

Factors Affecting Job Growth and Employer Skill Needs in New Jersey's Renewable Energy/ Energy Efficiency Industries

- Public Policy
- Economic Factors
- Technological Advancements in Renewable and Clean Energy Technologies
- Geography, Infrastructure, and Natural Resources
- Standards Adopted for RE/EE Projects
- Implications for Worker Skill Requirements



Shifting economic and policy environments, along with new technological breakthroughs and developments, make the exact mix of jobs and technical skill requirements of workers difficult to quantify and predict, especially in renewable energy markets.

Factors Affecting Job Growth and Skill and Education Requirements

- Public Policy
- Economic Factors
- Technological Advances
- Geography, Infrastructure, and Natural Resources (for RE jobs)
- RE/EE Project Standards

The green energy economy is poised for substantial growth. Public policies and private investments driven by volatile oil prices, technological advancements, and public concern about global warming and achieving energy independence are expected to drive growth in RE/EE jobs nationwide. This section describes five key factors that have driven, and will continue to drive, the pace and direction of job growth in the RE/EE industries, as well as the skills and educational requirements employers will place on future workers.

Factor #1: Public Policy

State and federal policies have a major effect on the pace and direction of job growth in the RE/EE sectors. Government incentives have long played a role in stimulating the adoption of various RE/EE technologies by subsidizing the significant upfront capital investment they require. Requirements for reductions in energy use and the adoption of renewable energy portfolios, which specify the percentage of total state or national energy use that must come from renewable sources, also affect the types of new jobs likely to be created. Finally, a host of other regulations, from zoning to building codes to environmental laws, can affect the ability of particular RE/EE sectors to thrive. For example, current federal and state environmental regulations may conflict with the drive to install large offshore wind farms in ocean waters off the New Jersey coastline.

The American Reinvestment and Recovery Act, passed in February 2009, features large investments in the energy sector, including energy efficiency and renewable energy. The stimulus includes such policies as raising fuel-economy standards, the weatherization of one million homes annually, and others, all of which experts estimate will create millions of jobs over the next decade. In addition to green jobs, the stimulus plan will spur growth in infrastructure projects and energy generation.

Locally, New Jersey's Energy Master Plan, and the Governor's Economic Assistance and Recovery Plan include a number of strategies promoting energy efficiency and a cleaner energy supply that will directly influence job growth and worker skill requirements in these areas. The following new energy policies, which include action items from the Energy Master Plan, proposals from the governor's economic stimulus plan, and recently passed legislation, have the potential for the greatest effects on green jobs and skills.

Energy Efficiency Policy Developments

- Energy Master Plan goal for reduction in energy consumption of at least 20% by 2020.
- Partnership with utilities to create a large statewide program in energy efficiency.

- Energy savings legislation allowing public entities to engage in long-term energy savings contracts.
- Proposal to develop new statewide building codes to be 30% more energy efficient.

Retrofitting commercial, industrial, and residential buildings throughout New Jersey will likely support the largest amount of green jobs in the state. An attempt to come up with an exact figure for the number of EE jobs that will be created by these policies would be futile. The current federal weatherization program, however, creates about 8,000 jobs per 140,000 homes weatherized, or a ratio of one job per 14 to 16 residences.¹¹ The American Council for an Energy Efficient Economy estimates that efficiency-related investments generate 5.4 jobs per million dollars of sales compared to 1.9 jobs per million dollars of sales in the energy supply sector, and that employment impacts are slightly higher in residential efficiency-related investments (8.1 jobs per million dollars of output) compared to efficiency investments in commercial (5.9), industrial (4.6), and transportation (4.7).¹²

The energy efficiency stimulus partnership with the state's seven utilities will largely concentrate on the weatherization of residential homes, at least initially. While the utilities will oversee the rollout of the several hundred million dollar investment, jobs associated with making the energy efficiency improvements may be outsourced to companies with energy savings experience and will be in the areas of insulation, door and window replacement, new appliance and heater installation, lighting and air conditioning upgrades, and other types of skilled labor. The extent to which these jobs will be unionized, and carry separate union entry and training requirements, is not yet known. Creating further demand in these areas is New Jersey's Energy Savings Improvement Program legislation (A-1185), which allows public entities to enter into long-term contracts to audit and retrofit facilities and buildings. The money saved by reducing the public entity's energy expenses would defray the cost of energy-saving infrastructure improvements. Energy service companies interviewed reported that the demand created by this bill will expand the energy efficiency market significantly and grow the need for skilled workers who are union members.

Energy Generation Policy Developments

- Energy Master Plan goal for 30% of New Jersey's electricity needs to come from renewable sources by 2020.
- Energy Master Plan goals of 2,120 GWh of solar energy and 3,200 MW of wind energy by 2020.
- Energy Master Plan goal of 900 MW of biofuels and biomass by 2020.
- Energy Master Plan goal of 1,500 MW of new cogeneration capacity by 2020.

The American Recovery and Reinvestment Act: A Boost for Green Energy

The American Recovery and Reinvestment Act will deliver an influx of at least \$50 billion to the energy efficiency and renewable energy sectors nationwide. This federal aid, the biggest financial impetus to the clean energy industry in U.S. history, comes in the form of tax incentives, loan guarantees, and grants to reduce energy consumption in the public and private sectors; encourages development of alternative energy technologies like wind and solar; and makes the electric grid more efficient. Additionally, about \$1 billion will be directed toward green jobs training efforts, including \$500 million in funding for training in the RE and EE sectors as defined in the Green Jobs Act of 2007, which was passed by Congress within the Energy Security and Independence Act of 2007, but never funded.

