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Renewable Energy Industries' Contribution to the North Dakota Economy

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Executive Summary

North Dakota is recognized as one of the leading energy-producing states in the nation. Energy production in the state is typically associated with fossil fuels, but in the past decade there has been considerable growth in renewable energy. Renewable energy in North Dakota is comprised of ethanol production, electricity generation from wind turbines, and the manufacture of wind turbine components. North Dakota has produced ethanol since the 1980s, but expansion of the industry in the 2000s increased capacity to 377.5 million gallons annually by 2011. Wind-generated electricity has followed a similar pattern. Several wind turbines were operational in the late 1990s, but rapid expansion occurred in the 2000s with the Wind Energy Production Tax Credit providing an incentive. Wind energy electrical generation capacity has grown to 1,444 megawatts in 2011, with an additional 234 megawatts coming on-line in 2012.

Expenditures data were collected from renewable energy firms in North Dakota to estimate their economic contribution to the state's economy. Data were collected for both the construction and operations phases of renewable energy firms. The North Dakota Input-Output Model was used to estimate the economic contribution renewable energy activities have made to the state's economy. Key economic measures such as personal income, retail trade, total business activity, employment, and tax collections were used to measure the economic contribution of the renewable energy industry.

Construction project expenditures (direct economic contribution) for the 2002-2011 period peaked in 2008 at $1.1 billion, followed by $824 million in 2009. Total construction expenditures for the 10-year period were nearly $2.7 billion. Applying the expenditure data to the North Dakota Input-Output Model estimates the total economic contribution of the renewable energy industries. Total economic impact (direct and secondary effects) peaked in 2008 and 2009 with $4.2 billion and $3.3 billion, respectively. Levels of business activity for these two years were much greater than for the other years, reflecting the rapid expansion of the renewable energy industry. During peak construction (2008) retail sales were estimated to be $684 million and payments to the Households Sector (personal income) were $866 million. In 2008, sales and use tax collections were estimated to be $31.7 million, personal income tax was $13.9 million, and corporate income tax was $8.2 million. Total tax collections for the 10-year period were approximately $129 million.

Operations expenditures are not one-time impacts like construction activities, but represent an annual economic effect. Renewable energy operations expenditures totaled $326 million in 2011. Ethanol plant operations were the largest ($208.5 million), followed by manufacturing ($86.4 million), and wind energy centers ($31.1 million). Direct employment by the renewable energy industry was 1,183 in 2011. The majority of jobs were with manufacturing firms (883) with 202 employed by ethanol plants, and 98 employed in wind electricity generation. In 2011, the total economic contribution of the renewable energy industry in North Dakota was nearly $1.2 billion. Of this total, manufacturing accounted for $281.2 million, ethanol production was $643.5 million, and wind energy was $98.7 million. Retail trade activity attributed to the industry was $204.2 million and economy-wide personal income totaled $337.5 million in 2011. Tax collections associated with the

renewable energy industry were $16.4 million in 2011. In addition to the workers directly employed by the renewable energy firms, the business activity generated by their operational expenditures would support 2,840 secondary (indirect and induced) jobs. A wind farm currently under construction is scheduled to be on-line in 2012, which would contribute another $9.2 million in business activity annually.

North Dakota's renewable energy has made a significant contribution to the state's economy in the past decade. Ethanol production capacity in 2011 was 377.5 million gallons, and wind-turbine-generated electricity totaled 5.3 billion KWH that same year. With the exception of one wind farm coming on-line in 2012, it appears that renewable energy in North Dakota has plateaued in the near term. The ethanol blend wall and possible expiration of the Wind Energy Production Tax Credit have produced an uncertain future for renewable energy. However, the fact remains that the renewable energy industry has made a substantial economic contribution to North Dakota, and is well positioned for future growth.

Renewable Energy Industry's Contribution to the North Dakota Economy

Randal C. Coon, Nancy M. Hodur, and Dean A. Bangsund[1]

Introduction

Many forces have stimulated interest in renewable fuels in the last decade. Crude oil prices, reliance on foreign oil, carbon dioxide reduction, and state and federal renewable fuels standards have driven expansion in renewable fuels. That interest and various public policies designed to foster growth and development in the renewable energy industry have led to a rapid increase in renewable energy production. Considerable growth in renewable energy has taken place in the last five years. The trend of rapid and recent expansion in renewable energy also holds true in North Dakota.

North Dakota is well positioned to take advantage of the growing demand for renewable energy. Infrastructure that exists from current energy production, coupled with a farm sector capable of producing large quantities of corn, and topography conducive to natural wind currents, makes renewable energy a good fit for the state's natural resources. North Dakota currently is one of the leading states in the production of energy from fossil fuels. The addition of renewable energy industries has further enhanced North Dakota's role of providing for the energy needs of the United States.

Need For Study

Ethanol production capacity has increased dramatically in North Dakota from 88.5 million gallons per year in 2006 to 377.5 million gallons per year in 2011 (Table 1), a 327 percent increase in just five years. During that same period, nationwide ethanol production increased by 185%, considerably less than the North Dakota growth rate (Figure 1). Between 2006 and 2008, four large ethanol plants were constructed in North Dakota adding 360 million gallons per year of production capacity (Table 1). No additional ethanol plants have been built in the state since 2008, and two small ethanol plants that operated in the 1980s closed in 2007 and 2012. Current North Dakota ethanol production capacity is 332 million gallons per year.

While the wind energy industry in North Dakota has grown substantially there is potential for much more growth. Electrical generation capacity in North Dakota from wind turbines has increased from 65.8 megawatts in 2003 to 1,444 megawatts in 2011 (Table 2), a 2,095 percent increase. Most of this growth has come on-line since 2007 (American Wind Energy Association 2012). The National Renewable Energy Laboratory (NREL) has

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rated North Dakota's wind potential at just over 770,000 megawatts, ranking it 6th in the nation (National Renewable Energy Laboratory 2011). This would suggest that North Dakota has not realized its wind energy potential. Wind energy production nationally has also increased dramatically since 1999, when less than 5,000 megawatts were generated compared to over 94,000 megawatts in 2010 (U.S. Energy Information Administration 2012b). In addition to the generation of electricity from wind turbines, North Dakota also has several production facilities that manufacture wind turbine components. These companies manufacture wind towers, blades, and turbines; key components needed to make a wind turbine. Availability of these products within the state has facilitated the growth of wind energy in North Dakota.

