

Energy, the Environment, and Delaware Jobs:

Summary of Findings

Daniel T. Brown
Edward C. Ratledge



Energy, the Environment, and Delaware Jobs:

Executive Summary

by

Daniel T. Brown
Edward C. Ratledge

July 31, 2011

The University of Delaware is committed to assuring equal opportunity to all persons and does not discriminate on the basis of race, color, gender, religion, ancestry, national origin, sexual preference, veteran status, age, or disability in its educational programs, activities, admissions, or employment practices as required by Title IX of the Educational Amendments of 1972, Title VI of the Civil Rights Act of 1964, the Rehabilitation Act of 1973, the Americans with Disabilities Act, other applicable statutes, and University policy. Inquiries concerning these statutes and information regarding campus accessibility and Title VI should be referred to the Affirmative Action Officer, 305 Hullihen Hall, 302/831-2835 (voice), 302/831-4552(TDD).

This workforce solution was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership. This solution is copyrighted by the institution that created it. Internal use, by an organization and/or personal use by an individual for non-commercial purposes, is permissible. All other uses require the prior authorization of the copyright owner.

Acknowledgements

We would like to thank the many people who helped make this series of reports possible. First, we would like to thank the leadership of Secretary John McMahon from the Delaware Department of Labor. We are also grateful to Dr. George Sharpley from Delaware's Department of Labor for providing invaluable comments, suggestions, and insights throughout the project. We would also like to thank Roberta Gibson, Tibor Tóth, Lisa Gilman, and Rebecca Bedford from our Center for their collaboration and assistance on various aspects of the reports. We would also like to recognize the excellent work of the graduate research assistants: Steven Douglas, Caitlin Olsen, Leo-Rey Gordon, Michelle Kung, Qinghua Nian, and Xuan Jiang.

Our reports could also not have been completed without the help of Dr. Keith Goossen and Tom Battagliese from the University of Delaware Department of Electrical Engineering, Dr. Simon Condliffe from West Chester University Department of Economics, Dr. Stephanie Smith and Alison Waters from Delaware Technical and Community College, Tracy Bakowski from the University of Delaware Office of Institutional Research, and Tony Papili from the Plumbers and Pipefitters Union Local 74. We would also like to thank those many businesses, nonprofits, households, and educators that completed our surveys and interviews.

Executive Summary

Concerns over climate change, energy security, and global instability have captured the public's attention. In light of these concerns, an idea has taken root that the economy and the environment need not be at odds with one another. The 'green economy' refers to those workers and businesses that have a direct financial incentive to engage in environmentally beneficial activities. A directive has been established to better understand the green economy, so that effective policies can be designed and properly evaluated. To assist in that goal, the Center for Applied Demography & Survey Research (the Center) recently completed a detailed analysis of Delaware's green economy.

The U.S. Department of Labor's Employment Training Administration awarded the Center with this project using funds obtained from the American Recovery and Reinvestment Act. The project was performed in collaboration with the Delaware Department of Labor. The project had multiple objectives; to estimate the number of green jobs that currently exist, identify the wages paid to those jobs, determine the education and training requirements for different green jobs, identify the ability of Delaware's training and education system to prepare workers for green jobs, and project the demand for these jobs in the future. These goals were accomplished in research that took nearly 18 months to complete. The results are published in a series of five reports.

This document summarizes the main results of that series.

Below is a brief overview of the five documents in the series.

1. *Energy Efficiency and the Manufacturing Sector*

This report analyzes the jobs that would be needed if Delaware's manufacturing industry took steps to improve its energy efficiency. A model is developed that indicates what industrial technologies are most likely to have energy-saving investment opportunities within Delaware's manufacturing sector, and how many jobs would be needed to perform those investments.

2. *Defining and Describing Green Businesses*

Businesses that sell green goods and services are analyzed in this report. Green businesses and non-green businesses are compared to one another based on their respective employment, wages, and occupational composition. Green businesses are also asked to identify relevant instructional programs and give their opinions on other important issues.

