The Greenjng of South Dakota's Economy

Labor Market Information Center
South Dakota Department of Labor and Regulation

May 2011

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Introduction



Photo courtesy of South Dakota Department of Tourism.

The current levels of low job creation have made for a slow recovery from the economic recession that started in December 2007. Unemployment in the United States has been at high levels for some time. Policy makers and business leaders across the nation have been focusing on strategies to create new jobs. One of the current ideas is to capitalize on the "greening" economy because of the jobs that will be created as new green technologies are implemented.

Nationally and in each state, there is growing interest in jobs that preserve and restore the environment. This trend is sometimes referred to as the "greening of the economy," and the jobs are often called "green jobs." Many of these green activities and new green jobs are technical in nature and require professional-level skills or training.

Changes in technology and increased social awareness have created ways to measure and price the environmental costs involved in doing business. Whether by saving energy or reducing waste, businesses are working to minimize costs and become more environmentally friendly. For most businesses, being green is a result of cost cutting due to higher energy prices or regulatory changes that place value on the use of environmental resources. For others, being green is a way to increase profits by joining a growing niche market. For still others, becoming green is a moral issue where being environmentally responsible is the right thing to do. This moral decision ultimately aids the reputation and sales of the company.

From an economic standpoint, environmental costs are referred to as externalities. These externalities are increasingly being internalized in production decisions, whether by regulatory change or through consumer demand. The internalization of environmental externalities improves the efficiency of production and benefits the economy.

Given the scarcity of world energy and natural resources and the ever-increasing demand for these resources, the internalization of environmental externalities likely represents a permanent change in the way we do business. It is important for the workforce to respond to this change by developing the knowledge and skills required for today's economy.

Existing statistics are not sufficient to understand the changes involved with the greening of the economy. Most labor statistics are organized by function into industries and occupations, but the green concept does not mesh well with these taxonomies. Environmentally-friendly production is often a change in process, not in function. Therefore, new survey research was needed to understand how the green concept fits into existing taxonomies.

At the same time these changes are occurring, the workforce is aging as the baby boom generation edges inexorably toward retirement. These two forces — a pending large scale retirement of the experienced workforce and an expanded demand for professional services — require that state research offices adopt new strategies as part of their career and occupational information programs.

South Dakota and many other states have undertaken research projects to measure and analyze the impact of the green economy. The new green jobs may require a new set of knowledge, skills or abilities. State and national leaders want to make sure employers have the workforce they will need. South Dakota used federal research funds for its work on green jobs. Some states are joining forces to work on research projects.

The U.S. Department of Labor, Employment and Training Administration (ETA) provided funding for a State Labor Market Information Improvement Grant to the Northern Plains and Rocky Mountain Consortium in December 2009. The Consortium was comprised of Labor Market Information (LMI) research offices in six contiguous states: Montana, Nebraska, Iowa, South Dakota, Utah and Wyoming. (In addition, Colorado joined the green jobs employer survey portion of the research project, using basically the same survey methodology as the consortium.) Broadly, the funds were to be used to maximize the efficiency of the current and future labor market by identifying the major features and trends in labor supply and demand, including the occupational characteristics and skills needs associated with the greening of the economy. The consortium's work included the use of multiple methodologies encompassing employer surveys, content analysis of administrative records, employment and training program evaluation, and contracting with academic experts for insight on developing technologies and their potential impact on the demand for labor. Each state took the lead in a particular subject area and research strategy. The consortium's goal was to look at green jobs from two perspectives — current levels of green workers and future demand for green workers. In turn, future demand for workers can be viewed in several different ways, including newly hired workers, green job openings listed in the labor exchange, projected worker demand, new and emerging green businesses and the regulatory environment.

Chapter 1

What 'Greening the Economy' Means

Although it is common to hear the words "green economy," to many the term implies a separate business activity or economic sub-sector. The use "greening" of the economy may be a better characterization because it recognizes green economic activities are crosscutting and involve jobs in many industries and occupations.

The concept of green is also relational. In comparison to other industries, the oil and gas industry is generally not considered green but includes environmental engineers who ensure environmental standards are met. In relation to past practices, the oil and gas industry is also becoming "greener" by reducing waste and utilizing renewable energy for the transportation of its goods.

Thus, the research focus was not on industry sectors but on green economic activities that result in environmental benefits. Those environmental benefits included improving energy efficiency, expanding the use of renewable energy, or supporting environmental sustainability.

South Dakota used six categories of green economic activities:

Renewable energy and alternative fuels: *The manufacturing, construction, design, research, delivery, operation, storage or maintenance of wind, solar, biomass, hydro, alternative transportation fuels, geothermal, methane and waste incineration as a fuel source.*

Energy efficiency and conservation: *The manufacturing, construction or installation of energy efficient products, energy efficiency services, weatherization, building retrofitting/efficiency, energy/efficiency production processes, energy distribution improvements and transportation technology.*

Pollution, waste and greenhouse gas (GHG) management, prevention and reduction: *Activities related to controlling emissions and pollution, including controlling and reducing greenhouse gas emissions, wastewater and pollutants.*

Environmental cleanup and restoration and waste cleanup and mitigation: *Environmental restoration, including the cleanup and disposal of pollution, waste and hazardous materials, Superfund/Brownfield redevelopment and landfill restoration.*

Sustainable agriculture and natural resources conservation: *Products and services to conserve, maintain and improve natural resources and the environment, including low carbon and organic agriculture, land management, water management and conservation, wetlands restoration and environmental conservation.*

Education, regulation, compliance, public awareness, and training and energy trading: *Activities that educate on energy efficiency, renewable energy, energy rating systems certifications and more efficient energy consumption. Enforcement of compliance requirements and regulation, and training on effective use of energy related products and processes.*

Just like the greening of the economy, the greening of jobs/occupations also occurs. The National Center for O*NET Development describes the impact of the green economy on occupations by using three shades of green.

Green increased demand occupations: An increase in employment demand for an existing occupation without significant changes in the work and worker requirements. The work context may change, but the tasks do not.

Green enhanced skills occupations: Significant change to work and worker requirements. The occupation's essential purposes remain the same, but tasks, skills knowledge and external elements, like credentials, have been altered.

Green new and emerging occupations: Creation of the need for unique work and worker requirements, generating a new occupation within the current taxonomy.

Put simply, a green job is a position where the work effort results in environmental benefits. Green jobs are best thought of as work that has been transformed to be more environmentally friendly in response to rising energy costs and a growing recognition of the importance of the environment and ecological services to our economy. In this sense, green jobs are not a new phenomenon, but another chapter of the ever-developing process to make production more efficient, to reduce costs and to eliminate unnecessary waste.

Green jobs are best thought of as work that has been transformed to be more environmentally friendly in response to rising energy costs and a growing recognition of the importance of the environment and ecological services to our economy.

This green job definition ties the concept of green activities to a specific job position, which is critical to the measurement of green jobs. Further, a worker must be essential to the production of the product or service. The concept of green jobs is rather nebulous because of changing technology, knowledge and context. Changing knowledge on managing the environment or changing technology can alter whether a job is considered green. In terms of context, diesel bus drivers are currently considered green because they promote energy conservation and reduce carbon emissions compared to other drivers. But these same workers would not be considered green when they switch to low-emission, hybrid vehicles for their commutes home. The consortium chose this green job definition in hopes of concentrating the focus on jobs where the greening of the economy has required workers to have different or new skills, knowledge or abilities.

Chapter 2

Identifying and Measuring Green Jobs

The green jobs study was an effort to identify and measure green jobs in South Dakota's economy through primary research. Because both industry and occupational taxonomies are slow to reflect change, primary research was needed to identify and measure green jobs in the state.

The South Dakota Department of Labor and Regulation's Labor Market Information Center undertook the green jobs research in April 2010 as part of a federally funded project. In 2007, federal legislation recognized a new occupational trend and mandated that state labor market research and information programs identify job openings in the renewable energy and energy efficiency sector. The U.S. Department of Labor's Employment and Training Administration (ETA) provided funding for a State Labor Market Information Improvement Grant to the Northern Plains and Rocky Mountain Consortium in December 2009. The consortium is comprised of Labor Market Information (LMI) research offices in six contiguous states (Montana, Nebraska, Iowa, South Dakota, Utah and Wyoming).

Prior to the start of the consortium project, several states had implemented research projects to study the greening of their respective economies and related green jobs. So it was possible to use some of their "lessons learned" to move the consortium research forward. The first step in the green jobs research project was to establish a baseline measurement of green jobs.

In order to accomplish the first part, South Dakota had to identify and measure jobs in the renewable energy and energy efficiency sectors. As mentioned in the Introduction, the process is complicated by the fact there are no current industry taxonomy categories which include "renewable energy and energy efficiency sectors." In most cases, those business activities take place within industries which are often referred to as the greening of the industry or economy. In some cases, there are new and emerging renewable energy and energy efficiency sectors. The best approach to capturing information on new and emerging sectors is to measure current green jobs and also research the implementation of new green technologies. (Chapter 8 of this publication discusses the implementation of new technologies.)

Another obstacle to identifying and measuring green jobs is how to define them. Defining the green economy and green jobs is a challenge because both concepts are still in the developmental stage. As discussed in the Introduction, just like the green economy, jobs are also different

shades of green. South Dakota and the other consortium states decided to use green activities to help define green jobs. The consortium states adopted the definition of green jobs recommended by the Workforce Information Council Green Jobs Study Group.

Another part of defining green jobs is determining which approach to use to identify them. There are basically two approaches:

1. The output approach, which identifies establishments that produce green goods and services and counts the associated jobs.

2. The process approach, which identifies establishments that use environmentally friendly production processes and practices and counts the associated jobs. (Some refer to this approach as the environmental impact approach.)

The consortium states decided to use the output approach, and South Dakota used that approach for its research. Many states that have already conducted green jobs research also used the output approach. A few states used variations of both the output and process methods in their research. The Bureau of Labor Statistics will incorporate both approaches in its green jobs research, although the survey implementing the process approach is only a one-time survey.

The consortium states decided to use the definition that "a green job is one in which an employee produces a product or service that improves energy efficiency, expands the use of renewable energy or supports environmental sustainability."

In addition to picking an approach to identifying green jobs, a decision had to be made about the level of analysis to be used for the research. The occupational level was used for the South Dakota green jobs research to measure green jobs. The term "green" is widely applied to many products, services and even lifestyle and consumer choices. Many employers in a variety of businesses identify specific positions as "green jobs." However, the green job position title and description at one firm might have very little in common with a green job with the same title and description at another employer. Thus, it was important to use the occupational level of analysis for this research. In this publication, occupations are viewed as groupings of work roles that span multiple organizations but share common purposes and common requirements of incumbents. The occupational level of analysis allows researchers to compare green jobs data measured at different points of time and across geographical areas.

Green Spotlight on a South Dakota Business

Great Plains Ethanol, LLC POET Biorefining is located in Chancellor, South Dakota, which is approximately 20 miles southwest of Sioux Falls in the heart of prime South Dakota corn growing country. The plant utilizes more than 30 million bushels of locally grown corn and processes it into more than 100 million gallons of ethanol on an annual basis. A unique aspect of the POET Chancellor facility is the ability to produce the energy used at the plant. Its solid waste fuel boiler burns several hundred tons of wood chips each day and captures and burns methane gas from the Sioux Falls city landfill. These efforts represent an opportunity to produce green energy from recycled fuel sources creating a win-win for the city of Sioux Falls and the Chancellor facility.

Chapter 3

Green Jobs Employer Survey Results

South Dakota used surveys of individual businesses to implement its "green jobs" measurement strategies. For the purposes of the South Dakota Green Jobs Employer Survey, "green workers" are operationally defined as those employees who are directly performing green-related activities as outlined in the definition of green jobs. Most green jobs research uses this same output approach to defining green jobs, although the percentage of time dedicated to "green activities" may be defined differently by other green jobs research efforts.

While some green jobs research projects restricted their surveys to pre-selected green industries, South Dakota did not. The state mailed surveys to 9,480 randomly selected businesses across all industry classifications in April 2010.

The survey questionnaire attempted to refine the measurement of green jobs with a strict definition of green jobs. First, the businesses in the survey were asked to categorize their economic activity into one of six green economic activities listed in the survey form or to indicate they were not involved in a green economic activity. Businesses were then asked to provide information on employees directly performing green-related activities. Even if the businesses were not in one of the six green economic categories, they were asked to list any green jobs they may have.

Survey respondents were asked to identify the number of workers by job title and to provide a brief description of the job. In addition to the job title and brief description, employers were asked to:

- Identify minimum education/training and any special requirements (licenses, certificates, credentials, etc.) for the job.
- Indicate the percentage of time dedicated to green work, using three different categories.
- Indicate the number of workers by listed wage category.

The last three parts of the survey dealt with green jobs recently created or modified, current green vacancies, and projected creation or elimination of green jobs. If the employers did not indicate any green jobs, they were asked to explain why.

Despite efforts to narrowly define green jobs through the use of this definition, the survey respondents demonstrated a tendency to utilize a more general understanding of the term green, a problem reported in other state surveys as well. Some respondents reported jobs as green because the worker participated in green practices, such as recycling or conserving energy, despite the fact these practices are ancillary to their primary job duties. Some respondents included all jobs as green jobs if the business's product or service was green, despite the use of the word "essential" and specific directions on the questionnaire to exclude nonessential or indirect positions like support staff. Other respondents used a more narrow definition of green jobs. One of the consortium states had an environmental regulatory agency that excluded their environmental engineers and reported only a few part-time positions as green. Another environmental regulatory agency included their administrative staff because a portion of their job duties is to process environmental permits.

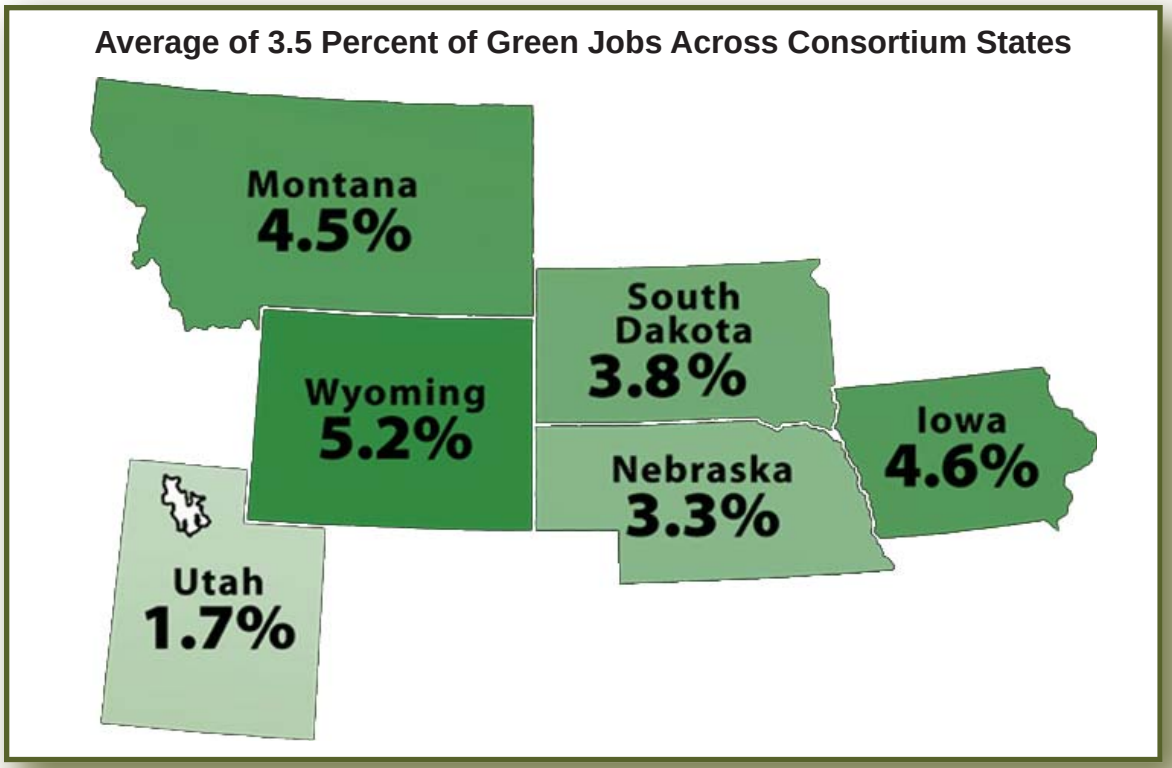
Because of the tendency by respondents to disregard or misunderstand the narrow definition of green, the state decided to publish two estimates for the number of green jobs. The first estimate is the number reported on surveys, which represents the average respondent's understanding about and definition of green jobs.

The second estimate is based on analysis using the Green Job Extractor application, which analyzes information provided via the survey instrument (industry, firm name, occupational title, etc.) to verify whether the jobs reported as green were truly green using the intended definitions and, if so, what "shade of green."

Northern Plains and Rocky Mountain Consortium Results

Because it included the samples from six states, the overall consortium sample was quite large, including more than 62,000 employers. The consortium's usable survey response was 42.3 percent, ranging from a low of 36.0 percent for Iowa to 48.7 percent for Nebraska.

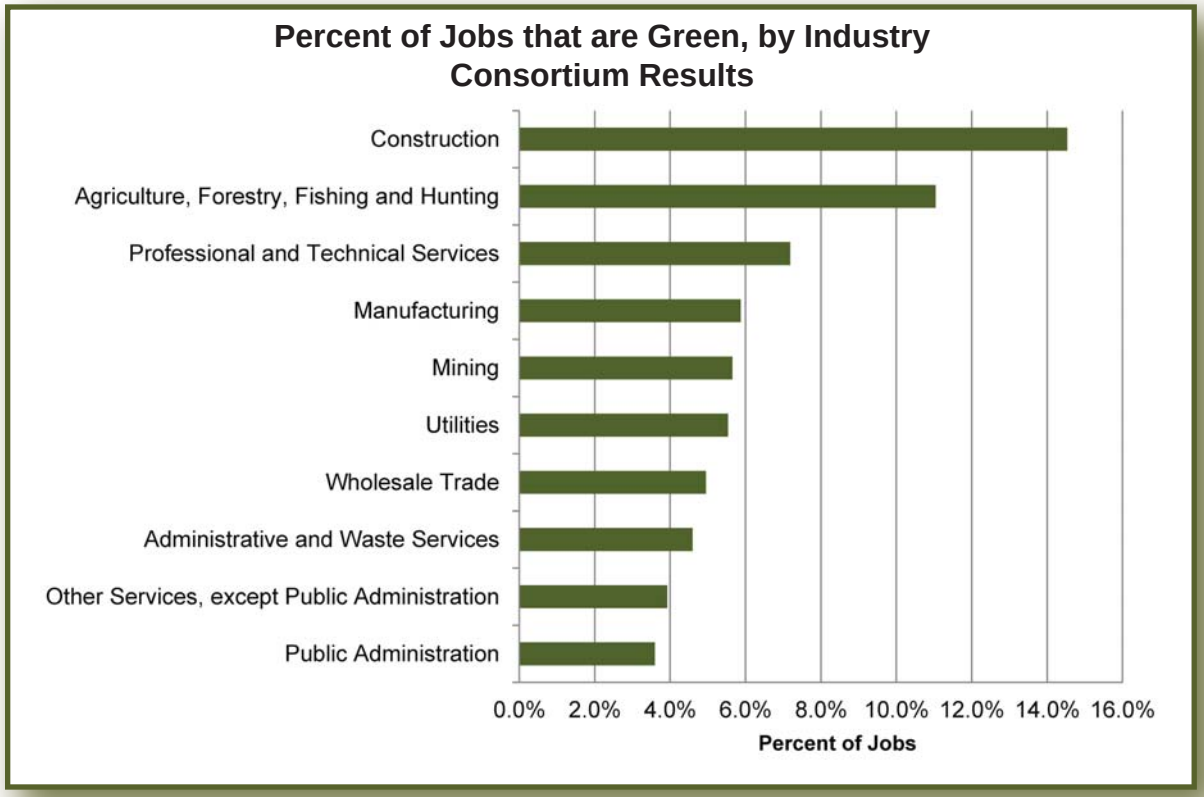
The survey results showed a total of 162,117 green jobs in the six states. The consortium totals for green jobs amounted to 3.5 percent of the total employment in the states. The individual states in the consortium found varying levels of green jobs. Wyoming, Iowa and Montana had the highest percentage of green jobs. Wyoming and Montana have a significant level of oil and gas production and coal mining, while Iowa has large numbers of wind turbine manufacturers. Utah had the lowest percentage of green jobs among the consortium states.



As shown in the table at the right, the consortium results indicated the construction industry has the greatest percentage of green jobs at 14.5 percent. The industry with the next highest concentration of green workers was the agriculture, forestry, fishing and hunting industry.

In the table below, it is not much of a surprise to find the occupational category with the largest number of green jobs across all consortium states was production workers. By definition, a green job is one in which an employee produces a product or service that improves energy efficiency, expands the use of renewable energy or supports environmental sustainability, which would encompass a wide range of manufacturing or processing jobs.

The second largest green jobs occupational category is construction and extraction occupations, which would include any construction crafts worker using energy efficient products or applying energy saving techniques to building or remodeling projects. There would also be a number of green extraction workers in this occupational category.



Green Jobs by Occupational Category
Consortium Results

Occupational Category	Percent of Jobs that are Green
Production Occupations	17.3%
Construction and Extraction Occupations	15.1%
Installation, Maintenance and Repair Occupations	11.5%
Transportation and Material Moving Occupations	7.1%
Architecture and Engineering Occupations	6.9%
Life, Physical and Social Science Occupations	5.9%
Office and Administrative Support Occupations	5.9%
Building and Grounds Cleaning and Maintenance Occupations	5.2%
Management Occupations	4.6%

Listed on the following page are the green occupations reported by employers, ranked in descending order by employment level. Again, many of these detailed occupations are production or construction jobs. Some of them may not sound like green jobs. Keep in mind the fact there are shades of greenness. Many of these occupations retain the same basic work context as non-green jobs, but may have additional green job responsibilities and/or skill requirements.

