

Job Vacancies in Minnesota's Renewable Energy Industries

An overview of employment at wind power generation
and biofuel production facilities

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Introduction

With more focus being placed on global climate change, leaders across the world are looking to cleaner sources of energy from renewable resources or new technologies. As this focus intensifies, Minnesota is taking the next steps to integrate renewable sources of energy into our electric power generation industry and transportation fuels. This report will focus on two sub-sectors of new energy innovations: biofuels (ethanol and biodiesel) and wind energy for electricity.

Methodology

Minnesota's Job Vacancy Survey, conducted during second and fourth quarters since 2000, was used as the tool by which to count job vacancies in these biofuels and wind power industries. The survey asks employers for information regarding current job openings, including education and experience requirements, and wage and benefit offers.

Because the survey relies on a random stratified sample to measure job vacancy levels in every industry economy-wide, special measures were taken to target these two small industries to ensure a more reliable count of vacancies, particularly within certain occupations. Public information sources¹ were used to identify the complete population of biofuel production facilities and, later, to identify the complete population of firms that hire wind turbine mechanics.

This means that many companies involved in these two industries are not reported on in this paper. Biofuel industry segments not reported on include service, transportation and supplier companies for example. The segment of wind related job vacancies reported on in this paper is even more limited: Segments of the wind industry not included in these findings include firms that are primarily engaged in the manufacture of turbines and parts, the transport of turbines and parts, installation, regulation, and administration. It is also important to note that companies were included in the survey only if they have a physical location within Minnesota. Many wind turbine technicians who service Minnesota based-turbines are still employed by companies located outside of Minnesota or the U.S.

¹ Ethanol production facilities were determined using the Minnesota Department of Agriculture's website: <http://www.mda.state.mn.us/renewable/ethanol/>.

Biodiesel production facilities were determined using the Minnesota Soybean Association's website: <http://www.mnsoybean.org/biodiesel/MinnesotaBiodieselPlants.cfm>.

Windfarm locations were determined using a list produced by the American Wind Energy Association, and found at their website: <http://www.awea.org/projects/>.

The population of biofuel production facilities was incorporated into the survey during the fourth quarter of 2007 and vacancy data have been compiled on a semiannual basis since then. Job vacancies within the wind power generation industry were compiled starting in the second quarter of 2009, and will continue to be measured on a semiannual basis.

Currently, the North American Industry Classification System (NAICS) is the primary mechanism for sorting and measuring employment within industries. Within this taxonomy, ethanol has its own code, *ethyl alcohol manufacturing*, but biodiesel production is grouped within *all other basic organic chemical manufacturing* or *soybean processing*, depending on the main source of revenue for the firm. Firms that maintain wind turbines can fall within several codes depending on their primary business. (See Table 3: Industries with Wind Component for examples.)

On the occupational side, there are similar issues. Biofuel production workers generally fall into various production categories depending on their role in the facility, while wind turbine mechanics have historically been coded in *installation, maintenance, and repair workers, all others*, a broad category which includes many different types of skill sets and industry settings. In fact, this has been recognized by the national committee that was in charge of revising the Standard Occupational Classification System (SOC) the nationally used occupational taxonomy, and with the 2009 revision there is now a stand-alone code for wind turbine mechanics. This should improve the accuracy and cross-state comparability of future tracking and reporting efforts around this emerging occupation.

As a result of these coding issues, much of the information presented in this report has been compiled from a variety of information sources. Source information is included where clarification seems important.

Overview of Ethanol/Biodiesel Industries

Within Minnesota, petroleum and diesel fuels are the most commonly used source of power for transportation needs although the state does not have any known reserves of its own to tap. Since the 1980s, the state has begun to develop more technologies supporting biofuels, or fuels derived from recently living biological matter (as opposed to fossil fuels, which come from long-dead biological matter). While biofuels make up a much smaller portion of the overall energy portfolio of the state, Minnesota is one of the top producers of ethanol, a starch-based biofuel, and biodiesel, an oil-based biofuel.