3. *An Analysis of Delaware's Green Educational Pipeline*

Delaware's postsecondary educational system is evaluated for its capacity to train the workforce for green occupations. Enrollment and completions are evaluated for academic and vocational instruction relevant to the green industry. Occupational information is provided for persons who received such instruction. Other pertinent information is also provided.

4. *Households and Energy Efficiency*

Homeowners in Delaware are surveyed to better understand the potential demand for energy efficient goods and services. Detailed information is collected on residential characteristics, green behavior, and stated consumer preferences. Future job forecasts are made for residential energy efficiency.

5. *The Economic Impact of Delaware's Green Business*

The macroeconomic impact of the green economy is estimated. Scenarios are developed that indicates what impact can be expected under different forecasts of future events. This final report integrates the results of the previous four.

Energy Efficiency and the Manufacturing Sector

This report explores the potential demand for a particularly important group of businesses in Delaware, the manufacturers. We explore what types of energy-saving activities are likely to exist in Delaware's manufacturing sector and estimate the cost of implementing those activities. Finally, we infer the number of jobs needed to justify those costs using current industry ratios. In effect, the paper indicates the specific skills and employment requirements of a hypothetical green initiative.

We find that Delaware manufacturers will have energy saving opportunities in many different industrial processes, such as industrial motors, lighting, ventilation, air compressors, combustive processes (i.e. boilers, furnaces, etc.), and heat recovery. We estimated that the energy efficient investments having payback times less than five years duration would likely cost \$120 million. If those investments were primarily capital intensive, then we estimate that 450 workers would be needed. If those investments are primarily labor intensive, 820 workers would be needed. Energy-saving investments whose costs can be recovered within 1.4 years will require approximately 175 workers. The areas with the greatest costs and subsequent employment estimates were in the combustive industrial technologies and heat recovery designs.

In order for workforce training solutions to be effective, they must be able to identify skill shortages in the workforce. This requires that issues of labor supply and demand be addressed. Although the paper addresses a relatively small component of the overall green economy, its narrow focus enables us to establish a link between vocational skills and potential business demand.

Defining and Describing Green Businesses in Delaware

The intention of this study was to measure the size and scope of Delaware's businesses that sell green goods and services. We achieved this objective by combining survey results with multiple sources of labor market information. Owing to the subjectivity embedded in the term 'green', we adopted the Bureau of Labor Statistics' definition of green goods and services.

Our survey found that 8.5% of Delaware business establishments produce green goods or offer green services. These companies employ approximately 16,250 persons in the state, or approximately 4.2% of the state's workforce. The majority of these businesses is classified in construction or the professional and technical services industries.

The majority of green businesses in Delaware offers energy efficient goods and services. Businesses that sell output intended to reduce pollution and businesses that relied on recycled inputs comprised the second largest sector of Delaware's green economy. The third largest sector produced goods and services that were intended to conserve natural resources. Companies involved in the renewable energy sector employed the least number of people in the green economy.

It is normal for businesses to fall into more than one green sector, either because the businesses sell a variety of goods and services, or because a particular good or service falls into a variety of green categories. For example, nearly 80% of the companies selling output in the renewable energy sector also sell output that classifies them in the energy-efficiency sector.

We also evaluated the wage and employment trends for companies that reported green goods and services in 2010. These trends were contrasted with similar, non-green companies. While all businesses reported falling employment during the recession, companies that sold green goods and services experienced stronger real wage growth than their non-green counterparts. However, we caution that these trends are only suggestive. For technical reasons, discerning actual trends from other influencing factors requires continual monitoring, akin to other labor market surveys.

Our survey also identified occupations that were commonly found among green businesses. Plumbers, pipefitters, and steam fitters were the most common occupations and heating, ventilation, and air conditioning workers were the third most common occupations in green companies. Carpenters, electricians, and vehicle mechanics were also relatively common. Other than the trade crafts, the engineering occupations were quite common. Civil engineers, mechanical engineers, electrical engineers, engineering managers, and architectural drafters were found frequently among Delaware's green businesses.

