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**Socioeconomic Impacts of the Langdon Wind Energy Center**

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## **Acknowledgments**

This report is a result of the input and assistance of a number of people and organizations. Our appreciation and thanks are extended to the Langdon area leaders who helped us understand the project history and its local effects.

Thanks are extended to Edie Watts for document preparation and to our colleagues who reviewed the manuscript.

The authors assume responsibility for any errors of omission, logic, or otherwise. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors.

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## Executive Summary

The Langdon Wind Energy Center is the largest wind energy facility to be developed in North Dakota to date. The Langdon Wind Energy Center consists of 106 turbines with a generating capacity of 1.5 MW each, mounted on towers 262 feet tall. The project is owned by FPL Energy and Ottertail Power Company; FPL Energy was the project developer. The wind generated electricity is purchased by Ottertail Power and Minnkota Power Cooperative, Inc. Construction of the facility was begun in July, 2007 and was completed in January, 2008. The peak construction work force was 269 workers. A force of 10 permanent employees will operate and maintain the energy center.

Construction of the Langdon Wind Energy Center is estimated to have resulted in payments of \$9.3 million to entities in the Langdon area (i.e., Cavalier County and adjacent counties) and an additional \$47 million to entities elsewhere in North Dakota. The major items purchased elsewhere in North Dakota were wind towers and blades, which represented a total of \$42 million. DMI Manufacturing in West Fargo produced the towers while LM Glasfiber in Grand Forks manufactured the blades. During operation, the facility will make payments of about \$1.4 million annually to North Dakota entities, including \$413,000 in payments to landowners with easement agreements (year 1).

The \$56.4 million in statewide direct impacts during the construction period were estimated to result in an additional \$169 million in secondary impacts for a total, one-time construction impact of \$225.7 million. The \$1.4 million in annual direct impacts associated with project operation lead to an additional \$3 million in secondary impacts for a total annual impact of \$4.4 million. This includes \$2.1 million of additional *household* sector gross receipts (gross business volume), which indicates that personal incomes of area residents would be increased by about \$2.1 million each year during project operation.

Project construction is estimated to create 1,656 secondary jobs statewide, in addition to the 269 peak construction jobs. Given the relatively brief duration of the construction phase, some of this secondary employment may have been reflected in longer hours and associated overtime pay for present employees, as opposed to new job creation. During the operation of the project, an estimated 21 secondary jobs are created, in addition to the 10 workers employed by the project. Based on information from local leaders, all 10 project employees were estimated to live in Cavalier County as were 8 secondary jobs.

The housing and public service needs associated with the project were also estimated. During project construction, there was a need for temporary housing. During project operation, housing impacts are negligible, as the work force is small and most jobs are filled by local residents. During both construction and operation periods, the effects on area schools were negligible – during construction because few nonlocal workers brought families to the area and during operation because of the small work force that was mostly filled by local residents.

During project construction, public service requirements were quite small, as most workers did

not bring families to the region. During project operation, public service effects are negligible.

The effects of the project on revenues and costs of state and local governments were estimated. During construction, the state was expected to receive substantial revenue from sales and use and personal income taxes. State revenues exceed added state costs by more than \$2 million. During operation, most of the added state revenue comes from these sources, while added state costs are virtually nonexistent because of the minimal population influx. Cavalier County experienced little effect on either its revenues or costs during the construction phase. During operation, the county is expected to receive \$191,000 in direct property tax payments and \$194,000 in total increased property tax revenues while having negligible increases in costs. The same pattern is repeated for the Langdon school district, where an estimated \$265,000 in property tax revenues will be received annually from the project during the operations period, and the district's net fiscal balance is expected to be \$271,000. The City of Langdon receives no revenue directly from the project, but is projected to have a small but positive net fiscal balance for both the construction and operations phase.

To summarize, wind energy has been viewed with interest for a number of years not only as a promising source of renewable energy but also as an opportunity for rural economic development. Commercial scale wind farms could benefit nearby communities by creating stable, well-paid jobs, through lease payments to land owners, and by adding to the local tax base. This case study of the Langdon Wind Energy Center quantifies these local economic benefits and shows them to be substantial. Further, construction of a wind farm results in a very substantial, albeit one-time, contribution to the state economy, primarily through purchases of towers and blades manufactured in North Dakota.



# **Socioeconomic Impacts of the Langdon Wind Energy Center**

**F. Larry Leistritz and Randal C. Coon<sup>1</sup>**

## **Introduction**

Concerns about the long-term environmental effects of consuming fossil fuels, together with the rising costs of oil and natural gas, have led to rising interest in renewable energy sources. Wind power in particular has been experiencing rapid growth. In 2007, the U.S. led the world in new wind capacity installed (5,244 megawatts [MW], compared to 3,552 MW in Spain and 3,449 in third ranked China) (Global Wind Energy Council 2008). The U. S. also led the world in new capacity installed in 2006 (Wiser and Bolinger 2007). Total U. S. installed capacity at the end of 2007 was 16,818 MW, second only to Germany (Wiser and Bolinger 2007, Hamilton 2008). Wind is generally considered the lowest cost renewable energy source for the Midwest region, and both a federal production tax credit (PTC) and state renewable portfolio standards (RPS) have favored expansion in recent years.

Although North Dakota has been estimated to have the greatest wind generation potential of any state (Pacific Northwest National Laboratory 1991), development was relatively slow until recently. In June of 2007, 172 MW of wind generating capacity was in place with 5 projects involving 125 turbines. However, by the end of 2007, 3 projects with 198 turbines and 297 MW of capacity had been added. The largest of these new projects is the Langdon Wind Energy Center with 106 turbines and 159 MW of generating capacity. Development of a facility like the Langdon Wind Energy Center promises substantial benefits for the landowners where the turbines are sited, as well as new jobs and additional tax revenues for local governments. The purpose of this report is to examine the socioeconomic effects of developing the Langdon Wind Energy Center.

The remainder of this report is organized into three sections. The first briefly describes the site area and the communities likely to be affected by the project. The next describes the Langdon Wind Energy Center while the third presents impact estimates for the project.

## **Site Area Characteristics**

The Langdon Wind Energy Center is located southeast of Langdon and extends south about 10 miles, just to the east of ND Highway 1 (see Figure 1).

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<sup>1</sup>Professor and Research Specialist, respectively, Department of Agribusiness and Applied Economics, North Dakota State University, Fargo.

## Population

Population trends for the counties and communities in proximity to the Langdon Wind Energy Center are summarized in Table 1. All of these counties and communities have lost population since 1980. The changes in population in this area are largely a result of underlying changes in the area economy, discussed in subsequent sections.

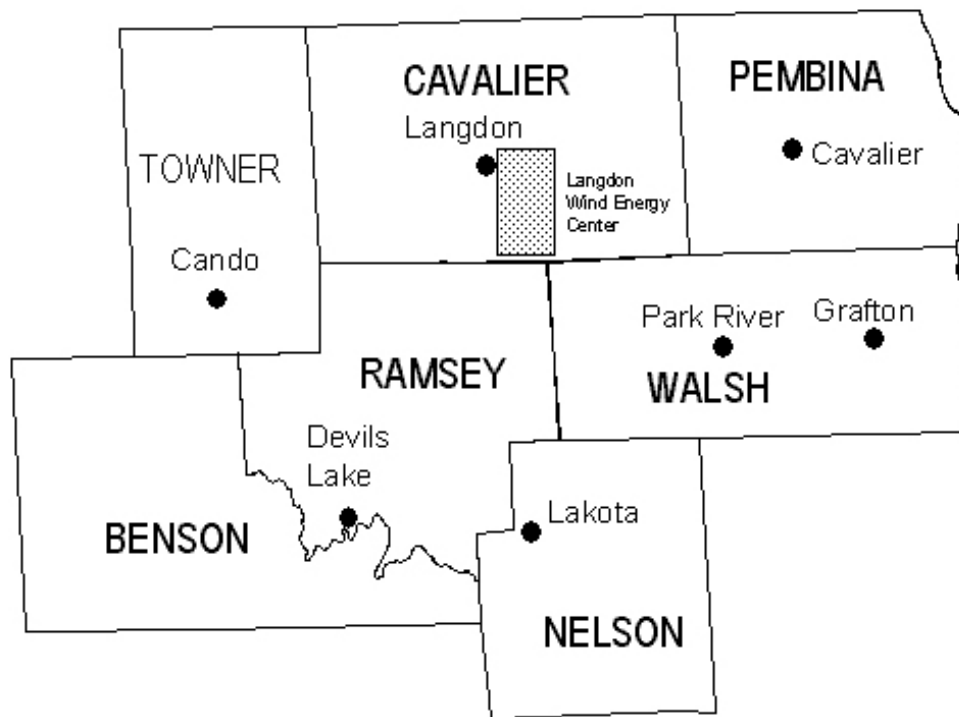


Figure 1. Langdon Wind Energy Center Study Area

Table 1. Population of Selected North Dakota Counties and Communities, 1980-2000, and Estimated 2006