Ethanol

Ethanol, a fuel typically produced from corn (although also derived from cellulosic feed stocks and sugar cane), is a large export in Minnesota, with 53 percent, roughly 290 million gallons, of the supply exported in 2006. Based on research using the Quarterly Census of Employment and Wages as well as

Number of Companies	Number of Minnesota Locations	Total Employment	Average Annual Wage
16	19	680 - 1,190	approx. \$55,400
Source: Minnesota Department of Agriculture and Quarterly Census of Employment and Wages, 2009 Note: There are 16 companies located in Minnesota, which operate 19 production facilities within the state.			

Department of Agriculture data², 19 production facilities were identified in Minnesota during the first half of 2009 with a total of between 700 and 1,200 employees. The

average annual wage of these workers was approximately \$55,000, somewhat higher than that of Minnesota's manufacturing sector as a whole. Since this research was conducted, two more facilities have opened in Minnesota but information on employment size is not currently available for these facilities.

Biodiesel

Currently, biodiesel is derived mainly from soybean oil, though a new biodiesel plant in Isanti will produce the fuel from algae and weeds as well as waste oils and sewage-treatment residue.³ Biodiesel is commonly blended with petroleum

Number of Plants	Total Employment	Average Annual Wage
3	253	\$49,200
Source: Quarterly Census of Employment and Wages, March 2009.		

diesel to produce transportation fuels. Since 2005, the state has required that all diesel products sold in the state contain at least 2 percent biodiesel; in May 2009, the mandated level was increased to 5 percent. This

change will increase the state's consumption of biodiesel by 40 million gallons per year, at least 20 million of which are to be produced within the state. The required blend will increase to 10 percent in 2012, and 20 percent in 2015.⁴

² Minnesota Department of Agriculture. *Minnesota Ethanol: Production, Consumption and Economic Impact*. July 2009. <http://www.mda.state.mn.us/renewable/ethanol/productionimpact.htm>.

³ Star Tribune, Biodiesel refinery in Isanti is ready to rev, September 2009.

⁴ Agricultural Utilization Research Institute. *Ag Innovation News*. June 2009. <http://www.auri.org/>

According to the Minnesota Soybean Association, there are 12 retailers in Minnesota that currently sell higher-than-required blends of biodiesel.

Based on research using the Quarterly Census of Employment and Wages as well as data from the Minnesota Soybean Association there were three biodiesel production facilities in operation in Minnesota during the first half of 2009 with a total employment of 253. These workers had an average annual wage of approximately \$49,200, slightly below that for the manufacturing sector as a whole in Minnesota.