Provisions of the Green Jobs Act direct funding to be used for training and support services, with priority going to veterans, displaced workers, and at-risk youth. Funding under the Act will include competitive grants that will be awarded to energy sector collaborative partnerships that connect industry employers with labor organizations, community organizations, educators, and representatives of the workforce system. Beyond the \$500 million associated with the Green Jobs Act of 2007, an additional \$500 million in training will be made available through a number of programs focused on developing various aspects of the nation's new energy workforce.

The stimulus bill dedicates about \$36.5 billion in energy efficiency and almost \$8 billion in renewable energy to promote job creation. Some important provisions include:

- \$5 billion to weatherize homes of one million low-income families,
- \$6.3 billion for energy-related grants to states,
- \$4.5 billion to retrofit federal buildings, and
- \$11 billion for modernization of the nation's electric grid.

Further, the bill provides an extension of the production tax credit for renewable energy and direct grants worth up to 30% of the cost of building a renewable energy facility. Wind and solar energy developers have recently seen much of their financing disappear, as the mortgage market collapse dried up banks' capacity to purchase tax credits that developers sold to banks. The alternative fuel vehicle industry gets a \$1.3 billion infusion in various grants and tax credits, and \$4.5 billion will be directed to research and development in basic energy science and EE and RE areas.

No one can be sure if the stimulus package will create the promised 500,000 green jobs by the end of 2010, but it is certain that there will be enormous opportunities for workers with a wide range of education and skills. The ways in which the U.S. Department of Energy and states spend the stimulus money will affect the number of jobs that are created by the stimulus plan, as will the pace of the private sector's uptake of key energy efficiency and renewable energy incentives. Workforce stakeholders should be preparing to work with industry to provide knowledge and skills training, both traditional and green, that will be necessary to meet the new demand.

Source: The American Recovery and Reinvestment Act, as summarized in J. Cleary and A. Kopicki, *Preparing the Workforce for a "Green Jobs" Economy* (New Brunswick, NJ: John J. Heldrich Center for Workforce Development, 2009).

A renewable portfolio standard of 30% is one of the most aggressive goals for alternative energy use in the nation. At the beginning of 2009, New Jersey had in place just 8 MW of onshore wind; the Energy Master Plan calls for 1,000 MW of offshore wind by 2012, and 3,000 MW of offshore wind and up to 200 MW of onshore wind by 2020. New construction on wind turbines offshore will not begin until the New Jersey Department of Environmental Protection finishes an ecological baseline, which is expected to be completed by summer 2009. Just about 1.3% of New Jersey's energy is currently derived from wind, solar, and biomass. Reaching these large-scale energy infrastructure goals would support the creation of a significant number of jobs associated with renewable energy in New Jersey, including workers in heavy construction and skilled trades workers who have had additional training and/or certification in working with RE technologies.

The funding stream for new cogeneration (combined heat and power plants) will come from the sale of carbon emission credits through the Regional Greenhouse Gas Initiative auction (deposited with the Economic Development Authority). Construction of these new plants, or retrofits of old or retired plants, will create a demand for skilled construction workers and engineers, as well as for operators and maintenance staff.

Factor #2: Economic Factors

Economic cycles and the price of traditional energy can affect the pace of private investment in RE/EE industries. For example, residential consumers and many businesses in today's recession-based economy may lack the capital to invest in RE/EE upgrades on their own. On the other hand, some larger companies may invest in energy efficiency to cut costs in the long term and venture capitalists appear to be investing in new RE/EE technologies to take advantage of the potential for growth based on a technological breakthrough or anticipated public investment.

Current employment trends, while not specifically related to new job growth, will affect the availability of replacement jobs. Given that the EE sector comprises 95% of current RE/EE employment, replacement job opportunities are likely to be abundant in that sector.

Factor #3: Technological Advancements in Renewable and Clean Energy Technologies

Technological advancements are an important influence on the pace and direction of job growth, as well as on the types of skills employers will need in the future. Many new RE/EE technologies are being developed and refined, but few have reached market viability with traditional fossil-fuel technology. Technological breakthroughs in a particular area could stimulate one or more products to dominate the RE/EE market.

As with any emerging market, it can be difficult to predict who the winner may be, especially in an age of rapidly advancing technology fueled by aggressive venture capital and government investments. The results of future technological breakthroughs will be an important determinant of the mix of jobs available and, hence, of the mix of skills and degrees employers will demand.

Factor #4: Geography, Infrastructure, and Natural Resources (Renewable Energy Jobs)

Renewable energy products depend on access to sources of energy and other resources that are not uniformly present in all states. Arizona and Florida, for example are ideal sites for solar energy installations given the length of sun exposure these states receive. Many midwestern states grow large amounts of corn, an essential ingredient in ethanol. Large wind turbine factories need to be sited near a large river to transport large components.