Based on the occupational composition reported in other surveys, businesses that sell green products distinguish themselves from similar, non green businesses by employing occupations requiring greater skills in science and math, as well as communication ability. Similar non-green counterparts are more inclined to employ occupations needing more traditional blue-collar skills, such as installation and repair abilities.

Green companies overwhelmingly stated that they thought a vo-tech high school certificate with a background in general construction was both relevant and desirable. Other frequently mentioned skills included LEED certification (engineering), energy management, HVAC training and geothermal technology. There was also a preference for employees to be trained in mechanical engineering, environmental engineering and the electrical trades. Green companies emphasized the importance of science, mathematics, and trade skills in the workforce.

The report also asked businesses for their general opinions on other relevant topics. For every company that made green output and claimed to be green via marketing campaigns, 2.2 other companies claimed to be green without making green output. This could imply that at least twice as many companies are “greening” their operations than are actually making green output. It also reflects the pervasiveness with which the term is being used.

Nearly 70% of green businesses reported that the government was somewhat important or very important to stimulate demand for their green goods and services. This was particularly true for businesses in the renewable energy and natural resource conservation sectors.

Although businesses stated that energy costs were very important to their profitability, most businesses were apathetic to the prospect of actually investing in energy efficiency. The most interest came from manufacturers and larger companies that owned multiple establishments. Businesses are most concerned with the perceived large up-front costs of making such investments. Finding qualified staff was not a major deterrent to making those investments.

An Analysis of Delaware’s Green Educational System

The green education pipeline refers to those academic and vocational instructional programs that teach the skills and concepts relevant to energy efficiency, renewable energy, natural resources, pollution control or remediation. The report’s main objective was to identify that pipeline in Delaware and provide pertinent information for the programs involved. A secondary objective was to understand the career outcomes of persons exiting different stages of that pipeline. The report also was an opportunity to provide context and commentary on other important issues related to education and the green economy in Delaware.

To put the green pipeline into context, Delaware's postsecondary academic schools conferred 1,822 certificate degrees, 1,733 associate's degrees, 5,505 bachelor's degrees, 2,465 master's degrees, and 528 doctoral degrees in 2010. The University of Delaware, Wilmington University, and Delaware Technical and Community College (DelTech) awarded the most degrees in the state. In addition, DelTech, the adult education division in each county's adult vocational school district, local trade unions, and other private organizations provide technical, non academic training after high school.

The types of degrees awarded by Delaware institutions has undergone a transition over the last 10 years. The state's educational system has been most rapidly expanding in the following areas: education, nursing, business, accounting, economics, and finance. Increases have also occurred in engineering and engineering technologies, construction, beauty and personal services, physical fitness, and sports management. Degrees in consumer economics and fashion have been declining.

Our definition of the green educational pipeline was based on those programs that equipped students with the skills necessary to perform certain green related occupations. Since there are so many different kinds of green occupations, we also added the requirements that faculty research interest or curriculum should focus on energy efficiency, renewable energy, natural resource conservation, pollution control or remediation. This limited our focus to programs in the following areas:

- agriculture
- engineering and engineering technologies
- wildlife, earth, and environmental science
- chemistry and biochemistry
- natural resource economics, operations research, and logistics
- public policy & environmental law
- construction and trades (mostly vocational training analyzed separately)

In terms of enrollment, engineering and engineering technologies was the largest component in Delaware's academic pipeline (2900 students). The next largest component includes programs related to the wildlife, earth, and environmental sciences (1000 students), followed by majors in chemistry and biochemistry (950 students) and agriculture (600 students). In terms of in-state student enrollment, engineering and engineering technologies was still the largest program in Delaware's academic pipeline (1350 students), followed by chemistry and biochemistry (600 students), and wildlife, earth, and environmental sciences (350 students). A smaller proportion of in-state students are enrolled in more advanced degree programs.