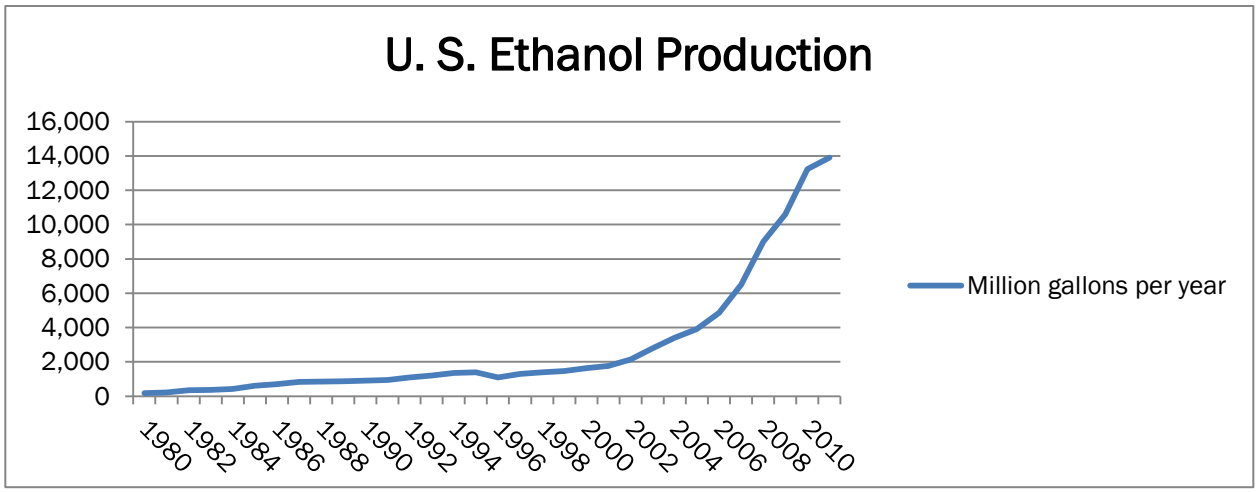

Figure 1. United States Ethanol Production, 1980-2011
Source: U.S. Energy Information Administration 2012a.

Because of the relative newness and rapid growth in the renewable energy sector little is known about the industry's contribution to the state's economy. Further, given the state's wind energy potential, the industry could become even more important to the state's economy. The objective of this study was to estimate the contribution the renewable energy industry makes to the North Dakota economy. This contribution will be measured in terms of key economic variables including personal income, retail trade, employment, and tax revenues.

Table 1. Expanded Ethanol Production and Total Ethanol Production, North Dakota, 1985-2012[1]

Year	Expanded Ethanol Production	Total ND Ethanol Production
	----------Million Gallons Per Year----------	
1985	28	38.5
2006	50	88.5
2007	50	128.0
2008	260	377.5
2009	--	377.5
2010	--	377.5
2011	--	377.5
2012	--	332.0

[1]An ethanol plant in Grafton, ND closed in 2007, and one in Walhalla, ND was closed in early 2012.
Source: Nebraska Energy Office 2012.

Table 2. Annual and Total Wind Turbine Electric Generating Capacity, North Dakota, 2002-2012

Year	Number of Turbines	Capacity Added	Total Generation Capacity
		----------Megawatts----------	
2002	8	4.50	4.50
2003	41	61.50	66.00
2004	0	--	66.00
2005	21	31.50	97.50
2006	52	80.48	177.98
2007	111	166.50	344.48
2008	247	369.66	714.14
2009	297	488.10	1202.24
2010	132	221.10	1423.34
2011	7	21.00	1444.34
2012	78	234.00	1678.34

Source: North Dakota Public Service Commission 2012.

Methods

An economic contribution assessment measures the changes in economic variables that result from in-state expenditures by a given industry. This approach is frequently used to estimate the impact of the construction and operations of a new business or industry, the impact of an entertainment event, or predicting the implications of a change in public policy (Bangsund and Leistritz 2004, Hodur et al. 2006a, Leistritz and Coon 2008, Baade and Matheson 2001, Chhabra et al. 2003, Hodur and Leistritz 2006). The specific occurrence being measured in this study is the change in economic activity in North Dakota as a result of the renewable energy industry. This assessment quantifies the economic contribution to the state's economy from the construction and annual operations of the renewable energy industry in North Dakota. North Dakota's renewable energy industry is defined as those complexes, facilities and enterprises related to the production of renewable energy. It is comprised of three distinct activities: the manufacture of components for wind turbines,

ethanol production, and wind farms that produce renewable electricity. Both one-time construction effects and the annual effects from operations were examined.

Economic effects for both construction and operations are categorized into direct and secondary effects. Direct effects are defined as the original expenditures made by the industry to in-state entities. Direct effects are often referred to as first-round effects. Direct effects for this analysis were available for both the construction and operations of the renewable energy industry in North Dakota. Secondary impacts, often referred to as the multiplier effect, are a result of subsequent rounds of spending and re-spending in the economy from the initial or first round dollars. The multiplier effect is based on linkages between basic and non-basic sectors of an economy (Schaffer et al. 2004). An increase in basic sector activities requires an increase in inputs in non-basic sector activities. An increase in both basic and non-basic sectors activities translates into increased aggregate wages and salaries for local households which are used to purchase goods and services. Input-output analysis is a common tool used to measure economic linkages. This methodology measures the number of times an original dollar (direct expenditure) turns over (multiplies) before it leaves that economy. For a complete discussion of economic base theory see Schaffer et al. (2004).

North Dakota Input-Output Model

The North Dakota Input-Output Model consists of interdependence coefficients, or multipliers, that measure the level of business activity generated in each economic sector from an additional dollar of expenditures in a given sector. A sector is a group of similar economic units, e.g., the firms engaged in retail trade make up the Retail Trade Sector. For a complete description of the North Dakota Input-Output Model, see Coon et al. (1989). The model estimates changes in gross business volume (gross receipts) for all sectors of the area economy resulting from the direct expenditures. For this analysis, the model was used to estimate these changes for both construction and operations of renewable energy enterprises in the state. These gross business volumes are used to estimate secondary employment and tax revenues based on historic relationships. Procedures used in this analysis are similar to those used to estimate the impact of other facilities and activities (Leistritz 1995, Leistritz and Coon 2008, Coon and Leistritz 2007). Empirical testing has confirmed the model's accuracy in estimating changes in levels of economic activity in North Dakota over the period 1958-2010. Estimates of state-wide personal income from the model averaged within 10 percent of comparable values reported by the U.S. Department of Commerce (Coon et al. 2012a, Bureau of Economic Analysis 2012).

A list of renewable energy firms that manufacture components of wind turbines, produce ethanol, and produce renewable electricity from wind farms were provided by the North Dakota Renewable Energy Council. These firms were surveyed to collect expenditure data on one-time construction and annual operations. Firms were first contacted by the study sponsor to advise them of the study and to elicit their participation. The research team then contacted each of the renewable energy firms individually. Estimates of industry expenditures for construction and annual operations were based on data collected from North Dakota renewable energy firms.

Separate questionnaires for ethanol producers, wind farms, and turbine component manufacturers were developed to reflect the specific characteristics of each industry (Appendix A). Renewable energy firms were asked to provide estimates of in-state expenditures for construction and operations in North Dakota. Expenditures to out-of-state entities were not included in the assessment. Expenditures to out-of-state entities represent leakages and were not included in the assessment (Schaffer et al. 2004).