In addition, built infrastructure can enable or hinder the development of a particular renewable energy industry. New Jersey, while rich in neither sun exposure or flat, open land, has many square miles of flat roof warehouses that make ideal sites for solar collectors. Backed by strong state incentives, the industry grew rapidly. In biofuels, interviews revealed expected growth of fuels derived from the urban environment, including industrial and restaurant waste (e.g., cooking oil) and landfills. New Jersey also has rail, road, port, and air transportation hubs, as well as its existing manufacturing infrastructure that make it an ideal site for many renewable energy manufacturing facilities.

Factor #5: Standards Adopted for RE/EE Projects

Several organizations have developed nationally recognized standards for RE/EE projects ranging from green building to weatherization. These standards often affect the training and certification that workers require. For example, the **Leadership in Energy and Environmental Design (LEED)** Green Building Rating System is a commonly used standard for new, energy efficient construction. Building professionals working on LEED-accredited projects must obtain LEED training and certification. Similarly, weatherization projects completed to the standards set by the Residential Energy Network (RESNET) must use RESNET-certified "green raters." RE and EE jobs performed by labor unions also require workers to obtain specialized training and education, generally provided by the unions themselves.

Standards for EE and RE work can be set by state agencies, employers, organized labor, or customers. New Jersey utilities and state agencies are currently considering the adoption of standards for key RE/EE initiatives to ensure consistency in the quality of work performed. Education and train-

ing institutions should continue to monitor the progress of these statewide standard-setting efforts in order to determine the training needs for different types of workers. In addition, workforce education professionals should check with local and regional employers to determine the types of training and certification they prefer workers to have as a condition of employment.

Implications for Worker Skill Requirements

Implication #1: The level of technical, scientific, mathematic, and financial knowledge many workers need is likely to grow as technologies in RE/EE become more complex.

As technological advances lead to an ever-growing array of complex products that use advanced materials and techniques, many jobs, especially in research and development and perhaps in manufacturing and installation, are likely to become more complex. In a globally competitive environment, engineers and scientists must master cutting-edge concepts to produce the most high-tech products on the market. To do this, they will most likely need an array of in-depth technical knowledge, as well as an increasing breadth of knowledge in interdisciplinary fields, from biology and chemistry to electronics and nanotechnology.

Implication #2: The demand for skilled labor in emerging green jobs in New Jersey is concentrated in skilled labor areas such as construction and manufacturing, which have seen significant job losses in recent years.

While the nature of job growth in areas of the RE/EE market is unpredictable because of its reliance on new and emerging technologies and government policy and investment, the skills and education requirements that will be in demand for New Jersey's future are centered around the building and construction trades. The projected increase in green jobs could act as a reemployment vehicle for a number of dislocated workers in this field, as well as provide opportunities for new workers to enter the field.

For example, retrofitting a home involves an energy use auditor, a cost estimator (rater), air sealers, electricians, and possibly HVAC workers. Commercial retrofitting and green building efforts also require architects, engineers, and construction managers.

In renewable energy, installation of wind turbines will involve traditional construction and transportation jobs, including heavy industrial equipment operators, truck drivers, crane operators, iron and steel workers, sheet metal workers, and machinists, among others. Wind technicians who oversee operations maintenance of the wind turbines is a new green job, with both traditional skills (engineering or technological science background) and technical knowledge in wind energy systems needed. Wind mechanic training programs are growing around the nation, from multi-day courses to

two-year associate degree certifications. The majority of jobs in wind energy come from component manufacturing, not the construction or operation of wind farms.¹³ The wind industry is already in need of suppliers and components and an effective production pipeline, including a ready supply of skilled workers. If New Jersey wants to grow wind energy manufacturing jobs, economic development efforts must attract and support a wind turbine components product sector and assess and build demand before workforce development efforts can begin.

Priority *Cross-Occupational* Skill Needs of Renewable Energy and Energy Efficiency Employers in New Jersey

■ Priority Skill Needs



The RE/EE industries produce innovation-oriented jobs that require workers to adapt to the complexities of a highly technical and global industry.

As workplaces in the RE/EE industries evolve in response to a technologically rich, global economy that is increasingly focused on energy conservation and climate change, job seekers and incumbent workers must acquire broad-based knowledge and skill sets that allow them to respond flexibly to emerging job opportunities. Beyond basic academic skills and job- or degree-specific knowledge, RE/EE employers agree on a set of core skills and competencies that nearly all industry workers need and will continue to need well into the future.

Priority Skill Needs

Not all green jobs currently require specialized training or skills beyond what is required for the base occupation. Employers, however, identified four sets of core knowledge and skills that cross occupational boundaries and that are becoming increasingly important for a wide range of workers to have as the state — and the nation — transition to a clean energy economy. These priority cross-occupational skill-related needs are as follows:

Energy Conservation and Sustainability Knowledge

Employers agree that workers of all types in the RE/EE industries need a basic understanding of energy conservation and sustainability concepts. Workers must understand the importance of the RE/EE industries to the world economy, through increased awareness of the factors affecting global climate change, and through greater knowledge of global warming, energy conservation, and efforts to reduce the use of fossil fuels. Workers also need broad knowledge of how RE/EE technologies and products interact with other types of environmental products and policies. Finally, knowledge of the policies and practices emerging to respond to global warming and the emerging energy crisis are highly valued.