According to the 2009 American Community Survey, career outcomes varied greatly for subjects within the green pipeline. Persons with bachelor's degrees in public affairs, policy, and social work were paid the lowest wages (\$41,000), and persons receiving bachelor's degrees in engineering were paid the highest wages (\$80,200).

Academic educators cited analytical thinking and mathematical ability as being the most crucial to student success in green-oriented majors, and high school mathematical attainment is an indicator of whether people enter a postsecondary academic program and which field they choose if they enter. The 2010 SAT10 mathematical performance scores indicate that 43% of 10th grade public school students did not meet the expected levels.

The construction and trades largely fell outside the academic component of the pipeline. For people pursuing a trade, we estimated that most were pursuing an apprenticeship to become electricians (300), followed by plumbers or pipefitters (220), and then HVAC repairmen (120). Apprentices in these trades and those taking technical training often develop the skills taught in the more familiar stand-alone green courses.

Enrollment in workforce training tied to more singular green issues, such as auditing a building for energy performance (45) and solar panel installation (15), is much smaller compared to those learning a broader set of trade skills. Programs in weatherization have attracted the most interest (estimated between 120-150 in 2010), but these programs were not much different from introductory training in the construction-related crafts. These vocational training programs are scalable to the size of applicant interest.

Vocational instructors indicated that job readiness and mechanical aptitude are crucial to the non-academic green pipeline. While these educators agreed that mathematical ability is also important and lacking in the workforce, they also believe that such knowledge is easy to teach at the necessary level of rigor. Mechanical skills, on the other hand, take longer to develop, and persons entering construction or the trades are mostly deficient in these skills. Mechanical deficiencies are blamed on policies that encourage academic over vocational education.

The recession has had profound effects on occupations related to the green sector, and no single explanation seems to describe those changes. Traditional trades, like plumbers, electricians, and carpenters, as well as some types of engineering technicians may be showing evidence of a decline in demand, however many other occupations attainable with a green-related education may be indicating declines in supply. Multiple reasons could explain that counterintuitive result, including discouraged workers, skill atrophy among the unemployed, applicant discrimination, or changing business conditions affect the skills desired by businesses.

Occupations requiring bachelor's degrees or higher levels of education in green majors had unemployment rates better than or equal to those in other disciplines. Green occupations needing associate's degrees or vocational training have higher rates of unemployment than non-green occupations. This is likely driven by the weak performance in the construction and manufacturing sector.

Households and Energy Efficiency

This report focuses on households in the green economy. In particular, the report attempts to understand homeowner green perceptions and behavior, both as employees to businesses and as consumers. We achieve these goals using a survey of more than 2,000 households in Delaware. We also apply the results of the survey to forecast the private residential demand for important energy efficient products and services. Using the forecasted consumer demand, we derive the forecasted labor demand.

A major contribution of this research is to better understand the Delawarean homeowner. The survey asked homeowners questions regarding the following topics:

- 1) Basic demographics, housing, and energy profile of the household;
- 2) Opinions regarding energy efficiency and pollution reducing behavior;
- 3) Financial considerations related to energy efficiency;
- 4) Opinions regarding energy audits and household behavior;
- 5) Attitudes concerning hybrid and electric vehicles;
- 6) Experience with green job training at their place of employment.

Next, we briefly discuss the most important results from each of these different sections.

The average household living in an owner-occupied house has been living there for 14 years, and more than 75% expect to stay for at least two more years. The average age of an owner-occupied housing unit in Delaware is 32 years old. Substantially larger percentages of owner-occupied housing units in Kent and Sussex were built in the last decade. Also, over 80% of housing in the state is of the single-family variety. Kent and Sussex have more mobile homes than New Castle, and New Castle has more duplexes and townhomes than Kent or Sussex.