Construction Phase Data

Expenditures for construction and expansion of renewable energy facilities were determined and used to estimate economic effects of these activities. Construction expenditures were allocated to calendar years based on start dates and completion dates for various projects. Construction start and completion dates and expenditures were obtained from the survey and secondary data sources. Percentages of total construction costs that were made to in-state entities were provided by survey data. All construction expenditures were reported in current year dollar values (i.e., dollars in terms of their purchasing power in each respective year). Expenditures for construction activities were allocated to the appropriate sectors of the North Dakota Input-Output Model to estimate the secondary impacts.

Because of the limited number of firms involved in construction activities in the manufacturing group and the ethanol group, construction expenditures for the three renewable energy groups were combined to avoid potentially disclosing proprietary information. While enough wind farm projects have been completed to report the industry's expenditures separately, there were not enough construction projects in the manufacturing and ethanol industries to avoid disclosing confidential information. Only one manufacturing expansion occurred (2008-2009) during the study period with four ethanol plants constructed in the 2006-2008 period.

Construction costs for non-responding wind farms were estimated using survey data from similar-sized wind farms. Average per-turbine construction cost was multiplied by the number of turbines installed to estimate overall construction costs. Construction costs for wind farms that responded to the questionnaire and estimated construction costs of non-responding wind farms were summed to estimate total construction expenditures. The allocation of expenditures to in-state versus out-of-state entities was estimated using previous research (Leistritz and Coon 2008). Construction costs were allocated to the year the facility became operational, unless the facility became operational very early in the year, in which case, construction costs were assigned to the previous year. Most wind farm construction was completed in less than 12 months. Due to the lack of response to the request for expenditure information from very small wind farms (two or less turbines), those non-respondents were excluded from the analysis.

Construction expenditures for ethanol plants were allocated to sectors of the North Dakota Input-Output Model according to the Standard Industrial Classification Manual (Office of Management and Budget 1972) (Appendix B). Consistent with previous analyses (Leistritz and Coon 2008), wind energy construction expenditures were allocated to the Communications and Public Utilities; Agricultural Processing and Miscellaneous

Manufacturing; Retail Trade; Finance, Insurance, and Real Estate; Business and Personal Services; Professional and Social Services; and Households Sectors. Construction expenditures for manufacturing plant expansion were allocated to the Construction, Retail Trade, and Business and Personal Services Sectors. The Households Sector includes payments for wages and salaries, land leases, and landowner payments. The Agricultural Processing and Miscellaneous Manufacturing Sector included expenditures for the purchase of wind turbine equipment including towers, turbines, and blades. Communications and Public Utilities represent electricity, natural gas, garbage disposal, water, and sewage costs. Worker benefits and insurance, other insurance, financing, and real estate expenses make up the Finance, Insurance and Real Estate Sector. Business and Personal Services Sector included expenditures for contract snow removal, maintenance contracts, computer services, and repair services.

Expenditures made by renewable energy firms for construction comprise the direct or first-round effects on the state's economy. The coefficients of the North Dakota Input-Output Model were applied by sector to direct expenditures to estimate secondary effects. Secondary effects result from the spending and re-spending of an additional dollar added to the economy, in this case the additional dollars were from construction activities. Direct plus secondary effects equal total economic impacts. Total economic impacts associated with the construction expenditures were estimated for the 2002-2011 period on a yearly basis. Wind energy electrical generation capacity in North Dakota is scheduled to increase by 234 megawatts in 2012 (Appendix C). Construction of this wind farm began in 2011 with a small amount of construction expenditures reported for that year. Remaining construction expenditures will be estimated for 2012 and discussed later in this report.

Operations Phase Data

Operations expenditures are the outlays a firm makes to run and maintain the facility. Operations expenditures occur annually providing the facility continues production. Operational expenditures were collected for the most recent full year of operations (2011).

Two of the three renewable energy manufacturing firms responded to the questionnaire. In order to avoid underestimating the economic effects of manufacturing operations in North Dakota, operations expenditures for the firm that did not respond to the questionnaire were estimated based on the firm's total employment. Previous research provided expenditures per worker by economic sector for manufacturing firms in North Dakota (Coon and Leistritz 1997) and it was assumed that expenditures per worker for the third firm would be similar to other manufacturing entities in North Dakota. A ratio of expenditures per employee was calculated and applied to the firm's employment to estimate annual expenditures by economic sector. The Consumer Price Index (U.S. Bureau of Labor Statistics 2012) was used convert expenditures reported in 1997 dollars to 2011 levels. Estimated expenditure data and actual data collected from the other two manufacturing firms were aggregated to estimate the direct economic impacts of renewable energy manufacturing.

Five ethanol plants were operating in North Dakota in 2011. Three of the five plants responded to the request for expenditure data for this study. Operations expenditures for

non-responding firms were estimated using expenditures for responding firms on a per million gallon capacity basis, and applying these average expenses to the non-respondent's plant nameplate capacity. Operating costs for participating ethanol firms and secondary sources (Leistritz 2007) were very similar per unit of capacity, suggesting a high degree of confidence in the estimates.

Not all expenditures for corn are considered to be economic contribution expenses. Other markets for corn exist and in the absence of the ethanol industry corn would be marketed for other uses, primarily animal feed (Swenson and Eathington 2006, Peters 2007, Hodur, et al. 2006b). Accordingly, total expenditures for corn were not included in the estimate of direct effects. However, the difference in the price paid for ethanol production over what would have been paid in alternate markets was included in the estimate of economic impacts. Based on a review of the historic difference between the price of corn delivered to an ethanol plant and alternate local markets, it was estimated, there was an average $0.05 per bushel premium for corn purchased at local ethanol plants (Maple River Grain 2012, The Arthur Companies 2012, Thorpe 2012).

Wind energy centers in North Dakota are owned and operated by only a few firms. All wind farms were contacted, and while not all firms responded to the request for data, survey data represented approximately 80 percent of the wind generation capacity in North Dakota. In order to avoid underestimating the economic effects of wind farm operations, operating expenses of non-responding wind farms were estimated. Using expenditure data from similar-sized wind farms, average expenditures per turbine were estimated and used as a proxy for operating expenditures at wind farms that did not participate in the survey. Average construction costs for non-responding wind farms were also estimated using average construction costs from participating wind farms of similar size. Total operation expenditures for all wind farms were calculated and allocated to the appropriate sectors of the North Dakota Input Output Model to estimate secondary economic effects (Leistritz and Coon 2008). Only commercial wind farms were included in the analysis (i.e., six small non-commercial wind turbines were not included in the study).

Results

The economic contribution of the renewable energy industry was estimated using economic measures such as personal income, retail trade activity, total business activity, tax revenues, direct employment, and secondary employment. Total impacts consist of direct expenditures plus the additional levels of business activity that results from the spending and re-spending of those expenditures. Construction impacts will be presented on an annual basis, while operational impacts will be shown for 2011 (the last year operational expenditures were available at the time the study was initiated).

Direct Construction Economic Impacts

Direct economic impacts (industry spending) for renewable energy-related construction in the previous 10 years are presented in Table 3. Construction expenditures were highest in 2008 and 2009 with totals of $1.1 billion and $824 million, respectively.