Occupations with Most Green Employment Reported
Consortium Results

Production Workers, All Other

Heating, Air Conditioning and Refrigeration Mechanics and Installers

Electricians

Managers, All Other

Laborers and Freight, Stock and Material Movers, Hand

Maintenance and Repair Workers, General

Retail Salespersons

Janitors and Cleaners, Except Maids and Housekeeping Cleaners

Landscaping and Groundskeeping Workers

Refuse and Recyclable Material Collectors

Water and Liquid Waste Treatment Plant and System Operators

Installation, Maintenance and Repair Workers, All Other

Construction Laborers

Plumbers, Pipefitters and Steamfitters

First-Line Supervisors/Managers of Production and Operating Workers

Truck Drivers, Heavy and Tractor-Trailer

Forest and Conservation Technicians

General and Operations Managers

Architects, Except Landscape and Naval

Automotive Service Technicians and Mechanics

Civil Engineers

Carpenters

First-Line Supervisors/Managers of Construction Trades and Extraction Workers

Farmworkers, Farm and Ranch Animals

Business Operations Specialists, All Other

Insulation Workers, Floor, Ceiling and Wall

Hazardous Materials Removal Workers

Glaziers

Farmworkers and Laborers, Crop, Nursery and Greenhouse

Environmental Scientists and Specialists, Including Health

Construction Managers

Engineers, All Other

Conservation Scientists

Environmental Engineers

Welders, Cutters, Solderers and Brazers

Chief Executives

Soil and Plant Scientists

Operating Engineers and Other Construction Equipment Operators

Office Clerks, General

Sales and Related Workers, All Other

Maids and Housekeeping Cleaners

Construction and Related Workers, All Other

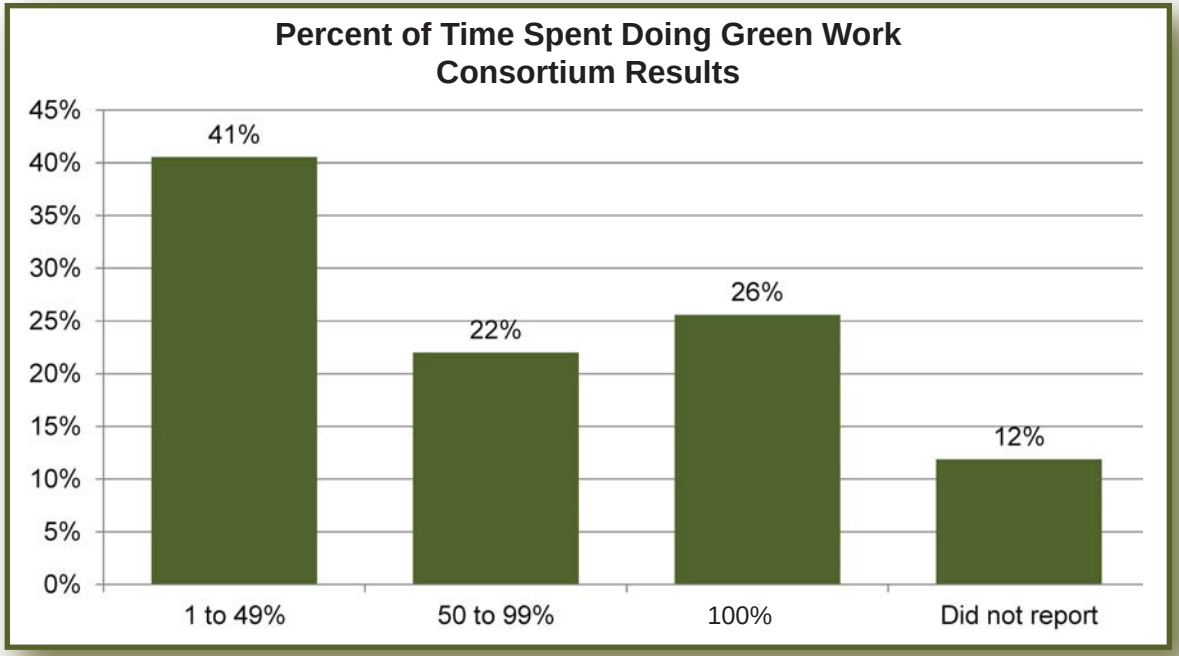
Executive Secretaries and Administrative Assistants

Zoologists and Wildlife Biologists

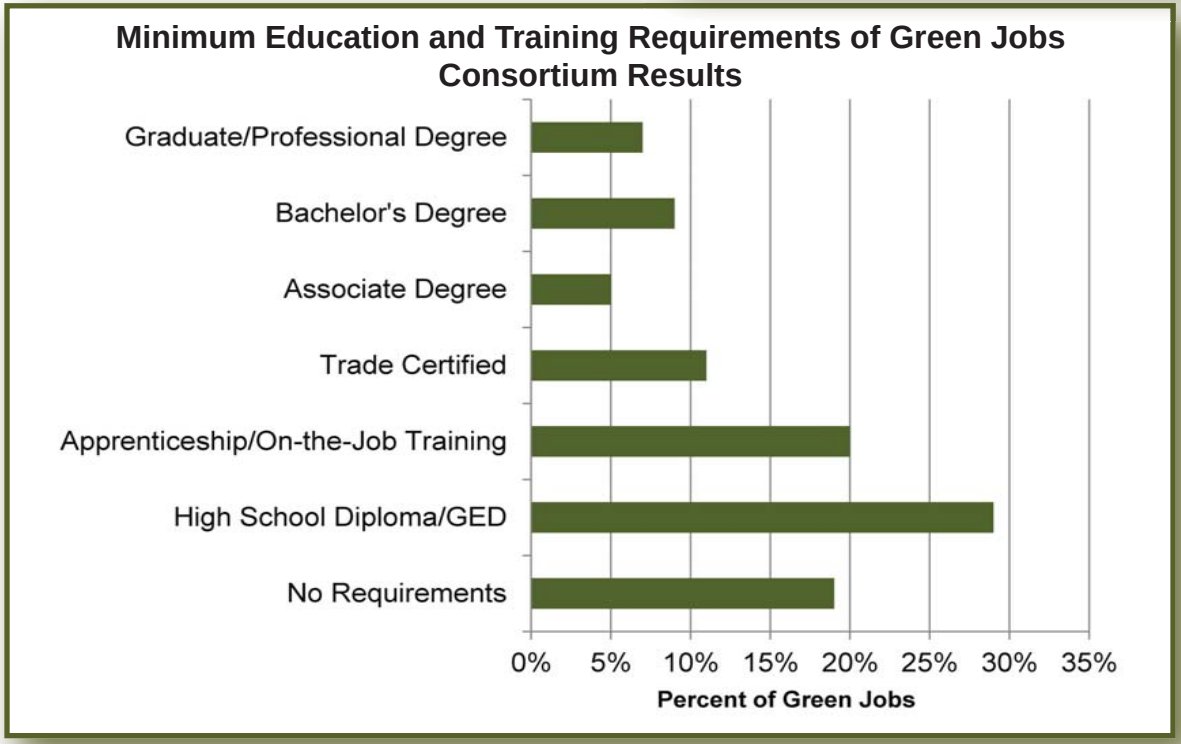
Farm Equipment Mechanics

Roustabouts, Oil and Gas

Survey results across the consortium states showed about one-fourth of green workers spend all their time dedicated to green activities.



With respect to the overall consortium results for the amount of time spent on green work, the largest percent spend 1 to 49 percent of their time on green activities. (See bar chart above.) However, more than 25 percent of the green workers spend 100 percent of their time dedicated to green activities.



Of those reporting an educational requirement, a large number of employers across the six consortium states (around 44 percent) indicated their green jobs either had no educational requirements or required only a high school diploma or GED.

As the chart at the left shows, around 14 percent of the green jobs needed a bachelor's degree or higher level of education. It is important to remember many of the green jobs reported on the survey are not very green. However, new green jobs with technical skill responsibilities would require higher education levels.

South Dakota Green Jobs Survey Response

All the consortium states used the same core questions for the surveys. Some states asked additional state-specific questions. A copy of the South Dakota survey questionnaire is exhibited in Appendix A.

The total universe represented for the 2010 South Dakota Employer Green Jobs Survey was 27,819 establishments and 389,967 employees. The sample was about 14 percent of the total universe; therefore, the survey responses were weighted to represent the entire universe. The sample for this survey was 9,480 establishments. A total of 3,934 employers provided usable responses. There were 146 out of business and 611 out-of-scope employers. In computing the overall response rate, the number of businesses that were closed or out-of-scope was subtracted from the total number of establishments.

South Dakota Survey Response

Response Status	Count	Percent
Usable	3,934	42%
Returned Mail/No Address Available	469	5%
Refusal	6	0%
Out of Business	92	1%
Temporarily Out of Business	16	0%
Sold/Merged	38	0%
Never Mailed/No Address Found	136	1%
Mailed Survey and Postcard/No Response	4,783	51%
Duplicate/Don't Survey	6	0%
Total	**9,480**	

"The fact disclosed by a survey of the past that majorities have been wrong must not blind us to the complementary fact that majorities usually have not been entirely wrong."

— Herbert Spencer

(British social philosopher)

South Dakota set an overall response rate goal for the green jobs survey and a minimum response of 40 percent for all size classes and for all major industry sectors. As the tables at the right and on the next page show, the 40 percent level was attained. The overall response rate was 45.1 percent.

Note: The usable sample is the adjusted sample after the out-of-business and out-of-scope establishments were removed.

South Dakota Survey Response by Size Class

Size		Usable Sample	Completed Survey	No Response	Response Rate
1	Less than 10 employees	3,418	1,478	1,940	43%
2	10 to 49 employees	4,022	1,883	2,139	47%
3	50 to 99 employees	756	341	415	45%
4	100 to 249 employees	385	177	208	46%
5	250 or more employees	136	55	81	40%
	Total	**8,717**	**3,934**	**4,783**	**45%**

The table below exhibits the response rate by industry sector. The 40 percent response goal was achieved for all industry sectors to be published. The mining, utilities, transportation and warehousing, and health care and social assistance industries had response rates above 50 percent.

South Dakota Survey Response by Industry Sector

NAICS	Major Industry	Usable Sample	Completed Survey	No Response	Response Rate
11	Agriculture, Forestry, Fishing and Hunting	354	148	206	42%
21	Mining	36	18	18	50%
22	Utilities	104	56	48	54%
23	Construction	606	249	357	41%
31	Manufacturing	464	209	255	45%
42	Wholesale Trade	500	203	297	41%
44	Retail Trade	1,154	473	681	41%
48	Transportation and Warehousing	464	267	197	58%
51	Information	204	84	120	41%
52	Finance and Insurance	393	191	202	49%
53	Real Estate and Rental and Leasing	389	185	204	48%
54	Professional, Scientific and Technical Services	486	239	247	49%
55	Management of Companies and Enterprises	88	38	50	43%
56	Administrative and Support and Waste Management and Remediation	359	147	212	41%
61	Educational Services	226	106	120	47%
62	Health Care and Social Assistance	538	292	246	54%
71	Arts, Entertainment and Recreation	330	133	197	40%
72	Accommodation and Food Services	695	289	406	42%
81	Other Services	854	393	461	46%
92	Public Administration	473	214	259	45%
	Total	**8,717**	**3,934**	**4,783**	**45%**

Note: NAICS is the North American Industrial Classification System.

South Dakota Employers by Green Economic Category		
Green Economic Categories (Weighted Response)	**Number**	**Percent**
Employers Identifying with at Least One Green Economic Category	3,881	14%
Renewable Energy and Alternative Fuels	541	2%
Energy Efficiency and Conservation	1,673	6%
Pollution, Waste and Greenhouse Gas (GHG) Management, Prevention and Reduction	513	2%
Environmental Cleanup and Restoration and Waste Cleanup and Mitigation	568	2%
Education, Regulation, Compliance, Public Awareness, and Training and Energy Trading	428	2%
Sustainable Agriculture and Natural Resources Conservation	807	3%
Employers Indicating They Do Not Participate in a Green Economic Category	23,640	85%
Note: Respondents could select more than one of the green economic categories.		

About 4 percent of all South Dakota workers could be classified as green workers using the definition, "a green job is one in which an employee produces a product or a service that improves energy efficiency, expands the use of renewable energy, or supports environmental sustainability."

The first question on the green jobs survey questionnaire asked the respondent how many employees the organization currently had at the listed establishment location. This total employment number provided a base level for some other statistical comparisons.

The next question asked about the organization's involvement in one or more of six listed green economic categories. About 14 percent said they were participating in one or more of the categories. The table above shows the percent involvement in the six listed green economic categories. The survey responses have been weighted to reflect all businesses in the sample universe.

The inside portion of the survey questionnaire requested employers to list the job title of workers who met the green job definition. Employers also reported the number of workers by each job title. As shown in the table below, the survey found approximately 4 percent of all workers could be classified as green workers. Meanwhile, about 11 percent of all South Dakota employers have employees performing green-related activities, based on the green jobs survey results.

South Dakota Employees with Green-Related Activities (Weighted Response)		
	Number	**Percent**
Employers Who Have Employees Performing Green-Related Activities	2,977	11%
Employees Performing Green-Related Activities	14,910	4%

Using the North American Industrial Classification System (NAICS) code assigned to the employer as part of sample selection, it was possible to categorize the green jobs by industry sector. The total worker tally came from the first question on the survey, where respondents indicated how many employees were at this establishment's location. As shown in the weighted response table at the right, employers in the health care and social assistance industry had the largest number of total workers in the sample universe. The green worker figures are based on responses from only those employers who indicated green jobs. The industry with the greatest number of green workers and the highest percent of green workers was the construction industry. The manufacturing industry exhibited the next largest number of green workers.

The green jobs survey asked employers to categorize their green workers by the amount of time dedicated to green work. About 43 percent of the employers who completed this question said their green employees spend less than one-half their time dedicated to green activities.

South Dakota Green Workers Percent of Time Dedicated to Green Work

Time Dedicated to Green Work	Number	Percent
Between 1-49%	6,331	43%
Between 50-99%	3,319	22%
100%	5,260	35%
Total	**14,910**	**100%**

South Dakota Green Employment by Industry Sector (Weighted Response)

NAICS	Title	Total Workers	Green Workers	Percent
11	Agriculture, Forestry, Fishing and Hunting	4,257	627	15%
21	Mining	845	12	1%
22	Utilities	2,373	172	7%
23	Construction	21,289	3,962	19%
31	Manufacturing	36,744	2,724	7%
42	Wholesale Trade	18,730	1,206	6%
44	Retail Trade	49,712	990	2%
48	Transportation & Warehousing	11,641	245	2%
51	Information	5,586	16	0%
52	Finance and Insurance	25,309	60	0%
53	Real Estate and Rental and Leasing	3,898	114	3%
54	Professional, Scientific and Technical Services	11,651	548	5%
55	Management of Companies and Enterprises	1,755	0	0%
56	Administrative and Support and Waste Management and Remediation Services	13,115	292	2%
61	Educational Services	35,260	717	2%
62	Health Care and Social Assistance	62,749	555	1%
71	Arts, Entertainment and Recreation	8,857	138	2%
72	Accommodation and Food Services	37,440	287	1%
81	Other Services	10,405	326	3%
92	Public Administration	28,351	1,917	7%
	Total	**389,967**	**14,910**	

Employers also provided a wage distribution for green workers, using the Occupational Employment Statistics (OES) wage categories. The $11.50-$14.49 and $14.50-$18.24 wage intervals contained the largest number of green workers.

South Dakota Wage Distribution for Green Workers

Hourly Wage Category	Number	Percent
Under $9.25	1,139	7.64%
$9.25-$11.49	1,851	12.41%
$11.50-$14.49	4,443	29.80%
$14.50-$18.24	3,052	20.47%
$18.25-$22.74	1,658	11.12%
$22.75-$28.74	996	6.68%
$28.75-$35.99	814	5.46%
$36.00-$45.24	816	5.47%
$45.25-$56.99	94	0.63%
$57.00-$71.49	19	0.13%
$71.50-$89.99	0	0.00%
$90.00 and over	28	0.19%
Total	**14,910**	**100%**

In the green jobs survey, respondents were asked to provide job titles for their green workers and a brief description of the job. South Dakota staff then matched these job titles and descriptions to a Standard Occupational Classification (SOC) code. A total of 14,910 green workers were identified in the survey.

South Dakota Occupations with Largest Number of Green Workers

SOC Code	SOC Title	Number of Green Workers	Percent of Total Green Workers
51-4072	Molding, Coremaking and Casting Machine Setters, Operators and Tenders	978	6.6%
51-9199	Production Workers, All Other	805	5.4%
47-2031	Carpenters	715	4.8%
47-2111	Electricians	539	3.6%
19-1031	Conservation Scientists	527	3.5%
47-2021	Brickmasons and Blockmasons	413	2.8%
49-9021	Heating, Air-Conditioning & Refrigeration Mechanics and Installers	364	2.4%
49-9042	Maintenance and Repair Workers, General	341	2.3%
49-9099	Installation, Maintenance and Repair Workers, All Other	308	2.1%
37-2011	Janitors and Cleaners, except Maids & Housekeeping Cleaners	304	2.0%

Note: SOC is the Standard Occupational Classification system.

The table above lists the 10 occupations with the largest number of green workers.

Employers responded to questions about green job creation, current vacancies and the projected number of jobs created or eliminated. The questionnaire asked how many of the green jobs reported by employers had been created or modified to include green tasks since January 2009. With respect to current vacancies, employers with green workers indicated how many current

South Dakota Green Jobs Creation, Modification & Current Vacancies

New Jobs with Green Tasks	Current Vacancies	Projected Jobs	
		Created	Eliminated
650	637	635	615

Note: A vacancy exists if it meets the following criteria: a specific position exists; work would start within 30 days; and the employer is actively seeking workers to fill the position.

vacancies the organization had for the green jobs listed. Respondents also provided information on how many green positions the organization expects to create or eliminate within the next two years. Because green jobs account for a small portion of all jobs, none of the numbers reported at the bottom of page 16 were significant.

In addition to the standardized questions asked by all consortium states, South Dakota asked employers who did not have any green jobs a couple of additional questions. One of them was, "What obstacles or limitations have prevented your organization from having green jobs?" It was not surprising to find "no green job opportunities in our business" was the most frequent response, by far.

The last state-specific question for employers who did not report any green jobs was, "Does your organization plan on creating any green jobs in the future?" Only 4 percent of those employers without green jobs indicated plans to create green jobs.

South Dakota Employers' Plans for Creating Future Green Jobs

	Number	Percent
Employers planning on creating "green" jobs in the future	1,054	4%

Among those employers who reported having no green jobs, the most common response, by far, as the reason for not having green jobs was simply that no green opportunities exist within their type of business.

South Dakota Employers' Reasons for Not Having Green Jobs

Employers Who Do Not Have Employees Who Perform Green-Related Activities	24,842	89%
Reasons for Not Having Green Jobs		
Cost of implementation	1,261	5%
Lack of information	1,282	5%
Shortage of workers with the knowledge or skills	406	2%
Shortage of available training programs	448	2%
There are no "green" job opportunities in our type of business	18,716	75%
Other	1,406	6%

Note: Respondents could select more than one reason.

Chapter 4

New Hires in Green Industries

One of the key components of the green jobs consortium project was to research the future demand for green jobs. Demand for workers can be looked at from many different perspectives, including occupational projections, job openings listed and workers being hired to staff businesses. South Dakota and four other consortium states decided to use data on newly hired workers to better understand future demand for green jobs. In addition, workers who have been recently hired were of special interest for this new hires research project because of the greater likelihood they would represent newly created green jobs.

One potential strategy to gather information about newly hired workers would be to conduct a large survey of all employers to determine the new hires. Instead, the research project attempted to reduce employer burden by obtaining some of the new hire information from state administrative databases. South Dakota selected new hires using a match between covered worker wage records and unemployment insurance accounts.

The first step in the new hires identification procedure was to determine which workers covered by South Dakota's unemployment insurance program could be classified as new hires in a specific quarter. Any worker who became employed by a covered business in the fourth quarter of 2009, but had not been employed in the previous quarter (third quarter 2009) and had not been employed in the fourth quarter of 2008 (to eliminate seasonal fourth quarter rehires) was considered a new hire. In addition, only those new hires who were still employed in the first quarter of 2010 were retained. The research involved both private-sector and public-sector new hires in South Dakota.

The administrative data research produced valuable information about the characteristics of newly hired workers. Through the use of the unemployment insurance covered worker, employment service placement and other sources of administrative data, the researchers were able to provide a clearer picture of newly hired workers. Wage records and other state administrative databases were used to provide information about these new workers' demographic characteristics, quarterly earnings, changes in earnings level, job tenure and placement services.

In addition to administrative data matching, the new hire research included a mail survey to gather information not available on administrative databases. State staff selected a small sample of new hires; the sampling frame included 1,380 new hires. Each survey form identified

one new hire at the firm. Each firm could get more than one survey, but there was a limit of four survey forms per employer. A copy of the New Hires Employer Survey questionnaire can be found in Appendix B.

While the South Dakota Green Jobs Employer Survey used a random sample of businesses in all industry sectors, the new hires survey was sent only to businesses in industries which exhibited a minimum level of green workers (at least 3 percent green workers and more than 10 green workers in the industry based on the South Dakota Green Jobs Employer Survey results). To minimize employer burden, it was important to make sure the new hires sample did not include any businesses that had been mailed the initial green jobs employer survey. A scientifically drawn sample was selected from employers in the four-digit North American Industry Classification System (NAICS) industry sectors meeting the minimum criteria. The only random part of the new hires selection process occurred when an employer had more than four new hires in the quarter, and only four new hires could be chosen.

For the purposes of the South Dakota new hires survey, green workers were operationally defined as those employees who dedicate more than 50 percent of their time to green activities related to producing a product or service that improves energy efficiency, expands the use of renewable energy or supports environmental sustainability. (This is different from the initial green jobs survey where green jobs included those dedicating less than 50 percent of their time.) Most green jobs research uses the output approach to defining green jobs, although the percentage of time dedicated to green activities varied. To help further define the level of greenness, the new hires survey asked a question about the reason for the new worker being hired.

The survey form sent to each employer contained the name of the newly hired worker. The employer had to verify that the worker was employed at the firm during the first quarter of 2010. The employer was then asked to identify the current position title of the listed worker. The survey requested information about the employee's current responsibilities. If the worker spent more than 50 percent of work time dedicated to green activities, the employer was asked to indicate the education and training, basic work skills and technical work skills required for the position. The survey provided a question about whether the individual had been hired to fill a newly created position because of additional green activities. The employer was also asked to rate the availability of job applicants with the right skills for the position. One of the last survey questions dealt with whether the position was listed with South Dakota's public labor exchange, SDWORKS.

A total of 1,380 new hires were selected for the new hires survey. The new hires survey was mailed to the 844 employers in November 2010. Employers had the option of returning the survey by mail, faxing the survey form or calling a toll-free number. Employers who did not respond were sent the survey a second time. Following the second mailing, the response rate reached the survey goal. In an effort to obtain additional occupational and skills information and to resolve questionable answers, a telephone follow-up of selected employers was undertaken.

Since employers have different views on what a green job really is, South Dakota staff tried several different approaches to further define green activities and green jobs. In addition to the survey question about whether the worker was hired for a newly created green job, they also used another process to determine the greenness of the workers position. South Dakota used R.M. Wilson Consulting Inc.'s Green Job Extractor to determine whether the newly hired worker's position should be classified as a green job.

New Hires Demographic and Economic Characteristics

Because the new hires research started with a relatively large group of new hires during the fourth quarter of 2009, the characteristics data on new hires was sufficient for comparisons to other research data and further analysis. The research gathered demographic characteristics, quarterly earnings, changes in earnings level, job tenure and placement services information about these new workers.

This section focuses on basically two groups of new hires — the 1,380 new hires in the employer survey sample and the larger group of new hires who met the new hire selection criteria. The new hires in both of these groups were based on new hires in the fourth quarter of 2009. It is important to remember only new hires in industries that employed a certain level of green workers were included in the new hires survey, and employers who were part of the initial green jobs survey were excluded from the new hires survey. There is an important distinction between these new hires counts and green worker numbers from the initial green jobs survey. It is highly likely some of these new hires are green workers, but the tabled data on these two groups of new hires is not intended to reflect the characteristics of green workers. (A later portion of this chapter will talk specifically about new hires who work in green activities.)

Using administrative data on quarterly earnings, staff did a comparison of quarterly earnings for workers who were new hires in the employer survey sample. A calculation of the data in the following table shows there was a 33.0 percent increase in quarterly earnings from the fourth quarter of 2009 to the second quarter of 2010. (The second quarter was the latest quarterly earnings data available at the time these estimates were compiled.) Of course, some of this change could be explained by differences in the number of hours worked in the different quarters. Nevertheless, the new hires showed a substantial gain in earnings.

Quarterly Earnings Increase Among New Hires in the Employer Survey Sample	
Number of New Hires	1,380
4th Qtr. 2009 Wages	$4,036.98
1st Qtr. 2010 Wages	$4,328.60
2nd Qtr. 2010 Wages	$5,369.09

South Dakota also calculated the change in earnings from fourth quarter 2009 to second quarter 2010 for all new hires across all industries, using the data at the top of the column to the right. The percentage increase for all new hires was much higher at 63.6 percent.

While the increases were smaller for the 1,380 new hires in the employer survey, their quarterly earnings were higher than for the larger group of new hires across all industries. In comparison, a calculation of the quarterly earnings for all workers (new hires plus incumbent workers) showed a decrease of 10.3 percent during those same quarters.

Quarterly Earnings Increase Among All New Hires	
Number of New Hires	29,736
4th Qtr. 2009 Wages	$2,716.27
1st Qtr. 2010 Wages	$3,664.23
2nd Qtr. 2010 Wages	$4,445.05

The following table exhibits the distribution of new hires in the employer survey sample by gender and shows the quarterly earnings for the three quarters used for comparison.