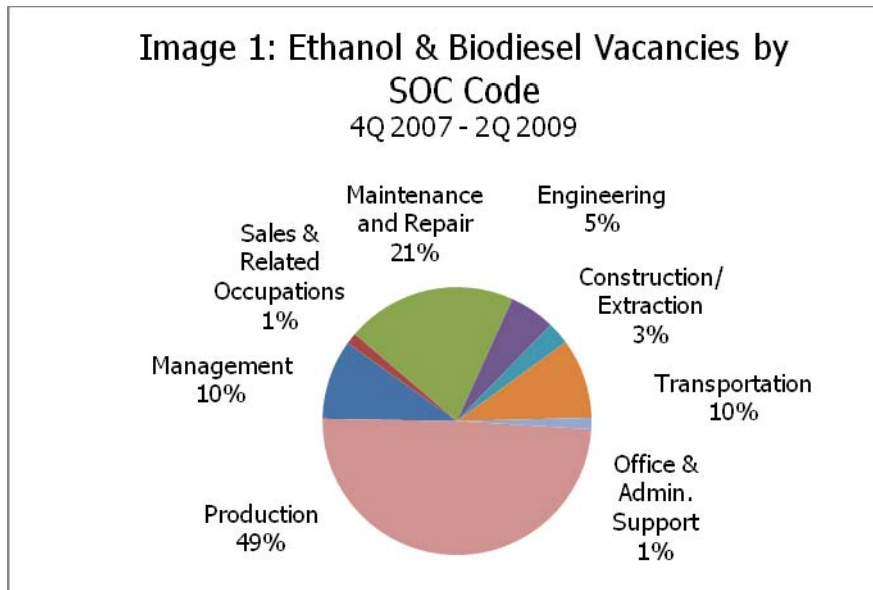
Job Vacancy Survey Results

For ethanol and biodiesel firms that responded to the Job Vacancy Survey, a total of 73 vacancies were reported between the end of 2007 and mid-2009, an average of approximately 18 vacancies per quarter. Of the 73 vacancies, 15 were reported by biodiesel facilities, while the remaining 58 were reported by ethanol facilities. Median wage offers hovered around \$14/hour but varied based on the type of position. Because the average survey response rate was only 65 percent, these vacancies represent only a portion of the potential job openings within the biofuels industries. Vacancies may exist within the firms that failed to respond to the survey.

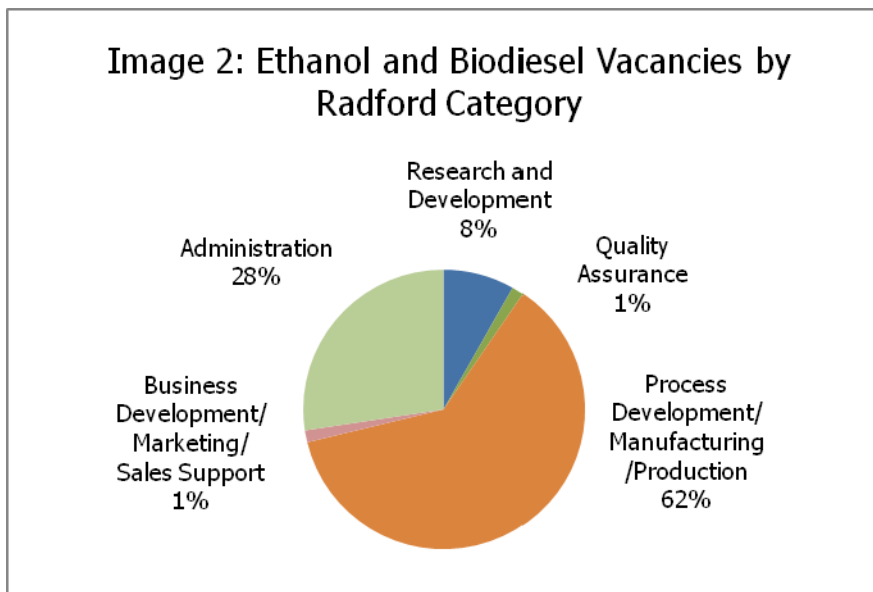
Occupations

Based on the Standard Occupational Classification (SOC) system, vacancies within ethanol and biodiesel were separated into eight occupational categories; Management, Sales & Related, Office & Administrative Support, Engineering, Construction & Extraction, Installation, Maintenance & Repair, Production, and Transportation & Materials moving.

The distribution of vacancies in ethanol and biodiesel plants fell heavily on installation, maintenance and repair occupations, along with production occupations. When looking at the two industries separately, ethanol plants had vacancies distributed across all occupational categories, while the biodiesel firms' vacancies were primarily located within the production and maintenance occupational categories. A total of seven of the vacancies reported over the two years were for management positions.



Another occupational classification system specific to the biosciences industry is called the Radford system. Based on this classification, the majority of vacancies in ethanol and biodiesel plants are found within the 'Process Development/Manufacturing/Production' and 'Administration' categories. No vacancies were found for positions within 'Quality Control,' 'Clinical,' 'Regulatory Affairs' or 'Information Systems'.