County/City	Population				Percent Change	
	1980	1990	2000	2006*	1990-2006	1980-2006
Cavalier Co.	7,636	6,064	4,831	4,009	-33.9	-47.5
Langdon	2,335	2,241	1,535	1,409	-37.1	-39.7
Nelson Co.	5,233	4,410	3,715	3,289	-25.4	-37.1
Lakota	963	898	781	726	-19.2	-24.6
Pembina Co.	10,399	9,238	8,585	7,906	-14.4	-24.0
Cavalier	1,505	1,508	1,537	1,420	-5.8	-5.6
Ramsey Co.	13,048	12,681	12,066	11,267	-11.2	-13.6
Devils Lake	7,442	7,782	7,222	6,718	-13.7	-9.7
Towner Co.	4,052	3,627	2,876	2,417	-33.4	-40.4
Cando	1,496	1,564	1,342	1,113	-28.8	-25.6
Walsh Co.	15,371	13,840	12,389	11,362	-17.9	-26.1
Grafton	5,293	4,840	4,516	4,163	-14.0	-21.3
Park River	1,844	1,725	1,535	1,407	-18.4	-23.7

\*2006 estimates were for July 1, 2006.

Source: U.S. Bureau of the Census (2006).

## Economic Base

One measure of an area's economy is its sales for final demand (a.k.a. its economic base), which are generally defined as those sales of goods and services to markets outside the area (Coon and Leistritz 1998). Sales for final demand for the six study area counties for 1980 - 2006 are summarized in Table 2. The values in Table 2 are expressed in 2006 dollars, meaning that the effects of economy-wide inflation over the 26-year period, 1980-2006, have been removed. The changes reflected in Table 2 can thus be termed *real* changes (i.e., after removing effects of inflation). The values in Table 2 indicate that the study area counties enjoyed some real growth in their sales for final demand over the period 1980-2006, but that these gains were not shared equally among counties or among economic sectors.

Table 2. Sales for Final Demand by Economic Sector, for Selected North Dakota Counties, 1980-2006  
(constant 2006 dollars)

Year/County	Sector						
	Ag	Energy	Mfg	Tourism	Exp Serv	Fed Govt	TOTAL
-----million dollars-----							
1980: Cavalier	163.5	--	2.8	3.2	--	48.8	218.3
Nelson	80.7	--	6.2	2.4	--	31.9	121.2
Pembina	234.3	--	66.2	3.5	--	67.7	371.7
Ramsey	107.9	--	8.6	17.0	--	112.0	245.5
Towner	95.1	--	1.3	4.1	--	29.8	130.3
Walsh	289.0	--	12.1	3.5	--	93.2	397.8
Total	970.5	--	97.2	33.7	--	383.4	1,484.8
Percent of Total	65.4	--	6.5	2.3	--	25.8	100.0
1990: Cavalier	113.3	--	0.7	5.4	--	73.9	193.3
Nelson	90.0	--	1.1	2.9	--	37.9	131.9
Pembina	194.1	--	56.3	4.0	--	95.3	349.7
Ramsey	85.3	--	3.3	20.4	--	133.4	242.4
Towner	64.3	--	5.0	4.7	--	41.6	115.6
Walsh	174.9	--	12.7	3.4	--	133.0	324.0
Total	721.9	--	78.4	40.8	--	515.1	1,356.9
Percent of Total	53.2	--	5.8	3.0	--	38.0	100.0
1995: Cavalier	105.3	--	6.8	11.3	--	76.8	200.2
Nelson	57.2	--	1.4	5.5	--	35.6	99.7
Pembina	201.8	--	89.2	8.0	--	104.2	403.2
Ramsey	76.2	--	6.3	40.4	--	147.5	270.4
Towner	71.8	--	7.6	9.7	--	41.4	130.5
Walsh	219.9	--	14.2	6.7	--	133.4	374.2
Total	732.2	--	125.5	81.6	--	538.9	1,478.2
Percent of Total	49.5	--	8.5	5.5	--	36.5	100.0
2000: Cavalier	109.8	--	1.9	36.6	2.2	79.6	230.1
Nelson	43.4	--	1.2	17.7	--	31.7	94.0
Pembina	266.7	--	116.9	25.5	--	104.0	513.1
Ramsey	48.0	--	14.0	131.9	5.1	160.9	359.9
Towner	52.7	--	10.7	31.7	--	32.1	127.2
Walsh	227.9	--	35.7	18.0	4.8	117.7	404.1
Total	748.5	--	180.4	261.4	12.1	526.0	1,728.4
Percent of Total	43.3	--	10.5	15.1	0.7	30.4	100.0
2006: Cavalier	142.3	--	26.1	42.0	2.0	86.8	299.2
Nelson	52.1	--	5.0	20.4	--	43.3	120.8
Pembina	220.5	--	75.1	29.3	--	111.1	436.0
Ramsey	78.7	--	14.1	149.1	4.5	209.4	455.8
Towner	80.5	--	5.1	36.3	--	50.3	172.2
Walsh	178.6	--	75.6	25.1	4.4	160.8	444.5
Total	752.7	--	201.0	302.2	10.9	661.7	1,928.5
Percent of Total	39.0	--	10.4	15.7	0.6	34.3	100.0

Table 2. Sales for Final Demand by Economic Sector, for Selected North Dakota Counties, 1980-2006 (constant 2006 dollars) continued

Year/County	Sector						TOTAL
	Ag	Energy	Mfg	Tourism	Exp Serv	Fed Govt	
Percent Change							
1980-2006	-22.4	--	106.8	796.7	--	72.6	29.9
1990-2006	4.3	--	156.4	640.7	--	28.5	42.1
2000-2006	0.6	--	11.4	15.6	-9.9	25.8	11.6

Source: Coon and Leistritz (2008).

During the 1980s, total sales for final demand in the study counties dropped substantially (26%), and all but one of the study counties (Nelson) shared in this decline. Since that time, total sales for final demand have grown (42%), and all but one of the study counties (Nelson) have shared in this growth.

The period since 1980 has also seen a substantial change in the composition of the economic base of the study area. In 1980, the *agricultural* sector (i.e., sales of crops and livestock and federal commodity program payments) accounted for 65 percent of total sales for final demand, *federal payments* (i.e., payrolls, transfer payments, etc.) for 26 percent, *manufacturing* for 6.5 percent, and *tourism* (i.e., expenditures by out of state visitors) for 2 percent. In 2006, the *agricultural* sector accounted for 39 percent, *federal payments* for 34 percent, *tourism* for 16 percent, and *manufacturing* for 10 percent.

## Employment

Employment provides another measure of an area's economy and the role of various economic sectors. Employment by economic sector for 2000 and 2006 for the six counties is summarized in Table 3. The area's leading sectors in employment in 2006 were services (22%), agriculture (21%), retail trade (18%), and government (14.5%). Total employment in the study area declined (5%) from 2000 to 2006. Most of the area's leading employment sectors shared in this decline.

## Per Capita Income

Per capita income in Towner and Cavalier Counties in 2005 exceeded that of North Dakota as a whole, although still less than the national average (Table 4). The other four study area counties registered values less than the state average. The study area counties differed considerably in their personal income change from 1995 to 2005. Towner and Cavalier Counties registered gains considerably above the state average (49% and 47%, respectively) as did Nelson County (39%). The other three counties registered gains less than the state average, and in Pembina County real per capita income declined (3%).