Peak construction expenditures coincide with the development of wind energy complexes and the construction of an ethanol plant in 2007-2008 and another plant in 2008-2009. Construction activities in other years during the study period were considerably less, ranging from a low of only $2 million in 2002 to nearly $256 million in 2007. Total in-state construction expenditures summed over the 10-year study period were nearly $2.7 billion. A large wind energy project is currently under construction and scheduled to come on-line in 2012. Construction costs that were already incurred for that project were included in the analysis of 2011 construction impacts. Remaining construction costs in 2012 for that wind farm and the economic effects of the construction and operation of wind energy projects scheduled to come on-line in 2012 will be estimated separately.

Substantial expenditures were made in the agricultural processing and miscellaneous manufacturing sector. Expenditures made in the agricultural processing and miscellaneous manufacturing sector totaled nearly $1.8 billion over the last 10 years, much higher than any other sector. Examples of expenditures allocated to agricultural processing and miscellaneous manufacturing would include manufactured components and equipment. Because the components for a wind turbine (towers, blades, turbines) are manufactured in North Dakota, the economic effects of those expenditures were substantial. Expenditures for business and personal services sector were the second largest expenditure category totaling just over $400 million. Examples of expenditures for business and personal services include expenses for advertising, printing services, equipment rental, computer services, computer software, security services, tax preparation, automotive/equipment/miscellaneous repairs, janitorial services, and overnight lodging.

Total Construction Economic Impacts

Total business activity peaked in 2008 and 2009 with $4.2 billion and $3.3 billion, respectively, in business activity (direct and secondary effects) (Table 4). Levels of business activity for these two years were much larger than for the other years of the analysis, reflecting the rapid expansion of renewable energy infrastructure in that time period, specifically expansion in wind generation capacity. Business activity in other years was considerable less than in the peak years. The next highest year was 2007 with $881 million in business activity, only 21 percent of the 2008 total.

Secondary effects were greatest in the household and retail trade sector. During peak construction in 2008, retail sales were estimated to be $684 million and payments to households of $866 million. Personal income (payments to households) in non-peak years ranged from $1.6 million in 2002 to $200 million in 2007. Total economic contributions (direct and secondary effects) of construction of renewable energy facilities over the 10-year period were estimated to be $10 billion.

Estimates of revenues from state sales and use tax, personal income, and corporate income taxes were also detailed in Table 4. Tax revenues from construction activities also peaked in 2008. In 2008, sales and use tax collections were estimated to be $31.7 million, personal income tax was estimated to be $13.0 million, and corporate income tax was $8.2 million. Total tax collections in non-peak construction years ranged from $1 million to $12

million with tax collection in 2011 of approximately $1 million. Total tax collections over the 10-year period were approximately $129 million.

Table 3. Direct Economic Impact for Construction Activities Associated with North Dakota's Renewable Energy Industry, by Input-Output Model Sector, 2002-2011[1] (Current Year Dollars)

Sector	2002	2003	2005	2006	2007	2008	2009	2010	2011	TOTAL
						$000				
Construction	--	--	4,216	14,500	56,018	77,498	5,000	--	--	157,232
Transportation	--	--	--	--	--	--	--	--	--	--
Communications & Public Utilities	4	208	166	169	292	1,900	1,628	374	39	4,780
Agricultural Processing & Miscellaneous Manufacturing	1,499	77,372	61,754	62,800	108,853	707,792	606,592	139,325	14,613	1,780,600
Retail Trade	97	4,985	5,002	7,564	20,607	66,196	42,082	8,977	942	156,452
Finance, Insurance, Real Estate	20	1,039	2,116	5,270	18,562	31,632	8,142	1,870	196	68,847
Business & Personal Services	312	16,097	13,623	15,733	32,952	162,595	128,204	28,987	3,040	401,543
Professional & Social Services	6	311	579	1,388	4,823	8,525	2,443	561	59	18,695
Households	74	3,843	3,686	5,247	13,628	45,793	30,126	6,920	726	110,043
TOTAL	2,012	103,855	91,142	112,671	255,735	1,101,931	824,217	187,014	19,615	2,698,192

[1]No renewable energy construction projects occurred in 2004.

Table 4. Total Economic Impact for Construction Activities Associated with North Dakota's Renewable Energy Industry, 2002-2011

Item	2002	2003	2005	2006	2007	2008	2009	2010	2011
Total Impact:($000)									
Construction	122	6,295	9,706	21,213	71,067	143,563	54,817	11,336	1,189
Communications & Public Utilities	170	8.776	7.674	9,425	21,236	92,467	69,484	15,803	1,657
Retail Trade	1,255	64,791	56,647	69,556	156,707	684,318	514,733	116,671	12,237
Finance, Insurance, Real Estate	274	14,161	13,419	18,774	48,045	166,744	111,827	25,499	2,674
Business & Personal Services	413	21,323	18,126	21,225	44,708	216,407	169,482	38,398	4,027
Professional & Social Services	113	5,854	5,439	7,387	18,414	67,114	46,286	10,543	1,106
Households	1,589	82,048	71,873	88,562	200,293	866,076	648,932	147,744	15,496
Other[1]	4,118	212,500	171,249	178,129	320,801	1,973,994	1,667,784	382,652	40,135
TOTAL	8,054	415,748	354,133	414,161	881,271	4,210,683	3,283,345	748,646	78,521
Tax Revenues: ($000)									
Sales & Use	58.1	2,999.8	2,622.8	3,220.4	7,255.5	31,683.9	23,832.1	5,401.9	566.6
Personal Income	23.8	1,230.7	1,078.1	1,328.4	3,004.4	12,991.1	9,734.0	2,216.2	232.4
Corporate Income	15.5	801.6	685.6	808.3	1,736.8	8,173.8	6,337.0	1,443.4	151.4
TOTAL	97.4	5,032.1	4,386.5	5,357.1	11,996.7	52,848.8	39,903.1	9,061.5	950.4
Employment: (Jobs)									
Secondary (FTE)	13	170	665	764	1,596	7,918	6,254	1,425	145

[1]Other includes agriculture, mining, transportation, agricultural processing and miscellaneous manufacturing, and government.

Typically, construction phase direct workforce is reported as the peak workforce for the project. That value, however, ignores the variation in the number of workers required over the course of construction. Because this analysis estimated the impacts for each calendar year, data on peak construction workforce were not collected. Further, reporting average annual workforce for construction activities would have been difficult for survey respondents to estimate. Secondary employment for construction activities was estimated using the North Dakota Input-Output Model (Table 4). Secondary jobs were estimated to range from a low of only 13 FTEs in 2002 to nearly 8,000 FTEs in 2009. In 2011, secondary employment associated with construction was 1,425 FTE jobs. Secondary employment figures however require proper interpretation.

Because of model assumptions, estimates of secondary employment are likely over estimated, especially during brief periods of heightened construction activity like that of wind energy and ethanol development in 2008 and 2009. Input-output models assume that all sectors are at full employment and that an increase in business volume in a basic sector (like renewable energy facility construction) translates directly into an increase in business volume in non-basic sectors and households (wages/salaries). Alternatively, any increase in business volume would translate into an increase in labor requirements to meet additional demand. However if the increase in business volume does not exceed the capacity of the current labor force no increase in labor (new jobs) would be needed to meet the additional demand. It is likely that the existing labor force would have been able to absorb much of the short-term spike in construction activities. Recent research on secondary workers in North Dakota's oil patch found that secondary jobs did not materialize as economic theory would suggest (Bangsund and Hodur 2012, Coon et al. 2012b).