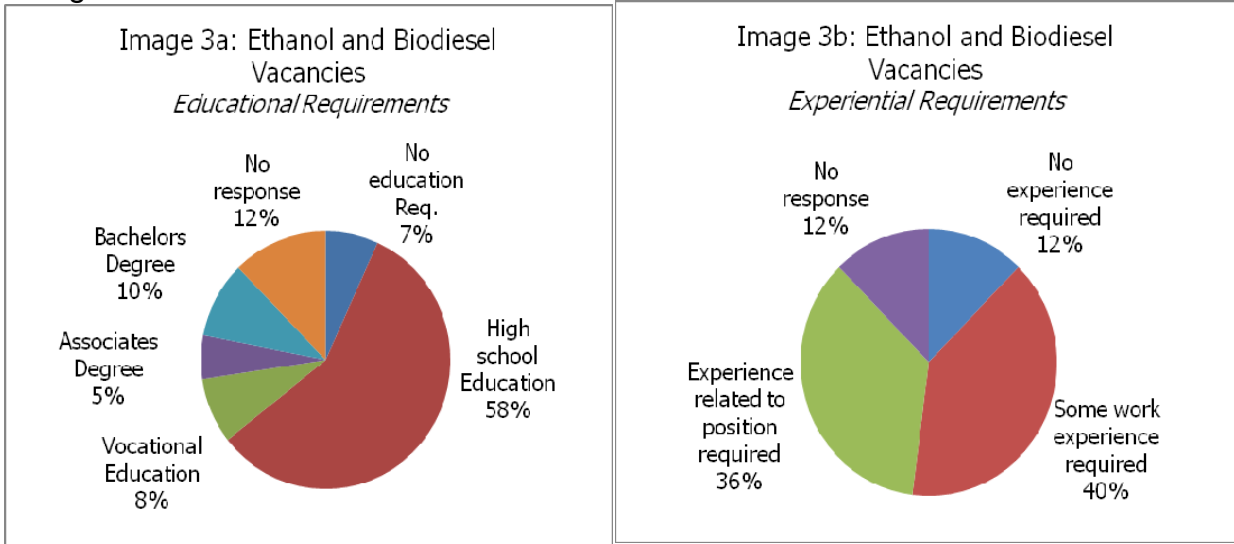
Note: Radford categories without reported vacancies were not included in the chart.

The classification of these vacancies was limited to the job title and entry-level wage, without a description of the position to aid in the categorization of the job vacancy. Additionally, it is noted that vacancies with supervisory roles, such as

'plant operator' or 'boiler operator,' in addition to many maintenance positions were classified as administrative occupations according to the Radford categories.

Educational and Experiential Requirements

In terms of educational requirement, 58 percent of biofuel vacancies required only a high school education and another twenty-three percent required education beyond a high school diploma. No vacancies required an advanced degree.



When looking at the experiential requirements of the vacant positions, ethanol and biodiesel employers sought workers who had some amount of work experience, both specific to the position and more general. About half of the positions required at least some work experience, while 36 percent of employers desired workers with experience specifically related to the vacant position.

Overview of the Wind Industry

Most of the state's electricity is currently derived from coal-fired or nuclear plants, both problematic sources due to their emissions and toxic waste by-products. Minnesota is one of the leading states in incorporating renewable sources of energy into its electricity portfolio, with 10.4 percent of the state's overall energy coming from wind,⁵ and additional contributions made from biomass and hydro-electric power.⁶

The share of electricity derived from wind is expected to grow in light of the state's renewable energy goal to have 25 percent of its energy derived from renewable resources by 2025. Additionally, Xcel Energy, one of the largest providers of wind energy, has pledged to supply 30 percent of Minnesota's



electricity from renewable resources by 2020. Given the high level of wind energy already present in Minnesota's energy portfolio, and plans to enhance the contribution, it is no surprise that jobs in the wind industry are growing.

Each wind turbine contains approximately 8,000 parts, with about half of those parts domestically produced.⁷ After manufacture, the technical nature of assembling a wind farm combines the construction of the actual site, along with the assembly of the turbine's tower, blades, nacelle and internal structure. As of June 2009, the American Wind Energy Association had counted 83 wind projects within Minnesota, producing approximately

1,805 MW of power (ranked 4th in the United States for installed capacity). No projects were identified as under construction, although the Minnesota Public Utilities Commission lists multiple wind farms as having received permits to begin their projects.