Table 3. Employment by Economic Sector for Selected North Dakota Counties, 2000 and 2006

Year/County	Sector									TOTAL	
	Ag	Const <sup>1</sup>	Trans, Comm, & Pub Util	Mfg	Energy Extract & Conv	Retail Trade	FIRE <sup>2</sup>	Services	Govt		
2000:											
Cavalier	1,059	106	136	142	--	371	101	594	282	2,791	
Nelson	619	47	45	157	--	194	76	381	229	1,748	
Pembina	1,112	182	372	1,539	--	988	129	729	741	5,792	
Ramsey	759	307	233	561	--	1,506	321	2,204	1,259	7,150	
Towner	656	27	45	164	--	127	77	230	155	1,481	
Walsh	1,165	202	358	762	--	1,390	166	1,537	1,124	6,704	
TOTAL	5,370	871	1,189	3,325	--	4,576	870	5,675	3,790	25,666	
Percent of Total	20.9	3.4	4.6	13.0	--	17.8	3.4	22.1	14.8	100.0	
2006:											
Cavalier	1,009	60	199	127	--	387	89	473	247	2,591	
Nelson	589	34	32	152	--	233	81	316	185	1,622	
Pembina	1,058	161	323	987	--	984	130	727	822	5,192	
Ramsey	723	241	292	493	--	1,602	305	2,071	1,196	6,923	
Towner	625	24	47	269	--	125	93	225	140	1,548	
Walsh	1,109	186	356	1,031	--	1,019	177	1,641	935	6,454	
TOTAL	5,113	706	1,249	3,059	--	4,350	875	5,453	3,525	24,330	
Percent of Total	21.0	2.9	5.1	12.6	--	17.9	3.6	22.4	14.5	100.0	
Percent Change 2000-2006	-4.8	-18.9	5.0	-8.0	--	-4.9	0.6	-3.9	-7.0	-5.2	

<sup>1</sup>Includes non-energy mining<sup>2</sup>Finance, Insurance, and Real Estate

Source: Coon and Leistritz (2008).

Table 4. Per Capita Personal Income for Selected Counties, North Dakota, and the United States, 1995 and 2005.

County	Per Capita Income*		Change 1995-2005	2005 PCI Comparison to	
	1995	2005		North Dakota	U.S.
	-----dollars-----			-----percent-----	
Cavalier	21,574	31,667	46.8	101.0	91.9
Nelson	18,908	26,232	38.7	83.7	76.1
Pembina	28,955	28,019	-3.2	89.4	81.3
Ramsey	23,563	28,996	23.1	92.5	84.1
Towner	21,576	32,197	49.2	102.7	93.4
Walsh	24,447	28,687	17.3	91.5	83.2
North Dakota	24,186	31,357	29.6	100.0	
United States	29,585	34,471	16.5		100.0

\*Constant 2005 dollars

Source: Bureau of Economic Analysis Internet Website. 1995 and 2005. Per Capita Personal Income Interactive Tables. U.S. Department of Commerce, Washington, D.C.

## Retail Trade

Retail sales for seven study area communities are summarized in Table 5. Devils Lake and Grafton serve as trade centers for multi-county trade areas and are classified as complete shopping centers (Bangsund et al. 1991). Cavalier and Langdon are classified as partial shopping centers, Cando and Park River are full convenience centers, and Lakota is a minimum convenience center. Inflation adjusted taxable sales in each of these communities declined from 2000 to 2006.

Pull factors measure a trade center's sales relative to the purchasing power of trade area residents. A value of 1.0 indicates that actual sales are equal to potential sales (estimated based on trade area population and per capita income). The pull factors for Devils Lake and Grafton are somewhat lower than the state average for complete shopping centers (0.84), while the pull factor for Cavalier is equal to the state average for partial shopping centers (0.64) and that for Langdon is somewhat less. The pull factor for Cando is substantially greater than the state average for full convenience centers (0.56), and Park River's is substantially lower. Lakota's pull factor is lower than the state average for minimum convenience centers (0.43). In general, these communities, like many of the state's smaller communities, appear to be struggling to maintain their retail and service sectors in competition with larger trade centers.

Table 5. Taxable Retail Sales and Pull Factors for Selected Communities, North Dakota, 1990-2006

Town	Taxable Sales*			Change 2000-2006	2005 Pull Factors
	1990	2000	2006		
	-----\$000-----			-----%----	
Cando	9,802	8,514	8,480	0.4	0.87
Cavalier	25,769	34,483	25,788	-25.2	0.64
Devils Lake	114,059	137,381	115,483	-15.9	0.75
Grafton	64,040	58,330	43,856	-24.8	0.66
Lakota	5,342	2,636	2,195	-16.7	0.23
Langdon	26,897	25,118	19,779	-21.3	0.49
Park River	11,249	12,022	9,310	-22.6	0.32

\*Constant 2006 dollars

Sources: Office of the State Tax Commissioner (1990, 2000, and 2006), Coon and Leistritz (2008).

## School Enrollments

Enrollments in study area school districts for the period 1995-96 to 2006-07 are summarized in Table 6. All districts experienced declining enrollments during this period. From 2000-2001 to 2006-2007, the decreases in enrollments ranged from -4 % in St. Thomas (Pembina Co.) to -49.5 % in Bisbee-Egland (Towner Co.).

The decrease in enrollments is similar to those being experienced in other nonmetro areas of the state. It is a product of the changing age structure of the population, which in turn has resulted from the high levels of net out-migration experienced over the past several decades.

Overall, the study area can be characterized as one that has been struggling economically. Area leaders have long sought economic development and diversification opportunities.



Table 6. School Enrollment (K-12) in Cavalier County School Districts, and Surrounding School Districts, 1995-2007

District	1995-1996	2000-2001	2006-2007	Change 2000-01 to 2006-07
	-----students-----			----percent----
Langdon	685	663	517	-22.0
Munich	<u>243</u>	<u>155</u>	<u>106</u>	-31.6
Cavalier Co. Total	928	818	623	-23.8
Dakota Prairie	566	399	273	-31.6
Lakota	<u>312</u>	<u>295</u>	<u>217</u>	-26.4
Nelson Co. Total	878	694	490	-29.4
Cavalier	715	633	431	-31.9
Drayton	274	248	144	-41.9
North Border (Pembina)	721	578	477	-17.5
St. Thomas	<u>142</u>	<u>124</u>	<u>119</u>	-4.0
Pembina Co. Total	1,852	1,583	1,171	-26.0
Devils Lake	2,192	2,217	1,075	-51.5
Edmore	168	113	79	-30.1
Starkweather	<u>140</u>	<u>121</u>	<u>87</u>	-28.1
Ramsey Co. Total	2,500	2,451	1,241	-49.4
Bisbee-Egland	155	111	56	-49.5
North Central (Rock Lake)	121	78	62	-20.5
Southern (Cando)	<u>363</u>	<u>308</u>	<u>204</u>	-33.8
Towner Co. Total	639	497	322	-35.2
Adams	115	113	67	-40.7
Fordville-Lankin	160	160	94	-41.3
Grafton	1,263	1,039	914	-12.0
Edinburg	179	144	122	-15.3
Minto	259	260	236	-9.2
Park River	<u>522</u>	<u>454</u>	<u>415</u>	-8.6
Walsh Co. Total	2,498	2,170	1,848	-14.8

Sources: North Dakota Department of Public Instruction Internet Website. North Dakota Educational Directory 2006-2007 and 2000-2001. Bismarck: North Dakota Department of Public Instruction;

North Dakota Department of Public Instruction Internet Website. 1994-2007 Finance Facts Data - Fall School Enrollment by District for K-12. Bismarck: North Dakota Department of Public Instruction.

## **Langdon Wind Energy Center – Project Background**

The Langdon Wind Energy Center consists of 106 turbines with a generating capacity of 1.5 MW each, mounted on towers 262 feet tall. The project is owned by FPL Energy and Ottertail Power Company; FPL Energy was the project developer. The wind generated electricity is purchased by Ottertail Power and Minnkota Power Cooperative, Inc. FPL Energy, with headquarters in Juno Beach, Florida, has been a leader in wind power development, both in the Dakotas and nationally. FPL Energy subsidiaries own five wind energy centers in North Dakota and one in South Dakota. These projects represent an investment of more than \$500 million and pay a total of \$1.4 million in state and local taxes each year. The projects employ a total of 32 staff and pay about \$1 million in landowner lease payments annually. FPL Energy is also the largest generator of wind energy in the nation with 55 facilities in 16 states and a generating capacity of 5,275 MW at the end of 2007.

Construction of the Langdon Wind Energy Center began in July, 2007 and was completed on January 12, 2008. The peak construction work force was 269 workers. A force of 10 permanent employees will operate and maintain the energy center. These workers were hired during 2007 and sent out of state for training. All but two of these employees were hired from the local area.

Langdon area leaders had been interested in the prospect of wind development since the 1990s. They had observed the development of the state's first commercial wind farm in the Edgeley-Kulm area, which was developed and constructed by FPL Energy. In 2004, they decided to put up a metrological (met) tower to gather wind data. They were assisted in this effort by a ND Dept. of Commerce matching grant of \$10,000. FPL Energy entered the scene in the fall of 2006, when they held an informational meeting in the area. FPL returned in March of 2007 to hold landowner meetings. They offered option agreements to landowners in exchange for the right to develop a wind farm. A few weeks later they returned seeking wind farm easements. The project came together fast. The availability of two years of data from the met tower likely expedited the design of the wind farm.