New Hires by Gender & Earnings Employer Survey Sample	
Gender Not Available	
Number of New Hires	279
4th Qtr. 2009 Wages	$4,194.59
1st Qtr. 2010 Wages	$4,100.82
2nd Qtr. 2010 Wages	$5,548.15
Female	
Number of New Hires	241
4th Qtr. 2009 Wages	$2,312.49
1st Qtr. 2010 Wages	$2,882.90
2nd Qtr. 2010 Wages	$3,299.15
Male	
Number of New Hires	860
4th Qtr. 2009 Wages	$4,469.11
1st Qtr. 2010 Wages	$4,807.63
2nd Qtr. 2010 Wages	$5,995.64

New Hires by Age Category and Earnings Employer Survey Sample				
Number of New Hires	Age Group	4th Qtr. 2009 Wages	1st Qtr. 2010 Wages	2nd Qtr. 2010 Wages
152	n/a	$5,360.19	$5,052.38	$6,884.14
8	14-15	$575.63	$660.38	$1,035.50
96	16-19	$1,746.04	$1,886.38	$2,606.64
221	20-24	$2,745.91	$3,375.36	$4,583.71
215	25-29	$3,650.75	$4,102.29	$5,334.71
152	30-34	$4,081.88	$4,482.41	$5,395.72
141	35-39	$4,139.44	$4,700.18	$5,897.84
116	40-44	$4,512.01	$4,637.28	$5,906.04
105	45-49	$4,607.52	$4,641.56	$6,413.00
76	50-54	$5,001.13	$4,726.33	$4,768.66
55	55-59	$7,466.78	$9,531.69	$7,539.26
40	60-79	$3,641.38	$3,220.13	$4,203.33
3	80+	$14,866.67	$3,200.00	$3,200.00

The age composition of the new hires in the employer survey sample is quite young. As shown in the table at the left, a large number of them are in their twenties, with the 20 to 24 and 25 to 29 age groups having the largest number of new hires.

The 14 to 15 age group must include mostly part-time workers, based on the low quarterly earnings. It is not surprising to learn the mid-age new hires earn more money, probably because they have more work experience.

Green Spotlight on a South Dakota Agency

The mission of the South Dakota Department of Agriculture is to:

- *Provide for the conservation of the soil and soil resources.*
- *Control and prevent soil erosion.*
- *Prevent floodwater and sediment damages.*
- *Further the conservation development, utilization and disposal of water.*
- *Preserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, preserve wildlife, protect the tax base, protect public lands, and protect and promote the health, safety and general welfare of the people of South Dakota.*

Because this report is on the greening of the South Dakota economy, it is important to look at the new hires from different viewpoints. One of those would be a review of the difference in new hires by business activity or industry sector. Because the industry designations were part of the sample selection criteria, the industry classification is available for all 1,380 new hires in the employer survey sample. Because of space constraints, only one quarter of annual earnings is shown.

Although the industry/quarterly earnings table lists major industry sectors, the counts do not include new workers from all the detailed industries found within the major sectors, because some of them would not have been selected during the sampling process. The new hire counts include only new workers found in detailed industries with a significant level of green workers (matching or exceeding the average found in the green jobs survey). The highest count of new hires in the employer survey sample for the second quarter of 2010 are found in the construction sector. This is not too surprising since that industry's hiring pattern is quite seasonal, and most contractors would be hiring during the second quarter for summer construction projects. The retail industry is a large employer, and a significant number of workers have to be hired each quarter. It is not surprising to note the health care and social assistance industry sector is among the highest paying sectors for new hires, since that industry is one of the highest paying overall. The hiring for new hires in the transportation and warehousing industry sector is a bit of a surprise, as it is not one of the higher paying industry sectors.

New Hires by Industry and Earnings
Employer Survey Sample

Number of New Hires	NAICS Code	Industry	2nd Qtr. 2010 Wages
118	11	Agriculture, Forestry, Fishing and Hunting	$6,998.06
2	22	Utilities	$3,495.50
694	23	Construction	$5,477.69
59	31	Manufacturing	$5,505.62
20	42	Wholesale Trade	$5,408.53
283	44	Retail Trade	$3,335.07
4	48	Transportation and Warehousing	$11,177.00
19	53	Real Estate and Rental and Leasing	$6,427.21
33	54	Professional, Scientific and Technical Services	$8,084.52
21	56	Administrative and Support and Waste Management and Remediation Services	$7,217.00
9	61	Educational Services	$4,641.56
9	62	Health Care and Social Assistance	$10,949.00
3	71	Arts, Entertainment and Recreation	$11,200.00
105	81	Other Services	$5,679.29
1	92	Public Administration	$2,503.00

Note: NAICS is the North American Industrial Classification System.

One of the components of this research was to review new hires for jobs advertised in a state labor exchange posting. One of the questions on the new hires survey form asked, "Was the opening for this position listed with the South Dakota Department of Labor or on the SDWORKS website?" South Dakota staff compared the quarterly earnings for the fourth quarter of 2009 to the earnings for the second quarter of 2010. The percentage increase for new hires in the employer survey sample not listed on SDWORKS was a 21.4 percent gain. The increase for new hires on SDWORKS was a 43.3 percent gain.

Although the new hires who were SDWORKS hires started from lower base earnings, they had a significantly higher earnings gain. Again it must be noted these new hires are not necessarily green workers, but new hires staffed in industries with a significant level of green workers.

SDWORKS Listed New Hires Employer Survey Sample				
Number of New Hires	In SDWORKS 2008 to 2009	4th Qtr. 2009 Wages	1st Qtr. 2010 Wages	2nd Qtr. 2010 Wages
552	No	$5,227.12	$5,463.45	$6,343.89
828	Yes	$3,243.56	$3,572.04	$4,646.55

In addition to researching new hires whose positions were listed on SDWORKS, the project included a review of earnings increases for workers who were unemployment claimants before being hired. Because the unemployment status comes from administrative data, the following table includes all 1,380 new hires in the employer survey sample. A comparison of earnings gains from fourth quarter 2009 to second quarter 2010 shows the unemployment insurance claimant new hires enjoyed the largest gains. This large gain is probably not too surprising since many of the unemployment insurance claimants had previous job experience and would have some pay-increase-potential advantages over workers without experience.

Unemployment Insurance Claimant New Hires Employer Survey Sample				
Number of New Hires	UI Claimants 4th Qtr 2008 to 4th Qtr. 2009	4th Qtr. 2009 Wages	1st Qtr. 2010 Wages	2nd Qtr. 2010 Wages
1,239	No	$4,101.14	$4,351.31	$5,324.08
141	Yes	$3,473.19	$4,129.04	$5,800.51

New Hires Survey Results

One of the first questions on the new hires survey form asked respondents to identify the job title and current responsibilities of the new hire's position. South Dakota staff used a computer program, the R.M. Wilson Consulting Inc.'s Green Job Extractor (GJE), to match job titles to Standard Occupational Classification (SOC) occupational titles.

Although all respondents were asked the question about job title and position, occupational information was only available for the 650 new hires provided by the employer survey respondents. The first table on the following page exhibits the 10 occupations that showed the highest counts of new hires. It is important to note new hires in these occupations may not be green workers; the occupations listed are those of new hires found in industries that contain a significant level of green workers.

The GJE program was also used to ascertain the greenness of a newly hired worker's position, based on the job titles and responsibilities.

Green Spotlight on a South Dakota Business

Enercept is located in Watertown, South Dakota. Since 1982, Enercept has become one of the world's leading manufacturers of structural insulated panels, known in the building industry as SIPs. Enercept SIPs, similar in design to "tilt-up" panels, are composed of a solid layer of EPS (expanded polystyrene insulation) laminated between oriented strand board (OSB) to form an exterior framing system of superb energy efficiency and strength. Engineered studies and performance tests have shown SIPs to be stronger, quieter, safer, faster to construct and 50 percent more energy efficient than traditional methods of construction.

Most Reported Occupations and Earnings Employer Survey Sample			
SOC* Code	SOC* Title	Number of New Hires	2nd Qtr. Wages
47-2061	Construction Laborers	99	$4,807
41-2011	Cashiers	48	$1,903
47-2031	Carpenters	41	$5,530
45-2093	Farmworkers, Farm, Ranch and Aquacultural Animals	26	$5,635
49-3023	Automotive Service Technicians and Mechanics	25	$4,317
47-1011	First-Line Supervisors/Managers of Construction Trades and Extraction Workers	22	$8,745
41-2031	Retail Salespersons	19	$2,729
47-2111	Electricians	19	$5,915
43-6014	Secretaries and Administrative Assistants, except Legal, Medical and Executive	15	$2,310
47-3012	Helpers, Carpenters	13	$2,740
*SOC - Standard Occupational Classification			

The Green Job Extractor uses six levels of greenness. The GJE green levels are defined in the table running across the bottom of this page.

As can be deducted from the top table on the following page, the GJE identified a sum of approximately 196 (30 percent) of the newly hired workers as being some level of green. Typically the number of green jobs reported through industry-wide employer surveys is around 3 percent, but a higher number was expected from this survey, as it targeted industries identified to be green. In the case of new hires, the highest level (dark green) was not reached for any of the new hires in the study.

Green Jobs Extractor (GJE) Green Level Descriptions		
Level	Description	Example
Dark Green	Jobs that are purely green in focus, activities and skills.	Environmental Sustainability Planner
Medium Green	Jobs that are primarily green in focus, activities and skills.	Solar Engineer (shares some skills with electrical engineers)
Light Green	Jobs that are somewhat green in focus, activities and skills.	Bus Driver (has green focus [mass transit] but activities and skills are similar to non-green drivers [ambulances])
Near Green	Typically non-green jobs working in support of the green economy.	Maintenance Technician (maintains operation of equipment; improved efficiency may reduce energy use)
Neutral	Jobs with no significant positive or negative impact on the green economy.	Bank Teller
Anti-Green	Jobs that can be in conflict with the goals of the green economy.	Military and mining occupations

The largest number of new hires were categorized in the neutral level by the GJE. Because not all employers responded to the survey or provided job position information, the GJE could not be applied to all new hires in the employer survey sample.

Level of Green Determined by Green Jobs Extractor Employer Survey Sample

Green Level	Number of Workers	Percent of Total
Dark Green	0	0%
Medium Green	7	1%
Light Green	111	17%
Near Green	78	12%
Neutral	473	71%
Anti-Green	1	0%
Total Workers	670	100%

Note: Percentages may not add sum to 100 due to rounding.

The following table shows quarterly earnings change by quarter for the workers determined to be green by the GJE. Since not all in the sample responded to the survey questionnaire, there is information on 670 out of the 1,380 total new hires. The non-respondents are shown on the first line of the table as n/a under the green code category.

There are many research sources that talk about new green jobs being higher-paying jobs. The table below shows the anti-green level and the medium green level have the highest quarterly earnings. However, the small number of new hires in those categories makes it difficult to generalize about earnings differences.

On a positive note for green jobs, the new hires in the light green level have higher earnings than the neutral or near green levels.

Although survey responses were limited, the research indicates anti-green and medium-green jobs have the highest earnings.

New Hires Level of Green and Earnings Employer Survey Sample

Number of New Hires	Green Code	Green Level	4th Qtr. 2009 Wages	1st Qtr. 2010 Wages	2nd Qtr. 2010 Wages
709	n/a	n/a	$4,515.41	$4,315.23	$5,755.78
2	G0	Anti-Green	$6,258.00	$6,919.50	$8,969.00
473	G1	Neutral	$3,183.44	$4,237.75	$4,633.19
78	G2	Near Green	$3,922.47	$4,298.08	$5,038.97
111	G3	Light Green	$4,433.12	$4,484.55	$6,418.53
7	G4	Medium Green	$7,614.57	$8,949.57	$7,309.86

Percentage of Time Dedicated to Green Activities 2010 New Hires Employer Survey				
Number of New Hires	Percentage of Time Dedicated to "Green" Activities	4th Qtr. 2009 Wages	1st Qtr. 2010 Wages	2nd Qtr. 2010 Wages
711	n/a	$4,510.19	$4,318.54	$5,749.34
215	Less than 50% of the time	$4,238.16	$4,749.69	$5,855.43
47	More than 50% of the time	$4,559.04	$6,282.98	$6,987.18
407	None of the time	$3,043.77	$3,898.05	$4,239.99

New Hires Green Jobs

In addition to the perspective from the Green Job Extractor table on the greenness of new hires' jobs, the new hires employer survey also asked respondents to identify the percentage of time dedicated to green activities. Only new hires who dedicated more than 50 percent of their time to green activities were considered to be green workers in the new hires survey. A total of 669 new hires were identified as green workers. From this data, it does appear newly hired green workers are better paid, although the sample is again quite small.

Approximately 7 percent of the new hires dedicated more than 50 percent of their time to green work activities, which are defined as "producing a product or service that improves energy efficiency, expands the use of renewable energy or supports environmental sustainability." The South Dakota Green Jobs Employer Survey found 3.8 percent of all jobs were green jobs. It appears the higher percentage of green workers among the new hires could mean that more of the new jobs are green and could lead to a higher percentage of green jobs overall. Also, the higher level of green in the New Hires Employer Survey is not unexpected, since the survey included only industries known to have green activities.

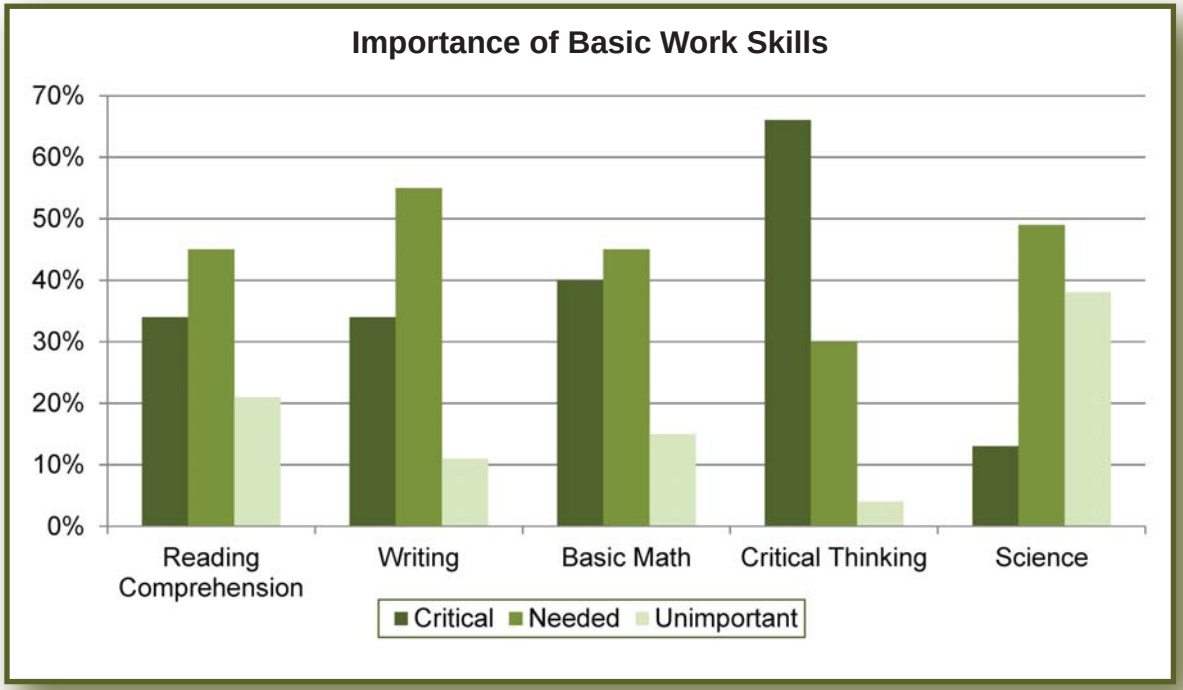
New Hires Green Jobs Education and Skills

One of the goals of the new hires survey was to collect information on education, training, basic work skills and basic technical skills for green workers. So this part of the analysis deals only with those green workers who spent more than 50 percent of their time on green activities. Although it helped to reduce employer burden, both of those factors resulted in a small number of new hire positions to analyze. However, the results of the new hires research can still be used as a complement to the much larger initial South Dakota green jobs survey data to provide a more comprehensive picture of education/skills and training requirements for green jobs.

The New Hires Employer Survey question on education and training revealed most new hire green worker positions require a high school diploma, work experience or on-the-job training, although the multiple responses make detailed comparisons difficult. The limited need for advanced education could possibly be explained by the probability that most of these new green jobs are on the lower level of greenness. They may be in the category of green enhanced demand occupations, which are green jobs with increased demand but entail no significant changes in the work and worker requirements. The work context may change, but the tasks themselves do not. So there is no need for advanced education to gain technical skills.

2010 New Hires Employer Survey Education and Training Requirements of Green Job		
Education or Training Required for the Position	**Number of New Hires**	**Percent of All New Hires**
None required	6	13%
High school diploma or GED	19	40%
On-the-job training	34	72%
Postsecondary technical training	2	4%
Associate degree	1	2%
Work experience in related occupation	15	32%
Licensure or certification	4	9%
Bachelor's degree or higher	3	6%
Other	3	6%
Note: Respondents could choose more than one response.		

The vast majority (more than 60 percent) of employers rated critical thinking as a vitally important skill for workers in green jobs.



The New Hires Employer Survey questionnaire included a question about whether the new hire was employed to fill a new position because of additional green activities. Not all employers responded to the question; the responses accounted for only 46 new hires. Five new workers (11 percent) were hired because there was a newly created green job. The survey also revealed 6 percent of the workers were hired to fill newly created positions because of additional green activities within businesses.

Regarding basic work skills, more than 60 percent of the employers who responded indicated critical thinking was a critically needed skill for the new hire position. Math was also rated highly as a critically needed skill, followed by writing and reading comprehension.

Another question asked respondents with newly hired green workers to list the most important technical work skills. Since responses to this question only included new hires who spend more than 50 percent of their time working in green activities, the total count was only 284. The following table lists those skills that at least three respondents indicated. (It should be noted several of the skills on this list are not technical skills, but basic work skills.) It appears employers believe computer proficiency is clearly needed for these types of newly hired.

Technical Work Skills for Green Positions

Technical Work Skills	Number of New Hires
Computer proficiency	19
Computer skills	7
Organizational skills	6
Math skills	5
Math	5
Computer familiarity	4
Steel fabrication	4
Communication skills	4
Problem solving	4
Comprehension of construction drawings	3
Rigging	3
Writing	3
Critical thinking	3
Physical ability	3
Valid driver's license	3
Leadership	3
People skills	3
Reading	3

Availability of Job Applicants with Skills Required for Green Positions

Types of Skills Required	Less than Adequate	Just Right	More than Adequate
Basic work skills	51%	36%	9%
Technical work skills	57%	21%	9%

New Hires Green Job Applicant Skills

Employers were asked to rate the availability of job applicants with the basic work skills and basic technical skills needed for the newly hired green worker's position. It appears that a large number of employers believe that the applicant pool is lacking in both basic work skills and technical work skills. Employers were asked to identify the one basic work skill critical for this position that was most often lacking in job applicants. The basic work skills responses to this question totaled 98. The next table displays the basic work skills that were listed by more than one respondent.

Basic Work Skills Lacking in Job Applicants

Basic Work Skills Critical for this Position that Applicants Lack	Number of Responses
Experience	5
Work ethic	7
Ethanol experience	4
Lacking basic education skills, writing, reading, following instructions	4
People skills	4
Showing up for work	4
Dependability	3
Attendance	2
Availability to travel	2
Common sense	2
Math	2
Positive work history	2
Reliability	2

Respondents with green workers were asked to indicate the one basic technical skill critical for this position that was most often lacking in job applicants. There were only 78 responses to this question. The next table displays the basic technical work skills that were listed by more than one respondent. Again, a few of these responses would not be classified as technical work skills.

Basic Technical Skills Lacking in Job Applicants

Basic Technical Skills Critical for this Position that Applicants Lack	Number of Responses
Problem solving	5
Ethanol experience	4
Dependability and attitude	3
Ambition	2
Basic carpentry	2
Common sense/ability to learn	2
Communication	2
Experience	2
Reading and understanding blue prints	2
Work ethic	2

South Dakota staff also used the O*NET skills profile to provide additional information about important skills needed for the green jobs reported on the new hires employer survey. Staff used the Autocoder software to classify the jobs from the new hires survey into the Standard Occupational Classification (SOC) system. Then those occupations were cross-walked to the O*NET list of skills. The resulting O*NET skills are listed at the right in descending order of relevance.

Critical thinking, active listening, coordination, monitoring, speaking and reading comprehension were among the most important skills for these occupations. These same skills were identified by the employers on the new hires survey, with critical thinking being highly ranked by employers.

In addition, coordination, problem solving and reading comprehension were also indicated by new hires employers. One of the biggest differences was computer skills — many new hires employers noted a need for computer skills among green jobs, while the O*NET skills profile did not list any computer-related skill except for computer programming — and it had a very low value ranking.

O*Net Critical Skills

Skills
Critical thinking
Active listening
Coordination
Monitoring
Speaking
Reading comprehension
Time management
Complex problem solving
Judgment and decision making
Operation monitoring
Social perceptiveness
Active learning
Quality control analysis
Operation and control
Writing

Active listening, coordination, monitoring and speaking joined critical thinking and reading comprehension on the list of skills essential for green occupations.

New Hires Green Jobs Listed on Public Exchange

Employers were asked if the new hire position was listed with a South Dakota Department of Labor and Regulation (DLR) local office or the SDWORKS website (the state hosted job search database). Not very many employer respondents indicated that these new green positions were posted with the public labor exchange. However, a review of the total number of new hires showed that about 60 percent of all new hires in the employer survey had been listed.

It was also possible to use the Green Job Extractor to determine how many green jobs had been listed with South Dakota's public labor exchange. Based on the Green Job Extractor analysis of green jobs, 64 percent of the new hires designated as green jobs were listed on SDWORKS.

The information gathered from the new hires research can be referenced by educators, employment training organizations and vocational counselors to identify those skills most needed by green activity employers in the state, and then to help develop curricula emphasizing those skills. This should improve the likelihood South Dakota employers will be able to find workers with skills essential to their businesses.

Green Spotlight on a South Dakota Business

GenPro Energy Solutions of Piedmont, South Dakota, provides environmentally friendly, renewable energy products in the form of photovoltaic (pv) modules, wind turbines, solar thermal heating systems and other energy systems for grid-tie and off-grid applications. They also specialize in energy efficient systems for water pumping, water purification and LED lighting.

GenPro provides expertise on the design and implementation of solar and wind power generation systems ready for off-grid, grid-tie, back-up and utility bill reduction. Its solar and wind power generation systems are used for residential, commercial, state and federal government entities nationwide.

Chapter 5

Green Skill Requirements in the Labor Exchange System

As previously discussed in Chapter 2, demand for green workers in an important part of research on the greening of the South Dakota economy. One way to gauge demand for green jobs is to look at job openings/vacancies for green workers. Because an employer survey would be costly and impose an additional burden on employers, the state decided to use administrative data already collected by the South Dakota Department of Labor and Regulation (DLR). Using that strategy, South Dakota looked at the level of openings for green jobs listed with the state's labor exchange.

The state conducted green research on job orders for workers placed by employers with the state's labor exchange system, SDWORKS. South Dakota used a process called data mining to learn about the greenness of the job orders and workers placed.

Green Jobs in the Labor Exchange System

Current published studies suggest between 1 and 4 percent (depending on the strictness of the definition) of the jobs in the economy are some shade of green. The results of South Dakota's Green Jobs Employer Survey indicates 3.8 percent of jobs are green. One might suspect the same level of greenness would be represented within the number of posted job ads. However, identifying the number of green jobs advertised within the much larger volume of non-green ads can be a daunting challenge because the definition of a green job is still evolving, including the keywords used to describe these jobs.