Based on the variety of services and products that make up the wind industry, numerous industrial classes can contain wind energy establishments. Some of the industries that contain wind energy related production and services are listed

⁵ Lawrence Berkeley National Laboratory. *2008 Wind Technologies Market Report*. July, 2009. <http://eetd.lbl.gov/ea/ems/re-pubs.html>. Pg. iii.

⁶ Energy Information Administration. *Minnesota Renewable Electricity Portfolio*. 2007 Edition. http://www.eia.doe.gov/cneaf/solar/renewables/page/state_profiles/minnesota.html.

⁷ Lawrence Berkeley National Laboratory. *2008 Wind Technologies Market Report*. July, 2009. <http://eetd.lbl.gov/ea/ems/re-pubs.html>. Pg. iv.

in Table 3. With the exception of *other electric power generation*, these industries contain only a small number of wind energy related firms, either related to manufacturing of turbines and parts, transmission or utilities.

Table 3: Industries with Wind Component, Minnesota, 2008						
NAICS Code	Industry	Avg. Number Firms	Avg. Number Employees	Avg. Weekly Wage	Avg. Annual Wage	Job Growth '00 - '08
221119	Other Electric Power Generation	22	230	\$1,299	\$67,456	400%
237130	Power/Communication System Construction	179	2,076	\$1,085	\$56,415	-11%
33361-	Turbine and Power Transmission Equipment	17	511	\$949	\$49,370	-26%
926130	Utility Regulation and Administration	22	608	\$974	\$50,674	3%
2211--	Electric Power Generation	175	7,502	\$1,712	\$89,106	-11.5%
All Industries		169,979	2,678,384	\$881	\$45,815	2.6%
Source: Quarterly Census of Employment and Wages, 2000-2008.						

To prepare for the Job Vacancy Survey, the author compiled a list of Minnesota-based firms that directly employ wind energy operations and maintenance technicians. This list excluded firms that focus primarily on development, IT consultation, construction power purchasing specialists and utilities. In total we found 14 companies with 16 locations in Minnesota and a total of 900 employees statewide. All of these locations were asked to report their job vacancies during June of 2009 so that we could understand more about their labor force needs.

Table 4: Wind Turbines Maintenance Firms Located in Minnesota		
MN. Companies	Total Employment	Average Annual Wage
14	906	\$52,200
Source: Quarterly Census of Employment and Wages, March 2009 and research conducted by author.		

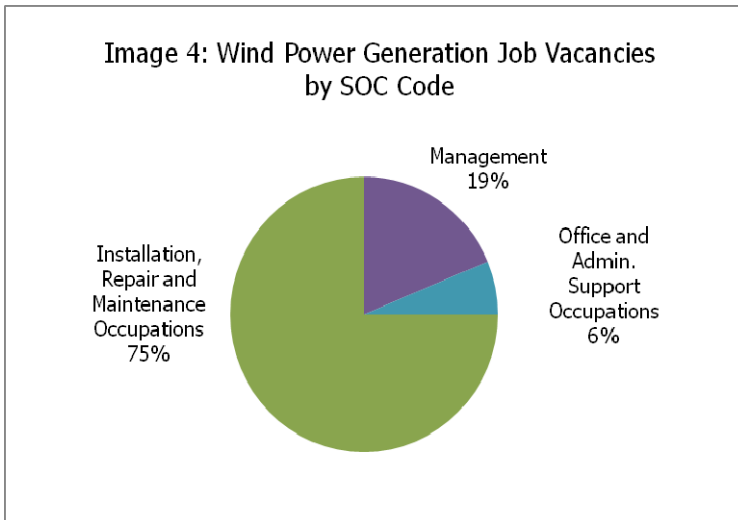
Job Vacancy Survey Results

A total of 16 vacancies were recorded by the 14 locations that responded to the survey. This 88 percent response rate for the population of wind firms surveyed means that we can assume some additional vacancies were not recorded by the Job Vacancy Survey during the period.

The 16 vacant positions found in the survey could be classified in just three distinct SOC code families: management, office and administrative support, and installation, repair and maintenance occupations (see Image 4). However, only five were for jobs other than technician positions. The median wage offered for these wind positions was \$17.50, only slightly lower than the state's median wage for specialized installation and maintenance workers.