Before on-site activity began, FPL held a Job Fair to hire local workers. FPL also leased housing for their personnel. As the construction labor force grew, the market for temporary housing and accommodations became tight. The workers used all available local housing. The motels were full, and all rental housing was taken. The trailer court also was full, and RVs were parked in the city park. Some workers stayed in Cavalier, Lakota, and even Devils Lake, but this was seen as a last resort, as workers were working long hours. The City and the Chamber helped workers find temporary housing.

Local leaders have indicated that local businesses did well during construction. The local repair shop did a good business, as did the hardware store. Warm clothing became a best seller as the weather cooled. A local restaurant/lounge did a good business. The construction jobs associated with the wind farm were seen as desirable, with good wage rates and the potential for lots of overtime.

During construction, a lot of material had to be delivered to the site. For instance, each turbine needed 3 blades, so the 106 turbines represented 159 semi loads of blades. However, Langdon missed much of the traffic, as most material was delivered via U.S. Highway 2 and ND Highway 1 (i.e., from the south). Local residents also noticed a major increase in traffic during shift changes. However, traffic returned to normal when construction ended.

Now that the project is in operation, the easement payments will be a boost for landowners' incomes. Another significant economic contribution will be local property taxes, which are estimated to total \$456,000 annually for all entities, with \$191,000 to the county alone. The school district will also benefit substantially (estimate is \$265,000).

### Estimated Langdon Wind Energy Center Impacts

Construction of the Langdon Wind Energy Center is estimated to have resulted in payments of \$9.3 million to entities in the Langdon area (i.e., Cavalier County and adjacent counties) and an additional \$47 million to entities elsewhere in North Dakota (Table 7). The major items purchased elsewhere in North Dakota were wind towers and blades, which represented a total of \$42 million. DMI Manufacturing in West Fargo produced the towers while LM Glasfiber in Grand Forks manufactured the blades. During operation, the facility will make payments of about \$1.4 million annually to North Dakota entities, including payroll and employee benefits and landowner payments.

Table 7. Estimated Direct Expenditures by the Langdon Wind LLC Project in the Langdon Area, Elsewhere in North Dakota, and Total, for Construction and Operational Phases, 2007-2008

Input-Output Sector	Construction Phase			Operational Phase
	Langdon	Elsewhere in ND	Total	
	-----\$000-----			
Comm & Pub Utilities	85	- -	85	40
Ag Proc & Misc Mfg	- -	42,000	42,000	- -
Retail	2,055	635	2,690	15
FIRE	320	250	570	100
Bus & Pers Service	4,985	3,775	8,760	50
Prof & Soc Service	100	75	175	- -
Households	<u>1,853</u>	<u>250</u>	<u>2,103</u>	<u>1,208</u>
TOTAL	9,398	46,985	56,383	1,413

## Impact Assessment Model

The model used in this analysis, referred to as the Microcomputer Economic Demographic Assessment Model (MEDAM), consists of four modules; an economic (input-output) module, a demographic module, a service requirements module, and a fiscal impact module. A more complete description of the model is contained in the Appendix.

### Economic Impacts

Input-output coefficients incorporated within the MEDAM model were used to estimate the secondary and total economic impacts of facility construction and operation. The \$56.4 million in statewide direct impacts during the construction period resulted in an additional \$169 million in secondary impacts for a total, one-time construction impact of \$225.7 million (Table 8). The \$1.4 million in annual direct impacts associated with project operation lead to an additional \$3 million in secondary impacts for a total annual impact of \$4.4 million. This includes \$2.1 million of additional *household* sector gross receipts (gross business volume), which indicates that personal incomes of area residents would be increased by about \$2.1 million each year during project operation. Other sectors receiving substantial impacts during construction included *manufacturing* (\$73.6 million), *households* (\$44.6 million), and *retail trade* (\$35.2 million).

Project construction is estimated to create 1,656 secondary jobs statewide, in addition to the 269 peak construction jobs (Table 9). Given the relatively brief duration of the construction phase, some of this secondary employment may have been reflected in longer hours and associated overtime pay for present employees, as opposed to new job creation. During the operation of the project, an estimated 21 secondary jobs are created, in addition to the 10 workers employed by the project.

The estimated residential location of construction phase and operation phase workers is shown in Table 10. During construction, 223 secondary jobs were estimated to be associated with local area construction spending. Of these, 133 were expected to be located within the four counties while the remaining 90 were estimated to be located in larger trade centers that serve the area (e.g., Grand Forks). As noted previously, some of the secondary jobs may represent more hours for existing employees, rather than new employees. During the operation phase (represented by 2008), 21 secondary jobs were estimated to be created in addition to the 10 project employees. Based on information from local leaders, all 10 project employees were estimated to live in Cavalier County as were 8 secondary jobs. Four secondary jobs were estimated to be created in the other three counties, while 9 were estimated to be located in larger trade centers.

Table 8. Estimated Direct, Secondary, and Total Economic Impact from the Langdon Wind LLC Project, Langdon Area and Project Total

Sector	Wind Farm Construction (Total)						Wind Farm Operational (Annual)		
	Langdon Area			Project Total					
	Direct	Secondary	Total	Direct	Secondary	Total	Direct	Secondary	Total
	-----\$000-----								
Construction	--	548	548	--	3,418	3,418	--	122	122
Transportation	--	103	103	--	698	698	--	14	14
Communications and public utilities	85	917	1,002	85	4,653	4,738	40	151	191
Manufacturing	--	316	316	42,000	31,550	73,550	--	60	60
Retail trade	2,055	4,517	6,572	2,690	32,479	35,169	15	1,011	1,026
Finance, insurance, and real estate	320	1,040	1,360	570	7,126	7,696	100	228	328
Business and personal services	4,985	438	5,423	8,760	2,839	11,599	50	85	135
Professional and social services	100	527	627	175	3,011	3,186	--	132	132
Households	1,853	5,978	7,831	2,103	42,462	44,565	1,208	861	2,069
Government	--	719	719	--	4,439	4,439	--	150	150
Other <sup>1</sup>	--	<u>773</u>	<u>773</u>	--	<u>36,667</u>	<u>36,667</u>	--	<u>138</u>	<u>138</u>
Total	9,398	15,876	25,274	56,383	169,342	225,725	1,413	2,952	4,365
Secondary employment (FTE jobs)		223			1,656			21	

<sup>1</sup>Includes agriculture, mining, and energy conversion.

Table 9. Employment Associated with the Langdon Wind LLC Project, for Construction and Operational Phases, 2007 and 2008

Year	Construction <sup>1</sup>	Operation	Secondary	Total
2007	269	0	1,656	1,925
2008	0	10	21	31

<sup>1</sup>Reflects peak employment.

Table 10. Workers<sup>1</sup> by Type and Residence, Langdon Wind LLC Project, 2007 and 2008

Year/County	Worker Type			Total
	Construction	Operation	Secondary	
Regional Impact:				
2007	269	0	223	492
2008	0	10	21	31
Cavalier County:				
2007	188	0	89	277
2008	0	10	8	18
Nelson County:				
2007	27	0	11	38
2008	0	0	1	1
Pembina County:				
2007	40	0	11	51
2008	0	0	1	1
Ramsey County:				
2007	13	0	22	35
2008	0	0	2	2

<sup>1</sup>The figures in this table refer to all workers of a given type, without regard to their origin (local vs. nonlocal).

## Demographic Effects

To estimate the effects of a project like the Langdon Wind Energy Center on an area's population, it is necessary to estimate the percentage of the project-related workers who will relocate to the area (or conversely, to estimate the percentage of the new jobs that can be filled by the area's unemployed or by local residents who enter the labor force). It has been estimated that 55 percent of the construction jobs, 80 percent of the operations jobs, and 85 percent of the secondary jobs will be filled by local workers (see Table 11).

Table 11. Demographic Parameters Used in Impact Assessment for the Langdon Wind LLC Project

Percentage of each worker type who will be nonlocal:

Construction	45%
Operation	20%
Secondary	15%

Percentage of nonlocal construction workers who will bring families to the area:

Families locating	5%
-------------------	----

Residential Location by worker type:

<u>County</u>	<u>Construction Workers (%)</u>	<u>Operation Workers (%)</u>	<u>Secondary Workers (%)</u>
Cavalier	70	100	40
Nelson	10	0	5
Pembina	15	0	5
Ramsey	5	0	10
<u>Town</u>			
Langdon	70	100	40
Lakota	10	0	5
Cavalier	15	0	5
Devils Lake	5	0	10

A second important parameter is the percentage of relocating construction workers who will bring families to the area. Based on the short duration of the construction phase and information from local leaders, it was estimated that only 5 percent of construction workers brought families.