R.M. Wilson Consulting Inc. developed the Green Job Extractor (GJE), to provide a standardized approach to identify green jobs hidden within job boards. The GJE is able to process large volumes of data, assigning a green level to each record; these green levels are defined in the GJE Green Level Descriptions table on the following page.

Green Jobs Extractor (GJE) Green Level Descriptions		
Level	**Description**	**Example**
Dark Green	Jobs that are purely green in focus, activities and skills.	Environmental Sustainability Planner
Medium Green	Jobs that are primarily green in focus, activities and skills.	Solar Engineer (shares some skills with electrical engineers)
Light Green	Jobs that are somewhat green in focus, activities and skills.	Bus Driver (has green focus [mass transit], but activities and skills are similar to non-green drivers [ambulances])
Near Green	Typically non-green jobs working in support of the green economy.	Maintenance Technician (maintains operation of equipment; improved efficiency may reduce energy use)
Neutral	Jobs with no significant positive or negative impact on the green economy.	Bank Teller
Anti-Green	Jobs that can be in conflict with the goals of the green economy.	Military and Mining occupations

The South Dakota DLR utilized the GJE to determine how many of the job openings posted to SDWORKS (the state-hosted job search database) during Program Year 2009 (July 1, 2009 through June 30, 2010) had green-related attributes.

Most (85 percent) of the job openings were found to be neutral, while 3 percent were anti-green.

Approximately 7,200 (12 percent) of the 59,604 job openings were classified as green. Only three of these green openings (0 percent) were classified as dark green, 212 (3 percent) were classified as medium green, and the remaining were classified as light or near green. The job openings posted to SDWORKS table at the right includes a summary of the jobs posted by the levels of greenness identified by the GJE.

South Dakota Department of Labor and Regulation Number of Job Openings Posted to SDWORKS July 1, 2009 through June 30, 2010		
Total Openings by Category	**Number of Job Openings**	**Percent of Openings**
Anti-Green	1,576	3%
Neutral	50,794	85%
Green	7,234	12%
Total	**59,604**	**100%**
Green Openings by Level of Greenness	**Number of Job Openings**	**Percent of Openings**
Near Green	3,970	55%
Light Green	3,049	42%
Medium Green	212	3%
Dark Green	3	0%
Total Green	**7,234**	**100%**

The GJE classified a much higher percent of job openings (12 percent) as green compared to the results of the green jobs employer survey, which showed 3.8 percent of all jobs in the South Dakota economy as being green. One reason the job openings show a higher rate of green jobs is related to openings which are advertised multiple times throughout a year due to high turnover rates for certain occupations. These multiple job listings throughout the year will have a multiplier effect on the number and percent of green jobs openings.

In addition to the multiple job openings factor raising the percentage of green job openings, there is another possibility. The green jobs employer survey applied a strict definition, requiring that green workers produce a green product or green service. In other words, a carpenter building an energy efficient house would be reported as a green worker, while a carpenter building a regular house would not be considered green in the initial green jobs survey. The GJE would probably classify all construction carpenters as green.

The continually evolving definition of a green job also comes into play. The GJE identifies occupations by levels of green. For instance, the South Dakota employer survey's guidance on what was meant by green indicated landscaping workers should not be counted as green. However, the GJE classified some landscaping and grounds keeping positions as green, and depending on their job descriptions, these workers were sorted into different levels of green (near, light, medium, etc.) The GJE classified 882 of the 1,354 landscaping job openings as green, which provides additional insight into why there is a higher rate of green jobs reported within the labor exchange system.

With respect to the job openings classified as green, it is interesting to note the openings classified as dark green and medium green represent about 3 percent of the green job openings, while the light green and near green jobs represent 97 percent of the total green openings.

Green Spotlight on a South Dakota Business

Jim Scull Construction Services is a leader in LEED practices (Leadership in Energy and Environmental Design). Jim Scull Construction is a South Dakota based company specializing in green or "sustainable" buildings which use key resources like energy, water, materials and land more efficiently than buildings that are just built to code. With more natural light and better air quality, green buildings typically contribute to improved occupant health, comfort and productivity. During the construction process of a green building, Jim Scull Construction utilizes the LEED System, a Green Building Rating System developed by the U.S. Green Building Council. LEED encourages the adoption of sustainable green building and development practices while providing guidelines and requirements for buildings. The benefits of green buildings include lower energy and water bills, reduced greenhouse gas emission, and less exposure to mold, mildew and indoor toxins.

Chapter 6

Forecasting Demand for Workers in Green Jobs

In addition to looking at current demand in the form of new hires and job openings, it is also important to determine the future demand for green workers. All the states in the consortium produce short-term and long-term occupational projections across all industries on a scheduled basis. However, forecasting demand just for green workers in those occupations is a new step for most states.

The normal state occupational projections include a base year level, a projected year level, and annual openings. Projected occupational annual openings include openings due to growth demand and openings resulting from replacement demand. Growth demand is a result of business growth; new and emerging industries hiring new workers would be just one example of growth demand. The second type of demand is replacement demand where job openings are created when incumbent workers permanently separate from the labor force because of death, illness, retirement, etc.

Future Demand for Green Jobs

Since future demand for green jobs was something new, a new methodology had to be developed. South Dakota staff tried two different methodologies to determine the future demand for green workers. First, they replicated a procedure proposed by the consortium's projections lead state. The original consortium plans for green jobs projections had included a rigorous methodology similar to one state's use for their normal occupational projections, including the application of specific green jobs separation rates. Because of time constraints, the consortium had to adopt a different procedure. The simplified consortium projections methodology for South Dakota used a combination of consortium-wide green jobs staffing patterns, South Dakota detailed occupational estimates for 2009, and South Dakota occupational short-term projections data for all occupations to forecast growth openings, replacement openings and total openings for green jobs. One of the problems with this procedure was the lack of publishable detailed green jobs information and concerns about the application of consortium-wide staffing patterns to individual states. So the first round of simplified projections was used only for the consortium totals for projected green job openings.

Occupations Expected to Create the Most Green Jobs Through 2012
South Dakota Green Jobs Employer Survey

SOC Code	Standard Occupational Classification (SOC) Title
51-4072	Molding, Coremaking, and Casting Machine Setters, Operators and Tenders, Metal and Plastic
47-2031	Carpenters
49-9044	Millwrights
51-9199	Production Workers, All Other
47-4041	Hazardous Materials Removal Workers
51-1011	First-Line Supervisors/Managers of Production and Operating Workers
41-2031	Retail Salespersons
51-4121	Welders, Cutters, Solderers and Brazers
47-2061	Construction Laborers
53-3032	Truck Drivers, Heavy and Tractor-Trailer
11-9021	Construction Managers
49-9021	Heating, Air Conditioning and Refrigeration Mechanics and Installers
47-2181	Roofers
47-2111	Electricians
41-4012	Sales Representatives, Wholesale and Manufacturing, except Technical and Scientific Products
11-1021	General and Operations Managers
47-2121	Glaziers
47-2131	Insulation Workers, Floor, Ceiling and Wall
49-2096	Electronic Equipment Installers and Repairers, Motor Vehicles
17-1011	Architects, Except Landscape and Naval
17-1012	Landscape Architects
17-2051	Civil Engineers
51-4021	Extruding and Drawing Machine Setters, Operators and Tenders, Metal and Plastic
51-9121	Coating, Painting and Spraying Machine Setters, Operators and Tenders

Note: Occupations are sorted in descending order by the weighted number of expected jobs to be created through 2012.

South Dakota decided to use the results from the green jobs survey to estimate future demand for green workers. In the survey questionnaire, employers were asked to indicate, "How many positions in this green job does your organization expect to create within the next two years?" Staff then tabulated the survey results across all responses, and then ranked them. The table on page 35 lists the green jobs expected to create the most openings in the next few years.

Expected Worker Replacement Needs for South Dakota Green Industries using Local Employment Dynamics (LED)

Corresponding with the aging of the baby boom generation, an increasing portion of South Dakota's workforce is approaching retirement age. Consequently, the share of replacement needs stemming from retirement will increase as well.

To determine how many workers are expected to retire in the near future and therefore estimate replacement needs, the Labor Market Information Center used Local Employment Dynamics (LED) data published online by the U.S. Census Bureau. The LED data includes the Quarterly Workforce Indicators (QWI), data derived from an innovative system that merges data already collected from various sources. State Labor Market Information (LMI) agencies supply key data from unemployment wage records and from businesses each quarter. The Census Bureau merges the data provided by the LMI agencies with current demographic information to produce the data found on the LED website.

The QWI data was utilized to compare the estimated number of green workers in South Dakota who are near, at or beyond retirement, compared to the total number of workers in South Dakota who are near, at or beyond retirement.

For the purposes of this study, "near, at or beyond retirement age" is defined as workers who are 55 to 99 years old. The reference period for this analysis was the first quarter of 2010, which was the latest complete QWI data set available for South Dakota at the time this analysis was conducted. Therefore, annual average data referenced in this analysis included data for the prior three quarters as well (first quarter 2009 through first quarter 2010).

Green Workers Near, At or Beyond Retirement Age

To estimate the number of green workers who are near retirement age, the ratio of green workers reported by employers through the South Dakota Green Jobs Employer Survey was applied to the QWI data, specifically to the level of workers classified within the 55 to 99 age grouping. Industry-specific ratios were used, summarized into the North American Industrial Classification System (NAICS) industry sectors.

Using this methodology, there are an estimated 1,900 South Dakota workers employed in green jobs who are near, at or beyond retirement age. The construction and manufacturing sectors are expected to have the highest number of replacement needs. Several industries reported few or no green jobs; therefore, they had no expected green job replacement needs.

Total Workers Near, At or Beyond Retirement Age

Almost 74,000 workers are near, at or beyond retirement age in South Dakota. This is equivalent to 19.6 percent of total employment in South Dakota. Summarized at the NAICS industry sector level, the health care and social assistance industry topped the charts with 12,639 workers age 55 to 99 years in South Dakota. Retail trade came in second with 9,876 workers, with educational services in the third spot with 9,618 workers.

With the exception of the mining, quarrying and oil and gas extraction industry, which employed 169 workers in the targeted age range, all other sectors with reportable data employed at least 500 workers ages 55 to 99 years.

The table on the following page summarizes the QWI data used to estimate replacement needs by industry sector, including total employment data compared to the estimated level of green workers.

The QWI data, which includes worker information for 48 states by industry, geography, gender and age for a variety of employment statistics including turnover rates and job flows, can be accessed on the U.S. Census Bureau's website at http://lehd.did.census.gov/led/datatools/qwiapp.html .

South Dakota Replacement Needs Due to Retirement
Number of Green Workers Near, At or Beyond Retirement Age

NAICS Code	NAICS Industry	Total Employment Ages 14-99 Years	Total Employment Ages 55-99 Years	Percent of Total Employment by Industry Ages 55-99	Estimated Number of Green Workers Ages 55-99 Years	Percent of Total Employ-ment Ages 14-99
11	Agriculture, Forestry, Fishing and Hunting	3,570	715	20.0%	82	2.3%
21	Mining, Quarrying and Oil and Gas Extraction	783	169	21.6%	0	0.0%
22	Utilities	2,686	600	22.3%	45	1.7%
23	Construction	21,272	3,086	14.5%	452	2.1%
31-33	Manufacturing	38,019	6,549	17.2%	376	1.0%
42	Wholesale Trade	18,406	4,048	22.0%	55	0.3%
44-45	Retail Trade	49,466	9,876	20.0%	149	0.3%
48-49	Transportation and Warehousing	9,527	2,592	27.2%	155	1.6%
51	Information	6,937	975	14.1%	0	0.0%
52	Finance and Insurance	25,458	4,313	16.9%	0	0.0%
53	Real Estate and Rental and Leasing	3,971	1,037	26.1%	20	0.5%
54	Professional, Scientific and Technical Services	11,538	2,188	19.0%	79	0.7%
55	Management of Companies and Enterprises	3,573	708	19.8%	0	0.0%
56	Administrative, Support, Waste Management and Remediation Services	11,977	2,075	17.3%	47	0.4%
61	Educational Services	33,937	9,618	28.3%	184	0.5%
62	Health Care and Social Assistance	58,120	12,639	21.7%	84	0.1%
71	Arts, Entertainment and Recreation	7,855	1,426	18.2%	9	0.1%
72	Accommodation and Food Services	36,238	3,702	10.2%	0	0.0%
81	Other Services (except Public Administration)	10,264	2,022	19.7%	48	0.5%
92	Public Administration	21,157	5,266	24.9%	150	0.7%
	Total	**374,754**	**73,604**	**19.6%**	**1,935**	**0.5%**

Note: NAICS is the North American Industry Classification System.
Source: Quarterly Workforce Indicators (QWI), Local Employment Dynamics Program, U.S. Census Bureau

Chapter 7

Current Alternative Energy Projects in South Dakota

A different perspective on the demand for green workers and the greening of the South Dakota economy is provided by a review of conventional and alternative energy in the state.

Resources and Consumption Overview

The U.S. Energy Information Administration website includes the following overview of energy resources and consumption in the state. South Dakota has few fossil fuel reserves but has substantial renewable energy potential. Small crude oil and natural gas reserves are concentrated in the western corners of the state. South Dakota's renewable energy potential includes flat open areas for wind power, the Missouri River for hydroelectric power, corn produced in the eastern part of the state for ethanol production, and geothermal resources located in the south-central part of the state. As one of the least-populated states, South Dakota has a low energy demand.

South Dakota has minimal crude oil production and no refineries. (The Hyperion refinery in eastern South Dakota is in the planning stages.) Several petroleum product and liquefied petroleum gas (LPG) pipelines supply South Dakota from neighboring states. Over two-tenths of South Dakota households use LPG as their primary fuel for home heating. South Dakota is one of the few states in the nation that allows the statewide use of conventional motor gasoline. (Most states require the use of specific gasoline blends in non-attainment areas due to air-quality considerations.) As a leading corn producer, South Dakota is one of the nation's leading producers of ethanol, which is currently produced at several large plants in the eastern part of the state. Additional ethanol plants are under construction.

South Dakota's natural gas consumption is very low. The state is supplied via pipelines from producers in Canada and Texas and ships over 90 percent of the natural gas it receives to Minnesota on the way to other Midwest markets. Nearly one-half of South Dakota households use natural gas as their primary fuel for home heating.

Electricity in South Dakota is generated primarily by hydroelectric and coal-fired power plants. Hydroelectric power typically supplies about one-half of the electricity consumed in the state, and three of the state's five largest electricity generation plants are hydroelectric. South Dakota relies on shipments of coal from Wyoming to meet its demand. The majority of the state's

non-hydroelectric and non-coal electricity is generated from natural gas and wind. Per capita electricity use in South Dakota is near the average for the United States, and about two-tenths of the state's households use electricity as their primary energy source for home heating.

South Dakota offers incentives, such as property tax exemptions, to encourage expansion of renewable sources for electricity generation within the state. In February 2008, South Dakota adopted a voluntary renewable portfolio objective that aims to have 10 percent of all electricity generation come from renewable sources by 2015.

Geothermal

Although not widely publicized, geothermal heat has a great history and potential in the state. John W. Lund from the Geo-Heat Center noted the following facts about geothermal heating in South Dakota in a 1997 article. South Dakota is normally not thought of as a geothermal state. However, geothermal direct use is probably one of the best kept secrets outside the state. In 1997, there were two geothermal heating districts in South Dakota which provided heat for multiple businesses in downtown areas, a resort community using the water in a large swimming pool, a hospital being supplied with part of its heat, numerous geothermal heat pumps, and many individual uses by ranchers, especially in the winter months for heating residences, barns and other outbuildings, and for stock watering.

The best known and most significant geothermal resource in the state is the Madison Limestone. It is well known as an aquifer and oil producing formation throughout the northern Great Plains and Rocky Mountains. The Madison (also known as the Pahasapa) contains about 179 miles of recoverable water with temperatures ranging from about 86 degrees Fahrenheit to 216 degrees Fahrenheit. The Madison is one of two geothermal aquifers presently used in direct-heat applications. Two early applications of direct utilization geothermal heat were the Philip district heating project (1982) and the Midland district heating project (1964); both were large projects heating multiple buildings.

One of the current success stories for direct utilization geothermal heat is the Midland School District. Geothermal water has heated the Midland elementary and high school for more than 30 years. According to Superintendent Denise Fox, the school district pays about $10,000 a year for phone, light and electricity. Fox said, "I tell people that we heat this way [with geothermal] and again it's a funding issue right now. The geothermal well also provides water to the school."

In addition to direct utilization geothermal heating, heat pumps can also be used to provide geothermal heating. A couple of the early heat pump commercial applications occurred in the heating of public buildings in Pierre, Belle Fourche and Deadwood, and a private facility in Hot Springs.

Many new homes in the state are now installing geothermal heat pumps to provide residential heating. Although statistics on the number of geothermal heat pumps are not available, it is possible to use manufacturing numbers to provide some insight. According to a 2010 report from the U.S. Energy Administration, South Dakota is one of the top manufacturers of geothermal heat pumps. The top five manufacturing states were: Florida, Indiana, Oklahoma, South Dakota and Texas, with almost 57 percent of the total capacity shipped from Indiana and Oklahoma. In addition, a significant number of geothermal heat pumps were shipped to South Dakota from other manufacturing locations.

South Dakota utilities offer energy conservation loan and rebate programs. Many utility loan and rebate programs are provided by municipal cities and utility companies throughout South Dakota. The details and requirements for each program vary for each utility. Loan and rebate programs are available for customers who install geothermal heat pumps and water heaters. Loans are given at low interest to help with the purchase and installation of geothermal and water heating technologies. Rebates are given as a one-time set amount for the initial cost of heat pumps and water heaters.

There is also a federal loan program which helps homeowners conserve energy. Homeowners can use energy-efficient mortgages (EEM) to finance renewable energy technologies in a home.

Wind Power

South Dakota has great potential for the generation of wind energy. One of the major issues is the transportation of the power to consumers. A second issue is the inconsistent source of wind to power the turbines. Although many South Dakotans complain the wind blows all the time, lack of wind power some days is an issue. However, there are many parts of the state that are excellent sites for wind energy projects.

Most wind energy projects involve the construction of wind farms, which include from a few to hundreds of wind turbines to generate electricity. South Dakota has several large wind farms in production. The South Dakota Public Utilities website lists the following large wind farms in the state.

- The South Dakota Wind Energy Center in Hyde County has 27 turbines that can produce 40.5 megawatts (MW) of energy. It is South Dakota's first major wind farm, beginning operation in 2003. It is owned by NextEra Energy Resources (formerly known as FPL Energy), and the power is sold to Basin Electric Power Cooperative.
- The *MinnDakota Wind Farm* in Brookings County began operating its 36 turbines in January 2008. The farm can produce 54 MW of electricity. Iberdrola Renewables owns the wind farm and sells the electricity to Xcel Energy.
- The *Tatanka Wind Farm* is located in McPherson County. Its 60 turbines began producing electricity in March 2008. It has a generating capacity of 88 MW. The project was developed by Acciona Energy and the power is sold into the Midwest ISO power market.
- The *Wessington Springs Wind Project* in Jerauld County began operating in February 2009. Owned by NextEra Energy Resources, the 51 MW of electricity the project is capable of producing with its 34 turbines is purchased by the Heartland Consumers Power District, which is headquartered in Madison, South Dakota.
- *Buffalo Ridge I Wind Farm* in Brookings County is a 24-turbine farm capable of producing 50.4 MW of wind energy. Developed by Iberdrola Renewables, the wind farm began operation in April 2009. Northern Indiana Public Service Company purchases the power.
- The first phase of the *Titan Wind Project* in Hand County went into production in December 2009. Built and operated by BP Alternative Energy, the energy from the 25-megawatt project is purchased by NorthWestern Energy. The wind farm has 10 turbines.
- The *Day County Wind Farm* began operation in April 2010. It was developed by NextEra Energy Resources and features 66, 1.5-MW turbines. It has a generating capacity of 99 MW of energy, purchased by Basin Electric Power Cooperative.

Green Spotlight on a South Dakota Business

Molded Fiber Glass Company *is a leader in the field of reinforced plastics and composites, serving diverse markets with a variety of composite material systems. The depth and breadth of the company as a specialist in fiber reinforced plastic (FRP) provides an unmatched asset to the world of manufacturing — a resource that customers large and small can turn to for composite materials expertise, dependable delivered goods and business integrity.*

MFG has been a premier supplier of wind blades, nacelles and spinners since the 1980s and has played a role in the evolution of these parts. In 2008, MFG entered the aftermarket segment with Wind Energy Services Company (WES), a wholly-owned entity that provides on-call, mobile repair and maintenance services to operators across America. The newest MFG entity is a greenfield plant of 300,000 square feet on 52 acres and is in Aberdeen, South Dakota. This plant is fully equipped for modern, major production of wind energy blades.

- *Buffalo Ridge II Wind Farm*, in Brookings and Deuel counties began production in December 2010. The farm is capable of producing up to 210 MW of wind energy. Developer Iberdrola Renewables intends to deliver power to customers served by the Midwest Independent System Operator.

- The *Crow Lake Wind Farm* in South Dakota started operations in February 2011. North Dakota-based Basin Electric Power Cooperative said the last of 108 turbines was ready in late February at the $363 million project just east of Chamberlain, South Dakota. It took about five months to complete construction. The wind farm was built by a Basin subsidiary. It has the capacity to produce 162 megawatts of power. Basin owns 150 megawatts, which Basin says makes it the largest wind project in the country owned solely by a co-op. Basin sends electricity to 135 rural electric systems in nine states.

There is additional wind energy generation capacity at smaller projects scattered around the state. Smaller projects are located around Chamberlain, Howard, Gary, Canova, Carthage, Oaklane Colony and Rosebud.

Other areas considered for wind energy development are Coteau des Prairies in the northeast; Buffalo Ridge, which extends north-south from Marshall County to Brookings County; Turkey Ridge within Turner and Yankton counties; Fox Ridge near Faith; and several central South Dakota counties and tribal lands.

Wind power capacity is normally indicated in megawatts (MW). A megawatt (MW) is considered to be enough electricity to power 1,000 homes, although some now say 650 homes because of increased electrical demand in new homes. Of course, there is considerable difference between wind power capacity and average electrical production, because wind is an intermittent source of power.

A January 2011 article in the Rapid City Journal stated, "South Dakota ended the year with 313 megawatts, putting it 20th among states in wind energy capacity, despite boasting the fourth best wind potential in the United States." South Dakota Wind Energy Association Executive Director Steve Wegman says, "South Dakota is just starting to reach its potential." He'd like the state to build at least two wind farms every year. He says, "The day these crews go home, they're not coming back."

According to research conducted by the Montana Manufacturing Extension Center for the consortium's green jobs project, the number/size of South Dakota wind energy farms would have to expand significantly to reach federal energy goals. South Dakota would have to attain a wind energy capacity of 5,000 to 10,000 MW to reach the U.S. Department of Energy's 2030 goal of using wind energy to generate 20 percent of the electricity demand. A significant portion of South Dakota's wind energy electrical production would be used to meet other states' electricity needs.

Biofuels

Biofuels are a wide range of fuels that are in some way derived from biomass. Biomass includes any biological material from recently living organisms that can be used as an energy source. The most common way of extracting energy from biomass is through burning it, but biomass may also be used to produce goods such as fibers or chemicals which are then used in energy production.

Biofuels are gaining increased public and scientific attention, driven by factors such as oil price spikes, the need for increased energy security and concern over greenhouse gas emissions from fossil fuels. There are two forms of biofuels that have economic importance in South Dakota and the United States. They are bioethanol and biodiesel. Bioethanol from corn and biodiesel from soybeans are considered the first generation of biofuels.

Ethanol

Ethanol can be used as a fuel for vehicles in its pure form, but it is usually used as a gasoline additive to increase octane and improve vehicle emissions. Bioethanol is widely used in the United States and Brazil.