Infrastructure limitations, housing shortages, businesses unwillingness to add employees for a short-term boom, technology advances, labor efficiencies, and competition for workers by other industries, all contribute to less secondary employment. Rapid growth can also lead to crowding out effects (Macke and Gardner 2012). It is likely that the existing labor force would have absorbed the demand associated with the short-term spike in renewable energy construction activity.

Direct Operations Economic Impacts

Operations expenditures represent annual direct economic effects. These are not one-time impacts like those associated with construction activities, but represent an economic effect that occurs annually. Direct economic impacts for wind tower component manufacturing, wind electricity generation, and ethanol production for 2011 are presented in Table 5. These expenditures represent payments to North Dakota entities. Payments made to out-of-state entities are considered economic leakages and excluded from economic contribution analysis.

Ethanol plants collectively have the largest in-state expenditures ($208.5 million) followed by manufacturing ($86.4 million), and wind energy centers ($31.1 million) (Table 5). Expenditures are largest in the Communications and Public Utilities Sector, with payments in 2011 of nearly $69 million. Ethanol plants use significant quantities of natural

gas, electricity, coal, and water; all representing expenses that were allocated to the Communications and Public Utilities Sector. Ethanol facilities also have substantial expenditures in the Transportation Sector, $49 million annually. Transportation expenditures for ethanol production would be associated with rail and truck transportation. Expenditures in the Households Sector were also quite high. Ethanol plants in North Dakota support just over 200 direct jobs with expenditures to households (economy-wide personal income) of over $30 million annually. Expenditures for corn were not included; however, the $0.05 per bushel premium paid over the price at alternative markets was included. While not included in this assessment, corn purchases represent a substantial expense for ethanol producers.

The largest single sector outlay among manufacturing firms was to the Households Sector. Wages and salaries represented 43 percent of manufacturers' in-state expenditures. In 2011, wind equipment manufacturers were estimated to spend over $37 million for wages and salaries. The next largest affected sector was Finance, Insurance and Real Estate. Expense payments in the Finance, Insurance and Real Estate Sector represented payments for loan service, interest on loans, insurance, workman's compensation, and other financial service outlays.

Wind farm operations expenditures are relatively small compared to operations expenditures for manufacturing and ethanol production. Total in-state expenditures were only $31 million annually compared to $86 million for manufacturing and $208 million for ethanol production. However, half of annual operation expenditures represented outlays to the Households Sector ($16 million). The next highest expenditure category was in the Finance, Insurance and Real Estate Sector which included payments for employee benefits, interest, and finance charges. Wind farm operations spent nearly $3 million annually in the Business and Personal Services Sector. These expenditures included specialized services for site and equipment maintenance. Direct economic impacts for renewable energy operations impacts are detailed in Table 5.

Table 5. Direct Economic Impact for Operations Associated with North Dakota's Renewable Energy Industry, by Input-Output Model Sector, 2011 (Current Year Dollars)

Sector	Manufacturing	Ethanol Production	Wind Farm Electric Generation	TOTAL
	----------$000----------			
Construction	5,165	4,948	527	10,640
Transportation	2,947	49,164	4	52,115
Communications & Public Utilities	2,302	68,952	1,054	72,308
Agricultural Processing & Miscellaneous Manufacturing	9,047	13,890	85	23,022
Retail Trade	6,206	7,170	1,044	14,420
Finance, Insurance, Real Estate	21,158	21,876	9,351	52,385
Business & Personal Services	707	4,401	2,905	8,013
Professional & Social Services	1,600	7,627	1	9,228
Households	37,281	30,500	16,112	83,893
TOTAL	86,413	208,528	31,083	326,024
Direct Employment (FTEs)	883	202	98	1183

Total Operations Economic Impacts

Secondary economic impacts were estimated by applying the coefficients of the North Dakota Input-Output Model to per-sector expenditures to produce estimates of the total annual economic contribution of renewable energy operations. These annual impacts will continue to accrue as long as operations continue at current levels. Total economic impacts (direct and secondary effects) are detailed in Table 6. In 2011, the total economic contribution of the renewable energy industry in North Dakota was $1.0 billion (Table 6). Of this total, manufacturing accounted for $281.2 million, ethanol production was $643.5 million, and wind energy was $98.7 million. Business volumes were greatest in the Retail Trade and Households Sectors. Retail trade activity for the industry was $204.2 million, of which $120.9 million was attributable to ethanol production. Activity in the Households Sector (economy-wide personal income) totaled $337 million with over half of the economic activity attributable to the ethanol industry, 30 percent attributable to manufacturing activities, and 12 percent attributable to wind farms.

Table 6. Total Economic Impact for Operations Activities Associated with North Dakota's Renewable Energy Industry, 2011

Item	Manufacturing	Ethanol	Wind Farm	TOTAL
Total Impact: ($000)				
Construction	11,588	18,455	2,968	33,011
Communications & Public Utilities	11,111	89,258	4,510	104,879
Retail Trade	61,619	120,921	21,693	204,233
Finance, Insurance, Real Estate	33,340	48,025	13,941	95,306
Business & Personal Services	5,641	14,147	4,820	24,608
Professional & Social Services	8,319	20,720	2,601	31,640
Households	102,389	195,117	39,981	337,487
Other[1]	47,207	136,885	8,155	192,247
TOTAL	281,214	643,528	98,669	1,023,411
Tax Revenues: ($000)				
Sale & Use	2,853	5,599	1,004	9,456
Personal Income	1,536	2,927	600	5,063
Corporate Income	482	1,225	163	1,870
TOTAL	4,871	9,751	1,767	16,389
Employment: (Jobs)				
Direct (FTE)	883	202	98	1,183
Secondary (FTE)	838	1,740	262	2,840

[1]Other includes agriculture, mining, transportation, agricultural processing and miscellaneous manufacturing, and government.

State tax collections associated with total (direct and secondary) business activity generated by the industry in 2011 were $9.5 million in sales and use tax revenues, $5.1 million in personal income tax, and $1.9 million in corporate income tax. Although local property taxes are usually not included in an economic impact analysis, it should be noted that they are a significant operations expenditure for wind farms. Property taxes were not included in this report because they were not available from the survey, and could not be estimated from existing simulation models.

Renewable energy operations also provide jobs for North Dakota residents. Manufacturing entities employed 883 full-time equivalent workers in 2011, ethanol plants employed 202 workers, and wind energy centers employed 98. Secondary employment was also estimated. Business volumes in the renewable energy industry could support 2,840 full-time equivalent secondary jobs, 838 jobs as a result of manufacturing activities, 1,740 as a result of ethanol production and 262 as a result of wind energy centers.