A third factor that is important in determining the community-level impacts of a project is where the relocating workers choose to live. The residential location assumptions that were developed for the Langdon project area are summarized in Table 11. All operations workers were assumed to live in Cavalier County, in or near Langdon. Construction workers were estimated to stay primarily in or near Langdon with some spillover to adjacent counties as shown in Table 11. Of the secondary jobs, 60 percent were expected to be in the four county area, with 40 percent expected to be in larger trade centers outside the local area.

The population implications of project construction and operation are presented in Table 12. In 2007 (during project construction), 196 persons were estimated to temporarily locate in the four-county region. The corresponding figure for 2008 is 4. The construction phase population growth included 122 new residents in Cavalier County. In 2008 (i.e., operations phase), the region would have 4 new residents.

Table 12. In-Migrating Population by Worker Type and County/City of Residence, Langdon Wind LLC Project, 2007 and 2008

County/City/Year	Worker Type			Total		
	Construction	Operation	Secondary	Male	Female	Total
Regional Impact:						
2007	136	0	60	159	37	196
2008	0	2	2	2	2	4
Cavalier County:						
2007	96	0	26	103	19	122
2008	0	2	0	1	1	2
Langdon City:						
2007	96	0	26	103	19	122
2008	0	2	0	1	1	2
Nelson County:						
2007	12	0	1	13	0	13
2008	0	0	0	0	0	0
Lakota City:						
2011	12	0	1	13	0	13
2016	0	0	0	0	0	0
Pembina County:						
2007	18	0	1	19	0	19
2008	0	0	0	0	0	0
Cavalier City:						
2007	18	0	1	19	0	19
2008	0	0	0	0	0	0
Ramsey County:						
2007	6	0	2	7	1	8
2008	0	0	0	0	0	0
Devils Lake City:						
2007	6	0	2	7	1	8
2008	0	0	0	0	0	0



## Housing Impacts

One of the most obvious implications of the population influx associated with the construction and operation of a major project is the need for housing or work-week accommodations for the workers and, in some cases, their families. The MEDAM model estimates the housing units that will be required to accommodate the in-migrating (relocating) population, based on coefficients that specify the housing type preferences of workers of each job type. The coefficients used in this analysis are shown in Table 13. These coefficients indicate, for instance, that only 5 percent of the nonlocal construction workers will desire single-family houses, while 30 percent will prefer apartments, about 35 percent will prefer mobile home (including RVs and travel trailers) accommodations, and 30 percent will be housed in motels, rented rooms, and similar work-week accommodations. Similar interpretations apply to the coefficients for the other worker types.

Table 13. Housing Requirements by Worker Type Associated with the Langdon Wind LLC Project

Worker Type	Housing Type			
	Single-Family Houses	Multi-Family Apartments	Mobile Homes <sup>1</sup>	Other <sup>2</sup>
	----- percent -----			
Construction	5	30	35	30
Operations	60	20	20	0
Secondary	35	35	20	10

<sup>1</sup>For construction workers, this category will include RVs and travel trailers.

<sup>2</sup>For construction workers, this category will include motels and rented rooms. For secondary workers, this category will include younger workers who live with their parents.

The housing requirements projected to be associated with Langdon Wind Energy Center construction and operation are summarized in Table 14. The regional impact of the project included a need for about 154 housing units or work-week accommodations at the peak of construction activity, while project operation will require about 4 additional housing units (or result in occupancy of some units now vacant). Construction phase impacts were greatest in Langdon, where 98 housing units or work-week accommodations were needed. However, since most construction workers were not accompanied by families, many housing units (e.g., apartments, motel rooms) may have accommodated more than one worker. During project operation, housing impacts are negligible, as the work force is small and most jobs are filled by local residents.

Table 14. Housing Requirements Associated with the Langdon Wind LLC Project, 2007 and 2008

County/City/Year	Housing Type				Total Units
	Single-family Houses	Multi-family Apartments	Mobile Homes	Other	
Regional Impact:					
2007	18	48	49	39	154
2008	2	1	1	0	4
Cavalier County:					
2007	9	30	33	26	98
2008	1	0	0	0	1
Langdon City:					
2007	9	30	33	26	98
2008	1	0	0	0	1
Nelson County:					
2007	2	5	4	4	15
2008	0	0	0	0	0
Lakota City:					
2007	2	5	4	4	15
2008	0	0	0	0	0
Pembina County:					
2007	2	6	6	5	19
2008	0	0	0	0	0
Cavalier City:					
2007	2	6	6	5	19
2008	0	0	0	0	0
Ramsey County:					
2007	1	3	3	2	9
2008	0	0	0	0	0
Devils Lake City:					
2007	1	3	3	2	9
2008	0	0	0	0	0

## School Impacts

Among the various public services likely to be affected by growth and development, the public schools are often of greatest concern. At least two factors explain the high level of interest in the effects on schools: (1) the high priority placed on primary and secondary education by state and local leaders and (2) the substantial portion of local government expenditures that the public schools typically represent.

Projections of the impact of construction and operation of the Langdon Wind Energy Center project on school enrollments are summarized in Table 15, for individual school districts, as well as for the region. During both construction and operation periods, the effects are negligible – during construction because few nonlocal workers brought families to the area and during operation because of the small work force that was mostly filled by local residents.

Table 15. School Enrollment Increases Associated with the Langdon Wind LLC Project, 2007 and 2008

District/Year	School Enrollment Increase		
	K-8	9-12	Total
Regional Impact:			
2007	13	5	18
2008	0	0	0
Langdon:			
2007	6	1	7
2008	0	0	0
Lakota:			
2007	1	0	1
2008	0	0	0
Cavalier:			
2007	1	0	1
2008	0	0	0
Devils Lake:			
2007	1	1	2
2008	0	0	0

## **Public Service Impacts**

Impacts of the in-migrating population on a variety of public service dimensions are estimated by the MEDAM model, using a series of per capita rates applied to the in-migrating population of each affected jurisdiction. The rates used to estimate additional requirements and demands on medical services, social services, law enforcement, fire protection, water, and solid waste are shown in Appendix, Table 7. The impact estimates that result when these rates are applied to the in-migrating population associated with Langdon Wind Energy Center development are shown in Table 16. During project construction, public service requirements were quite small, as most workers did not bring families to the region. During project operation, public service effects are negligible.

## **Fiscal Impacts**

The fiscal impact component of MEDAM develops estimates of a project's effects on the revenues and expenditures of state and local governments (counties, municipalities, and school districts). Estimates of changes in public sector revenues are based on changes in (1) income – personal income tax, (2) business receipts – corporate income tax, (3) retail sales – sales and use tax, (4) property value – property tax, and (5) population – highway, liquor, and tobacco taxes and user fees (Coon et al. 1993). State transfer payments to local governments are estimated from changes in population and school enrollments. Estimates of capital costs for new public facilities (if required) are based on the estimated needs of the in-coming population. Capital costs that cannot be funded from current revenues are assumed to be amortized over 20 years at 7 percent. Changes in operating expenses for the various levels of government are estimated based on changes in population or school enrollments. The impact estimation procedure is based on the experience of communities that were affected by large-scale coal development, as well as other types of industrial and resource development (Leistritz and Murdock 1988, Leistritz and Sell 2000).

Estimates of the effects of the Langdon Wind project on state government revenues and expenditures are summarized in Table 17. During construction, the state is expected to receive substantial revenue from sales and use and personal income taxes. State revenues exceed added state costs by more than \$2 million. During operation, most of the added state revenue comes from these sources, while added state costs are virtually nonexistent because of the minimal population influx.

Fiscal impact projections also were prepared for local jurisdictions which were anticipated to experience substantial population effects from the project. Fiscal impact estimates for Cavalier County are presented in Table 18. Projections for the Langdon school district are shown in Table 19, and projections for the city of Langdon are summarized in Table 20. Cavalier County experienced little effect on either its revenues or costs during the construction phase. During operation, the county is expected to receive \$191,000 in direct property tax payments and \$194,000 in total increased property tax revenues while having negligible increases in costs. The same pattern is repeated for the Langdon school district, where an estimated \$265,000 in property tax revenues will be received annually from the project during the operations period, and the district's net fiscal balance is expected to be \$271,000. The City of Langdon receives no revenue directly from the project, but is projected to have a small but positive net fiscal balance for both the construction and operations phase.