Heat is provided mainly by electricity (29.9%), natural gas (40.1%), fuel oil (18%), and propane (8.1%). Kent and New Castle counties have similar energy profiles, with the exception that New Castle uses less propane than Sussex. The average age of the heating system is almost 10 years, with 13% of heating systems being older than 20 years. The average age of water heaters is nearly seven years, and 20% of these are more than 10 years old. Also, the average monthly bill for electricity was \$222.00, and the average gas bill was \$208. This information is especially important to determining household demand for green goods and services.

Next we moved on to understanding the perceptions and behavior of homeowners as it relates to various green goods and services. For example, 37% of homeowners thought they used less energy than their neighbors, while only 10% thought they used more. Nearly 84% reported that they were already trying to reduce energy use, and 61% claimed to take additional steps to cut pollution. Almost 70% asserted that reducing energy use was definitely a worthwhile goal, and 75% of respondents indicated that they recycled.

As for their stated behavior performance, 53% reported making home improvements in the last two years that was intended to reduce energy use. Of those projects mentioned, windows and doors were the most common (20.3%), followed by laying insulation (13.1%), making changes to the heating system (10.3), and sealing cracks or making repairs and alterations to the exterior (8.6%). Approximately 8.1% stated that they purchased a new appliance in the last two years in order to save energy, and over 74% of the homeowners interviewed suggest that they buy ENERGY STAR appliances when replacing old appliances. Approximately 1.6% said that they made some type of renewable energy purchase (solar photovoltaic, solar heat and hot water, and geothermal HVAC)

We also found that many homeowners do not take the most cost effective ways of conserving energy. For example, nearly 18% of homeowners would immediately save energy if they used the programmable thermostat in their homes. In addition, nearly a third of homeowners with a forced air system have not changed the air filter in at least three months. When compared to the nation, Delaware homeowners said that they were much more likely to perform a home improvement project on their own instead of calling a professional.

When asked what were the most important issues to consider before making an energy saving home improvement, respondents indicated that financial issues were most important. Social reasons, such as the environment, reduction of oil imports, and reputation were much less important. Financial issues were also the most important factor that could discourage households from conducting such a project. In fact, the stated rate of return demanded by households for energy efficiency was extremely high, which may reflect the real or perceived financial risk of investing in energy efficiency.

Only 34% of respondents indicated that they would be likely to replace a working appliance with a more energy efficient appliance. Similarly, less than 20% were willing to replace a water heater until it breaks. When asked whether they would consider installing solar panels, 18.7% of homeowners said that they were either *very likely* or *definitely likely* to do so. However, approximately the same proportion of respondents expressed interest in each income group, probably implying that many homeowners have not seriously considered the upfront costs.

Residential energy audits identify wasteful energy consumption in the home, so homeowners can know which projects are most beneficial. About 22% of respondents indicated that they were *very interested* or *definitely interested* in an energy audit. When homeowners consider the price (\$200-\$600) and a potential 20% rebate via follow-up questions, approximately 14% of homeowners remained interested.

Almost 60% of the respondents indicated that the fuel mileage will be a factor in purchasing their next vehicle, but only 26% believed that an all-electric vehicle was attractive. However, if all-electric vehicles were priced competitively with other vehicles, 34% said that they would find all-electric vehicles attractive.

The survey also asked employed respondents to describe any work activities or experiences that were relevant to energy efficiency and pollution reduction. Approximately 55% said reducing energy use was either *very important* or *definitely important* to their employer, and more than half (51.4%) felt that their employer made it relatively easy to suggest ways of improving energy use and/or reduce pollution. Over 70% of respondents said that their employers actively were trying to reduce energy use or cut pollution.

When asked what type of energy saving activities they did at their jobs or could think of doing, the most common answer was general awareness or occupation-specific training, going paperless, recycling, turning off lights and equipment, and working from home. This suggests that most of those processes that businesses do to reduce energy and lower pollution requires behavioral changes from their employees, and not necessarily job training. This also suggests that the ability to manage employee behavior is critical to improving energy efficiency.

The final section uses the results from the survey along with supplementary data to predict the annual future demand for six home improvement projects critical to the efficient use of energy. This project list includes insulation, water heaters, air conditioning systems, heating systems, windows and doors, and roofs.