Alternative Energy Technologies Knowledge and Skills

Knowledge of alternative energy technologies and products is also important for workers at all levels of the RE/EE industries. This includes understanding the array of existing and emerging renewable energy technologies, from photovoltaics to geothermal, as well as energy efficiency and clean power technologies. As products evolve and new technologies are adopted, workers in a range of occupations, from installation specialists to salespeople, must learn to integrate them into their work practices and inform customers of their benefits and costs.

Knowledge of mechanisms for financing alternative energy technology is essential. Workers will be expected to understand and explain new products such as carbon credits, renewable energy credits, and government incentives. Carbon credits and renewable energy certificates, for example, are designed to allow businesses and individuals that install renewable energy

systems to sell or trade credits to others looking to offset their carbon emissions, thus providing a revenue stream to reduce the cost of installation. A utility company producing carbon-based energy can reduce its carbon footprint by purchasing solar renewable energy certificates from producers of solar renewable energy, thereby ensuring increased production of energy on the wider energy grid from a renewable source.

Solar panel installation and energy efficiency companies have developed financing tools for their products, designed to reduce the capital outlay for consumers. In most cases, the RE/EE company offers a long-term financing option for the upfront cost of the installation or retrofit, paid over time through the energy savings from the project. Some solar installers offer a leasing option, selling the energy produced back to the grid and at a reduced cost to the solar panel host. These financing plans are increasingly popular in an environment of high energy prices, but are vulnerable to energy price declines. Workers in a variety of occupations, from architects to accountants, need to be aware of these financing options and how they work in order to market them effectively to customers or to utilize them for their own companies.

Life Cycle Analysis Skills

Life cycle analysis involves understanding the impact of technologies on the environment and energy use based on the entire industrial process involved in creating a product. From extraction of materials to manufacture and continued use, life cycle analysis allows workers to analyze the true costs and benefits of various RE/EE products and communicate the return on investment to financial decision makers. Life cycle analysis is an increasingly essential skill for a variety of workers, from facilities managers to architects to salespersons.

Interdisciplinary Skills, Certificates, and Degrees

The majority of green jobs in the energy sector are not newly created jobs, but traditional jobs with new skill and knowledge requirements. Employers in both the RE/EE industry and other sectors will seek workers who have developed depth of skill in their primary area of work, and show breadth of skill in a related RE/EE area. For example, electricians who have additional training in direct current energy and photovoltaics can install solar panels. Diesel mechanics will need advanced training in order to work on fleets of trucks converted to run on biodiesel or natural gas. Facilities managers will need to understand which technology can save the most energy and financial resources over time in a warehouse or large retail store. In general, workers with traditional electrical, mechanical, or other engineering backgrounds will be highly valued if they contribute additional skills, certifications, or degrees in an alternative energy or energy efficiency related field.

Employers in the Industry Workforce Advisory Councils convened for this study reported that there are a number of nationally recognized certificate programs that are useful for building worker skills in a variety of areas. While some are job-specific (primarily in the installation and building trades occupations), others provide key skills that cross a range of occupations and build interdisciplinary skill sets. See Appendix B for a list of common certifications in the RE/EE sectors.

Priority *Occupational Skill* Needs of Renewable Energy and Energy Efficiency Employers in New Jersey

- Construction, Installation, Repair, and Maintenance
- Architecture, Engineering, and Project Management
- Manufacturing/Production
- Research and Development
- Corporate Administration/Business/Financial/Sales and Marketing/Information Technology



RE/EE employers in New Jersey need access to skilled workers for many types of jobs.

This section of the report describes common green job categories found in the RE/EE sectors, including the key skills, education, and certifications that employers often seek within these positions.

Employers identified priority skill needs in all five functional areas of RE/EE operations. While future job demand in these areas is difficult to predict, educational institutions can begin to build a broad understanding of the priority skills that employers generally look for in these areas. The exact training needs will not only be determined by the number and types of jobs that grow in coming years, but also by the standards that are set by employers, state agencies and others for the work that is to be performed. These standards often determine the types of training and certification workers need. Key skill and educational requirements for each job category are as follows:

Construction, Installation, Repair, and Maintenance

Most building and construction occupations require traditional training, and often apprenticeship, in particular occupational areas. For example, an electrician or HVAC technician needs specialized training often provided by unions to perform the basic functions of the job. These positions do not usually require a college degree, but may result in one after years of specialized apprenticeship training.

Among skilled trades workers and related occupations, many workers need various levels of **electrical and mechanical skills** and the knowledge of how to **install and/or repair a range of RE/EE technologies**, from solar panels to energy efficient HVAC systems. For example, electricians who install or repair solar panels need more advanced knowledge of direct current technology than is currently taught in most traditional electrical training programs (solar panels convert to direct current electricity; the U.S. grid relies mostly on alternating current, or AC, electricity). Workers also need more **hands-on experience** working with new RE/EE technologies.

In addition, many employers prefer workers to obtain RE/EE certifications that are relevant to their jobs. Many of the existing nationally recognized certifications are for green-collar workers, especially in green construction, building retrofits, and RE product installation, such as PV installer certifications.

Architecture, Engineering, and Project Management

Jobs in this functional area generally require at least a Bachelor's degree, often in a science field with an RE/EE focus for engineers or a business background with a focus on sustainability and RE/EE technology for project managers.