Table 16. Public Service Requirements Associated with the Langdon Wind LLC Project, 2007 and 2008

County/ Year	Medical Services		Law Enforcement			Crimes			Fire Departments		Water Consumption	Solid Waste
	Physicians	Hospital Beds	Social Workers	Officers	Total Workers	Total	Violent	Property	Fighters	Trucks		
-----number-----											gallons/day	lbs/day
Regional Impact:												
2007	0.1	1.1	0.2	0.4	0.4	3.8	0.2	3.6	0.4	0.0	37,240	902
2008	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	760	18
Cavalier County:												
2007	0.0	0.7	0.1	0.2	0.2	2.4	0.1	2.3	0.2	0.0	23,180	561
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	380	9
Nelson County:												
2007	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0	2,470	60
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Pembina County:												
2007	0.0	0.1	0.0	0.0	0.0	0.4	0.0	0.4	0.0	0.0	3,610	87
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
Ramsey County:												
2007	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	1,520	37
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0

Table 17. Changes in State Tax Revenues and Expenditures Resulting from the Langdon Wind LLC Project, 2007 and 2008

Year	Tax Revenues			Expenditures						
	Sales & Use Tax	Personal Income Tax	Other State Taxes <sup>1</sup>	Education Transfers	Highway Maintenance	General Government	Highway & Other Transfers <sup>2</sup>	Net Fiscal Balance	Capital Expend	Net Fiscal Balance after C.E.
	-----\$000-----									
2007	1,628	669	683	285	33	225	74	2,363	310	2,053
2008	48	31	8	0	0	2	0	85	0	85

<sup>1</sup>Includes corporate income tax, highway taxes, cigarette and tobacco taxes, and liquor and beer taxes.

<sup>2</sup>Includes highway, personal property tax replacement, and cigarette and tobacco taxes.

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Table 18. Changes in Revenues and Expenditures for Cavalier County Resulting from the Langdon Wind LLC Project, 2007 and 2008

Year	Revenues		Expenditures			Net Fiscal Balance
	Property Taxes	State Transfers <sup>1</sup>	General Government	Roads	Other <sup>2</sup>	
	-----\$000-----					
2007	37	8	8	11	11	15
2008	194	0	0	0	0	194

<sup>1</sup>Includes highway fund transfers and personal property tax replacement.

<sup>2</sup>Includes health and human services, law enforcement, education, emergency services, environment, and miscellaneous.

Table 19. Changes in Revenues and Expenditures for Langdon School District Resulting from the Langdon Wind LLC Project, 2007 and 2008

Year	Revenues		Expenditures		Net Fiscal Balance
	Local Property Taxes	State Transfers	School Operating Costs		
			K-8	9-12	
-----\$000-----					
2007	79	27	37	14	55
2008	271	0	0	0	271

Table 20. Changes in Revenues and Expenditures for Langdon City Government Resulting from the Langdon Wind LLC Project, 2007 and 2008

Year	Revenues			Expenditures				Fiscal Balance
	Local Property Tax	User Fees & Special Assessments	Other Revenues <sup>1</sup>	General Government	Public Safety	Net Public Works	Other <sup>2</sup>	
	-----\$000-----							
2007	38	50	5	11	15	32	6	29
2008	3	1	0	0	0	1	0	3

<sup>1</sup>Includes highway fund transfers, cigarette and tobacco tax transfers, and personal property tax replacement.

<sup>2</sup>Includes health and welfare, culture and recreation, and miscellaneous expenditures.

## **Conclusions and Implications**

Wind energy development has been viewed as a promising rural development opportunity for North Dakota for a number of years. North Dakota is estimated to have the greatest wind generating potential of any state, but development was relatively slow until recently. Remoteness from major markets and a transmission grid operating near capacity were frequently cited as factors limiting wind development. In 2007, wind development picked up substantially, and North Dakota's installed wind generating capacity increased three-fold during the year. The purpose of this study was to examine the effects of developing the Langdon Wind Energy Center on nearby communities and the state economy.

Construction of the Langdon Wind Energy Center was completed over a 6 month period and resulted in expenditures of \$9.4 million within the multi-county area and an additional \$47 million elsewhere in the state. The bulk of the expenditures made elsewhere in the state were purchases of towers and blades. When the multiplier effects of these expenditures are included, the total contribution to the North Dakota economy was more than \$225 million. This level of economic activity would support about 1,650 secondary jobs, in addition to the project construction work force. (Given the short duration of the construction phase, some of the estimated secondary employment likely represented additional hours for existing employees, rather than new jobs.)

During project operation, local economic effects will stem from (1) project jobs and operating expenses, (2) lease payments to landowners, and (3) property tax payments. The 10 maintenance workers are expected to live in the Langdon area, and project operation will support about 8 secondary jobs in Langdon, as well as a few in other communities. Thus, project payrolls and operating expenditures should help support local businesses. The lease payments will represent a substantial increase in landowner incomes (\$413,400 for year 1). Finally, the project will add substantially to local tax revenues, with the county government expected to receive more than \$190,000 and the Langdon school district more than \$260,000.

For some projects, an important question is whether project-related revenues will be sufficient to offset project-related costs (i.e., costs of providing services to in-migrating workers and their families). However, in the case of the Langdon Wind Energy Center, these costs were negligible because (1) very few construction workers brought families to the area and (2) project and secondary employment during the operation phase was quite small with most of the jobs filled by local residents. Finally, most local services have substantial excess capacity because of past population decreases.

Local leaders were asked about area residents' reaction to the project. The reaction has been very positive. Local leaders felt the community did well accommodating the temporary housing needs of construction workers but cautioned that other communities might have more difficulty. Langdon has more infrastructure than many communities its size, dating from the early 1970s when an antiballistic missile defense site was constructed south of town. The mobile home park, which was full at the peak of wind farm construction, dates from the defense site



construction. Developers planning projects in remote locations may need to assess housing and accommodation availability and perhaps explore alternatives for worker accommodation and transportation.

To summarize, wind energy has been viewed with interest for a number of years not only as a promising source of renewable energy but also as an opportunity for rural economic development. Commercial scale wind farms could benefit nearby communities by creating stable, well-paid jobs, through lease payments to land owners, and by adding to the local tax base. This case study of the Langdon Wind Energy Center quantifies these local economic benefits and shows them to be substantial. Further, construction of a wind farm results in a very substantial, albeit one-time, contribution to the state economy, primarily through purchases of towers and blades manufactured in North Dakota.

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## **Appendix**

## **MEDAM Computer Model Update - 2008**

The original MEDAM impact assessment model was developed in 1992 to 1993 with the documentation published in June 1993 (Coon et. al., 1993). Coefficients in the model were updated in 2002 in response to the prospects for additional energy development in western North Dakota. These updates provided a more accurate tool that can be used for economic, demographic, services, and fiscal impact analysis. With potential large-scale energy development in North Dakota, updating the parameters of the MEDAM assessment model in 2008 will continue to provide the most accurate impact estimates. In the nearly 16-year period since the model was developed, many tax rates, etc. have changed. Many of the default values in the model (particularly in the services and fiscal models) are presented for approval or change, but productivity ratios and tax rates are constant values within the model. These locked-in rates were changed to reflect current rates and values. The updated version of the model has been named MEDAM08.

This text is not a complete documentation of the MEDAM08 assessment model, but rather a listing of updated values entered into the model's source code, and the data sources used. All methodology and algorithms remained the same as for the original model. Changes were made to the economic module (the user will not be able to see these changes because rates are not presented) and the fiscal module. Fiscal model default values were changed, but as with the previous versions, the default values may be altered by the user. Public service requirements for the services module were updated, but no changes were made to the demographic model parameters.

### **Economic Module**

Changes to the economic module consisted of updating the productivity ratios (Table 1) and tax rates associated with the input-output portion of the model (Table 2). Productivity ratios were calculated using input-output model generated gross business volumes and employment data (Coon and Leistritz 2008). State-level productivity ratios were used by MEDAM08 to estimate secondary employment. Tax rates in 2002 were determined using gross business volumes generated by the input-output model, and actual tax calculations. (Coon and Leistritz 2002, Office of the Tax Commissioner 1995-2000; Strombeck 2002). Similar methodology was used to determine 2008 tax rates (Coon and Leistritz 2008: Office of the Tax Commissioner (2001-2006); Office of the Tax Commissioner (2007). Tax rates calculated for the 2008 update were virtually unchanged from those used in 2002. This is consistent with public policy, because major tax rates have not changed during that period.