Table 5: Vacancies for Wind Turbine Maintenance Firms	
2nd Quarter, 2009	
Wind Vacancies	16
Survey Response Rate	88%
Source: Wind Energy Job Vacancy Survey, 2009	

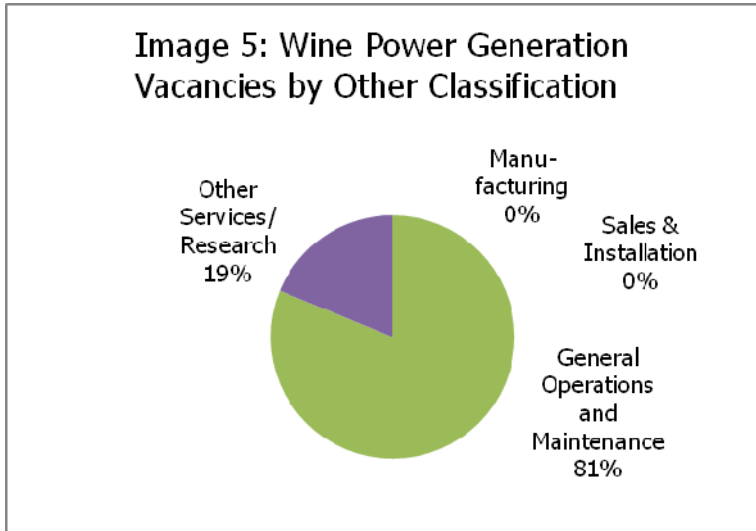
Many of the occupations within the wind industry are relatively new, and therefore do not easily fit within the Standard Occupational Coding structure. In 2009, the Standard Occupational Classification Policy Committee released a new taxonomy, incorporating many new occupations, in particular, Wind Turbine Service Technicians, into their taxonomy. Additionally, the Occupational Information Network (O*NET) has also unveiled a new taxonomy to incorporate new occupations into its database, including Wind Turbine Service Technician, Wind Energy Operations Managers, Wind Energy Project Managers, and Wind Energy Engineers.



While the Radford classification system was used to organize the vacancies found within the ethanol and biodiesel industries, these categories are less pertinent to the wind energy industry. Based on work done by the Career Awareness for Renewable Energy grant administered by the WIRED Region (see page 12)⁸, the

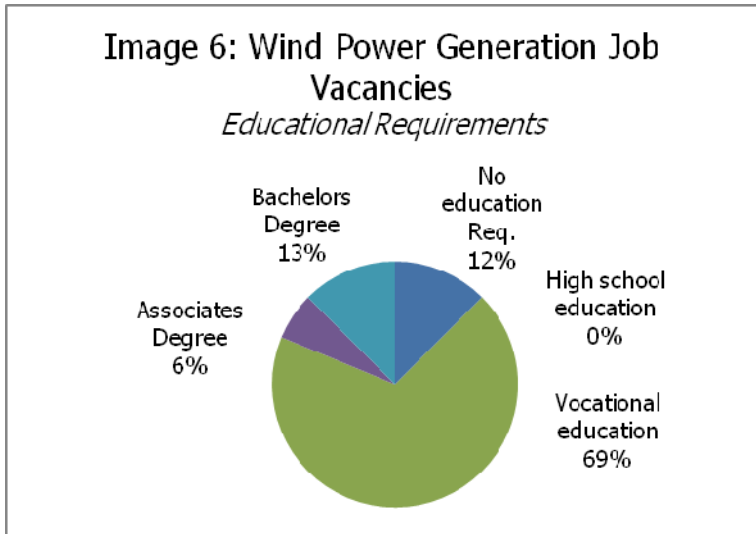
⁸ This workforce solution was funded by a grant awarded under Workforce Innovation in Regional Economic Development (WIRED) as implemented by the U.S. Department of Labor's Employment and Training Administration. The solution was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the

classification of wind careers can be simplified into four overarching categories: manufacturing, sales and installation, general operations and maintenance, and other services or research.