For companies to successfully implement green projects, such as the construction of a green building or building retrofits designed to increase energy efficiency, employers need workers in this job category who understand **whole systems design**. Employers require architects, construction engineers, and project managers to take a holistic approach to implementing conservation and sustainability goals and to understand how various energy conservation and RE/EE technologies work together to achieve energy savings and other environmental benefits. Often, these workers, who tend to be engineers, have **interdisciplinary training in engineering and environmental disciplines**.

Manufacturing/Production

Production jobs that involve manufacturing RE/EE products often require few specialized green skills to work the equipment. Supervisors and managers may need more knowledge of the product technology. Individuals responsible for managing energy or waste usage at manufacturing plants, however, require a college degree in sustainability and knowledge of green manufacturing techniques.

Key Nationally Recognized Organizations that Provide RE/EE Industry Certifications

The **Association of Energy Engineers (AEE)** provides energy efficiency-related certifications for facilities managers, HVAC installers, and other positions, including geothermal.

The **North American Board of Energy Practitioners (NABCEP)** attributes certifications for photovoltaic (PV) and solar thermal installers, as well as a more general, entry-level certificate in PV technology that can enhance a wide range of existing curricula from construction and trades to engineering.

The **Building Performance Institute (BPI)** offers certifications for building analysts, heating and air conditioning professionals, and others that incorporate significant knowledge about whole systems design, energy efficiency, and renewable energy. BPI certification is required for Energy Star contractors and is a preferred certification among employers in the building trades.

Energy Star provides online training to contractors on energy efficient building design.

Solar Energy International (SEI) is a private training provider in Colorado that offers online and in-person courses in renewable energy sectors that are highly regarded by some employers.

The **Leadership in Environmental and Energy Design Accredited Professionals (LEED AP)** program, whose online and in-person courses across the nation teach green building techniques, is overseen by the **U.S. Green Building Council (USGBC)**.

The **Residential Energy Services Network (RESNET)** sets standards for weatherization and certifies “green raters”.

Research and Development

Occupations in Research and Development can require a range of educational backgrounds, from a Bachelor's degree in science with knowledge of RE/EE technologies, to more advanced degrees. Some laboratory positions, such as laboratory technicians, may require just an Associate's degree. RE/EE employers are concerned about **potential shortages of students in the science, engineering, technology, and mathematics (STEM) educational pipeline** based on difficulties they are experiencing finding engineers, scientists, and other workers who have the science skills and degrees they require. RE/EE employers report particular difficulties finding qualified engineers with **electrical, mechanical, chemical, and energy backgrounds**. As the demand for scientists and others with strong science and other technical backgrounds increases, employers believe that too few students are pursuing science-based education. Given the number of years it takes to acquire advanced STEM knowledge and/or degrees, employers worry that fewer students entering the pipeline will mean severe shortages of skilled workers in the state and the nation well into the future. It should be noted, however, that while employers are concerned about shortages in the STEM pipeline, based on current hiring difficulties, more research is needed to determine the extent that such a shortage exists.

Corporate Administration/Business/Financial/Sales and Marketing/Information Technology

RE/EE employers need a host of business-oriented workers in their corporate structure that understand the RE/EE field, including sustainability and energy conservation products and concepts. These workers often require a college degree, from an Associate's degree to a Bachelor's degree, in a business-related field.

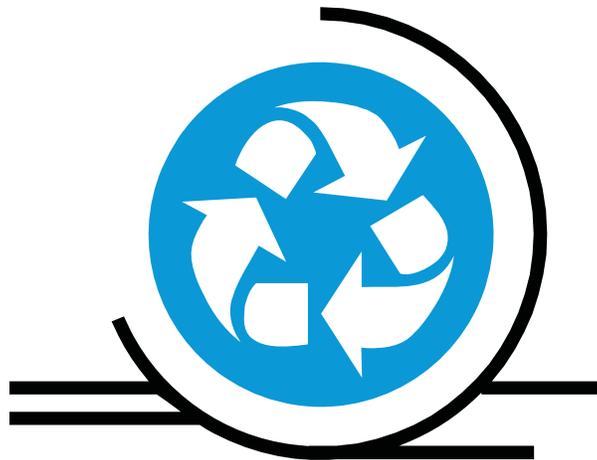
To be effective in an RE/EE organization, however, these workers may need to develop specialized knowledge relevant to their jobs within an RE/EE setting. In particular, accountants working in RE/EE-specific firms need a thorough understanding of **emerging trends in financing alternative energy projects, tax incentives at the national and state levels, and emerging carbon and renewable energy certificate trading markets**.

There are several emerging occupations in this category, including **carbon credit and renewable energy certificate traders and brokers, corporate energy or resource managers, and company sustainability officers**. Brokers and traders need to understand the financing concepts inherent in buying and selling credits or certificates that offset the carbon-based energy use of corporations and other businesses. Energy and resource managers are responsible for managing company-wide energy conservation plans and need an understanding of the many ways that the corporations consume energy. They also require a working knowledge of carbon credit trading markets, alternative energy products and financing schemes, as well as life cycle and

cost/benefit analysis for large-scale RE/EE projects. Corporate sustainability officers provide companies with advice and support in reducing greenhouse gas emissions, producing and buying “green” products, and complying with environmental regulations. Sustainability officers or executives require a wide range of skill sets, including knowledge of environmental and financial regulations, understanding of life cycle analysis, manufacturing experience, and purchasing and procurement expertise.