Energy Capacity Under Construction

A sizeable wind farm is under construction and scheduled to come on-line in 2012. The project will have 78 wind turbines with an electrical generation capacity of 234 megawatts. This represents a nearly 9 percent increase in the number of turbines on-line and a 16 percent increase in wind generation electricity capacity over 2011 levels. Considering the size of the project it was deemed appropriate to estimate expenditures for inclusion in this analysis. Construction expenditures that were made in 2011 were available and included in the assessment of 2011 construction impacts. However, 2012 construction and operations expenditures were not available during the data collection phase of the study. Estimates of 2012 construction expenditures and annual operations expenditures were made using survey data.

Procedures

Total construction costs for this project in 2012 were estimated based on survey data provided by existing firms in the state. An olympic average was used to estimate representative per turbine construction costs ($2,915,456 per turbine). The average cost was multiplied by the number of turbines (78) to obtain a total project cost. Construction costs reported for 2011 were subtracted to estimate the 2012 expenditures. Total 2012 construction expenditures were allocated to economic sectors of the North Dakota Input-Output Model based on 2002-2011 wind farm construction expenditures in Table 3. Estimated direct economic impacts for the wind energy construction project scheduled to be completed in 2012 are presented in Table 7.

Construction Impacts

In-state construction expenditures in 2012 were estimated to be nearly $208 million (Table7). The largest share of expenditures (nearly $155 million) was made to the Agricultural Processing and Miscellaneous Manufacturing Sector for wind towers, turbines and blades. Expenditures to the Business and Personal Services Sector totaled just over $32 million and payments to the Households Sector totaled nearly $7.7 million.

Table 7. Estimated Direct Economic Impact for Construction Activities Associated with North Dakota Wind Energy Project, by Input-Output Model Sector, Scheduled for Completion in 2012

Sector	Estimated Expenditures
	----------$000----------
Construction	--
Transportation	--
Communications & Public Utilities	416
Agricultural Processing & Miscellaneous Manufacturing	154,805
Retail Trade	9,974
Finance, Insurance, Real Estate	2,078
Business & Personal Services	32,208
Professional & Social Services	623
Households	7,688
TOTAL	207,791

Total economic contribution (direct and secondary effects) from construction expenditures in 2012 was estimated to be nearly $832 million (Table 8). Secondary effects were highest in the Households Sector with expenditures of $164 million and the Retail Trade Sector with expenditures of $130 million. These levels of business activity would account for $6 million in sales and use tax collections, $2.5 million in personal income taxes, and corporate income tax revenues of $1.6 million. Estimates of workforce or peak workforce for construction activities were not available. Secondary employment was also estimated using the North Dakota Input-Output Model. This level of business activity would be expected to support 2,300 jobs. However, as previously discussed due to the short duration of the construction period, actual secondary employment estimates are likely to be considerably less.

Operations Impacts

Survey data were used to estimate average operating expenditure per wind turbine. The average operations expenditures for each sector were multiplied by the 78 wind turbines to obtain projected annual expenditures for operations (Table 9). Expenditures were allocated to the appropriate sectors of the North Dakota Input-Output Model consistent with the allocations used elsewhere in this study. The values calculated represent the economic effects of operations for a 12-month period after the wind farm is on-line and fully operational. Annual operations expenditures totaled $2.9 million, with nearly $1.5 million going to the Households Sector (wages and salaries, leases, etc.).

Table 8. Estimated Total Economic Impact for Construction Activities Associated with North Dakota Wind Energy Project Scheduled for Completion in 2012

Item	Amount
	-------$000-------
Total Impact:	
Construction	12,595
Communications & Public Utilities	17,559
Retail Trade	129,633
Finance, Insurance, Real Estate	28,332
Business & Personal Services	42,665
Professional & Social Services	11,714
Households	164,158
Other[1]	425,164
TOTAL	831,820
Tax Revenues:	
Sales & Use	6,002
Personal Income	2,462
Corporate Income	1,604
TOTAL	10,068

[1]Other includes agriculture, mining, transportation, agricultural processing and miscellaneous manufacturing, and government.

Table 9. Estimated Annual Direct Economic Impact for Operations Associated with North Dakota Wind Energy Project, by Input-Output Model Sector, Scheduled to be On-line in 2012

Sector	Estimated Expenditures
	----------$000----------
Construction	49
Transportation	--
Communications & Public Utilities	98
Agricultural Processing & Miscellaneous Manufacturing	8
Retail Trade	97
Finance, Insurance, Real Estate	869
Business & Personal Services	270
Professional & Social Services	--
Households	1,498
TOTAL	2,889

Total economic contribution (direct and secondary effects) associated with the operation of the current wind farm under construction was estimated to be $9.2 million annually with $3.7 million accruing to households in the form of personal income. Nearly $2.0 million in business activity accrued to the Retail Trade Sector (Table 10). These levels of business activity would generate $93,000 in sales and use taxes, $56,000 in personal income tax, and $15,000 in corporate income tax for North Dakota. Based on employment

levels at existing wind farms with a similar number of turbines, an estimated eight workers would be needed to operate the facility. The levels of business activity generated by the wind farm would support 25 secondary workers.

Table 10. Estimated Annual Total Economic Impact for Operations Associated with North Dakota Wind Energy Project Scheduled to be On-line in 2012

Item	Amount
Total Impact: ($000)	
Construction	276
Communications & Public Utilities	419
Retail Trade	2,016
Finance, Insurance, Real Estate	1,296
Business & Personal Service	448
Professional & Social Service	242
Household	3,716
Other[1]	758
TOTAL	9,171
Tax Revenues: ($000)	
Sales and Use	93
Personal Income	56
Corporate Income	15
TOTAL	164
Employment: (Jobs)	
Direct (FTE)	8
Secondary (FTE)	25

[1]Other includes agriculture, mining, transportation, agricultural processing and miscellaneous manufacturing, and government.

Outlook and Conclusions

North Dakota's renewable energy industry has grown considerably in the last decade and especially in the last five years. Growth has been spurred by increasing energy prices, an interest in greater energy independence, and the use of renewable energy sources. In many cases, government policy has influenced the rate and level of development of renewable energy sources. Ethanol requirements and the Wind Energy Production Tax Credit are perhaps two of the most visible incentives. North Dakota is well positioned to develop a substantial renewable energy industry with abundant corn feedstock for ethanol production, wind currents that are conducive for producing electricity from turbines, and in-state manufacturers of wind turbine components. NREL has estimated North Dakota has the 6th greatest wind energy potential in the nation at over 770,000 megawatts, an over five-fold increase of current production capacity.

From 2006-2008 four ethanol plants were built that today produce approximately 332 million gallons of ethanol per year. Electricity generated from wind turbines, whose components are manufactured in North Dakota, has grown from only 56 megawatts in 2003 to over 1400 megawatts in 2011. Another 234 megawatts are scheduled to come on-line in 2012. In calendar year 2011, wind turbines in North Dakota generated 5.3 billion KWH of electricity (Office of the State Tax Commissioner 2012). Construction activities over the last 10 years have generated $2.7 billion in direct economic impacts and over $10 billion in total (direct and secondary effects) economic impacts. Annual operations from ethanol production, wind generated electricity, and the manufacture of components for wind turbines had in-state expenditures of $326 million in 2011. Additional wind energy generating capacity under construction will add another $3 million in direct economic impacts. The total (direct and secondary) economic contribution from renewable energy operations in the state totaled just over $1 billion annually. To add some context, the North Dakota lignite coal industry is about 3 times the size of the renewable energy industry with approximately $3 billion in annual total economic impacts.