Based on these categories, the existing job vacancies within Minnesota’s wind energy industry fell into two categories, with 13 vacancies in general operations and maintenance, and 3 vacancies within other services or research (Image 5).

Educational & Experiential Requirements



While the vacancies within the wind energy industry displayed a wide range of educational requirements, the experiential requirements were standard across all 16 vacancies. Most jobs required at least vocational education, while a few positions required more schooling beyond that level. Twelve percent of the vacancies listed no

specific level of education required for the job.

Conversely, all of the vacancies reported by survey respondents required work experience related to the position. More experienced technicians are emerging from specialized training programs throughout the state, where hands-on

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training combined with specialized courses are producing increasingly large numbers of wind technology specialists and technicians. These graduates are in high demand and technical schools report very high levels of job placement both before and after graduation.

Minnesota's WIRED Region

When examining jobs and firms in these industries, the spatial pattern of their location and development is also of interest. One area of focus is the Workforce Innovation in Regional Economic Development (WIRED) region of Minnesota, a set of counties currently receiving federal funding from the U.S. Department of Labor, Employment and Training Administration, to promote renewable energy and regional economic development (Figure 1).⁹ The focus of this project is to create jobs based on products like ethanol, biodiesel, and wind energy and to ensure that a sufficient supply of skilled workers are available to take these jobs.

The area is made up of 36 counties in the West and Southwestern part of the state, and many of the job vacancies in the ethanol, biodiesel and wind energy industries were found in this region.

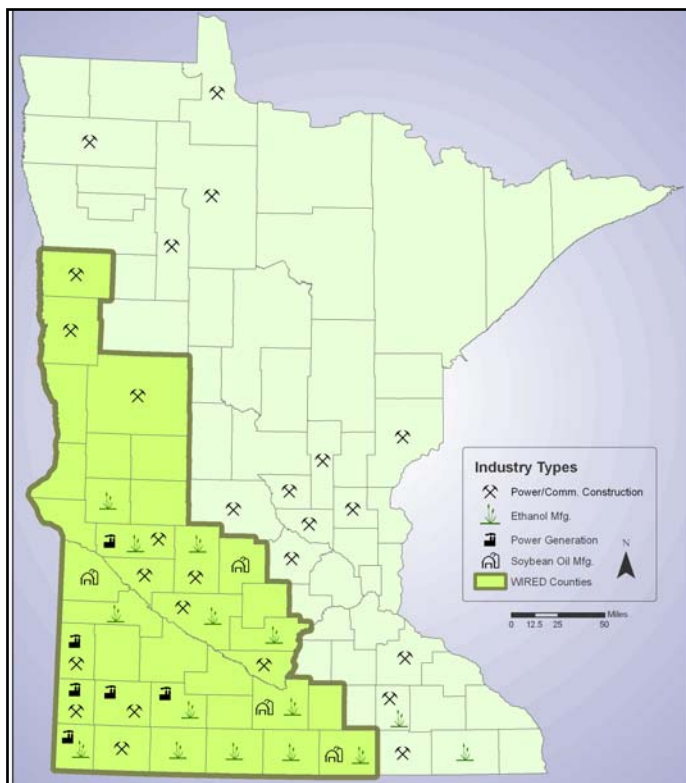


Image 7: WIRED Region & Renewable Energy Industries. Produced by DEED LMI, July 2008.

Nearly 50 percent of all ethanol and biodiesel production facilities are located in the WIRED region. Soybean processing, the parent industry of biodiesel, is completely located within the region, with all firms found within these 36 counties. Similarly, 73 percent of Minnesota's ethanol plants, and approximately 89 percent of production capacity, are located in the WIRED region. Wind generation, however, is more dispersed throughout the state, with about 36 percent of

⁹ More information about Minnesota's WIRED region and related grant can be found at the Minnesota Renewable Energy Marketplace website, www.mnrem.org.

other electric power generation (primarily wind in Minnesota) located within the WIRED region (Table 6).