Strategies to Address the Skill Needs of New Jersey's Renewable Energy and Energy Efficiency Industry Employers

- Current State and Regional Initiatives to Address Industry Skill Needs
- Suggested Next Steps



Given the emerging nature of many segments of the RE/EE market, educational institutions and state agencies should work to ensure that New Jersey's students, job seekers, workers, and residents have access to the flexible, industry-informed education and training options needed to obtain and succeed in jobs as they become available.

New Jersey's employers consistently cite the state's highly skilled workforce as a primary reason for doing business here. To keep the state a competitive location for RE/EE employers, New Jersey's policymakers, educational institutions, and workforce stakeholders must ensure that employers have continued access to a world-class workforce. Significant statewide curriculum development efforts are underway as part of Governor Corzine's Economic Growth Strategy for the State of New Jersey. In addition, several educational institutions and local governments have implemented programs to improve the preparedness of students and industry workers for jobs in the RE/EE industries.

This section provides an overview of current state and regional efforts to address employer skill needs, as well as suggested strategies for state agencies and educational institutions to build on these important efforts.

Current State and Regional Initiatives to Address Industry Skill Needs

Several initiatives are underway in New Jersey to support the development of a qualified workforce for the RE/EE industries, which are targeted in Governor Corzine's Economic Growth Strategy for the State of New Jersey. Key state-led initiatives include the **Innovation Partnership Institutes (IPIs)**, which are led by consortia of educational institutions, employers, and other stakeholders and which seek to develop curriculum modules in priority skill areas for New Jersey's key industries. Currently, two IPIs are addressing priority skill needs in the RE/EE industries. Essex County College is leading an effort focused on addressing green skill and certification needs in the area of facilities and construction management, while the New Jersey Institute of Technology is developing curricula in the area of nuclear energy. The curricula developed within these IPIs will focus on providing employer-recognized credentials, linking training at multiple levels of education, and ensuring broad distribution of new curricula to other educational institutions across the state.

The New Jersey Department of Labor and Workforce Development (NJLWD) has also funded several efforts to promote a prepared workforce for the state's emerging energy economy. NJLWD convened several **Industry Workforce Advisory Councils** to advise state policymakers and educational institutions on the emerging skill and certification needs of RE/EE employers. These groups included senior human resource managers from some of the state's key RE/EE companies and were instrumental in developing this report. NJLWD has also funded several green training initiatives through its customized training program and has provided grant funds to the community-based organization, Isles, to develop energy efficiency-related job training for residents of the city of Trenton. NJLWD has made \$500,000 available through its **Regional Economic Development Initiative** program to assist workforce investment areas and community colleges to coordinate green job development efforts and to provide professional development to work-

force and education staff on understanding the green jobs labor market.

Youth Transition to Work programs also train young workers to enter energy efficiency and environmental remediation occupations.

The New Jersey Department of Education has issued a grant to The College of New Jersey to develop a sustainability and green jobs awareness curriculum for high schools to use. That curriculum will help New Jersey high school students to learn the basics of environmental sustainability and energy conservation principles.

The cities of Trenton and Newark have begun to plan city-wide green jobs efforts that will include job creation and job training efforts.

The New Jersey Energy Master Plan contains a number of action items to support green jobs workforce development, including recommending that curricula align with workforce training, particularly in urban centers, and designating the energy sector IWAC as the forum for identifying workforce skill needs. The Energy Master Plan also directs the establishment of the Energy Institute of New Jersey to support basic and applied energy research efforts at the colleges and universities in the state, with a board of representatives from a number of state agencies.

Finally, several colleges, universities, high schools, vocational schools, and Workforce Investment Boards have implemented new or revised curricula that address some of the skill and occupational needs covered in this report, though these individual programs are too numerous to cover for this report.

Suggested Next Steps

If New Jersey is to continue to attract and retain quality RE/EE jobs, state agencies must work with educational institutions, building and construction trades, organized labor, and community organizations to expand educational and training efforts to ensure that employers have access to workers with the right types of training and education to meet the changing demands of this dynamic industry.

Given the impending increase in green jobs in New Jersey's energy sector, New Jersey policymakers and educational institutions should consider taking the following steps:

Step 1: Support and expand current efforts to build capacity in priority cross-occupational skill areas throughout the K-16+ curricula.

State agencies can ensure that core priority employer skill needs in the RE/EE sectors are addressed through current and future efforts to address green skills in the K-12 system. Potential strategies include:

Strategy 1: Ensure that the Innovation Partnership Institutes established for the RE/EE industry incorporate priority cross-occupational skills and align efforts to transform higher education curricula with similar efforts at the K-12 level.

Strategy 2: Expand current Department of Education efforts to integrate knowledge of green jobs and sustainability into high school curricula to include basic knowledge of priority cross-occupational skills and transfer knowledge to the K-8 level.

Strategy 3: Improve the delivery of current career information on the RE/EE industries in K-12 schools, colleges, and One-Stop Centers. In particular, use technology to provide current career-related content to students across the state.

Step 2: Track and disseminate real-time information about employer demand for workers and training.

New Jersey requires a mechanism to obtain real-time information on how policy is affecting “boots on the ground” — the development of actual jobs. In addition, education and training institutions need to know which areas of training and which types of credentials employers demand. Two strategies will assist New Jersey to do this:

Strategy 1: Institutionalize the Green Energy Industry Workforce Advisory Council: The NJLWD convened two meetings of employers to provide input on the industry's evolving hiring and skill needs in spring 2008. This Industry Workforce Advisory Council should be convened on a regular basis as a partner with the state in improving and creating training programs and helping to inform curriculum and workforce policy.