While North Dakota's renewable energy industry is making an important contribution to the state's economy and the potential for renewable energy is great, the future of renewable energy is uncertain and may at least for the near term have plateaued. Ethanol production capacity nationwide has peaked and flattened. The ethanol blend wall and the lack of additional market opportunities will likely limit industry expansion in the near term. Further, drought conditions throughout the Corn Belt in 2012 reduced corn production and resulted in nearly record high corn prices. High corn prices, represent at least in the near term, a substantial challenge for ethanol producers. Given current conditions it is unlikely additional ethanol production capacity will be added in the near future. However, a potential ethanol plant that may be part of an energy park in central North Dakota is still under consideration. That plant is being considered as a next generation ethanol plant utilizing isobutanol technology.

The potential for expanding wind generation in North Dakota is very good, however, future growth in wind generated electricity in North Dakota at this time is at best uncertain.

Growth in the wind energy industry tracks closely with the Wind Energy Production Tax Credit. The industry has experienced strong growth when the tax credit was in place. When the credit was reinstated in 2006 strong growth in the industry followed in 2007 and 2008. Currently, the Wind Energy Production Tax Credit is scheduled to expire at the end of 2012 and is not likely to be renewed before it expires. The effects of the lapse in the production tax credit are already apparent. No additional capacity is scheduled to come on-line in North Dakota in 2013 and two of North Dakota's three manufacturing facilities are undergoing major changes. One firm has negotiated the sale of the business with the contract being finalized October 31, 2012. The plant currently is closed and all 216 workers have lost their jobs. The new owners have not indicated if the plant would manufacture wind turbine components, or if it will open at all. Another North Dakota manufacturer has announced lay-offs of over 300 workers and will be moving a large share of manufacturing activities to Brazil. At the current time, the wind industry not only in North Dakota, but nationwide remains sensitive to the production tax credit incentives.

North Dakota's renewable energy currently consists of electricity produced from wind turbines and ethanol manufactured from corn. The next generation of renewable fuels may be quite different from what is now being produced. It is possible the next ethanol plants will utilize different feed stocks such as switchgrass, energy beets, and other cellulose materials. Also, soybeans have the potential to produce bio-diesel. As technology evolves, the next generation of renewable energy products could enhance the state's current renewable energy industry. This could greatly expand the renewable energy industry's presence in North Dakota.

While future growth in renewable energy in North Dakota is somewhat uncertain, the industry is making a substantial economic contribution to the state economy. To what degree the industry expands in the near future seems to be largely contingent on public policy initiatives.

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Appendix A
Renewable Energy Study Questionnaires

RENEWAL ENERGY EQUIPMENT MANUFACTURING
EXPENDITURES QUESTIONNAIRE

Company:

Location:

Contact Person:

I. Listing of expenditures made in FY 2011

Expenditure Categories	Estimated Annual Expenditures in North Dakota
	----------$----------
Wages and salaries	
Benefits	
Construction	
Plant maintenance and overhaul	
Transportation	
Communications	
Public utilities: Electricity	
Natural Gas	
Water	
Garbage/Waste Disposal	
Miscellaneous manufacturing	
Wholesale trade	
Retail trade	
Finance	
Insurance	
Real estate	
Business and personal services	
Professional and social services	
Other Expenses	

Items For Which Expenditures were Made	Estimated Annual Expenditures in North Dakota
	----------$----------
Government (taxes paid in ND)	
Property taxes	
Sales and use taxes	
Unemployment	
Other taxes (please specify)	

II. Total annual revenue: $_____

III. Number of employees in full-time equivalents: _____ FTEs

IV. What year did manufacturing renewable energy equipment begin? _____

V. Has manufacturing capacity been increased since operations began? YES NO

If yes, please provide some additional information on your expansion(s)

What year(s) did the increase occur? _____

How much was capacity increased? _____%

How many FTE employees were added? _____ FTEs

Were shifts added, plant expanded, or both? _____

What were the construction costs? $_____

ETHANOL PRODUCER OPERATIONAL EXPENDITURES QUESTIONNAIRE

Company:

Location:

Contact Person:

I. **Listing of expenditures made in FY 2011**

Expenditure Categories	Estimated Annual Expenditure In North Dakota
	----------$----------
Corn from North Dakota	
Wages and salaries	
Benefits	
Construction	
Plant maintenance and overhaul	
Transportation	
Communications	
Coal	
Public utilities: Electricity	
Natural gas	
Water	
Garbage/waste disposal	
Miscellaneous manufacturing	
Wholesale trade	
Retail trade	
Finance	
Insurance	
Real estate	
Business and personal services	
Professional and social services	
Other Expenses	

Items For Which Expenditures were Made	Estimated Annual Expenditure In North Dakota
	----------$----------
Government (taxes paid in ND)	
Property taxes	
Sales and use taxes	
Unemployment	
Other taxes (please specify)	

II. **Total annual revenue:** $_____

III. **Number of employees in full-time equivalents:** _____FTEs

IV. **Corn Purchased from North Dakota entities:** _____Bushels

V. **Annual Ethanol Production:** _____Gallons

VI. **Plant Construction:** Beginning date _____

Completion date _____

VII. **Cost of Plant Construction:** $ _____

WIND FARM OPERATIONAL EXPENDITURES QUESTIONNAIRE

Company:

Location:

Contact Person:

I. Listing of expenditures made in FY 2011

Expenditure Categories	Estimated Annual Expenditure In North Dakota
	----------$----------
Wages and salaries	
Benefits	
Construction	
Site and equipment maintenance	
Transportation	
Communications	
Public utilities: Electricity	
Natural Gas	
Water	
Garbage/Waste Disposal	
Miscellaneous manufacturing	
Wholesale trade	
Retail trade	
Finance	
Insurance	
Real estate	
Business and personal services	
Professional and social services	
Other Expenses	

Items For Which Expenditures were Made	Estimated Annual Expenditure In North Dakota
	----------$----------
Government (taxes paid in ND)	
Property taxes	
Sales and use taxes	
Unemployment	
Other taxes (please specify)	

II. Total annual revenue: $_____

III. Number of employees in full-time equivalents: _____FTEs

IV. What year did the wind farm construction begin? _____

V. What was the construction cost for the wind farm? $ _____

VI. In what year did the wind farm become operational? _____

VII. Has the wind farm expanded since it became operational? YES NO

If yes, please provide some additional information regarding the expansion(s).

