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An Analysis of the Economic Impact on Utah County, Utah from the Development of Wind Power Plants

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INTRODUCTION

In the face of rising natural gas prices and dwindling economically recoverable coal reserves in Utah, wind power development has been proposed as an alternative to diversify Utah's sources of electricity generation. Wind power is commonly touted as a "win-win" for the environment and local communities, generating virtually emission-free electricity and spurring economic opportunities in the construction and operation of wind parks, particularly in agricultural communities. The feasibility of developing wind for electricity, however, is contingent on a number of issues, including sufficient wind resources, transmission access, siting approval, avian issues, aesthetics, and local community support.

The purpose of this report is to provide information for decision-makers by quantifying the likely economic impact of wind development on Utah County in the state of Utah using an input-output economic model developed by the National Renewable Energy Laboratory (NREL) called the "Jobs and Economic Development Impact Model," hereafter referred to as the JEDI Model (Goldberg, Sinclair, and Milligan 2004). Using basic information about a wind project (e.g., size of facility, etc.) and county-level multipliers and personal expenditure patterns, JEDI calculates the project cost (i.e., specific expenditures) as well as the number of jobs, income (i.e., wages and salary), and total related economic activity that a wind project will stimulate (Goldberg, Sinclair, and Milligan 2004). The economic analysis for Utah County was conducted for five wind project size scenarios by their capacity in megawatts (MW): (1) 5 MW, (2) 10 MW, (3) 14.7[1] MW, (4) 20 MW, and (5) 25 MW. This analysis may interest city, county, and state government officials; wind developers; renewable energy advocates; and other interested stakeholders contemplating decisions about Utah's energy and economic future.

Report Overview

This report is organized into three sections. Part I provides a brief description of recent wind power industry trends vis-à-vis other fossil fuel sources for electricity and how these issues affect the state of Utah's energy market. Part II describes our evaluation methods and results, and Part III reports the economic impacts for Utah County based on the construction and operation of commercial wind parks of different sizes. The Appendices contain background on the mechanics of the JEDI Model as a projection tool.

[1] A 14.7-MW capacity project is reported in this analysis rather than a hypothetical 15-MW project because the city council in the city of Spanish Fork in Utah County has already approved a project of this size in June 2005 (*Deseret Morning News* 2005).

PART I: WIND POWER TRENDS

Wind Power Trends—Industry Wide

Wind power is the world's fastest-growing energy source, averaging about 15.8 percent growth annually over the past five years (Halperin 2005). Wind, nevertheless, generates less than one percent of the world's energy. In the face of escalating, volatile fossil fuel prices, global demand for wind power (and other alternative fuels) is expected to increase significantly in the coming years (Smith 2005).

Natural gas prices in the United States, for example, doubled during 2005, exerting significant pressure on electricity prices given that about 20 percent of the nation's electricity supply comes from natural gas. In some states, such as Colorado and parts of Texas, it is now cheaper for users to sign up for "green" energy programs that provide electricity from wind turbines than it is to buy "standard" electricity from gas- or coal-fired generation units (Smith 2005). Because wind power's cost is derived primarily during the construction phase with comparatively minimal operating costs and is not subject to volatile fuel costs, wind power's cost stability and predictability make it an attractive alternative to natural gas. In short, wind power's cost-competitiveness and stability are making it increasingly attractive to U.S. utilities and electricity users, and 22 states, including Colorado, Montana, Arizona, and Texas, have implemented renewable portfolio standards mandating that a certain percentage of state energy supplies must come from non-fossil-fuel sources (Baird 2005).

Wind Power Trends—Utah State

To date, Utah wind sites have not been developed for commercial electricity generation. A wind resource map, which was developed by TrueWind Solutions for The U.S. Department of Energy (DOE) and validated with available surface data by the NREL and wind energy meteorological consultants, was published in September 2003 (DOE 2003). It reported that Utah had wind resources to generate approximately 5,000 MW of electricity capacity[2] (Mims 2003). Local wind developers, utility representatives, and wind advocates in Utah whom we interviewed during the fall of 2005 conservatively estimate Utah's wind potential to be about 700 to 1000 MW of capacity. However, other wind developers and advocates have estimated Utah's wind potential could be as high as 2000 MW of capacity.

[2] The term "capacity" refers to the electricity output of a power generation facility if it operated at maximum output 100% of the time. The actual amount of power produced over time divided by total capacity is called the "capacity factor." Because of wind's varying speed and intermittency, the capacity factor for most wind parks ranges from 25% to 40% (AWEA Wind Web Tutorial 2004).

Currently, about 95 percent of the state's electricity is generated from coal (Utah Geological Survey 2005). A recent report by the Utah Geological Survey noted that Utah has an estimated economically recoverable coal reserve of about 319 million tons to last an estimated 12 to 15 years (Anderton 2005). Although the state has another 9 billion tons of coal reserves, they are located in areas with land use restrictions, prohibiting recovery (Anderton 2005). In the face of increasing risk from dwindling accessible coal reserves and rising, unpredictable natural gas prices, Utah must diversify its portfolio of electricity sources; the development of wind power plants can contribute significantly to the diversification of Utah's energy portfolio.

Although Utah wind resources have not been commercially developed, some Utah energy consumers are already buying wind power imported from other states. The state's largest electricity utility provider, Utah Power, offers a voluntary program called "Blue Sky," in which customers can buy 100-kilowatt-hour blocks of wind power generated outside of the state for a premium of $1.95 each over the standard electricity rate. As of February 2006, Utah Power reported that more than 16,727 residential and business customers in Utah (approximately 2 percent of Utah Power's customers in the state) participated in the Blue Sky program (Utah Power Press 2006).