	NAICS Code	NAICS Title	Firms in WIRED Region	Percent of Statewide Firms Located in WIRED Region
Ethanol & Biodiesel	31-33	All Manufacturing	1,226	13.2%
	32519	Other Basic Chem. Manufacturing	16	48.5%
	325193	Ethyl Alcohol Manufacturing	14	73.7%
	-----	Biodiesel	3	100.0%
	311222	Soybean Processing	8	100.0%
	325199	All Other Basic Organic Chemical Manuf.		<i>Suppressed</i>
	311211	Wet Corn Milling		<i>Suppressed</i>
WIND	22111	Electric Power Generation	41	23.4%
	221119	Other Electric Power Generation	8	36.4%
	237130	Power/Communication Systems Construction	26	14.5%
	926130	Utility Regulation & Administration	3	13.6%

Source: Quarterly Census of Employment and Wages, 2008.
 Note: Data for All Other Basic Organic Chemical Manufacturing and Wet Corn Milling has been suppressed in order to protect the confidentiality of the firms that report their data to the State of Minnesota.

Renewable energy job vacancies are also clustered in the WIRED region: A total of 73 percent of the wind and biofuel vacancies identified through the survey fall within the 36-county region.

	WIRED Region	Non-WIRED	Percent of Total Job Vacancies in the WIRED Region
Ethanol Vacancies	37	21	63.8%
Biodiesel Vacancies	15	0	100.0%
Wind Energy Vacancies	13	3	81.3%
Total	65	24	73.0%

Source: Biobusiness Job Vacancy Survey, 2007-2009. Wind Energy Job Vacancy Survey, 2009.

General Demographics

Because demographics are not available by detailed industry, more general industry categories are used for this analysis: *Basic chemical manufacturing* contains both ethanol and biodiesel manufacturing, and *electrical power generation* contains wind.

Both of these industries are highly male dominated (see Table 8 for male to female ratios). In 2008 women represented only 16 percent of the workforce in *basic chemical manufacturing*, and 13 percent of new hires. In *electric power generation*, women represented only 10 percent of the workforce and only one-fifth of the new hires in 2008. In *electrical power generation*, the monthly and annual earnings of women are about 60 percent of the salaries of their male counterparts. Earnings were closer in *basic chemical manufacturing*.

	Basic Chemical Manufacturing (NAICS 325)	Electric Power Generation & Supply (NAICS 2211)	All Industries
Total Employment	4.9 : 1	2.8 : 1	0.97 : 1
New Hires	6.2 : 1	5.0 : 1	1.0 : 1
Avg. Monthly Wage	1.3 : 1	1.4 : 1	1.6 : 1
Note: This table uses the average of the most recent 4 quarters of data, the 3 rd and 4 th quarter data of 2007 and the 1 st and 2 nd quarter data of 2008. Source: Local Employment Dynamics, 2008.			

Unfortunately more detailed industry demographic data for biofuels and wind power generation are not currently available. It might be useful to conduct focus groups with men and women in these fields to examine barriers to entry and/or retention for women. However, in general, women are underrepresented in production and engineering fields within the U.S.

Conclusion

These industries represent the future of Minnesota's energy production and an important part of the future economy as a whole. As demand for renewable energy increases and technologies advance, workforce demand and skill requirements will change. In fact these changes are happening as we write up these findings. For example, Outland Renewable Energy, a Minnesota based firm,

has just signed a contract with a Belgian company to provide maintenance for their 6,000 North American turbines and as a result they are currently hiring technicians¹⁰. As maintenance shifts to the United States, Minnesota is in a strong position, regionally and in terms of workforce preparation and the current stage of advancement of our wind industry, to capture contracts with European, Chinese and Indian turbine manufactures for all aspects of wind turbine production and maintenance. The job vacancy survey offers a unique way to monitor these changes and will continue to provide valuable insight into how best to meet our state's future workforce needs.

¹⁰ Outland Renewable Energy. *Hansen Partners with Outland*. September 8, 2009. <http://outlandenergy.com/hansen-partners-with-outland/>