Ethanol can be produced from any feedstock that contains plentiful natural sugars or starch that can be readily converted to sugar. Popular feedstocks include sugar cane (Brazil), sugar beets (Europe) and maize/corn (United States). Ethanol is produced by fermenting sugars. Corn grain is processed to remove the sugar in wet and dry mills (by crushing, soaking and/or chemically treating), the sugar is fermented, and the resulting mix is distilled and purified to obtain

South Dakota Ethanol Plants			
Name	Location	Operating Production	Expansion Capacity
ABE South Dakota-Aberdeen	Aberdeen	50.0m gal	n/a
ABE South Dakota-Huron	Huron	32.0m gal	33.0m gal
Dakota Ethanol, LLC	Wentworth	50.0m gal	n/a
Glacial Lakes Energy, LLC	Watertown	100.0m gal	n/a
Glacial Lakes Energy, LLC-Mina	Mina	107.0m gal	n/a
North Country Ethanol, LLC	Rosholt	20.0m gal	n/a
NuGen Energy	Marion	110.0m gal	n/a
POET Biorefining-Big Stone	Big Stone City	79.0m gal	n/a
POET Biorefining-Chancellor	Chancellor	110.0m gal	n/a
POET Biorefining-Groton	Groton	53.0m gal	n/a
POET Biorefining-Hudson	Hudson	56.0m gal	n/a
POET Biorefining-Mitchell	Mitchell	68.0m gal	n/a
POET Biorefining-Scotland	Scotland	11.0m gal	n/a
Redfield Energy, LLC	Redfield	50.0m gal	n/a
Valero Renewable Fuels	Aurora	120.0m gal	n/a
South Dakota Total		**1,016.0m gal**	**33.0m gal**

anhydrous ethanol. In the United States, corn is the most widely used feedstock used to make ethanol.

Ethanol production is big in South Dakota. Corn is the normal input for ethanol production, and the ethanol is used for blending with gasoline for the output energy source. The state is one of the top ethanol producers in the nation; South Dakota is currently the fifth largest producer of ethanol in the United States. The table above from the Renewable Fuels Association shows the various ethanol plants in the state, their location, their operating production in millions of gallons and their under construction/expansion capacity in millions of gallons.

Cellulosic Ethanol

A second generation of biofuels is being developed. Because of concerns about the impact on corn prices and amount of energy required to produce corn, a new focus has been placed on the production of ethanol using other sources of biomass. The second generation of biofuels converts biomass or cellulosic material from grass, corn cobs and stover, trees or waste into ethanol. Researchers at South Dakota State University (SDSU) have had a switchgrass breeding program for this type of bioenergy since the 1980s. The new product is called cellulosic ethanol. With additional processing, plants and other biomass residues (including urban wood waste, forestry residue, paper and pulp liquors, and agricultural residue) can be processed into fermentable sugars. Such potentially low-cost resources could be exploited to yield significant quantities of fuel-quality ethanol.

New research at SDSU focusing on cellulosic biomass and cyanobacteria — also known as blue-green algae — is providing alternatives to broaden the scope of ethanol production and use even further. A current five-year project at the North Central Sun Grant Center at SDSU has researchers working to optimize another native grass, prairie cordgrass, for ethanol production. This project is also developing biomass fractionation pretreatments, techniques to reuse enzymes, thermotolerant yeast, and a new generation of high solids bioreactors. Additionally, a U.S. Department of Defense project at SDSU is working to produce jet fuels from biomass such as prairie cordgrass.

Sioux Falls-based POET, a leading producer of ethanol, has been producing cellulosic ethanol at a pilot plant near Scotland, South Dakota since 2008 and is constructing its first commercial scale cellulosic ethanol plant at Emmetsburg, Iowa; it is scheduled to begin operating in 2012.

While ethanol produced from corn and cellulosic feedstocks offers a viable renewable

energy alternative, it also comes with some limitations — primarily the fact the majority of America's transportation fuel infrastructure (pipelines and distribution networks, storage facilities and engines) have been designed for petroleum products, not ethanol.

Because of this, researchers at SDSU and around the country are pushing ahead to develop third generation biofuels that could be used as direct replacements for gasoline, diesel or jet fuel. "Because these third generation biofuels are similar or identical to their petroleum-derived counterparts, they are called direct 'drop in' replacements. They will seamlessly fit into the existing fuel transportation, storage and utilization infrastructure," explained Dr. William Gibbons, professor of industrial microbiology at SDSU.

Research at SDSU to create these third generation biofuels is focusing on two approaches. One approach uses photosynthetic cyanobacteria — a bacterial version of algae — which can be re-engineered to convert sunlight, carbon dioxide and water directly into third generation biofuels. "They are like little factories that spit out biofuel molecules without the need for starch or cellulose," explained Gibbons.

A second process, called thermochemical pyrolysis, uses high temperatures and pressures to convert cellulosic biomass into long hydrocarbon chains that are similar to gas, diesel or jet fuel. Gibbons acknowledged the challenge with these third generation processes is obtaining high yields at fast rates, but the research is promising. He anticipates seeing these third generation fuels in pilot scale, pre-commercial testing by 2015.

Some industry experts say the U.S. could produce as much as 1.3 billion dry tons of cellulosic biomass per year, the energy content equivalent to four billion barrels of crude oil, or 65 percent of American oil consumption.

Some industry experts say the United States could potentially produce 1.3 billion dry tons of cellulosic biomass per year, which has the energy content of four billion barrels of crude oil. This translates to 65 percent of American oil consumption.

Biodiesel

Biodiesel is made from vegetable oils, animal fats or recycled greases. Biodiesel can be used as a fuel for vehicles in its pure form, but it is normally used as a diesel additive to reduce levels of particulates, carbon monoxide and hydrocarbons from diesel-powered vehicles. Biodiesel is produced from oils or fats using transesterification and is the most common biofuel in Europe.

Predominant feedstocks for biodiesel production are soybean oil in the United States, rapeseed and sunflower oil in Europe and palm oil in Malaysia. Biodiesel also can be produced from a variety of other feedstocks, including vegetable oils, tallow and animal fats, and restaurant waste and trap grease.

In 2008, there were 105 biodiesel plants in the United States, with only a few located in the Northern Plains and Rocky Mountain Consortium states. In 2005, the first South Dakota biodiesel plant was established by Midwest Biodiesel Producers LLC. Ten agricultural producers formed the Alexandria, South Dakota, cooperative to add value to their oilseed crops. The facility had the capacity to produce seven million gallons of biodiesel per year and had plans to expand the scope to include the crushing of oilseeds. The plant loaded its first tanker of biodiesel in January 2007. In 2008, Midwest Biodiesel Producers changed its business plan, focus and name. As Hanson County Oil Producers LLC, they are in the process of building a multi-crush facility and updating their current biodiesel plant to a multi-feedstock plant that can produce renewable fuel from a variety of oilseed crops and animal fat products. They remain the only biodiesel producers in the state.

Based on information from the Texas State Energy Conservation, the 2008 national production of biodiesel was 864 million gallons. According to the ANTARES Group Inc. report for the consortium's green jobs project, the 2008 federal renewable fuels legislation known as EISA requires the U.S. Environmental Protection Agency (EPA) to set renewable fuels target usage levels. Biomass-based diesel requirements, including biodiesel and renewable diesel from waste greases, should reach one billion gallons per year in 2012. The requirements are explicitly defined up until 2012 and will

be determined thereafter through an EPA rulemaking process, but will be no less than one billion gallons.

Biofuels Production Constraints

As previously mentioned, a key uncertainty for ethanol production is the availability of sufficient land resources for large-scale expansion of the cultivation of biofuel crops, given the intense competition with conventional agricultural products for arable land. Competition will favor those crops most profitable for farmers, accounting for such factors as growing region, farming practice and soil type. Currently, corn and soybeans are competitive energy crops, because they provide high value to farmers at prices low enough to allow the biofuel industry to produce a product competitive with petroleum fuels. However, some parts of the agricultural sector are concerned ethanol plants' competition for corn will negatively impact their businesses.

Cellulosic biomass from switchgrass, hybrid willow and poplar trees, agricultural residues, and other sources has significant supply potential, possibly up to four times the potential of corn. Switchgrass and poplars could be grown on Conservation Reserve Program (CRP) lands, where corn cannot be grown economically, but they would not be competitive with corn until corn prices rose, or the capital and non-feedstock production costs of cellulosic ethanol were significantly reduced. To expand beyond a production level of 15 to 20 billion gallons per year without seriously affecting food crop production and prices, the industry must make a transition to crops with higher yields per acre and grow crops in an environmentally permissible manner on CRP lands, while continuing to provide profits for producers.

Estimated Potential Biomass Resource in Tons per Year

	Crop Residues	Forest Biomass	Primary Mill Residues	Urban Wood Waste	Total
South Dakota	5,140,289	124,999	141,856	6,518	5,413,662

Another factor affecting expansion of the biofuel industry is the availability of tax credits and other subsidies to make processing cost effective. In addition, the development of the necessary infrastructure for collecting, processing and distributing large volumes of biofuels is a limiting factor. Currently, most of the biofuels are produced in the cornbelt in the middle of the country, and most of the consumption centers are on the coasts. Ethanol is not easily transported by rail or pipeline, because it can be easily contaminated by water and biodiesel-dissolved entrained residues in the pipeline. As a result, railroad cars and tanker trucks made from biofuel-compatible materials are needed to transport large volumes of biofuels to market.

Based on a recent National Wildlife Federation evaluation of the state's alternative energy potential, there is great possibility of biomass power generation using a wide variety of materials. South Dakota has 16 million dry tons of biomass available each year that could be used to generate about 3,200 MW of electricity.

As part of the consortium's green jobs project, the ANTARES Group Inc. prepared an estimate of the biomass resource potential for South Dakota in dry tons/year. (See table above.) The largest potential source, by far, is crop residues. Although South Dakota has a significant forest biomass, the majority of it is National Forest Service land and is managed for limited harvest. The ANTARES Group's biomass resource potential estimate is more detailed, but smaller than the NWF publication shows.

Solar Energy

Solar power is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaics converts light into electric current using the photoelectric effect.

PV installations can pay for themselves in five to 10 years in many places. "Grid-connected" systems — those systems that use an inverter to connect to the utility grid instead of relying on batteries — now make up the largest part of the market.

Excess electricity from photovoltaic systems can also be sent to the transmission grid, where it can be used to meet existing demand or temporarily stored for later use. Grid-tied electrical system policies often give

Devoting just one square mile in South Dakota to solar power could provide enough electricity for about 1,200 households each year.

photovoltaic system owners a credit for the electricity they deliver to the grid. This credit is used to offset electricity provided from the grid when the photovoltaic system cannot meet demand. Where there is net metering, the credit is equivalent to or greater than the cost of electricity to the consumer.

With respect to the national solar energy perspective, the federal government is emphasizing research to connect solar systems to the energy grid. In its Renewable Systems Interconnection Technical Report, the U.S. Department of Energy (DOE) states: "Now is the time to plan for the integration of significant quantities of distributed renewable energy into the electricity grid. Concerns about energy independence, climate change, the adoption of state-level renewable portfolio standards and incentives, and accelerated cost reductions are driving steep growth in U.S. renewable energy technologies. The number of distributed solar photovoltaic (PV) installations, in particular, is growing rapidly. As distributed PV and other renewable energy technologies mature, they can provide a significant share of our nation's electricity demand. However, as their market share grows, concerns about potential impacts on the stability and operation of the electricity grid may create barriers to their future expansion."

The federal government has been funding research efforts to encourage connections to an energy grid. Some of these projects are part of the Solar Energy Grid Integration Systems (SEGIS) program. A South Dakota based company, Northern Plains Power Technologies (NPPT), has partnered with PV Powered (Bend, Oregon) on a Stage II SEGIS research and demonstration project that enables distributed photovoltaic systems to communicate with power utilities. NPPT has also partnered with Florida Solar Energy Center, a research institute of the Unversity of Central Florida, on a project to solve technical challenges that must be overcome to include higher PV penetration levels in larger electrical systems.

There are a few commercial solar energy systems and a large number of farm or ranch solar energy systems in South Dakota. The EROS Data Center in South Dakota is a government facility whose active solar energy system is equipped with 9,124 square feet of flat plate collectors, 26,893 gallons of hot water storage in an underground vault and two auxiliary electric hot water boilers. The system provides 40 percent of the hot water load.

Meanwhile, there is more activity concerning residential solar energy. One of the reasons for interest in residential solar energy applications in South Dakota is because the state provides incentives for residential applications. The state offers a property tax exemption for solar energy systems. Residents of South Dakota who own and install renewable energy systems on their residential property are eligible for a property tax exemption of 100 percent of the total cost, including installation of the system and equipment. Eligible renewable energy technologies for this tax exemption include solar space heat, solar water heat, solar thermal process, photovoltaics, landfill gas, biomass, geothermal electric, geothermal heat pumps and wind energy systems.

South Dakota utilities offer energy conservation loan and rebate programs. Many utility loan and rebate programs are provided by municipal cities and utility companies throughout South Dakota. The details and requirements for each program vary for each utility.

Public utilities offer a residential energy conservation subsidy exclusion. This is a personal exemption of 100 percent of energy conservation subsidies provided by public utilities. The value of a purchase or installation of any energy conservation measure by a customer, such as solar water heat, solar space heat or photovoltaics, will not be included in the customer's gross income. Customers of an electric utility company who participate in the utility's energy conservation program may receive a rate reduction of electricity furnished, or a nonrefundable credit against the purchase price of the electricity on each monthly electric bill.

There is also a federal loan program that helps homeowners conserve energy. Homeowners can use energy-efficient mortgages (EEM) to finance renewable energy technologies in a home.

Net metering is one of several issues related to residential solar energy systems. So far,

Employment and Revenues of South Dakota Solar Companies					
	Number of Employees	Sales in SD		Sales outside SD	
Company	in SD	kW	$$$	kW	$$$
GenPro Energy	22	18	$125,000	300	$2,000,000
Power Plus Electric	13	300	$2,100,000	600	$4,200,000
Birdneck Renewable	1	<1	n/a	<1	n/a
Black Hills Solar	1	9	$63,000	n/a	n/a
Lynn's Heating and Air	2	<1	n/a	<1	n/a
Absolute Renewable	1	<1	n/a	<1	n/a
Cleaner Greener	2	<1	n/a	<1	n/a
Oakleaf, Inc.	5	n/a	n/a	n/a	n/a
Go Solar Distributing	2	5	$35,000	12	$84,000
Johnson Environmental	1	<1	n/a	<1	n/a
Total	**50**	**332**	**$2,323,000**	**912**	**$6,200,000**

the state legislature has not addressed this issue. So, for now, it is up to the utility company to decide how to net-meter a new solar electricity system.

South Dakota has enough solar resources to produce 4,500 to 5,500 watts per hour (Whr) per square meter using photovoltaic systems and 4,000 to 5,000 Whr per square meter using concentrating solar power systems. This means devoting just one square mile in South Dakota to solar power can provide enough electricity for about 1,200 households each year.

In 2010, Dr. Mary Berry of the University of South Dakota conducted a survey of solar companies in the state. Berry tabulated the data in the table above on employment and revenues of those companies.

Solar sector activities in South Dakota were primarily related to solar panel installation, distribution and design for the installation of solar power in operations (solar powered water pumps by GenPro). No solar cell manufacturing was reported in the state, with most cells originating from manufacturers in China.

Smart Grid

A smart grid is a form of electricity network utilizing digital technology. A smart grid delivers electricity from suppliers to consumers using two-way digital communications to control appliances at consumers' homes; this could save energy, reduce costs, and increase reliability and transparency if the risks inherent in executing massive information technology projects are avoided. The "smart grid" is envisioned to overlay the ordinary electrical grid with an information and net metering system that includes smart meters.

Funding from the American Recovery and Reinvestment Act (ARRA) provided Smart Grid Investment Grant funding to South Dakota electrical energy companies for implementation work on smart grids and smart meters. Black Hills Power Inc. in Rapid City, South Dakota was awarded a $6.1 million Smart Grid Investment Grant to install more than 69,000 smart meters and a communications infrastructure that will help consumers reduce their energy use and save money.

Sioux Valley Energy in Coleman, South Dakota, received a $4 million grant to install a smart grid network for all of the company's consumers; it will improve the efficiency and reliability of the system while helping consumers save money.

Other electrical power companies are also making smart grid investments in the state. Homes and businesses receiving power from Basin Electric Power Cooperative's South Dakota wind farm will benefit from smart grid technologies on the farm's 101 wind turbines. These new high efficiency amorphous transformers will reduce losses as electricity moves through the wind farm's transformers, so that every spin of the turbine blade delivers more energy to consumers. In addition to maximizing productivity of the electrical network, smart grid technologies also help improve productivity of renewable energy generation, making investments in green technology more attractive to developers.

Green Spotlight on a South Dakota Business

Millennium Recycling, Inc. *in Sioux Falls, South Dakota services a large portion of the upper Midwest. They process various grades of recyclable materials. Since 1999, they have been building a solid customer base in and around the Sioux Falls area, catering to both residential and commercial scrap generators. In 2007, Millennium Recycling converted to the single stream recycling process. Single stream allows residents to combine all recyclables into one container. In the last few years, the amount of recycling has increased dramatically. In 2010, Millennium Recycling processed 43,000 tons of material including plastic, cardboard, mixed paper, aluminum, tin and container glass.*

Millennium Recycling has also launched a community education outreach program designed to inspire all ages and demographics in the Sioux Falls area. Presentation and educational materials are available to schools, business and professional organizations. The Millennium Recycling Ecomaniacs provides a free event cleanup and recycling service powered by community not-for-profit fundraising groups and local sponsors.

Chapter 8

New and Emerging Green Business Sectors

One of the goals of the South Dakota green jobs project was to learn about demand for green jobs in new and emerging industry sectors. As previously mentioned, getting that information is difficult since current industry and occupational taxonomies are slow to change. It takes time for new industry activities and trends to be recognized and then measured. South Dakota and the other consortium states decided upon a separate strategy. The consortium states decided to collect information on new green technologies from "subject matter experts" in academia and private industries. The consortium contracted with the Montana Manufacturing Extension Center (MMEC) based at Montana State University to take the lead on this project.

The strategy was to learn from energy subject matter experts about green technology research projects that might eventually be implemented as business activities. Each state nominated "area experts" who had been working on new and emerging green technology research and who were considered regional/national experts in those areas. Two South Dakota university researchers provided input to this research. Dr. William Gibbons at South Dakota State University (SDSU) provided information on his biofuels and bio-lubricants research, specifically algae/cyanobacterial production of second and third generation biofuels and biochemical conversion to second and third generation biofuels. Dr. Mary Berry from the University of South Dakota (USD) provided information on her solar technologies research, specifically nanostructured solar cells (photovoltaics), bulk heterojunction (BHJ) solar cells, and dye-sensitized solar cells (DSSC, Graetzel cells).

The MMEC published the complete findings of the green technologies research in a report titled *Researching the Green Economy*. (The publication is very comprehensive and is over 200 pages in length.) The final report can be obtained by contacting the South Dakota Department of Labor and Regulation's (DLR) Labor Market Information Center in Aberdeen, South Dakota. The publication is also available online at www.researchingthegreeneconomy.com.

A variety of "green" energy technology sectors were evaluated to determine what new and emerging technologies have potential for commercial viability within the next five to 10 years and what impacts they would have on the green job market. The technology sectors evaluated included: wind energy; commercial-scale carbon capture/sequestration; biofuels and bio-lubricants (including methane capture); biomass; smart grid and transmission; solar; geothermal;

and other green technologies that may be deployed; and other traditional technologies that may offset the use of fossil fuels.

The consortium initiated the research project by developing a list of 90 potential subject matter experts (SMEs) from universities, industry, trade associations and state and federal agencies. MMEC contacted the appropriate universities, state and federal agencies, research centers and industry associations in the consortium states to identify potential SMEs and also sought input from consortium representatives.

MMEC staff discussed the green technology project with each potential SME and pared down the list to 26 entities according to several factors, including interest and availability in participation within the project timeframe, knowledge of emerging technologies and budget. Eight entities were ultimately selected to submit reports to MMEC on 19 emerging green energy technologies.

The table at the right identifies the technologies selected for review.

The subject matter experts provided detailed reports on these new green energy technologies. They included detailed descriptions of the fuels and technologies, analyses of their development progress, and issues to be considered in their production and deployment. The SMEs provided detailed information about the job creation potential impacts of each fuel and technology. The SMEs also provided an analysis of the education and job skills training required to develop, deploy, transport and maintain each fuel or technology. In most cases, the job creation impacts were described for the natural resource harvesting, manufacturing,

Green Technologies Selected for Review

Technology Sector	Energy Technology
Wind energy	Horizontal axis wind turbines
Carbon capture and sequestration	CO2 capture and geological sequestration
Biofuels and biolubricants	Algae/cyanobacterial production of 2nd and 3rd generation biofuels
Biofuels and biolubricants	Biochemical conversion to 2nd and 3rd generation biofuels
Biofuels and biolubricants	Biodiesel
Biofuels and biolubricants	Bio-oils from lignocellulose
Biofuels and biolubricants	Cellulosic ethanol
Biofuels and biolubricants	Pyrolysis
Biomass	Cofiring
Biomass	Methane capture/biogas
Biomass	Solid fuel combustion
Biomass	Gasification
Biomass	Pellet fuels
Smart grid and transmission	Primary assets and functions
Solar	Nanostructured solar cells (photovoltaics)
Geothermal	Advanced adiabatic compressed air energy storage
Geothermal	Smart thermosiphon arrays
Other	Hybrid-nuclear energy
Other	In-stream hydrokinetic energy

Eight subject matter experts contributed to the greening of the economy research by the Northern Plains and Rocky Mountain Consortium, focusing on 19 emerging green energy technologies.

construction, marketing and maintenance categories. In addition, the SMEs described the potential economic, social, environmental, transportation, political and financial obstacles to deployment of the technologies.

South Dakota staff excerpted parts of the MMEC green technology report for inclusion in this section of the South Dakota green jobs report. The data presented in the MMEC document require periodic updating to remain current. The technologies evaluated for the report evolve rapidly, significantly impacting job projections.

Wind Energy Using Horizontal Axis Wind Turbines

Robb Larson, an assistant professor at Montana State University, conducted the analysis on wind energy. Wind energy is available on both small and large scales, each contributing to the electrical grid. Single, small 100 watt or 10-kilowatt (kW) wind turbines can be found on farms or residences, while large wind farms employ turbines capable of generating between 700 kW to 1.8 MW of power. Wind farm turbines are typically 160 to 300 feet in height and are tied directly into utility transmission systems.

South Dakota Wind Energy Capacity	
Wind Energy Year-end Capacity (MW)	313.164 MW
2030 Goal	5-10,000 MW

The table above shows the South Dakota Wind Energy Capacity (in megawatts of energy) as of December 31, 2009, and the additional power needed to meet the U. S. Department of Energy's 2030 goal to use wind energy to generate 20 percent of the electricity demand.

Larson used the National Renewable Energy Laboratory Jobs and Economic Development Impact (JEDI) model to help determine impacts in South Dakota. The following table shows the job impact based on new capacity needed to reach the 20 percent capacity goal by 2030.

Job Creation Impacts of Reaching 2030 Capacity Goals	
Occupational Category	Number of Jobs
Construction jobs	956
Operations/maintenance jobs	35
Total Jobs	**991**

Commercial Scale Carbon Capture and Sequestration

John Talbott and Lindsey Tollefson of Big Sky Carbon Sequestration Partnership wrote the report on this topic. Carbon capture and storage (CCS) is a process for capturing carbon dioxide emissions from existing stationary sources, such as power plants using coal, oil or natural gas, cement kilns, paper plants, refineries, ethanol plants and other industrial sources. (In South Dakota, coal-fired electricity generation plants account for 23 percent of the total electrical energy produced.) The capture and sequestration process includes capturing the carbon dioxide at the source, transporting it to a storage location, and injecting the carbon dioxide into geologic formations deep underground for permanent safe storage. Retrofitting the existing fleet of coal-fired power plants, ethanol plants, refineries and other industrial sources of greenhouse gases (GHG) would be a daunting exercise. In many cases, it would make more economic sense to retire older coal-fired power plants and replace them with new generation coal facilities, natural gas-fired facilities or renewable energy.