We estimate that approximately \$300 million will likely be spent each year by existing Delaware homeowners over the next decade. Nearly 60% of that expenditure is expected to be spent on roofs, windows, and doors. Replacing water heaters is projected to be the second most common project (21,000 water heater repairs /replacements in Delaware each year), but due to the low cost of these projects, \$15 million of homeowner expenditure will be spent each year.

Translating these expenditures into employee requirements, finds that 1,629 employees will be needed to do the six type of projects each year. 510 workers will be needed for roof repairs, 388 for windows and doors, 286 for heating systems, 307 for air conditioning systems, 82 for water heaters, and 55 workers will be needed to lay insulation. This is approximately 7.6% of the construction sector, and 0.4% of covered employment in Delaware.

The Economic Impact of Delaware's Green Business

In the final report, we outlined many of the organizations and policies in Delaware's green economy. We demonstrate how various policies and legislation have altered the financial flows within the conventional economy in order to promote the "greener" elements. One of the major themes that this shows is how the green economy is much more than a list of goods and services or an occupational skill. The system that determines future labor market demands is a complex mix of market and legislative forces.

The simple characterization of the green economy was used to model the impact of four different questions. The economic simulation we used to do this, REMI PI+, is a dynamic regional model that is structural in nature, meaning that important economic relationships are expressed mathematically and that any policy changes carry forward through time. The model has been tailored to Delaware and the surrounding counties, so that state-specific policies can be forecasted with the most accurate data available. The model is essentially a laboratory for analyzing the economic impact of different policies.

The first policy evaluated the hypothetical impact of making energy efficient improvements in the manufacturing sector. The second policy evaluated what the economic impact in the next ten years as households purchase green related appliances. The third policy we evaluated the contribution of Delaware businesses that sold green related goods and services. And the final policy evaluated the short term impact of selected green programs. The scenarios utilized the findings from previous reports in this series.

In order to analyze energy efficiency in manufacturing, we constructed a stylized policy to draw useful conclusions regarding energy efficient investments. The baseline model assumed that \$42 million out of \$120 million of potential investment expenditures would be implemented, and that half of the expenditures would be spent on durable equipment and the other half on labor services. A government program invests in energy efficiency evenly over the next five years, and requires 15% administrative costs. Electricity taxes generate 100% of the revenue to fund the investments. In addition, we also assumed that the program would crowd out 25% of private investments. We feel these assumptions are relatively conservative, and provide a good comparison for alternative policy designs.

Under this base scenario, an average of 124 additional jobs is added to the economy each year for the next 10 years. Employment ramps up as the investments reduce energy costs, but tapers off as the energy saving investments depreciate. An average of \$24 million (2010 prices) per year in gross domestic product (GDP) is added over the next ten years, with between \$28 to \$33 million of GDP forecasted for the five years after the program ends. Real disposable income increases by a total of \$25 million in the first five years of the policy.

Alternative scenarios were also modeled to draw relevant policy conclusions. The main conclusion is that net economic benefits are only positive each year if the energy saving opportunities are profitable enough to offset the negative effects of paying for those investments. Less profitable investments will generate short term economic losses, but long-term economic gains, and whether the gains outweigh the losses depend on the investments' profitability.¹ In this respect, energy saving investments is no different from other investments.

The other important conclusion we reached is that the net economic benefits fall when a policy pays for an investment that would have occurred anyway (i.e. crowd-out rate). This is because the net impact of using electricity tax revenues to reduce business costs was negative. From an economic perspective, the best policy is one that encourages the most profitable investments that would not have otherwise occurred. In addition, that encouragement uses the least amount of tax revenue to do it, which would imply having the lowest possible administrative costs.

¹ We only considered investments that could have their nominal costs repaid in 5 years or less (payback less than 5).