Strategy 2: Establish a mechanism to track the effects that federal and state policy are having on jobs. Using up-to-date information on policy developments and economic analysis, state agencies should coordinate efforts to understand and document the effect that policy is having on job creation. This information should be disseminated to a range of stakeholders, including education, training, and workforce providers.

Step 3: Create a Green Energy Talent Network to promote coordination of green jobs workforce and economic development programs in the state and maximize resources.

A Green Jobs Talent Network would provide the vehicle for coordinating statewide efforts in skills training and education, providing flexibility and momentum to support the state's emerging RE/EE industries and allow them to remain adaptable and competitive. More importantly, the Network can ensure broad statewide alignment of education efforts with industry hiring needs in a dynamic labor market.

To ensure the success of the Green Jobs Talent Network, state agencies should consider the following strategies:

Strategy 1: Assign a point person for the Green Jobs Talent Network to organize network activities, track green jobs policy changes, and act as a liaison for green jobs employers, the Industry Workforce Advisory Council, and Talent Network members.

Strategy 2: Establish a Green Energy State Leadership Council, potentially as a subcommittee of the State Employment and Training Commission Board. Consisting of state agency administrators, the council can guide the efforts of the larger Talent Network and strategize on ways to combine public funding streams, where feasible.

Strategy 3: Map existing green jobs education assets and develop a State-wide Green Jobs Action Plan to prioritize investments in green jobs workforce education efforts.

Possible initiatives of the Green Jobs Talent Network and/or its members could include:

- Develop a Green Energy Training Center to offer hands-on training with RE/EE technologies and expert career advising. Florida has created such a center in a partnership with the University of Central Florida and key employers. In New Jersey, the center could be coordinated with the Energy Institute of New Jersey, the entity proposed by the Energy Master Plan to oversee basic and applied energy research efforts at the colleges and universities in the state.
- Build green jobs career pathways by creating “stackable” credentials that allow workers to earn nationally recognized skill certificates and apply the training and/or on-the-job experience toward more advanced training or college credit. Effort should include consultation with major industry credentialing bodies, some of which may have developed curricula as well as certification standards. (See Appendix B for a list of major credentialing bodies in the RE/EE sectors.)
- Strengthen existing partnerships with labor unions to ensure that underemployed workers in New Jersey’s labor market have access to new and replacement jobs in the RE/EE sectors.

Endnotes

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3 New Jersey Energy Master Plan, <http://www.state.nj.us/emp/>.

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5 Ibid.

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10 Participant comment, Industry Workforce Advisory Council, May 6, 2008.

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12 Karen Ebrhardt-Martinez and John A. Laitner, *The Size of the U.S. Energy Efficiency Market: Generating a More Complete Picture* (Washington, D.C.: American Council for an Energy-Efficient Economy, May 2008).

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Appendix A: Employers and Individuals Consulted for this Study

The New Jersey Department of Labor and Workforce Development convened two Industry Workforce Advisory Councils that provided input on the priority workforce and skill needs of renewable energy and energy efficiency employers in the state. These councils included the Renewable Energy and Energy Efficiency Industry Workforce Advisory Council, which met twice in spring 2008, and the Green-Collar Jobs Industry Workforce Advisory Council. In addition, Heldrich Center researchers conducted select interviews with employers and other stakeholders. The employers and others consulted for this report are listed below.

Employers

1st Light Energy
Justin Krum, President

Advanced Power Associates
Vladimir Brunstein, CEO

Advanced Solar Products
Lyle Rawlings, President/CEO

Alternative Energy Associates
Frank Dewitt
Owen Hyland

American Wind Power and Hydrogen
James Sherman, Vice President

Bayshore Recycling Corporation
Valerie Montcalvo, President

Belfer Group
Evelyn Maldonado, Vice President of Human Resources

CODE Electrical Contractors, Inc.
Charles Kartsaklis

The Conti Group

Lou Langlais

Continuum Dynamics

Todd Quackenbush

Converted Organics, Inc.

John Weigold

Diamond Materials

Veronica Veress

Dr. Oleg Voronov, President and Co-Founder

Dome-Tech Group

Ed Liberty, Vice President

Eastern Energy Services

Fred Hauber, President

Ecological Systems

Sky Simms, Owner

Ecostream US, Inc.

Peter Burcat, Executive Vice President/Co-Founder

Electric Solar Power

Tom Ryan, President

Environ

Bettina Miguez, Associate

EPV Solar

Delores Phillips, Director

Exelus

Dr. James Nehlsen, Senior Process Design Engineer

First Solar Electric

Robert Rynar

Gabel Associates

Steven Gabel, President

GeoGenix, LLC

Thomas Matulewicz, President

Geothermal Services (Division of Craig Test Boring Co., Inc.)