Biofuels Production Using Algae/ Cyanobacteria Systems

Two subject matter experts from SDSU provided the report on biofuels and biolubricants. They were Dr. William Gibbons, professor of industrial microbiology and Sand Zhengrong Gu, assistant professor of agricultural and biosystems engineering.

Ethanol and biofuels can be produced from algae or cyanobacteria by three mechanisms:

1. Photoautrophic-feeding carbon dioxide to algae to promote growth and the conversion of algae into oils using light as the energy source;

2. Chemoheterotrophic-supplying algae with sugars and other nutrients to promote growth and then conversion of algae into oils; and

3. Mixotrophic-supplying algae with carbon dioxide and organic compounds as sources of carbon dioxide to produce oils. Sources for carbon dioxide could be coal-fired electricity generating plants, providing reductions in greenhouse gas emissions.

The table below shows the number of manufacturing and maintenance jobs by production stage for algae/cyanobacteria systems producing third generation biofuels in terms of jobs per plant.

Job Creation Impacts per Plant for Producing Third Generation Biofuels

Manufacturing Jobs	Jobs
Algae cultivation	12
Cells harvest	1
Fuel extraction and production	8
Co-products	1
Total Jobs	**22**
Maintenance Jobs	**Jobs**
Incubation	5-13
Cells harvest	1-2
Fuel extraction and production	2-5
Co-products	1
Total Jobs	**8-21**

Gibbons and Gu also identified the types of jobs that would be required for staffing algae/cyanobacteria systems producing third generation biofuels.

Types of natural resource harvesting and processing jobs

- Strain breeder or molecular biologist
- Process development scientist
- Assay analyst for cell incubation

Types of manufacturing jobs

- Engineering managers
- Mechanical engineers
- Electrical and electronic engineers
- Tool and die makers
- Mechanical engineering technicians (QC)
- Forming/extruding/drawing machine operators
- Metal and plastic workers and boilermakers for producing evaporators and boilers
- Quality control inspectors

Types of maintenance jobs

- Operators for liquid or aquaculture systems
- Roofers, plumbers, pipelayers and pipefitters
- Electricians
- Chemical and mechanical operators
- Operators for oil extraction systems, chemical reactors and fuel pumping/packing systems

Types of construction jobs

- Construction managers and first-line managers of construction trades and extraction workers
- Construction laborers and helpers
- Construction and building inspectors
- Construction equipment operators
- Civil and environmental engineers and technicians

Types of construction jobs, continued

- Well drillers
- Electrical engineers, technicians and telecommunications line installers and repairers
- Floor sanders and finishers
- Pipelayers

Biofuels Production Using Biochemical Systems

Gibbons and Gu also submitted reports in the area of second and third generation biofuels produced via the biochemical route. The biochemical route for second and third generation biofuel production involves similar unit operations (pretreatment, hydrolysis, fermentation, separation) as the process used to convert corn into first generation biofuel, ethanol. The feedstock for second and third generation biofuels is lignocellulosic biomass.

The table on page 52 shows the number of natural resource harvesting, manufacturing and maintenance jobs, by production stage, for producing second and third generation biofuels via biochemical route in terms of jobs per plant.

Biodiesel Production

The ANTARES Group Inc., a consulting engineering firm specializing in advanced energy technologies for industry, power production and transportation, was responsible for information about biodiesel production. President Edward Gray, Project Manager Tim Rooney and Senior Scientist Dr. Arthur Wiselogel provided input for the report. Biodiesel

Job Creation Impacts from Production of Second and Third Generation Biofuels via Biochemicals	
Natural Resource Harvesting Jobs	**Jobs**
Biomass harvesting, densification and storage	15
Biomass transport	5-10
Biomass quality control, impact of removal	2
Total	**22-27**
Manufacturing Jobs	**Jobs**
Pretreatment	5
Saccharification	5
Fermentation	10
Clarification	5
Fuel (ethanol or soluble alcohol recovery)	5
Fuel (volatile hydrocarbon or insoluble product recovery)	5
Fuel shipping	5
Co-products	3
Total	**48**
Maintenance Jobs	**Jobs**
Biomass harvesting	5
Pretreatment	3-5
Saccharification	3-5
Fermentation	3-5
Clarification	2
Fuel (ethanol or hydrocarbon or other fuel) or co-products recovery	2
Fuel shipping	3-5
Total	**21-29**

is a renewable transportation fuel that can be used by diesel combustion engines without any modification. Biodiesel is typically blended with petroleum diesel at 5 percent, 10 percent or 20 percent by volume. The technology is fully commercialized and well understood. As of August 2010, there were 148 operational diesel plants in the U.S. with production capacity of 2.264 million gallons. The most common feedstock for biodiesel production in the U.S. is soybean oil.

New job creation in the feedstock production area would be limited unless a non-food grade oil seed crop is developed and produced for biodiesel. Manufacturing major components for a biofuels facility is most likely to occur outside the consortium states, unless the specific equipment manufacturer locates in one of the states. Construction of a biodiesel plant will require anywhere from 50 to 150 jobs at any given time during the construction period. The maintenance and operation of the biodiesel facility is the next largest contributor to employment impacts.

Based on information from the Texas State Energy Conservation, the 2008 national production of biodiesel was 864 million gallons. According to the ANTARES Group Inc. report, the 2008 federal renewable fuels legislation known as EISA requires the EPA to set renewable fuels target usage levels. Biomass-based diesel requirements, including biodiesel and renewable diesel from waste greases, should reach one billion gallons per year in 2012. The requirements are explicitly defined up until 2012 and will be determined thereafter through an EPA rulemaking process, but will be no less than one billion gallons. There is only one biodiesel plant in South Dakota.

Job Creation Impact for a Lignocellulosic Ethanol Plant		
Job Creation by Category	**Sugar Platform**	**Thermochemical Platform**
Annual biomass use (dry tons)	250,000	285,714
FTEs		
Harvesting jobs	36	43
Plant operations and maintenance jobs	32	32
Construction jobs	200	200
FTEs per unit of capacity (MMGY)		
Harvesting jobs	1.8	2.15
Plant operations and maintenance jobs	1.6	1.60
Construction jobs	10	10.0
Note: MMGY= million gallons per year		

Lignocellulosic Ethanol

The ANTARES Group Inc. was responsible for information about the production of lignocellulosic ethanol. There are a number of advanced biofuel technologies being developed that may be available in the 2010 to 2025 time frame. The key differences between these and current commercial technologies are the types of biomass feedstocks used for production. Current technologies typically use grain and oil seed crops, while the advanced technologies use lignocellulosic biomass such as wood, switchgrass and agricultural residue.

The job requirements in the lignocellulosic ethanol plants will experience economies of scale. For example, a typical 20 million gallon plant might have a staff of 35 people (including about five for management), while a 100 million gallon plant may only have a staff of about 50 people. The table above shows job creation for a lignocellulosic ethanol plant.

Bio-oils from Lignocellulose (Pyrolysis)

As part of the consortium project to review emerging green technology, the ANTARES Group Inc. provided information about the production of bio-oils from lignocellulose. Converting lignocellulosic feedstocks to bio-oils begins with pyrolysis as the primary conversion process. Crude bio-oils can be upgraded from there to clean hydrocarbon fuels via hydro treatment followed by hydrocracking at a petroleum refinery. The table below summarizes the job creation impact of a five million gallon per year (MMGY) pyrolysis facility.

Job Creation Impact of a Pyrolysis Facility	
Job Creation by Category	**Pyrolysis**
Average plant size	5 MMGY
Annual biomass use (dry tons)	313,087
FTEs	
Harvesting jobs	85
Plant operations and maintenance jobs	31
Construction jobs	100
FTEs per unit of capacity (MMGY)	
Harvesting jobs	17.00
Plant operation and maintenance jobs	6.20
Construction jobs	20.00
Note: MMGY=million gallons per year	

A number of advanced biofuel technologies using lignocellulosic biomass such as wood, switchgrass and agricultural residue are being developed and may be available by 2025.

Biomass Resource Potential for South Dakota					
	Crop Residues	Forest Biomass	Primary Mill Residues	Urban Wood Waste	Total
South Dakota	5,140,289	124,999	141,856	6,518	5,413,662

Note: All the numbers are in dry tons/year.

The ANTARES Group Inc. prepared an estimate of the biomass resource potential for South Dakota in dry tons/year. (See table above.) The largest potential source, by far, is crop residues. Although South Dakota has a significant forest biomass, a majority of it is National Forest Service land which is managed for limited harvest.

Methane Capture/Biogas

The ANTARES Group Inc. prepared a report on methane capture/biogas for the consortium green jobs project. Biogas, a gaseous mixture containing 50 to 95 percent methane, depending upon the source, is generated from a variety of sources and can be captured and used for heat and power generation. Methane is commonly produced through anaerobic digestion of organic material. The major sources of organic materials in this report include landfills, wastewater treatment facilities and livestock production.

According to the most recent data from the Energy Information Administration (EIA), the United States emitted 160.7 billion standard cubic feet (SCF) of methane in 2007. Of this total, landfills accounted for 38.8 billion SCF, solid waste from animals for 14.9 billion SCF, and wastewater management for 6.1 billion SCF. At many of these sources, biogas can be collected and used on site or transported to a central location, where it can be refined to pipeline-quality gas or combusted for electrical generation or heating. Biogas capture at many of these facilities can be an effective, affordable way to reduce greenhouse gas emissions by reducing methane emissions and displacing fossil fuels for energy production.

The average electric capacity for farm-based anaerobic digesters that generate electricity is approximately 300 kW based on 151 total systems in 2010 with power generation of 323 million kW hours per year and an assumed system capacity factor of 85 percent power generation. Many systems are smaller, in the 100 kW range or less. A farm-based anaerobic digester system would require no new natural resource harvesting or manufacturing jobs. However construction of such a system would require a small construction crew of approximately two to three persons, including one electrician with specialized expertise in on-site power systems, one plumber and one heavy equipment operator.

Biomass Co-firing

The ANTARES Group Inc. was the subject matter expert for this topic. Co-firing is the simultaneous combustion of different fuels in the same boiler. Many coal- and oil-fired boilers at power stations have been retrofitted to permit multi-fuel flexibility. Biomass is a well-suited resource for co-firing with coal as an acid rain and greenhouse gas emissions control strategy.

Biomass co-firing will require 0.38-2.18 jobs per MW of installed capacity to grow and prepare biomass fuel sources, transport it to the power plant facility, and receive and process the biomass once it reaches the facility. The switch from an all-coal facility to a co-fired facility would result in, on average, a job creation equivalent of 0.65 employee per MW of installed capacity. No jobs would be created with regard to maintenance and upkeep of the co-firing facility, since the workers at the original coal facility could continue to provide these services with only minimal changes to the operational procedures.

Job Creation Impacts from Biomass Solid Fuel Combustion			
Job Creation By Category	**Biomass Cogeneration Combustion**	**Biomass Cogeneration Combustion**	**Biomass Cogeneration Combustion**
Average plant size	5 MWe 15 MWt	20MWe 60 MWt	50 MWe
Annual biomass use	39,099 dry tons	156,404 dry tons	391,011 dry tons
FTEs			
Harvesting jobs	15	43	106
Plant operations and maintenance jobs	14	21	29
Construction jobs	50	75	150
FTEs per unit of capacity	(Per MWe)	(Per MWe)	(Per MWe)
Harvesting jobs	3.00	2.15	5.30
Plant operations and maintenance jobs	2.80	1.05	1.45
Construction jobs	10.0	3.75	7.50
Note: Capacity units are MWe=Megawatts electric, MWt=Megawatts thermal			

Biomass Solid Fuel Combustion

Direct combustion of solid fuel biomass in a boiler to generate steam for process or power is the most common way of converting biomass into a usable energy. The ANTARES Group Inc. prepared the summary above of job creation impacts from biomass combustion at various size plants.

Biomass Gasification-Based Power Generation

There are numerous biomass gasification-based power generation and CHP (combined heat and power) technology offerings being tendered at varying levels of commercial readiness throughout the world. A key driver in modern biomass gasification research is to develop systems that can take advantage of high efficiency energy cycles. Gasification technologies have been somewhat successfully deployed for coal by integrating coal-gasification with gas turbines, and there is hope the same can be accomplished using biomass fuels.

A key driver in modern biomass gasification research is to develop systems that can take advantage of high efficiency energy cycles.

Green Spotlight on a South Dakota Business

Comfort Windows & Doors LLC (Larson Manufacturing) has been manufacturing energy efficient doors and windows since 1954. The company is based out of Brookings, South Dakota, and employs more than 1,500 workers nationwide. Comfort Windows & Doors features energy-saving Low-E Glass in their products. Low-E Glass stands for low-emissivity glass, which is a coating on the glass surface that reflects heat or cold back into the environment (inside or outside) to keep it from transmitting through glass.

Job Creation Impacts from Biomass Gasification-Based Power Generation		
Job Creation By Category	**Biomass Cogeneration Combustion**	**Biomass Cogeneration Combustion**
Average plant size	5 MWe	20MWe
	15 MWt	60 MWt
Annual biomass use	39,099 dry tons	156,404 dry tons
FTEs		
Harvesting jobs	15	43
Plant operations and maintenance jobs	14	21
Construction jobs	50	75
FTEs per unit of capacity	(Per MWe)	(Per MWe)
Harvesting jobs	3.00	2.15
Plant operations and maintenance jobs	2.80	1.05
Construction jobs	10.00	3.75
Note: Capacity units are MWe=Megawatts electric, MWt=Megawatts thermal		

The ANTARES Group Inc. prepared the table above on job creation for biomass power at various sizes.

Biomass Pellet Fuels

The ANTARES Group Inc. prepared the report on the biomass pellet fuels technology. Wood pellet technology is a mature technology as is the production of wood briquettes and fire logs. The production of wood pellets requires the use of dry wood (10 percent moisture content) reduced to fine sawdust particles. The wood is either forced through an extruder or a die at pressure of 45,000 psi. Pellet fuel production in 2008 in the U.S. was about 1.8 million tons, which is approximately 66 percent of total capacity. Recently, several pellet operations supplying the domestic market have closed and many others have curtailed operations due to increasing feedstock costs and limited market growth in pellet appliances. The ANTARES Group provided the following table which summarizes the employment impacts of biomass pellet manufacturing.

Job Creation Impacts from Biomass Pellet Fuel Manufacturing	
Job creation by category	**Pellet Manufacturing 100,000 tons/year**
Annual biomass use (dry tons)	121,000
FTEs	
Harvesting jobs	36
Plant operations and maintenance jobs	24
Construction jobs	50
FTEs per unit of capacity	
Harvesting jobs	0.36
Plant operations and maintenance jobs	0.24
Construction jobs	0.50

Although the ANTARES Group Inc. reported on jobs/occupations for each specific type of biofuels, bio-oils and biomass energy production, they have been grouped here because many of the same jobs/occupations appeared multiple times. (See listing on the next page.)

Biofuel, Bio-oil and Biomass Energy Production Occupations:

Natural Resource Management Jobs

- Agricultural equipment operators
- Farm laborers
- Forestry technicians
- Heavy equipment mechanics
- Logging and farm management
- Logging equipment operators
- Logging supervisors
- Truck drivers

Construction Jobs

- Concrete pouring/finishing workers
- Construction managers and supervisors
- Heavy equipment operators
- Electrical workers
- Engineering management
- Metal fabricators
- Plumbing, pipe-fitting workers
- Truck drivers
- Welders

Operations and Maintenance Jobs

- Accounting/administrative
- Boilerhouse mechanics
- Boiler operators
- Business managers
- Chemists
- Conveyer operators

Operations and Maintenance Jobs, continued

- Electricians
- Environmental Managers
- Front-end loader operators
- Fuel procurement managers
- Industrial equipment mechanics
- Janitorial/maintenance assistants
- Maintenance supervisors
- Plant engineers
- Plant managers
- Plant technicians (sampling)
- Truck drivers

Smart Grid and Transmission

Rob Pratt of the Pacific Northwest National Laboratory developed the report on smart grid and transmission for the consortium states. Technological advancements in electricity generation will be marginalized with significant efficiency upgrades to the nation's electrical grid. The U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability is working to "lead national efforts to modernize the electric grid, enhance security and reliability of the energy infrastructure, and facilitate recovery from disruptions to energy supply."

Nationally, according to a study conducted by KEMA on behalf of the GridWise Alliance (a consortium of smart grid stockholders), the development of a national smart grid will create about 280,000 jobs and an additional 140,000 industry supplier jobs.

Many of these jobs will be filled by a mix of existing utility employees and outside consultants. The Pacific Northwest Smart Grid Demonstration Project is expected to create 1,500 jobs in the five participating states. Washington will get the largest share of those jobs (500) with the remaining 1,000 divided among Idaho, Montana, Oregon and Wyoming. (Montana and Wyoming are consortium states.) In South Dakota, Black Hills Power Inc., Sioux Valley Energy, and Basin Electric Power Cooperative have received grants to make smart grid investments in the state.

The development of a national smart grid will create about 280,000 jobs and an additional 140,000 industry supplier jobs.

Solar Energy: Nanostructured Solar Cells (Photovoltaics)

Dr. Mary Berry, a professor at USD, provided the analysis of solar energy and solar cells. Solar energy can be used for a variety of energy technologies, from producing steam for industrial processes to heating fluids and producing electricity. The report evaluates developments in photovoltaic cells, devices made of semiconductor material that converts sunlight into electricity. Photovoltaic technology is rapidly improving and developing.

Berry developed the following table comparing the number of solar related companies in the consortium states.

Number of Solar Energy Companies in the Consortium States	
State	Number of Companies
South Dakota	9
Nebraska	10
Wyoming	10
Iowa	22
Montana	18
Utah	40

The current economic impact of solar industries in consortium states is small. Specific data about solar industry impacts in all consortium states was not available. A survey of the solar companies in South Dakota was completed in 2010 by Berry. Information about solar employment in the remaining consortium states could be extrapolated from the South Dakota survey and the number of solar companies in each state.

Using information from her 2010 survey of solar companies, Berry tabulated the data at the right on employment and revenues.

Solar sector activities in South Dakota were primarily related to solar panel installation, distribution and design for the installation of solar power in operations (solar powered water pumps by GenPro). No solar cell manufacturing was reported in the state, with most cells originating from manufacturers in China.

Solar Energy and Solar Cell Sectors Jobs/ Occupations:

Architectural drafters

Bookkeeping, accounting and auditing clerks

Computer specialists

Chemical engineers

Chemical plant and system operators

Chemical technicians

Chemists

Customer service representatives

Drivers/sales workers and truck drivers

Electrical and electronic equipment assemblers

Electrical engineering technicians

Electricians

Electronic engineering technicians

Engineering managers

Extruding, forming, pressing and compacting machine setters, operators and tenders

First-line supervisors/managers of production and operating workers

Employment and Revenues of South Dakota Solar Companies					
	Number of Employees	Sales in SD		Sales outside SD	
Company	in SD	kW	$$$	kW	SSS
GenPro Energy	22	18	$125,000	300	$2,000,000
Power Plus Electric	13	300	$2,100,000	600	$4,200,000
Birdneck Renewable	1	<1	n/a	<1	n/a
Black Hills Solar	1	9	$63,000	n/a	n/a
Lynn's Heating and Air	2	<1	n/a	<1	n/a
Absolute Renewable	1	<1	n/a	<1	n/a
Cleaner Greener	2	<1	n/a	<1	n/a
Oakleaf, Inc.	5	n/a	n/a	n/a	n/a
Go Solar Distributing	2	5	$35,000	12	$84,000
Johnson Environmental	1	<1	n/a	<1	n/a
Total	**50**	**332**	**$2,323,000**	**912**	**$6,200,000**

Solar Energy and Solar Cell Sectors Jobs/ Occupations, continued:

- Human resources, training and labor relations specialists, all other
- Industrial engineers
- Industrial machinery mechanics
- Inspectors, testers, sorters, samplers and weighers
- Laborers and freight, stock and material movers, hand
- Laborers and material movers, hand
- Maintenance and repair workers, general
- Miscellaneous production workers
- Mixing and blending machine setters, operators, and tenders
- Office clerks, general
- Packaging and filling machine operators and tenders
- Packers and packagers, hand
- Production, planning and expediting clerks
- Solar energy systems engineers
- Solar sales representatives and assessors
- Sales engineers
- Sales representatives, wholesale and manufacturing
- Shipping, receiving and traffic clerks
- Solar energy installation manager
- Secretaries and administrative assistants
- Secretaries, except legal, medical and executive
- Team assemblers

Geothermal Energy

The report on geothermal energy was compiled by Dr. Kent S. Udell of the University of Utah's Sustainability Research Center. Geothermal energy has enormous potential for power production, but remains largely undeveloped in the consortium states. Geothermal energy can be and already is accessed by drilling water or steam wells in a process similar to drilling for oil. One of the more common technologies is a process called radiogenic heat productions which makes geothermal energy directly available for heat and power generation. Power plants have radiogenic heat production for dry steam plants. More common today are flash steam plants that pump water at temperatures greater than 360 degrees Fahrenheit and under high pressure to generation equipment. When the water reaches the generation equipment, pressure is reduced, allowing some hot water to convert into steam. The steam is then used to power turbine/generator units.

Other current geothermal technologies include binary cycle plants and geothermal heat pumps. Binary cycle pumps pass moderately hot geothermal water by a secondary fluid with a lower boiling point than water, causing the secondary fluid to flash to vapor — which then drives the turbine. Geothermal heat pumps absorb heat from the ground to warm houses in the winter and reverse the process in the summer by removing heat and transferring into the ground.

South Dakota has a significant geothermal resource in the Madison Limestone formation, a well-known aquifer and oil producing formation throughout the northern Great Plains and Rocky Mountains. The Madison contains about 179 miles of recoverable water with temperatures that range from about 86 degrees F to 216 degrees F. The Madison is one of the two geothermal aquifers that are presently used for direct-heat applications.

Thermal Energy Storage

The report on thermal energy storage was also compiled by Udell. Thermal energy storage is an energy management strategy with various applications. As with batteries for electrical energy storage, thermal energy storage shifts energy capacity from low demand to high demand times.

There are numerous variations of thermal energy storage strategies. Some of the most common ones include underground and above ground tank storage with stratified liquid, lakes and solar ponds, encapsulated or bulk phase-change materials in storage tanks, earth pits, underground rock caverns, storage using underground aquifer water and underground storage directly in soil.

Smart Thermosiphon Arrays

The report on smart thermosiphon arrays was compiled by Udell as well. Efficient heat transfer from soils can be realized with vapor/liquid phase change, improving thermal performance of each borehole. Push technologies can be economically used to insert the tubing into the ground since liquid and vapor flow do not require large pipes for the large energy they can transport. An interesting version of this phase change transport mechanism is the thermosiphon heat pipe.

Advanced Adiabatic Compressed Air Energy Storage

Udell also analyzed advanced adiabatic compressed air energy storage. Compressed air energy is a method to meet high peak load electrical power demands and to level power from intermittent renewable energy sources such as solar and wind. The concept is to run high efficiency compressors when electrical energy availability is high to compress ambient air. The compressed air is then stored in a large cavern. When additional power is needed, the compressed air is released through a turbine connected to an electrical generator to produce power. Ideally the overall compression and expansion cycle would be adiabatic, meaning no heat is lost or added to the process.