In what year(s) did expansion occur? _____

How many wind turbines were added? _____

How much generating capacity was added? _____MW

How many FTE employees were added? _____

What were the construction costs for the expansion? $_____

Appendix B
Sector Delineations for Renewable Energy Expenditures

DEFINITIONS FOR EXPENDITURE CATEGORIES

The following definitions are derived from Standard Industrial Classification Manual (SIC codes) and have been provided to assist in allocating expenses into common categories. If needed, please refer to the following web site for additional examples of the expenses included in each category: http://www.osha.gov/pls/imis/sic manual.html Each category has several Major Group numbers, which contain additional detail on the type of activities in each category.

Construction: Includes expenses for construction projects, such as construction (including new work, additions, alterations, remodeling, and repairs) of residential, industrial, public, office, warehouse, and other buildings and structures. (Major Groups 15, 16, and 17)

Transportation: Includes expenses for railroad, motor freight, water transportation, air transportation, and other transportation to include packing and crating services, and rental of transportation equipment. (Major Groups 40, 41, 42, 43, 44, 45, 46, and 47)

Communications: Includes expenditures for telephone, telegraph, radio, television, satellite services, Internet transactions, and other communication services. (Major Group 48)

Public Utilities: Includes expenses for natural gas, electricity, water supply, and sanitary (sewer & garbage) services. (Major Group 49)

Manufacturing: Includes expenses for on-site fabrication of processing components, contract manufacturing for items used in processing operations, and the rebuilding of machinery and equipment at the plant. (Major Groups 20 through 39, with emphasis on 35-39)

Wholesale Trade: Expenses paid to establishments primarily engaged in selling merchandise to retailers; to industrial, commercial, institutional, or professional users; or to other wholesalers, or acting as agents in buying merchandise for or selling merchandise to such persons or companies. (Major Groups 50 and 51)

Retail Trade: Includes expenses for building materials, hardware, food, general merchandise, office supplies, automobile fuel, computers, eating and drinking establishments, work uniforms, and most other business and office-related supplies. (Major Groups 52, 53, 54, 55, 56, 57, 58, and 59)

Finance, Insurance, and Real Estate: Includes expenses for loan service, interest on loans, investment counseling, insurance, real estate transactions, brokerage fees, and any other financial service expenditures. (Major Groups 60, 61, 62, 63, 64, 65, 66, and 67)

Business and Personal Services: Examples of business and personal services include expenses for advertising, collection services, photocopying/duplication/printing services, equipment rental, computer services, computer software, security services, tax preparation, automotive/equipment/miscellaneous repairs, entertainment, janitorial services, and overnight lodging. (Major Groups 70, 72, 73, 75, 76, 78, 79, and 87)

Professional and Social Services: Includes expenses for health/pharmaceutical, medical, legal, educational, research and development, child care, vocational training, and other professional services. (Major Groups 80, 81, 82, 83, 84, 86, 88, and 89)

Source: Office of Management and Budget 1972.

Appendix C
Wind Energy Project Inventory

Phase Name	State	Year Completed	Project Developer	Project Capacity (MW)	Number of Wind Turbines	Project Owner	County
Grafton	ND	1997		0.065	1	Grafton Tech. College	Walsh
Sacred Heart Monestary	ND	1997		0.25	2	Richardton Abbey	Stark
Spirit Lake Wind Energy Project	ND	1997		0.10	1	Spirit Lake Sioux	Benson
Oriska Hills	ND	2001		0.90	1	Minnkota Power Cooperative	Barnes
PrairieWinds Minot Wind	ND	2002	Basin Electric Power	2.6	2	PrairieWinds ND 1	Ward
Petersburg Wind Turbine	ND	2002		0.90	1	Minnkota Power Cooperative	Nelson
North Dakota Wind I	ND	2003	NextEra Energy Resources	40.50	27	NextEra Energy Resources	LaMoure
North Dakota Wind II	ND	2003	NextEra Energy Resources	21.00	14	NextEra Energy Resources	LaMoure
Wilton Wind Farm (2005 portion)	ND	2005	NextEra Energy Resources	31.50	21	NextEra Energy Resources	Burleigh
Velva	ND	2006	Global Renewable Energy Partners/Acciona Energia	11.88	18	Acciona Energy	McHenry
Oliver Wind Energy Center	ND	2006	NextEra Energy Resources	50.60	22	NextEra Energy Resources	Oliver
Wilton Wind Farm (2006 portion)	ND	2006	NextEra Energy Resources	18.00	12	NextEra Energy Resources	Burleigh
Langdon Wind Project	ND	2007	NextEra Energy Resources	118.50	79	NextEra Energy Resources	Cavalier
Oliver II	ND	2007	NextEra Energy Resources	48.00	32	NextEra Energy Resources	Oliver
Tatanka	ND	2008	Acciona Energy	91.50	61	Acciona Energy	Dickey; McIntosh
Turtle Mountain College	ND	2008	Distributed Gen	0.66	1	Turtle Mountain Community College	Rolette
Ashtabula Wind Center - NextEra Energy Resources	ND	2008	NextEra Energy Resources	148.50	99	NextEra Energy Resources	Barnes
Ashtabula Wind Center(OTP)	ND	2008	NextEra Energy Resources	48.00	32	Otter Tail Power Co.	Barnes
Langdon II	ND	2008	NextEra Energy Resources	40.50	27	NextEra Energy Resources	Cavalier
Langdon (OTP)	ND	2008	NextEra Energy Resources	40.50	27	Otter Tail Power Co.	Cavalier
Rugby	ND	2009	Iberdrola Renewables	149.1	71	Iberdrola Renewables	Pierce
Wilton Wind Energy Center II	ND	2009	NextEra Energy	49.50	33	NextEra Energy Resources	Burleigh
Ashtabula II	ND	2009	NextEra Energy Resources	120.00	80	NextEra Energy Resources	Griggs; Steele
Luverne Wind	ND	2009	Otter Tail Power	49.50	33	Otter Tail Power Co.	Steele
PrairieWinds Minot Wind 2	ND	2009	PrairieWinds ND 1, Inc.	4.5	3	PrairieWinds ND 1	Ward
Prairie Winds ND1	ND	2009	PrairieWinds ND 1, Inc.	115.50	77	PrairieWinds ND 1	Ward

Bison Wind 1A	ND	2010	Minnesota Power	36.80	16	Minnesota Power	Oliver; Morton
Baldwin	ND	2010	NextEra Energy	102.40	64	NextEra Energy Resources	Burleigh
Ashtabula III	ND	2010	NextEra Energy Resources	62.40	39	NextEra Energy Resources	Barnes
Cedar Hills	ND	2010		19.50	13	Montana-Dakota Utilities	Slope; Bowman
Bison Wind 1B	ND	2011	Minnesota Power	21	7	Minnesota Power	Oliver; Morton
Bison Wind 1B	ND	2012	Minnesota Power	24.00	8	Minnesota Power	Oliver; Morton
Bison Wind 2	ND	2012	Minnesota Power	105.00	35	Minnesota Power	Oliver; Morton
Bison Wind 3	ND	2012	Minnesota Power	105.00	35	Minnesota Power	Oliver; Morton
TOTAL				1678.655	994		

Source: American Wind Energy Association 2012.