Jim Moench

Global Environmental Outreach
Gregory O'Reilly

Island Wind, Inc.
Michael Mercurio, President

Jersey Solar LLC
Richard Brooke, President

Lenterra
Dr. Valery Sheverev, President

Millennium Cell
George Zalepa, Vice President, Administration

NEI Corporation
Dr. Ganesh Skandan, CEO

New Age Solar
Jerry Sorgento, President

New Jersey Solar Power
Bill Hoey, Manager

New Jersey Utilities Association
Karen Alexander, President/CEO

Petra Solar
Dr. Shihab Kuran, President and CEO

Pfister Energy
Wayne Pfister, President

PicoTurbine
Michael Burghoffer, President

Princeton Power Systems
Darren Hammell, President/CEO

PSEG Global
Michelle Hallerdin, Vice President

Rutgers, The State University of New Jersey
Dr. Jerry Kukor, Dean

Sea Bright Solar
Regina Kelly

Skylands Renewable Energy
Roger Dixon, Dealer

Sun Farm Ventures, Inc.
Pam Frank

Trinity Solar
William Condit, COO

Turtle Energy
John Geraghty

World Water and Solar Technologies
Anand Rangarajan, Executive Vice President and Chief Technology Officer

Government and Education Partners

The College of New Jersey, Municipal Land Use Center
Winnie Fatton, Project Manager

The Fund for New Jersey
Mark Murphy, President

The Governor's Office of Economic Growth
Angie McGuire, Deputy Chief
Karen McKeon, Business Analyst
Christine Lenart, Business Analyst
Laurie Williams, Business and Energy Policy Analyst

New Jersey Commission on Higher Education
Jane Oates, Executive Director

New Jersey Commission on Science Technology
Joshua Trojak

New Jersey Department of Education, Career and Technical Education
Marie Barry, Director

New Jersey Department of Labor and Workforce Development
Marilyn Davis, Deputy Commissioner
James Moore, Assistant Commissioner
Michelle Richardson, Assistant Commissioner
David Socolow, Commissioner

New Jersey Department of Labor and Workforce Development, Center for Occupational Employment Information
Eugene Blicharz, CIDS Manager
Robert Massanova, Staff Director

New Jersey Institute of Technology
Dr. Somenath Mitra, Professor
Judith Sheft, Associate Vice President

New Jersey State Employment and Training Commission
Henry Plotkin, Executive Director
David Novak, Supervising Admin. Analyst

New Jersey Technology Council
Paul Frank, Vice President
Ethan Hasbrouck, Director, Government Affairs

Rutgers University
Vijay Shukla, Professor

Rutgers University, Center for Advanced Energy Systems
Dr. Michael Muller, Director

Rutgers University, Center for Energy, Economic, and Environmental Policy
Nora Lovrien, Research Project Coordinator

Rutgers University, Solid Waste Resource Renewal Group
Priscilla Hayes, Executive Director

Stevens Institute of Technology
Richard Cole, Professor, Mechanical Engineering

Future efforts will include:

New Jersey State Building Trades Council
William Mullen, President

In addition to other affiliates/associates of the building and construction industry.

Appendix B: Widely Recognized Industry Certifications

Several certifications and certification providers are widely recognized in the industry and should be consulted by the Green Jobs Talent Network. Employers cited several organizations that provide widely recognized certifications for jobs in the industry. Some of the most often mentioned organizations and certificates included:

The **Association of Energy Engineers (AEE)**, which issues certificates providing key competencies in energy efficiency for facilities managers, HVAC installers, and other positions including those in the geothermal field. Certifications are not tied to particular curricula. Each certification, however, has prerequisites that include job experience, specific types of degrees, and relevant coursework covering core concepts in energy efficiency and clean/renewable technologies. Self-study guides are also available to assist workers with an online testing and certification application process.

The **North American Board of Certified Energy Practitioners (NABCEP)** provides certifications for Photovoltaic (PV) and Solar Thermal installers, as well as a more general, entry-level certificate in PV technology that can enhance a wide range of existing curricula from construction and trades to engineering. The first two certifications can be obtained through a combination of job experience, education covering competency requirements, and/or self-study. The entry-level certificate can only be issued by an approved provider with a NABCEP-approved curriculum. No approved providers are currently in New Jersey. NABCEP also has a small wind installer certification under development.

The **Building Performance Institute (BPI)** offers certifications for building analysts, heating and air conditioning professionals, and others that incorporate significant knowledge about whole systems design, energy efficiency, and renewable energy. BPI certification is required for Energy Star contractors and is a preferred certification among employers in the building trades. Currently, two private training sites in New Jersey offer training for BPI certifications, including Proceed Inc. and Conservation Services Group in New Jersey.

Energy Star, the joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy, provides online training to contractors on energy efficient building design.

Solar Energy International (SEI) is a private training provider in Colorado that offers online and in-person courses in renewable energy sectors that are highly regarded by some employers. The courses do not result in certification, but may help prepare workers for key certifications mentioned above. SEI has affiliate sites in other states, but none in New Jersey.

The **Leadership in Energy and Environmental Design (LEED)** Green Building Rating System is a third-party certification program and the nationally accepted benchmark for the design, construction, and operation of high-performance green buildings. The U.S. Green Building Council provides online education and workshops across the nation, as well as an accreditation program.

The **Residential Energy Services Network (RESNET)** provides nationally recognized certification for green raters.

The **North American Insulation Manufacturers Association (NAIMA)** developed a program, 3 E Plus, that offers Energy Insulation Audits to determine energy loss, costs and amount of greenhouse gas units released into the environment. 3 E Plus also trains and certifies Energy Insulation Auditors.

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