Hybrid Nuclear Energy

Michael Keller, president and CEO of Hybrid Power Technologies LLC, produced a report for the consortium states on the topic of hybrid nuclear energy. An emerging hybrid-nuclear technology is a breakthrough energy solution that allows the U.S. to utilize our most abundant resource, coal, while dramatically reducing air pollution as well as greenhouse gas emissions without resorting to problematic carbon dioxide sequestration. The hybrid is based on the integration of the existing, well-known technologies of the combustion turbine, combined-cycle power plant and coal gasification as well as the maturing helium gas reactor being developed by the Department of Energy. The absolutely fail-safe nuclear reactor cannot melt, and the hybrid is significantly safer than the current generation of nuclear power plants.

The complete MMEC final report has much more detail about the different technologies and contains a wealth of production process, job, skill and education requirements information on these specific emerging green technologies.

Green Spotlight on a South Dakota Business

G & R Control Services *has been assisting building owners, consulting engineers and mechanical contractors since 1977. Their three locations — Sioux Falls, South Dakota, Rapid City, South Dakota, and Fargo, North Dakota — serve local and surrounding areas by providing service and support in reducing energy usage. Some of their services include:*

- *Boiler-burner service & combustion analysis*
- *Hydronic pumps & accessories*
- *Mechanical HVAC repair & maintenance*
- *Building automation systems*
- *Pneumatic temperature control service*
- *Energy management solutions*
- *Indoor air quality evaluations*

Chapter 9

Economic Impact of Renewable and Energy Efficiency Projects

Another component of the consortium research was to determine the impact of federally funded projects to green America's environment. South Dakota conducted an inventory of American Recovery and Reinvestment Act (ARRA) projects. The ARRA is an economic stimulus package enacted by Congress in February 2009. The stimulus was intended to create jobs and promote investment and consumer spending during the recession. The ARRA includes federal tax incentives, expansion of unemployment benefits, social welfare provisions, domestic spending in education, health care and infrastructure, including the energy sector.

After completing the inventory of ARRA projects, South Dakota staff determined which ones would be considered "green." The state then chose one type of project to estimate the economic impact of those federally funded green projects. South Dakota staff determined the economic impact of sewage treatment projects on the state's workforce. To estimate the direct and indirect jobs, related earnings and other economic impacts created by these projects, South Dakota staff used IMpact analysis for PLANning (IMPLAN) software, an economic modeling package used to assess local- level economic impacts.

The industry sector which includes sewage treatment facilities received a significant amount of stimulus funds, thus this industry was chosen as the focus of this study. The process of sewage treatment involves the removal of contaminants from wastewater and household sewage (both runoff and domestic). This includes physical, chemical and biological processes to remove contaminants, with the final objective of producing environmentally safe fluid and solid product suitable for disposal or reuse.

The data selected for this study includes stimulus funding grants during 2009 (February 17 through December 31), which includes all of the 2009 South Dakota allotments for sewage treatment projects posted on the Recovery.gov website. The site's primary mandate is to give taxpayers user-friendly tools to track Recovery funds. This can track how and where they are spent in the form of charts, graphs, and maps that provide national overviews down to specific zip codes. The total local amount awarded for this industry activity ($80,660,272) was the input used to analyze the economic impact of these funds. The table on the following page details the sewage treatment projects and the local amounts awarded in South Dakota.

American Recovery and Reinvestment Act (ARRA) Infrastructure Grants Awarded for Sewage Treatment Projects South Dakota Calendar Year 2009

Award Key	Funding Agency	Local Amount	Project Activity Description
6558	Public and Indian Housing	$4,000,000	Water and Sewer Line and Related Structures Construction
6558	Public and Indian Housing	$4,000,000	Water and Sewer Line and Related Structures Construction
18381	Environmental Protection Agency	$731,382	Water and Sewer Line and Related Structures Construction
18381	Environmental Protection Agency	$390,000	Water and Sewer Line and Related Structures Construction
24231	Rural Utilities Service	$873,000	Water Supply and Irrigation Systems
24233	Rural Utilities Service	$2,156,000	Sewage Treatment Facilities
27390	Rural Utilities Service	$415,000	Water Supply and Irrigation Systems
39038	Rural Utilities Service	$32,210	Sewage Treatment Facilities
39203	Rural Utilities Service	$295,000	Sewage Treatment Facilities
42203	Bureau of Reclamation	$56,190,925	Water and Sewer Line and Related Structures Construction
42422	Rural Utilities Service	$305,000	Sewage Treatment Facilities
42425	Rural Utilities Service	$61,000	Sewage Treatment Facilities
42425	Rural Utilities Service	$61,000	Sewage Treatment Facilities
43457	Rural Utilities Service	$584,000	Sewage Treatment Facilities
43457	Rural Utilities Service	$584,000	Sewage Treatment Facilities
47683	Rural Utilities Service	$281,000	Water Supply and Irrigation Systems
47683	Rural Utilities Service	$281,000	Water Supply and Irrigation Systems
47684	Rural Utilities Service	$1,496,000	Sewage Treatment Facilities
47685	Rural Utilities Service	$810,000	Sewage Treatment Facilities
47685	Rural Utilities Service	$810,000	Sewage Treatment Facilities
47686	Rural Utilities Service	$38,000	Sewage Treatment Facilities
50417	Indian Health Service	$3,300,000	Water and Sewer Line and Related Structures Construction
53600	Rural Utilities Service	$637,000	Water Supply and Irrigation Systems
53600	Rural Utilities Service	$637,000	Water Supply and Irrigation Systems
60992	Rural Utilities Service	$352,000	Sewage Treatment Facilities
72263	Indian Health Service	$858,755	Water and Sewer Line and Related Structures Construction
82247	Rural Utilities Service	$141,000	Sewage Treatment Facilities
82251	Rural Utilities Service	$340,000	Sewage Treatment Facilities
	Total	**$80,660,272**	

IMPLAN Sector Factors for Analysis Water, Sewage and Other Treatment and Delivery Systems							
Industry Sales	Employment	Employee Compensation	Proprietor Income	Reference Year	Output Deflator	Gross Domestic Product Deflator	Local Purchase Share
$80,660,272	537	$27,668,860	$7,008,102	2009	1	1	100%

Some of the award recipients detailed in the table on the previous page received multiple grants in different calendar quarters, all of which are included in the total funding received. This analysis focused on the statewide impact and was completed as an industry change, which IMPLAN defines as the impact on a specific industry or a set of firms.

The first step in deriving the IMPLAN analysis of Water, Sewage and Other Treatment and Delivery Systems (IMPLAN sector 33) was determining the factors shown in the table above.

IMPLAN sector 33 is linked to the benchmarked data published by the Bureau of Economic Analysis (BEA), U.S. Department of Commerce, for the North American Industrial Classification System (NAICS) code 2213, titled Water, Sewage and Other Systems.

Economic Modeling Results

The economic impact analysis conducted using IMPLAN was based on industry sales for the Water, Sewage and Other Treatment and Delivery Systems industry sector for the reference year 2009. The estimated impacts of the stimulus funds and related activity are identified by the type of economic activity incurred in the region, which include:

- Direct effects include added workers and payroll expenditures of the new business.
- Indirect effects include jobs and earnings generated by suppliers of the firm.
- Induced effects include the economic activity generated when employees of the firm and employees of the firm's suppliers spend wages on goods and services. This spending is associated with creating additional jobs in the economy, which is another induced effect of the added employment.

The table below summarizes the economic impact from the IMPLAN analysis. There were 537 workers added due to direct effects, 151 workers added due to indirect effects, and 276 workers added due to induced effects. Labor income and output as well showed positive effects related to these green grants.

The economic impact of South Dakota sewage treatment projects funded through ARRA was 964 jobs, $51,204,669 in labor income and a total value added of more than $86 million.

Economic Impacts of Sewage Treatment Plant Projects				
Impact Type	Employment	Labor Income	Value Added	Output
Direct	537	$35,502,744	$60,961,112	$82,433,640
Indirect	151	$6,582,377	$8,943,484	$16,967,702
Induced	276	$9,119,548	$16,747,919	$29,411,168
Total	**964**	**$51,204,669**	**$86,652,515**	**$128,812,511**

Top 10 IMPLAN Sectors Impacted by Sewage Treatment Projects					
Sector	Description	Employment	Labor Income	Value Added	Output
33	Water, sewage and other treatment and delivery systems	537	$35,514,624	$60,981,504	$82,461,216
39	Maintenance and repair construction of nonresidential structures	59	$2,636,532	$2,767,704	$5,665,794
413	Food services and drinking places	36	$539,849	$792,197	$1,813,138
397	Private hospitals	19	$996,517	$1,046,483	$2,098,768
369	Architectural, engineering and related services	18	$952,545	$966,113	$1,993,198
368	Accounting, tax preparation, bookkeeping and payroll services	16	$619,370	$742,228	$1,323,688
394	Offices of physicians, dentists and other health practitioners	13	$1,078,580	$1,249,733	$1,831,710
354	Monetary authorities and depository credit intermediation activities	12	$660,723	$1,734,743	$2,477,303
324	Retail stores, food and beverage	11	$240,890	$367,594	$597,762
398	Nursing and residential care facilities	11	$300,374	$311,385	$454,345

The 10 industries most affected by increased employment from this influx of stimulus funds include:

- Water, sewage and other treatment and delivery systems
- Maintenance and repair construction of nonresidential structures
- Food services and drinking places
- Private hospitals
- Architectural, engineering and related services
- Accounting, tax preparation, bookkeeping and payroll services
- Offices of physicians, dentists and other health practitioners
- Monetary authorities and depository credit intermediation activities
- Retail stores, food and beverage
- Nursing and residential care facilities

The table above shows the employment and income effects of the ARRA funding for sewage treatment plants in South Dakota.

It is not surprising the majority of these stimulus funds impacted the water, sewage and other treatment and delivery systems industry (IMPLAN Sector 33), as most the awards were used to update or replace existing sewage systems which were outdated or in poor condition. Nearly all the green ARRA projects had a positive impact on South Dakota's economy due to job creation. However, some goods or services needed for these projects, such as specific manufactured goods, had to be imported, which benefited other economies outside our state borders.

This sector also received the most employment and labor income benefits. The maintenance and repair construction of nonresidential structures industry (IMPLAN Sector 39) also received a large gain in employment and labor income due to these stimulus funds.

It is important to note the positive impacts were not limited to the larger cities in South Dakota. Smaller communities, such as Waubay, Summit and Rosholt, also benefited from the stimulus funds. The positive economic effects are especially important for smaller communities where funding can sometimes be limited and can help foster the opportunity for growth in towns with shrinking populations.

See references in Appendix E.

Chapter 10

The Regulated Environment's Impact on Green Jobs

As part of the Labor Market Information Improvement Grant to the Northern Plains and Rocky Mountain Consortium, Wyoming and South Dakota researched the regulatory impact on the staffing of green jobs in their respective states. Certain green jobs are a product of regulatory requirements, related to attempts to protect the environment and natural resources.

This research involved a detailed review of the environmental regulations and programs, as well as interviews of regulatory staff to identify private and public sector staffing impacted by regulation and technology changes. These changes will help determine the types of jobs businesses and government agencies will need in order to operate effectively in the South Dakota regulatory environment. Some of these jobs will involve regulated activities, while others will provide services to help regulated businesses and individuals meet environmental requirements.

South Dakota Department of Labor and Regulation (DLR) staff worked with the state's Department of Environment and Natural Resources (DENR) staff to identify regulations and programs in six areas: air quality, drinking water quality, ground water quality, surface water quality, minerals and mining, and waste management. The original strategy was to have DENR staff produce a report on the staffing requirements related to environmental regulations, with the goal of providing detailed occupational information using the Standard Occupational Classification (SOC) taxonomy. However, DENR staff could not readily provide the needed information. Therefore, it was decided the best way to gather the data would be to interview key DENR staff. Although DLR researchers were more familiar with obtaining data through the surveys, the interview process provided a unique opportunity to gain insight into the possible occupational staffing impacts of environmental regulations. An example of the interview form is included in Appendix C.

South Dakota staff published the complete findings of this research in publication titled *Regulated Environment's Impact on Green Jobs in South Dakota's Economic Landscape*, which is available from the Labor Market Information Center, South Dakota Department of Labor and Regulation. Staff excerpted information from that publication for this chapter.

Impact on Industries

One of the project's goals was to identify the types of businesses impacted by the regulatory environment. The table at the right and continued over the next several pages titled "Types of Businesses Impacted by DENR Regulations," shows the industry sectors that include businesses affected by DENR regulations.

For more information about South Dakota Department of Environment and Natural Resources' regulations, visit their website at http://denr.sd.gov.

Types of Businesses Impacted by DENR Regulations by North American Industry Classification System (NAICS) Industry Code & Title

NAICS Code	NAICS Title
112112	Cattle Feedlots
112120	Dairy Cattle and Milk Production
112210	Hog and Pig Farming
115112	Soil Preparation, Planting and Cultivating
211111	Crude Petroleum and Natural Gas Extraction
212221	Gold Ore Mining
212319	Other Crushed and Broken Stone Mining and Quarrying
212321	Construction Sand and Gravel Mining
212325	Clay and Ceramic and Refractory Minerals Mining (including Bentonite)
213111	Drilling Oil and Gas Wells
213112	Support Activities for Oil and Gas Operations
221112	Fossil Fuel Electric Power Generation
221210	Natural Gas Distribution
221310	Water Supply and Irrigation Systems
221320	Sewage Treatment Facilities
236220	Commercial and Institutional Building Construction
237110	Water and Sewer Line and Related Structures Construction
237310	Highway, Street and Bridge Construction
237990	Other Heavy and Civil Engineering Construction
238910	Site Preparation Contractors
311111	Dog and Cat Food Manufacturing
311222	Soybean Processing
311611	Animal (except Poultry) Slaughtering
311615	Poultry Processing
312112	Bottled Water Manufacturing
321113	Sawmills
321114	Wood Preservation

Types of Businesses Impacted by DENR Regulations by North American Industry Classification System (NAICS) Industry Code & Title, continued

NAICS Code	NAICS Title
324121	Asphalt Paving Mixture and Block Manufacturing
325193	Ethyl Alcohol Manufacturing
325199	All Other Basic Organic Chemical Manufacturing
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing
327310	Cement Manufacturing
327320	Ready-Mix Concrete Manufacturing
327991	Cut Stone and Stone Product Manufacturing
327999	All Other Miscellaneous Nonmetallic Mineral Product Manufacturing
332710	Machine Shops
337110	Wood Kitchen Cabinet and Countertop Manufacturing
337122	Non-upholstered Wood Household Furniture Manufacturing
337211	Wood Office Furniture Manufacturing
423120	Motor Vehicle Supplies and New Parts Merchant Wholesalers
423140	Motor Vehicle Parts (Used) Merchant Wholesalers
423730	Warm Air Heating and Air-Conditioning Equipment and Supplies Merchant Wholesalers
423830	Industrial Machinery and Equipment Merchant Wholesalers
423930	Recyclable Material Merchant Wholesalers
424510	Grain and Field Bean Merchant Wholesalers (including Grain Elevators)
424610	Chemical and Allied Products Merchant Wholesalers
424690	Other Chemical and Allied Products Merchant Wholesalers
424710	Petroleum Bulk Stations and Terminals
424720	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)
441120	Used Car Dealers
441310	Automotive Parts and Accessories Stores
443111	Household Appliance Stores
447110	Gasoline Stations with Convenience Stores
447190	Other Gasoline Stations

The South Dakota Department of Environment and Natural Resources' motto is "**Protecting** South Dakota's Tomorrow ... **Today**."

More detailed results of research focusing on the impact the regulated environment has on green jobs in South Dakota is available from the Labor Market Information Center. Full results were published in a booklet titled *Regulated Environment's Impact on Green Jobs in South Dakota's Landscape*. Download it from their website at www.sdjobs.org/lmic or contact them at 605.626.2314.

Types of Businesses Impacted by DENR Regulations by North American Industry Classification System (NAICS) Industry Code & Title, continued

NAICS Code	NAICS Title
452910	Warehouse Clubs and Supercenters
454312	Liquefied Petroleum Gas (Bottled Gas) Dealers
484110	General Freight Trucking, Local
484230	Specialized Freight (except Used Goods) Trucking, Long Distance (including Hazardous Waste)
486210	Pipeline Transportation of Natural Gas
493130	Farm Product Warehousing and Storage (including Grain Storage Elevators)
532490	Other Commercial and Industrial Machinery and Equipment Rental and Leasing
541310	Architectural Services
541330	Engineering Services (including Environmental Engineering Services)
541370	Surveying and Mapping (except Geophysical) Services
541380	Testing Laboratories
541620	Environmental Consulting Services
561710	Exterminating and Pest Control Services
561730	Landscaping Services
562111	Solid Waste Collection
562112	Hazardous Waste Collection
562119	Other Waste Collection
562212	Solid Waste Landfills
562910	Remediation Services
562920	Materials Recovery Facilities
562991	Septic Tank and Related Services
562998	All Other Miscellaneous Waste Management Services
611310	Colleges, Universities, and Professional Schools
622110	General Medical and Surgical Hospitals
622210	Psychiatric and Substance Abuse Hospitals
622310	Specialty (except Psychiatric and Substance Abuse) Hospitals
713110	Amusement and Theme Parks

Types of Businesses Impacted by DENR Regulations by North American Industry Classification System (NAICS) Industry Code & Title, continued	
NAICS Code	**NAICS Title**
811111	General Automotive Repair
811113	Automotive Transmission Repair
811121	Automotive Body, Paint, and Interior Repair and Maintenance
811412	Appliance Repair and Maintenance
812320	Drycleaning and Laundry Services (except Coin-Operated)
921140	Executive and Legislative Offices, Combined
923120	Administration of Public Health Programs
924110	Administration of Air and Water Resource and Solid Waste Management Programs
924120	Administration of Conservation Programs
926120	Regulation and Administration of Transportation Program

Green Spotlight on a South Dakota Business

The Advanced BioEnergy, LLC plant of Huron, South Dakota, produces 32 million gallons of ethanol per year. Situated in an area of ample corn supply and expanding corn acres, the Huron plant consumes approximately 11.4 million bushels of corn annually. This site has a beneficial grain origination agreement with South Dakota Wheat Growers. This facility also produces and distributes both wet and dry distiller's grains. The plant is adjacent to a Dakotaland Feeds facility that purchases a majority of the distiller's co-product.

An expansion of the Huron plant is planned to commence as soon as economically feasible. To date, significant engineering, site work and permitting has been completed. The Huron expansion will increase the plant's overall capacity to 65 million gallons of ethanol per year. Existing infrastructure will be upgraded to accommodate the additional capacity. When fully operational, the expanded plant will consume roughly 22.8 million bushels of corn.

Impact on Occupations

Another goal was to determine the types of green jobs impacted by the regulatory environment as well as the types of workers and jobs DENR staff work with to ensure regulated activities meet state and federal requirements. A list of job titles for those workers was produced, including many professional/technical level jobs. The table at the right, titled "Largest Occupations Involving Green Activities Employed in the Types of Businesses Impacted by DENR Regulations," lists the occupational titles of employees who work directly with DENR staff to plan and implement activities that meet regulatory standards.

The occupations listed were identified by DENR staff as involving green activities; however, only those occupations also identified through the initial green jobs employer survey as having employment of 20 or more were included. The information is presented using the 2000 Standard Occupational Classification (SOC) taxonomy.

Largest Occupations Involving Green Activities Employed in the Types of Businesses Impacted by DENR Regulations by Standard Occupational Classification (SOC) Occupational Code & Title

SOC Code	SOC Title
11-1021	General and Operations Managers
17-1011	Architects, except Landscape and Naval
19-1013	Soil and Plant Scientists
19-1031	Conservation Scientists
19-2031	Chemists
19-4093	Forest and Conservation Technicians
25-1053	Environmental Science Teachers, Postsecondary
29-2012	Medical and Clinical Laboratory Technicians
43-5071	Shipping, Receiving and Traffic Clerks
45-2093	Farmworkers, Farm and Ranch Animals
47-2031	Carpenters
49-9042	Maintenance and Repair Workers, General
51-1011	First-Line Supervisors/Managers of Production and Operating Workers
51-8031	Water and Liquid Waste Treatment Plant and System Operators
51-9199	Production Workers, All Other
53-7081	Refuse and Recyclable Material Collectors

Impact on Green Jobs

In addition to the businesses regulated by state and federal laws, other companies provide third-party vendor services to help protect the environment and natural resources. These activities may not be directly regulated, but are impacted by regulations and create green jobs. The research produced a list of job titles of green workers impacted by the regulatory environment. The table on the following two pages, titled "Green Job Titles Indicated by DENR Staff as Being Impacted by Regulations," lists job titles for those types of workers. The job titles provided by DENR staff were crosswalked to O*Net occupational codes and titles. For more information on the research conducted regarding the Regulated Environment's Impact on Green Jobs, find the full report on our Green Jobs Web page at the address below.

http://dlr.sd.gov/lmic/greening.aspx

Green Job Titles Indicated by DENR Staff as Being Impacted by Regulations Crossed to O*Net Codes

Job Title Reported	O*Net Code	O*Net Title
Air quality engineer	17-2081.00	Environmental Engineers
Air quality professional	19-2041.00	Environmental Scientists and Specialists, including Health
Air quality safety officer	17-2111.01	Industrial Safety and Health Engineers
Ambient air monitor and tester	19-4091.00	Environmental Science and Protection Technicians, including Health
Asbestos abatement worker	47-4041.00	Hazardous Materials Removal Workers
Biologist	19-1020.01	Biologists
Boiler operator	51-8021.00	Stationary Engineers and Boiler Operators
Chemical plating equipment operator	51-4193.00	Plating and Coating Machine Setters, Operators, and Tenders, Metal and Plastic
City engineer	17-2051.00	Civil Engineers
City planner	19-3051.00	Urban and Regional Planners
Civil engineer	17-2051.00	Civil Engineers
Community planner	19-3051.00	Urban and Regional Planners
Construction air quality consultant	19-2041.00	Environmental Scientists and Specialists, including Health
County planner	19-3051.00	Urban and Regional Planners
Environmental specialist	19-2041.00	Environmental Scientists and Specialists, including Health
Environment and safety officer	19-2041.00	Environmental Scientists and Specialists, including Health
Hazardous materials remediator	19-2041.00	Environmental Scientists and Specialists, including Health
	47-4041.00	Hazardous Materials Removal Workers
Hydrologist	19-2043.00	Hydrologists
Landfill operator	53-1031.00	First-Line Supervisors/Managers of Transportation and Material-Moving Machine and Vehicle Operators
	53-7081.00	Refuse and Recyclable Material Collectors
Mining engineer	17-2151.00	Mining Engineer
Mine environmental coordinator	17-2151.00	Mining Engineer
Mine permitting specialist	17-2151.00	Mining Engineer
Oil and gas drilling contractor	47-5012.00	Rotary Drill Operators, Oil and Gas
Oil and gas landman	11-9141.00	Property, Real Estate and Community Association Managers
Oil and gas well operator	47-5013.00	Service Unit Operators, Oil, Gas and Mining

Green Job Titles Indicated by DENR Staff as Being Impacted by Regulations Crossed to O*Net Codes, continued

Job Title Reported	O*Net Code	O*Net Title
Petroleum remediator	19-2041.00	Environmental Scientists and Specialists, including Health
	47-4041.00	Hazardous Materials Removal Workers
Petroleum contaminated soil landfarm operator	53-1031.00	First-Line Supervisors/Managers of Transportation and Material-Moving Machine and Vehicle Operators
	53-7081.00	Refuse and Recyclable Material Collectors
Radon testing & mitigation consultant	19-2041.00	Environmental Scientists and Specialists, including Health
	47-4041.00	Hazardous Materials Removal Workers
Stack tester (air emissions)	19-2041.00	Environmental Scientists and Specialists, including Health
Surface reclamation contractor	19-2041.02	Environmental Restoration Planner
Underground and above-ground tank installer	47-1011.00	First Line Supervisors/Managers of Construction Trades and Extraction Workers
	49-9041.00	Industrial Machinery Mechanics
Water tester (laboratory)	19-4091.00	Environmental Science and Protection Technicians, including Health
Water treatment plant operator	51-8031.00	Water and Liquid Waste Treatment Plant and System Operators
Waste tire handler	51-9199.01	Recyling and Reclamation Workers
Wastewater treatment plant operator	51-8031.00	Water and Liquid Waste Treatment Plant and System Operators

Chapter 11

Planning and Preparing for Green Careers

As businesses implement new environmentally friendly practices or begin producing "green" products or services, those firms may need to hire workers with different education, training or skills requirements. One of the goals of the consortium green jobs research project was to develop a career information backdrop to help jobseekers and students to better understand the greening economy and its impact on the workplace. A focus was to identify linkages between green jobs and related training courses or programs that help workers gain the skills and competencies needed for green jobs.