**Table 1. Productivity Ratios Used by MEDAM08 to Estimate Secondary Employment**

Sector	2006 Productivity Ratio
Ag, Livestock	211,300
Ag, Crops	211,300
Nonmetallic Mining	282,800
Construction	146,400
Transportation	24,000
Communications & Public Utilities	143,000
Ag Processing & Misc Manufacturing	117,300
Retail Trade	202,000
Finance, Insurance, Real Estate	159,800
Business & Personal Service	49,100
Professional & Social Services	23,900
Households	- -
Government	24,500
Coal Mining	319,200
Coal Conversion	941,200
Petroleum Exploration/Extraction	815,700
Petroleum Refining	891,500

Source: Coon and Leistritz (2008).

**Table 2. Tax Rates Used by MEDAM08 to Estimate Tax Revenues Associated with Input-Output Algorithm**

Tax	Base	Rate
Sales & Use	retail trade sector	4.63%
Personal Income	household sector	1.50%
Corporate Income	all business sectors	0.31%

Sources: Coon and Leistritz (2002); Office of the Tax Commissioner (1995-2000); Strombeck (2002); Coon and Leistritz (2008); Office of the Tax Commissioner (2001-2006; Office of the State Tax Commissioner (2007b).

## Fiscal Module

The fiscal module consists of revenues and expenses for the state government, for the county government, for the city government, and for the school district. Summary tables present the new rates for state government (Table 3), county government (Table 4), city government (Table 5), and school districts (Table 6). These values were updated from MEDAM02 version which used 2000 or 2001 data for all items. Data for all items were updated using the most current information available. The most recent data for many categories was still from census reports. These items could not be changed because the necessary census data reports have not been updated since 2002.

**Table 3. MEDAM08 Default State Government Rates for Revenues, Expenses, and Capital Investments**

Item	Rate
State Government Revenues:	
Sales and Use Tax	4.63% x Retail Sales
State Personal Income Tax	1.50% x Personal Income
State Corporate Income Tax	0.31% x All Business Sectors
Highway Taxes	\$383.18 per Capita
Cigarette & Tobacco Taxes	\$36.89 per Capita
Liquor & Beer Tax	\$9.70 per Capita
State Government Expenses:	
Educational Transfer to School District (K-8)	\$2,990.07 per Student
Educational Transfer to School District (9-12)	\$3,182.93 per Student
Highway System Operating Expenditures	\$88.38 per capita
General Government Operations	\$389.69 per Capita
Highway Fund Transfers	\$80.83 per Capita
Cigarette & Tobacco Transfers	\$2.21 per Capita
Personal Property Tax Replacement Trans. (County)	3% Incr. Property Tax Rev. (County)
Personal Property Tax Replacement Trans. (City)	4% x Incr. Property Tax Rev. (City)
State Government Capital Investment:	
Highway System	\$536.74 per Capita

**Table 4. MEDAM08 Default County Government Rates for Revenues, Expenses, and Capital Investments**

Item	Rate
County Government Revenues:	
Local Property Tax	1.99% x Market Value of Property
Highway Fund Transfers	\$53.45 Per Capita
Personal Property Replacement Transfer	3% x Increased Property Tax Revenue
County Government Expenses:	
General Government	\$65.79 per Capita
Law Enforcement	\$27.72 per Capita
Education	\$14.12 per Capita
Emergency	\$3.54 per Capita
Health & Human Services	\$39.65 per Capita
Environment	\$4.97 per Capita
Highway and Roads	\$91.01 per Capita
Miscellaneous	\$3.17 per Capita
County Government Capital Investment:	
Roads	\$190.93 per Capita

**Table 5. MEDAM08 Default City Government Rates for Revenues, Expenses, and Capital Investments**

Item	Rate
City Government Revenues:	
Local Property Tax	1.99% x Market Value of Property
Highway Fund Transfers	\$27.38 per Capita
Cigarette & Tobacco Transfers	\$3.71 per Capita
User Fees (Water, Sewer, Solid Waste)	\$337.56 per Capita
Special Assessments	\$76.06 per Capita
Personal Property & Tax Replacement	4% x Increased Property Tax Revenue
City Government Expenses:	
General Government	\$92.51 per Capita
Public Safety	\$125.62 per Capita
Public Works	\$264.05 per Capita
Health & Welfare	\$16.09 per Capita
Culture & Recreation	\$20.36 per Capita
Miscellaneous	\$18.66 per Capita
City Government Capital Investment:	
Roads	\$236.13 per Capita



**Table 6. MEDAM08 Default County Government Rates for Revenues, Expenses, and Capital Investments**

Item	Rate
School District Revenues:	
Local Property Tax	1.99% x Market Value of Property
Educational Transfers from State (K-8)	\$2,990.07 per Student
Educational Transfers from State (9-12)	\$3,182.93 per Student
School District Expenses:	
School Operating Expenditures	\$5,924.96 per Student
School District Capital Investment:	
School Facilities (K-8)	\$14,437.50 per Student
School Facilities (9-12)	\$23,375.00 per Student

State Government Revenues:

1. Sales and Use Tax - Revenue is estimated by applying 4.63 percent sales and use tax estimates to the retail trade sector gross business volume.  
Sources: Coon and Leistritz (2008); Office of the Tax Commissioner (2001-2006)
2. State Personal Income Tax - Personal income tax estimator is (1.5 percent) applied to the gross business volume of the household sector.  
Sources: Coon and Leistritz (2008); Office of the Tax Commissioner (2007b).
3. State Corporate Income Tax - the corporate income tax estimator of 0.31 percent is applied to the gross business volume of all business sectors.  
Sources: Coon and Leistritz (2008); Office of the Tax Commissioner (2007b).
4. Highway Taxes - Highway taxes included revenues from motor vehicle excise and use tax, motor vehicle fuel and special fuel tax, and motor vehicle license fees. Highway tax revenues were estimated to be \$383.18 per capita.  
Sources: Schatz (2008); Olzweske (2008); Bureau of the Census (2007).
5. Cigarette and Tobacco Taxes - Cigarette and tobacco tax revenues were divided by population to obtain per capita revenue (\$36.89).  
Sources: Office of the Tax Commissioner (2007b); Bureau of the Census (2007).
6. Liquor and Beer Taxes - Liquor and beer tax revenues were divided by the state's population to determine per capita revenue (\$9.70).  
Sources: Office of the Tax Commissioner (2007b); Bureau of the Census (2007).

## County Government Revenue:

1. Local Property Tax - The local property tax estimator is 1.99 percent of the market value of the property (Office of the Tax Commissioner 2007a). State average mill rate for 2006 was 397.41. The calculation is as follows:

\$1.00	True & full value
<u>x .50</u>	Assessment factor (50%)
.50	
<u>x .10</u>	State average assessment ration (10%)
.05	Taxable Value
<u>x .39741</u>	State average mill rate
.019870	Property tax
<u>x 100</u>	To convert to percent
1.99%	Property Tax Rate

Estimated housing costs for the three types (homes, apartments, and manufactured homes) used in the model are as follows:

Homes	\$156,800
Apartments	\$ 46,000
Manufactured homes*	\$ 45,000

\*Mobile homes prefer to be known as manufactured homes. Housing costs for manufactured homes was obtained from a survey of local manufactures.

Sources: Multiple Listing Service (2007), Ericksmoen (2007); Van Redan Homes (2004).

Disbursement of property tax revenues to counties (24 percent), cities (25 percent), and school districts (51 percent) is based on 2005 data from the Office of the Tax Commissioner (2005).

2. Highway Fund Transfers - County revenue from highway fund transfers were calculated per capita. Data to update the 2002 per capita highway fund transfers (\$53.45) were not available.  
Sources: Bureau of the Census (2002b); Bureau of the Census (2002a).
3. Personal Property Replacement Transfer - 3% x increased property tax revenue.

### City Government Revenues:

1. Local Property Tax - 1.99 percent of market value of property
2. Highway Fund Transfers - \$27.38 per capita; Bureau of the Census (2000b)
3. Cigarette and Tobacco Transfers - \$3.71 per capita; Office of the Tax Commissioner (2005).
4. User Fees (Water, Sewer, Solid Waste) - \$337.56 per capita; Bureau of the Census (2000b).
5. Special Assessments - \$76.06 per capita; Bureau of the Census (2000b).
6. Personal Property Replacement Transfer - 4% x increased property tax revenue.