The model also implied that how one finances energy saving investments matters greatly to the economic impact. For example, if the investments were paid entirely by increased production costs (no crowding out of investments, no electricity tax, and no administrative costs), the net economic benefits nearly double. When tax revenue is collected via an income tax, GDP and employment are higher, but income and consumption are lower. Funding the investments by broadly reducing other types of government spending has the worst economic effects.

Finally, our analysis of energy efficiency indicates just how important reducing energy costs are to the economy. For the energy efficient investments considered in this model (payback of 5 years or less), more employment was generated due to reduced energy bills than was used to make the initial investments and repairs.

Moving on, in the next section we evaluated the likely impact due to households performing energy-efficient renovations. The fourth report in the series estimated the household demand for projects involving insulation, water heaters, air conditioning systems, heating systems, windows and doors, and roofs over the next ten years. Each of these home improvement projects typically require contract labor to perform the services, so a direct connection can be drawn between expected repairs and specialized labor.

We projected that the ENERGY STAR home remodeling projects will likely be responsible for employing 350 construction workers and 225 other workers each year for the next decade. These green projects would also be responsible for \$63 million of the state's GDP and \$18 million in real disposable income. These ENERGY STAR home improvement projects represent approximately one quarter of the economic impact coming from these types of home remodeling projects. The forecast may be conservative in that it does not consider the benefits that accrue to households who will have lower energy use. It also assumes that historical market penetration for ENERGY STAR products will continue to apply to the future.

Next, we used the results from the second report in the series to evaluate the contribution of businesses that sell green goods and services to the economy. In total, nearly 16,250 people were employed in a Delaware company that sold green products and services. The REMI PI+ model estimated that 9,450 additional jobs are attributed to these companies once the indirect and induced effects are taken into account. This implies an employment multiplier of 1.58 for the green industry. The energy efficiency sector had the highest multiplier (1.60) and those in the renewable energy sector had the lowest (1.49).

The green economy in Delaware seems mostly concentrated within a relatively small number of industries. In terms of employment, the largest three industries were construction (8,750 jobs), professional and technical services (3,200), and state and local government (2,900). Other industries strongly influenced by the green industry include wholesale trade (1,900), administrative and waste services (1,800), manufacturing (1,750), other services except public administration (1,600), and retail trade (1,350).

The REMI PI+ model also predicted that companies selling green goods and services are responsible for an average of \$2.93 billion in the state's GDP. They are also responsible for \$540 in real disposable income per capita, and nearly 6% of the state's wages and compensation.

Finally, we evaluated the possible expenditures due to energy efficiency and renewable energy policies coming from various government programs. As of March 2011, nearly \$46.8 million of ARRA funding had not yet been spent on green related construction projects. The Weatherization Assistance Program (WAP) and the Greenhouse Gas Reductions Project (GGRP) are also projected to add nearly \$6 million of green spending each year in the future. We estimate that when these dollars are spent, approximately 530 jobs will initially be created in Delaware, but that between 45 and 60 jobs will be generated in following years due to the WAP and the GGRP.

There are two caveats to those job estimates. First, other green programs will be important in the future, such as the Renewable Portfolio Standards and the Sustainable Energy Utility. However, the probable long term employment effects of these programs are uncertain. Second, it is not clear what the energy savings are for the WAP or the GGRP, but to the extent that they do reduce energy use, there will likely be an increase in employment. Although there is little we can say regarding the energy saved by these two programs, we did find that reducing electricity costs for the commercial and industrial sector produces the most economic benefits, while lowering residential electricity costs generates the least economic benefits.

About Us

The Center for Applied Demography & Survey Research (the Center) is a research organization within the University of Delaware. Our primary mission is to ensure that the best possible data and information on important public issues are developed and made available to members of the College, its clients, and, most importantly, to the policy-makers who affect the way we all live and work in Delaware. The Center is a project oriented organization that continually reshapes itself to fit the task at hand. We have a permanent staff of ten professionals, thirty part-time staff, three graduate students, and access to faculty and other professionals in the university. More information is available at our website, <http://www.cadsr.udel.edu>.