One approach taken to determine the education, training and skills needed for green jobs was the Green Jobs Employer Survey undertaken as part of the consortium research project. (Chapter 3 contains information on the results of the survey.) A second approach was to interview state regulatory staff to gain information about the types of green jobs required by businesses which operate in the regulatory environment. (Chapter 10 discusses the regulatory environment and its impact on jobs.) Based on what was learned from the survey and the interview of regulatory staff, three career products were developed.

To help increase awareness of career opportunities available through the greening of the state's economy, South Dakota staff designed and printed a colorful 11-by-17 inch poster featuring new and emerging energy industries and jobs. The green jobs poster was designed to appeal especially to those career explorers and decision-makers who value environmental preservation and improvement. (See image of poster in Appendix D.)

To complement the poster and provide additional information to those whose interest in green career opportunities was piqued by the poster, a greening Web page on the Labor Market Information Center's website provides more information (such as skill requirements and wages) on the industries and occupations featured.

Another goal closely related to creating interest in green career opportunities was ensuring the availability of objective labor market data on the green economy so the employment and training system can efficiently and effectively respond to the needs of workers and employers. An important starting point was to inventory existing education and training programs focused on preparing workers with the skills and competencies needed for green jobs.

South Dakota staff completed a thorough review of such education and training programs available through the entities who were awarded funding from the South Dakota Department of Labor and Regulation (DLR) through the State Energy Sector Partnership (SESP) Grant. The $2.5 million grant, authorized by the American Recovery and Reinvestment Act (ARRA), included allocations to 11 applicants. These applicants include two universities, four technical institutes, one community college, three training/learning centers and one private company. The grants covered a wide array of green careers training, including the development of a minor in sustainable energy, upgrades in training for employees in the ethanol and biofuel industries and green building construction programs.

The website links below provide access to more detailed information about the green careers training programs offered through South Dakota's postsecondary educational programs/training providers and funded by SESP Grant funds. A diverse range of training is offered, including Leadership in Energy and Environmental Design (LEED) certification, environmental engineering, green building, biofuels and wind energy. The information included below is merely a summary of the inventory taken of education and training programs related to green jobs. Access more detailed information regarding green education and training programs on our Green Jobs Web page at the address at the bottom of the next page.

Summary of Green Careers Training Inventory

As of April/May 2011

(Visit the indicated websites for more information on specific green-related training opportunities.)

South Dakota State Energy Sector Partnership (SESP) Grant: http://dlr.sd.gov/news/default.aspx
(Note: DLR news releases dated May 6, 2010, May 12, 2010 and March 29, 2011)

South Dakota State University: www.sdstate.edu/news/articles/green-education.cfm

Lake Area Technical Institute (Watertown, South Dakota)

Homepage: www.lakeareatech.edu

Agriculture: www.lakeareatech.edu/academics/programs/ag/index.html

Ag-Environmental Technology Option: www.lakeareatech.edu/academics/programs/ag/environmental/index.html

Automotive Technology: www.lakeareatech.edu/academics/programs/auto/index.html

Aviation Maintenance Technology: www.lakeareatech.edu/academics/programs/aviation/index.html

Building Trades Technology: www.lakeareatech.edu/academics/programs/btt/index.html

Diesel Technology: www.lakeareatech.edu/academics/programs/diesel/index.html

Energy Operations: www.lakeareatech.edu/academics/programs/energyops/index.html

Energy Technology: www.lakeareatech.edu/academics/programs/energytech/index.html

Environmental Technology: www.lakeareatech.edu/academics/programs/environmental/index.html

Mitchell Technical Institute (Mitchell, South Dakota)

Homepage: www.mitchelltech.edu

Architectural Design and Building Construction: www.mitchelltech.edu/programs/ViewProgram.aspx?id=9&ContentID=9

Heating and Cooling Technology: www.mitchelltech.edu/programs/ViewProgram.aspx?id=11&ContentID=9

Wind Turbine Technology: www.mitchelltech.edu/programs/ViewProgram.aspx?id=24&ContentID=9

Corporate Education – Green Energy Training: http://mitchelltech.edu/corporateeducation/businessindustrytraininghome

Outreach – Dual-credit Introduction to Energy Career Training: www.mitchelltech.edu/programs/ViewProgram.aspx?id=41&ContentID=9

Southeast Technical Institute (Sioux Falls, South Dakota)

Homepage: www.southeasttech.edu

Architectural/Construction Engineering Technology, AAS Degree: www.southeasttech.edu/Academics/Degrees/Engineering/Pages/ArchitecturalConstructionEngineeringTechnology.aspx

Landscape Design Technology, AAS Degree: www.southeasttech.edu/Academics/Degrees/Hort/Pages/LandscapeTechnology.aspx

BPI Building Analyst: www.trainingsolutionsinstitute.com/Construction/Pages/BPIBuildingAnalyst.aspx

BPI Envelope & Shell Professional: www.trainingsolutionsinstitute.com/Construction/Pages/BPIEnvelopeShellProfessional.aspx

BPI Multi-Family Building Analyst: www.trainingsolutionsinstitute.com/Construction/Pages/BPIMulti-FamilyBuildingAnalyst.aspx

Certified Lead Renovator Training: www.trainingsolutionsinstitute.com/Construction/Pages/CertifiedLeadRenovatorTraining.aspx

Green Associate: www.trainingsolutionsinstitute.com/Construction/LEEDCertificationTraining/Pages/GreenAssociate.aspx

Sustainable Energy and Going Green (in partnership with Gatlin Education Services): www.gatlineducation.com/bit/green.htm

Western Dakota Technical Institute (Rapid City, South Dakota)

Homepage: www.wdt.edu

Environmental Engineering Tech: www.wdt.edu/Programs/Environmental_Engineering_Tech/Environmental_Engineering_Tech.aspx

Green Building and Preparing for LEED Green Associate Exam: http://westerndakota.augusoft.net

WDT is Going Green (2010): www.wdt.edu/catalog.aspx?id=6690

Appendix A

Green Jobs Employer Survey Form

Referenced in Chapter 3

If you indicated in question 3 that your organization currently has no "green" jobs, please answer questions 5 and 6 below.

5. What obstacles or limitations have prevented your organization from having "green" jobs?
(Please select all that apply.)
- ❑ Cost of implementation.
- ❑ Lack of information.
- ❑ Shortage of workers with the knowledge or skills.
- ❑ Shortage of available training programs.
- ❑ There are no "green" job opportunities in our type of business.
- ❑ Other: (Please specify.) _____

6. Does your organization plan on creating any "green" jobs in the future?
- ❑ Yes
- ❑ No

7. Would you like to be added to the mailing list to receive the *South Dakota e-Labor Bulletin*, which provides a monthly update of South Dakota labor economics statistics at no cost?
- ❑ Yes (Please make sure to provide your e-mail address in the Contact Information section below.)
- ❑ No

You're almost done!
Please complete the section below, then return this survey form in the envelope provided.

Contact Information

Name: _____

Phone Number: _____

E-mail Address: _____

Date Completed_____/_____/_____

If your organization would like a copy of the findings, how would you like it delivered?

- ❑ E-mail
- ❑ Postal Mail

Thank you for taking the time to provide us with this valuable information.

south dakota department of labor

greenjobs

The **Northern Plains & Rocky Mountain Consortium**
Iowa, Montana, Nebraska, **South Dakota**, Utah & Wyoming
Researching the green economy

We are conducting an Employers Survey about jobs in our economy where green activities result in environmental benefits. Your response to the survey is important even if you do not consider your business activities to be green. Please complete all items to the best of your knowledge, using one of the options below. **Please respond by June 30, 2010.** If you have any questions about the survey, please contact the Labor Market Information Center at 800.592.1881. Thank you for your time.

Options for completing the Employers Survey :

- Complete online at **www.researchingthegreeneconomy.com**
  Username: <<Username>>
  Password: <<Password>>
- Complete this paper survey and return in the envelope provided.
- Call us at 800.592.1881.

If your organization is not currently in operation, please indicate which situation best applies and return the survey form in the envelope provided.

- ❑ Temporarily out of business
- ❑ Permanently out of business
- ❑ Sold/Merged

Organization Information

1. How many employees does your organization currently have at this location? _____
(Please do not include contractors or temporary agency employees not on your payroll.)

2. Your *organization* may be involved in more than one of the green economic categories listed below, but please check the box that most closely corresponds to the primary green activity within your organization.
(Please see the enclosed insert for further definitions and examples of the green economic categories.)

- ❑ **Renewable Energy and Alternative Fuels**
  Manufacturing, construction, design, research, delivery, operation, storage or maintenance of wind, solar, biomass, hydro, alternative transportation fuels, geothermal, methane and waste incineration as a fuel source.
- ❑ **Energy Efficiency and Conservation**
  Manufacturing, construction or installation of energy efficient products, energy efficiency services, weatherization, building retrofitting/efficiency, energy efficient production processes, energy distribution improvements and transportation technology.
- ❑ **Pollution, Waste and Greenhouse Gas (GHG) Management, Prevention and Reduction**
  Activities related to controlling emissions and pollution. Includes controlling and reducing greenhouse gas emissions, waste water and other pollutants.
- ❑ **Environmental Cleanup and Restoration and Waste Clean-up and Mitigation**
  Environmental restoration including the cleanup and disposal of pollution, waste and hazardous materials, Superfund/Brownfield redevelopment and landfill restoration.
- ❑ **Education, Regulation, Compliance, Public Awareness, and Training and Energy Trading**
  Activities that educate on energy efficiency, renewable energy, energy rating systems certifications and more efficient energy consumption. Enforcement of compliance requirements and regulations, and training on effective use of energy related products and processes.
- ❑ **Sustainable Agriculture and Natural Resources Conservation**
  Products and services to conserve, maintain and improve natural resources and the environment, including low carbon and organic agriculture, land management, water management and conservation, wetlands restoration and environmental conservation.
- ❑ **None of the Above** *This organization does not participate in any of the above green categories.*

Please continue to next page

Note: The Green Jobs Employer Survey form was printed on 11-by -7 inch paper and is shown above in reduced format. If you would like a survey form as originally printed, please contact the Labor Market Information Center, South Dakota Department of Labor and Regulation at 605.626.2314.

This portion of the survey is intended to capture information on employees directly performing green-related activities (as defined in the green section below) as a part of their job duties. Even if you answered "None of the Above" on question 2, you may have employees performing green-related activities. Please do not include:

- consultants, contractors or temporary agency employees not on your payroll
- employees not directly involved in green activities, such as administrative support employees
- employees who perform green activities that do not directly contribute to your business's product or service, like those who carpool or recycle

3. Based on these instructions, how many employees at this location perform green-related activities? _____ If you have no employees who perform green-related activities, please continue to question 5 on page 4.

4. Please fill out the matrix below by job title for the green employees indicated in question 3.

A green job is one in which an employee produces a product or service that improves energy efficiency, expands the use of renewable energy or supports environmental sustainability.

Job Title & Brief Description	Number of Employees	Minimum Education/Training Requirement	Special Requirements	Number of Workers Who Have Green Job Responsibilities (Based on percent of time dedicated to green work)			Indicate the number of workers having green job responsibilities in each wage category. (Please do not include the value of benefits.)												Jobs Recently Created or Modified	Current Vacancies[1]	Projected Creation or Elimination	
Only list current jobs which produce a product or service that can be considered green. List job title and briefly describe duties related to green-related activities	Enter the number of employees with this job title who participate in green activities.	**Use the following codes:** 1 = No Requirements 2 = HS Diploma/GED 3 = Post HS, No Degree 4 = Apprenticeship/ On-the-Job Training 5 = Trade Certified 6 = Vocational Degree 7 = Associate Degree 8 = Bachelor's Degree 9 = Graduate/Professional Degree	Please list any required licenses, certificates or other training above and beyond the normal requirements of this occupation which are necessary due to the green activities of this position.	Between 1-49%	Between 50-99%	100%	*Hourly Wage*	Under $9.25	$9.25 - $11.49	$11.50 - $14.49	$14.50 - $18.24	$18.25 - $22.74	$22.75 - $28.74	$28.75 - $35.99	$36.00 - $45.24	$45.25 - $56.99	$57.00 - $71.49	$71.50- $89.99	$90.00 and over	How many of these jobs were created as green job positions or modified to include green tasks since January 2009?	How many current vacancies does your organization have in this green job?	How many positions in this green job does your organization expect to create or eliminate within the next two years?	
							Annual Salary	Under $19,240	$19,240 - $23,919	$23,920 - $30,159	$30,160 - $37,959	$37,960 - $47,319	$47,320 - $59,799	$59,800 - $74,879	$74,880 - $94,119	$94,120 - $118,559	$118,560 - $148,719	$148,720 - $187,199	$187,200 and over			Create	Eliminate
Example: Wind Turbine Technician - Installs & repairs wind turbines	***7***	***5***	***Renewable energy technician certification***	***2***	***4***	***1***					***6***	***1***								***2***	***1***	***5***	***1***
1.																							
2.																							
3.																							
4.																							
5.																							
6.																							
7.																							
8.																							
9.																							
10.																							

[1] A vacancy exists if it meets the following criteria: a specific position exists; work could start within 30 days; and you are actively seeking workers to fill this position.

Note: The Green Jobs Employer Survey form was printed on 11-by -7 inch paper and is shown above in reduced format. If you would like a survey form as originally printed, please contact the Labor Market Information Center, South Dakota Department of Labor and Regulation at 605.626.2314.

Appendix B

New Hires Survey Form

Referenced in Chapter 4

Skills of Job Applicants

15. How would you rate the availability of job applicants with the basic work skills required for this position?

❑ Less than adequate ❑ Just right ❑ More than adequate

16. Name the one basic work skill critical for this position that was most often lacking in job applicants.

_____

17. How would you rate the availability of job applicants with the technical work skills required for this position?

❑ Less than adequate ❑ Just right ❑ More than adequate

18. Name the one basic technical skill critical for this position that was lacking in most of the job applicants.

_____

19. Was the opening for this position listed with a South Dakota Department of Labor local office or on the SDWORKS website?

❑ Yes ❑ No

20. Was the National Skills Readiness Certificate used as a screening tool when filling this position, to ensure candidates possessed the needed skills? (If you are not familiar with the National Skills Readiness Certificate, please see the information in the blue box below.)

❑ Yes ❑ No

Resources Available to Employers

20. Would you like to be added to the mailing list to receive the South Dakota e-Labor Bulletin, which provides a monthly update of South Dakota labor economics statistics at no cost?

❑ Yes (Please make sure to provide your e-mail address in the Contact Information section below.)

❑ No

The South Dakota Department of Labor (DOL) has a new worker recruitment tool to help your business! The National Career Readiness Certificate is a credential which measures individuals' basic employability skills including Reading for Information, Locating Information and Applied Mathematics. This will save you time in identifying the most qualified applicants. To learn more, contact your local DOL office or visit www.sdjobs.org.

Contact Information for Person Completing Questionnaire (Please print.)

Name_____ Title_____

Phone Number (with area code)_____ E-mail address_____

Would you like to receive a copy of the statistical report compiled from all of the results of this questionnaire?

❑ Yes, please send the report via e-mail. ❑ Yes, please send the report via postal mail. ❑ No

Please return this form either by mail using the enclosed envelope or fax it to 605.626.2322 by December 20, 2010.

south dakota department of labor

greenjobs

The **Northern Plains & Rocky Mountain Consortium**
Iowa, Montana, Nebraska, **South Dakota**, Utah & Wyoming
Researching the green economy

Employer name
Employer address
Employer address 2
Employer city, state zip

Dear Employer:

Enclosed is a questionnaire we would like you to complete regarding the skill requirements of job openings recently filled in your firm. The information gathered through this survey will be used by educators, employment training organizations and vocational counselors to identify those skills most needed by employers in the state, and then develop curricula emphasizing those skills. This will help you and employers like you access the skilled labor force essential to your business.

Positions from your company were randomly selected to represent many businesses, so it is important you complete the forms and return them as soon as possible. For your convenience, you may respond by any of the following methods:

- Complete the questionnaire and return it in the self-addressed, stamped envelope enclosed.
- Fax it to us at 605.626.2322.
- Call us toll free at 800.592.1881 and provide your responses over the phone.

Please respond to the questionnaire no later than **December 20, 2010**.

The results of this study will be published and distributed to those who are concerned with employee skills, in order to encourage discussion. These results will also be posted on our website at www.sdjobs.org/lmic. All of the information you provide will be kept confidential, as protected by law. For more information on our confidentiality policies or this study, please contact the Labor Market Information Center at 800.592.1881 or via e-mail at SDDOLLMIC@state.sd.us.

Thank you in advance for your cooperation.

Sincerely,

Bernie Moran

Bernadette Moran
Administrator, Labor Market Information Center

Note: The New Hires Survey form was printed on 11-by-17 inch paper and is shown above in reduced format. If you would like a survey form as originally printed, please contact the Labor Market Information Center, South Dakota Department of Labor and Regulation at 605.626.2314.

South Dakota Department of Labor Job Skills Survey
Labor Market Information Center
PO Box 4730 □ Aberdeen, SD □ 57402-4730
Telephone: 800.592.1881 □ Fax: 605.626.2322

We expect this form to take approximately 10-15 minutes to complete. All information provided will remain strictly confidential; results will be published only as summary statistics. **Please return completed form by December 20, 2010.**

Employee and Position Information

For the majority of this survey (questions 1-14) we would like to focus on the employee listed below.

1. Our records indicate the individual listed below was an employee of your business during the reference period of January, February and March 2010. Is this correct?

❑ Yes (Please continue with question 2.)

❑ No (Please stop completing the survey and return the form by mail using the envelope provided, or fax it to 605.626.2322. Thank you for your time.)

Employee:

2. What is the job title of the current position held by this employee? (Examples: secretary, accountant, custodian, environmental engineer, etc.?

_____

3. What are this employee's current primary responsibilities? (Examples: typing and filing, reconciling financial records, cleaning and maintaining facilities, remediation of environmental hazards, etc.)

_____

_____

4. What percentage of this employee's time is dedicated to "green" activities related to producing a product or service that improves energy efficiency, expands the use of renewable energy or supports environmental sustainability?

❑ None of the time ❑ Less than 50% of the time ❑ More than 50% of the time

If the answer to the previous question is "More than 50% of the time," please continue to the next question. If you chose one of the other answers, please stop completing this survey form and return it by mail using the enclosed envelope or by faxing it to 605.626.2322. Thank you.

5. For this employee who spends more than 50 percent of work time dedicated to "green" activities, please indicate the education or training required for the position.

❑ None required
❑ High school diploma or GED
❑ On-the-job training
❑ Postsecondary technical training
❑ Associate degree
❑ Work experience in related occupation
❑ Licensure or certification
❑ Bachelor's degree or higher
❑ Other (Please specify; for example, a course in medical terminology)

_____

_____

6. Please list any required licenses, certificates or other training above and beyond the normal requirements of this type of position which are necessary due to the "green" activities of this position.

_____

7. Was the individual hired to fill a new position created because of additional "green" activities within this business?

❑ Yes ❑ No

Basic Work Skills

We are seeking information about the importance of the following basic work skills for the current position in which the employee is working. Please use the scale provided to indicate the most appropriate response for each skill.

8. How would you rate the level of importance of reading comprehension for this position? (Understanding written sentences and paragraphs in work related documents.)

❑ Critical ❑ Needed ❑ Unimportant

9. How would you rate the level of importance of writing for this position? (Communicating effectively in writing as appropriate for the needs of the audience.)

❑ Critical ❑ Needed ❑ Unimportant

10. How would you rate the level of importance of basic math for this position? (Using mathematics to solve problems.)

❑ Critical ❑ Needed ❑ Unimportant

11. How would you rate the level of importance of critical thinking for this position? (Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, and approaches to problems.)

❑ Critical ❑ Needed ❑ Unimportant

12. How would you rate the level of importance of science for this position? (Using scientific rules and methods to solve problems.)

❑ Critical ❑ Needed ❑ Unimportant

13. Please list one basic work skill that is critical for this position because of the green activities involved (as compared to similar positions without green activities).

_____

Technical Work Skills

14. What are the most important technical skills required for this position? Please list up to five in order of importance. (Examples: MIG welding, computer proficiency, product design verification (engineering), wind turbine fabrication, composite repair, etc.)

a. _____
b. _____
c. _____
d. _____
e. _____

Please continue on next page.

Note: The New Hires Survey form was printed on 11-by-17 inch paper and is shown above in reduced format. If you would like a survey form as originally printed, please contact the Labor Market Information Center, South Dakota Department of Labor and Regulation at 605.626.2314.

Appendix C

Interview Form Used with Department of Environment and Natural Resources Staff

Referenced in Chapter 10

South Dakota Department of Environment and Natural Resources: Air Quality
Name of SD DENR Staff: _____

1. Have you had an opportunity to read the Statement of Need for this study that was e-mailed to you before the interview? Yes__ No__ If no, repeat key points.

   We are conducting these interviews because DENR staff is knowledgeable about regulated industries. We hope to gain information about the types of firms and public entities covered by regulations, the principle kinds of jobs involved, and the direction the industry appears to be headed by virtue of technological, economic or regulatory change, either current or anticipated. The information we collect will be published in a summary report and no individual will be identified. Do you have any questions?

2. With regard to the following Air Quality programs or functions I am going to list, what kind of contact do you (or your staff) have, e.g., grant permits, on-site inspections, information gathering, information dissemination, collecting fees, etc.? Tell me about any programs or functions that I have missed.

3. For each of these programs or functions that I am going to list, tell me about the kinds of private business or public sector entities that you (or your staff) work with most frequently.

4. For each of these programs or functions that I am going to list, do you (or your staff) have an estimate of the number of businesses and public sector entities involved?

5. For each of these business types or public sector entities, what part of the business activity do you (or your staff) oversee, e.g., boiler emissions, asphalt plant emissions, ethanol plant emissions, asbestos abatement, acid rain monitoring, etc.?

6. What kinds of work activities do the employees of each type of business or public sector entity engage in, e.g., operating asphalt plant, monitoring emissions, controlling dust, collecting lab samples, etc.?

7. Are we talking about a significant number of workers (more than 50) involved in these work activities? Any estimate of the number of workers?

8. Identify the types of certification, licensing or specific training needed by each of these employees to perform their jobs.

9. For each job type, identify any employee shortages/training issues that cause problems for the private firms or public entities in meeting environmental rules and regulations.

10. Identify current or developing technology that will affect staffing for firms performing work in the regulated environment (within your area of authority).

11. Identify new or revised regulations that will affect staffing for firms performing work in the regulated environment (within your area of authority).

12. Identify new or revised regulations that might affect DENR staffing (in your area of authority).

Note: The interview form used with Department of Environment and Natural Resources staff was printed on 8.5-by-11 inch paper and is shown above in reduced format. If you would like an interview form as originally printed, please contact the Labor Market Information Center, South Dakota Department of Labor and Regulation at 605.626.2314.

Appendix D
Green Careers Poster

Referenced in Chapter 11



Note: The "going green" career poster was printed on 11-by-17 inch paper and is shown above in reduced format. If you would like a copy of the poster as originally printed, please contact the Labor Market Information Center, South Dakota Department of Labor and Regulation at 605.626.2314.

Appendix E

References

Chapter 9, Economic Impact of Renewable and Energy Efficiency Projects

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