### School District Revenues:

1. Local Property Tax - 1.99 percent of market value of property
2. Educational Transfers from State (K-8) - \$2,990.07 per student
3. Educational Transfers from State (9-12) - \$3,182.93 per student

Educational transfers were based on 2006-2007 school year base payment per student of \$2,879.00. A weighting factor is used to determine the payment per student for different categories. The K-8 and 9-12 categories were averaged to determine an average school district revenue. The calculations were as follows:

<u>school</u>	<u>weight factor</u>	<u>payment</u>
preschool	1.1258	\$3,241.18
kindergarten	0.6710	1,931.81
elementary (<100)	1.3854	3,988.57
elementary (>100)	1.0064	2,897.43
grades 7-8	1.0043	2,891.38
	average =	\$2,990.07
high school (less than 120)	1.2864	3,703.55
high school (120 - 299)	1.0303	2,966.23
high school (300 or more)	1.0000	2,879.00
	average =	\$3,182.93

Source: Department of Public Institution (2007a)

### State Government Expenses:

1. Educational Transfer to School District (K-8)	\$2,990.07
2. Educational Transfer to School District (9-12)	3,182.93
3. Highway System Operating Expenditures	\$88.38 per Capita
4. General Government Operations	\$389.69 per Capita
5. Highway Fund Transfers	\$80.83 per Capita
6. Cigarette & Tobacco Transfers	\$2.21 per Capita
7. Personal Property Tax Replacement Transfer (County)	3% x Increased Property Tax Revenue (County)
8. Personal Property Tax Replacement Transfer (City)	4% x Increased Property Tax Revenue (City)

Several sources provided data used to calculate state government expenses. Education transfers to school districts were per student, and other expenses on a per capita basis.

Sources: Department of Public Instruction (2007a); North Dakota Department of Transportation (2008); Bureau of Census (2001b); Bureau of the Census (2002b); Bureau of the Census (2000b); Bureau of the Census (2001a); Office of Tax Commissioner (2005); Bureau of the Census (2002a); Bureau of Census (2007).

### County Government Expenses:

1. General Government	\$65.79 per Capita
2. Law Enforcement	\$27.72 per Capita
3. Education	\$14.12 per Capita
4. Emergency	\$3.54 per Capita
5. Health & Human Services	\$39.65 per Capita
6. Environment	\$4.97 per Capita
7. Highway & Roads	\$91.01 per Capita
8. Miscellaneous	\$3.17 per Capita

Census Data provided expenditures for all categories of county government expenses. All county government expenses were calculated per capita.

Sources: Bureau of the Census (2002b); Bureau of Census (2002a).

### City Government Expenses:

1. General Government	\$92.51 per Capita
2. Public Safety	\$125.62 per Capita
3. Public Works	\$264.05 per Capita
4. Health & Welfare	\$16.09 per Capita
5. Culture & Recreation	\$20.36 per Capita
6. Miscellaneous	\$18.66 per Capita

All city government expenses were based on Census data for local government finances, and were calculated on a per capita basis.

City per capita expenses were calculated using urban population as a proxy for city population.

Data were not available to update the 2002 expenses to 2008 levels.

Sources: Bureau of the Census (2000b); Bureau of Census (2002).

School District Expenses:

1. School Operating Expenses \$5,924.26 per Student

Source: Department of Public Instruction (2007b).

State Government Capital Investment:

1. Highway System \$536.74 per Capita

Sources: North Dakota Department of Transportation (2008); Bureau of the Census (2007).

County Government Capital Investment:

1. Roads \$190.93 per Capita

Sources: Bureau of the Census (2001b); Bureau of the Census (2000a).

City Government Capital Investment

1. Streets \$236.13 per Capita

Sources: Bureau of the Census (2000c); Bureau of the Census (2000a).

School District Capital Investment:

1. School Facilities (K-8) \$14,437.50 per student

2. School Facilities (9-12) \$23,375.00 per student

Expansion costs of school facilities were estimated to be \$137.50 per square foot for 2007. Per pupil required space was 105 square feet per elementary student and 170 square feet for secondary student.

Construction cost per student was calculated as follows:

Elementary:  $105 \text{ square ft/student} \times \$137.50/\text{sq ft} = \$14,437.50$

Secondary:  $170 \text{ square ft/student} \times \$137.50/\text{sq ft} = \$23,375.00$

Sources: Department of Public Instruction (2007c); Shultz (2008).

## Services Module

The services module contains a set of default per capita service requirements that are used to estimate additional service needs likely to be associated with a project. Service areas for which needs are estimated include housing, schools, medical services, social services, law enforcement, fire protection, roads, water and sewer, and solid waste disposal. Default values for the initial model were drawn from national standards believed to be applicable to rural areas, or state standards for North Dakota when available. Service requirements estimated by MEDAM are only for the impact population (i.e., additional or in-migrating population associated with a specific project).

Default housing requirements by worker type used in MEDAM are presented in Table 7. These values are based on data from previous economic impact analyses (Coon et al 1993) and are to be used as a guideline. These values can be changed when running an analysis, and the user is encouraged to do so if they have better information regarding a specific project.

Public service parameters built into the MEDAM model are presented in Table 8. These coefficients have not been updated since the original 1993 version of the model was developed. The default value and source for each item is as follows:

Physicians - The persons per physician was set at 2,500 per capita (Garland 2008). This value is based on federal standards for areas with physician shortages. Currently, 80 percent of North Dakota counties are in this category. In 2006, North Dakota reportedly had 1,747 physicians (1 per 364 persons), but a large majority of these were concentrated in a couple urban counties (Kaiser Family Foundation, 2008a). The ratio of one physician per 2,500 persons was used in MEDAM08 because it represents a threshold number to add a physician for the large portion of North Dakota, and is more in line with the value used in the previous version of the model.

Hospital Beds -The number of hospital beds per 1,000 people in North Dakota was 5.5 in 2005 (Kaiser Family Foundation 2008b). This translates into 1 bed per 182 people in North Dakota.

**Table 7. MEDAM08 Default Housing Types for Construction, Operational, and Secondary Workers**

Type of Housing	Type of Worker		
	Construction	Operational	Secondary
	-----percent-----		
House	15	60	40
Apartment	10	20	33
Mobile Home	60	15	25
Other	<u>15</u>	<u>5</u>	<u>2</u>
	100	100	100

**Table 8. MEDAM08 Default Values for Public Service Requirements**

Category		Number Required	Population Base	Decimal Equivalent
Medical:	Physicians/Population	1	2,500	.0004
	Hospital Beds/Population	1	182	.0055
Social Services:	Workers/Population	1	1,000	.001
Law Enforcement:	Law Officers/Population	1	539	.00186
	Total Workers/Population	1	394	.00194
Crimes:	Total Population	1	51	.0197
	By Males/Population	1	69	.0146
	By Females/Population	1	194	.0051
	Percent Violent		--	.060
	Percent Property		--	.940
Fire:	Fire Fighters/Population	1	2,083	.00048
	Trucks/Population	1	10,000	.00010
	Pumpers/Population	1	10,000	.00010
Roads:	Highways (miles/person)	.0133	1	.0133
	County/Township (miles/person)	.1188	1	.1188
	City Streets (miles/person)	.0061	1	.0061
Water:	Daily Consumption (gallons/person)	190	1	--
Solid Waste:	Daily Total (pounds/person)	4.6	1	--

Social Services - The national average of 1 licensed social worker per 1,000 people was used for North Dakota (Center for Health Workforce Studies 2006).

Law Officers/Total Workers - The actual number of law enforcement officers and total law enforcement workforce numbers were available for North Dakota for 2006 (Stenhjem 2007). These workers were divided by estimated 2006 population (Bureau of Census 2007) to obtain one law officer per 539 people, and one total law enforcement worker per 394 people.

Crimes - North Dakota crime data (Stenehjem 2007) provided crimes per total population (Bureau of Census 2007) (one crime per 51 persons), one crime by a male per 69 people, one crime by a female per 194 people, with 6 percent violent crime, and 94 percent property crime.

Fire - Full-time fire fighters in North Dakota was 304 in 2006 (Bureau of the Census 2008) Dividing fire fighters by 2006 population (Bureau of Census 2007) resulted in a ratio of 2,083 people per fire fighter. The one fire truck and one pumper per 10,000 population determined by the Denver Research Institute (1979), and used in the 1993

version of MEDAM, will also be used for this update. Data to update this parameter were not available at this time for a rural region like North Dakota.

Roads - The number of highways, county/township roads, and city streets were available for North Dakota in 2006 (North Dakota Department of Transportation 2006). These values were divided by 2006 population (Bureau of Census 2007) to obtain .0133 highway miles per person, .1188 county/township miles per person, and .0061 city streets per capita.

Water - Daily consumption of water per person was unchanged at 190 gallons per person per day. Current water use in North Dakota for consumption use (North Dakota State Water Commission 2005) remains nearly the same as the usage incorporated in the 1993 version of MEDAM.

Solid Waste - The national average solid waste generation was a rate of 4.6 pounds per person per day in 2006 (Environmental Protection Agency 2007).



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