Salt Lake City is the largest Blue Sky partner, currently buying 1,350 Blue Sky blocks per month.[3] In November 2004, the U.S. Environmental Protection Agency (EPA) recognized Utah's Greater Moab Area as the nation's first Green Power Community – the first city in America to meet and exceed the EPA Green Power Partnership's minimum benchmark for green power usage with voluntary purchases; Moab achieved that status by buying Blue Sky wind energy from Utah Power (Utah Power Press 2005). Blue Sky ranks second nationally in voluntary participation.

Utah Power's parent company, PacifiCorp, has called for adding 1,400 MW of wind and other renewable energy sources to its portfolio of electricity generating resources across its multistate service market in its 2004 Integrated Resource Plan (IRP). Wind and other renewable sources (e.g., geothermal) are necessary, in part, to mitigate volatile fuel cost risks and other risks associated with future environmental regulations such as a "carbon adder" or tax that could be imposed on fossil-fuel-burning power plants. Consequently, there have been increasing calls for Utah to develop its own wind resources to meet local Blue Sky demand for wind power and capitalize on the development opportunities of PacifiCorp's IRP (Baird 2005).

In Utah County, a map published by the Utah Energy Office prior to the DOE wind resource map (derived from estimates from wind developers based on potential wind resources, siting feasibility, and transmission access) suggested that about 10 to 20 MW of wind could be harvested economically. In June 2005, the city council of Spanish Fork (a city in Utah County) approved a change in zoning in the Spanish Fork Canyon to allow

[3] Lisa Romney, Environmental Advisor to the Mayor, Salt Lake City, Utah, via personal communication, April 10, 2006.

seven 2.1-MW wind turbines (14.7 MW of total capacity) in what ultimately could become the state of Utah's first commercial wind generating facility (*Deseret Morning News* 2005).[4] In early 2006, however, some local residents called for the Spanish Fork city council to consider a moratorium on the project because of concerns over the visual impact, noise, proximity to homes, and financial benefit to the community (Conlon 2006). This report attempts to address this latter issue by quantifying the potential economic opportunities created by wind development, including projections for the 14.7-MW project in Spanish Fork Canyon, for Utah County.

[4] The total capacity for the Spanish Fork Wind Park eventually may reach 18.9 MW. For our analysis, we used the total capacity approved by the city council in June 2005 of 14.7 MW.

PART II: THE ECONOMIC EVALUATION USING JEDI

For this evaluation, economic and demographic data were obtained in the fall of 2005 from three sources: (1) the Economic Development Corporation of Utah (EDCU)[5]; (2) IMPLAN multipliers for Utah County supplied by NREL (details discussed below); and 3) two local wind developers (who will remain anonymous for proprietary reasons).

General Overview of the JEDI Model

JEDI is an easy-to-use model to analyze the economic impacts of constructing and operating wind power plants (Goldberg, Sinclair, and Milligan 2004). Users enter basic information about a wind project (i.e., state, construction year, and facility size) to determine project cost (i.e., specific expenditures) and the income (i.e., wages and salary), economic activity, and number of jobs that will accrue to the state or local region from the project. The more project-specific the data, the more localized the analysis.

Although JEDI contains default data for virtually every input field, not every project follows this exact "default" pattern for expenditures. Project size, location, financing arrangements, and numerous site-specific factors influence the construction and operating costs. Similarly, the availability of local resources, including labor and materials, and the availability of locally manufactured power plant components can have a significant effect on the costs and the economic benefits that accrue to the state or local region.

Project-specific data include costs associated with actual construction of the facility and supporting roads as well as costs for equipment, annual operating and maintenance costs, and expenditures spent locally, financing terms, and tax rates. Specifically, the model requires the following project inputs:

- Construction Costs (materials and labor)
- Equipment Costs (turbines, rotors, towers, etc.)
- Other Costs (utility interconnection, engineering, land easements, permitting, etc.)
- Annual Operating and Maintenance Costs (personnel, materials, and services)
- Other Parameters (financial: debt and equity, taxes, and land lease).

The model provides reasonable default values for each of the above inputs and all of those necessary for the analysis. As incorporated in the model, these values represent average costs and spending patterns derived from a number of sources (project-specific data contained in reports and studies) and research and analysis of renewable resources undertaken by the model developer during the past 10 years. The model contains default data for each of the 50 states.

[5] The Economic Development Corporation of Utah is a private nonprofit group that is funded by cities, counties, and organizations interested in economic development to recruit companies from out of the state to relocate or expand into Utah.

Our Evaluation Method

To use JEDI to estimate the economic development benefits of a county or region, we had to develop specific multipliers for the local area to enter into the model; we also had to adjust the other input parameters, such as local share of spending, to accurately reflect the region or county.

The wind park construction and operation input data used for the analysis came from two local wind developers, who will remain anonymous. Because these developers sometimes organized their costs differently than the categories specified in the JEDI Model, some input data required the use of estimates and reasonable reallocation of costs. For example, in "equipment costs," developers provided information about their total costs, but the JEDI Model requires equipment costs to be separated into the cost of turbines, blades, and towers. Estimates for reallocating cost data to fit the parameters of the JEDI Model were derived from discussions with the developers and/or Marshall Goldberg (the architect of the JEDI Model) or based on the ratios noted in the model's default values for the state of Utah. Because many of the developers' expenditures were to be spent outside the county, the estimated reallocation of costs in most instances was inconsequential for determining local economic impacts.

Year of Construction: 2005 was selected for the year of analysis.

Project Location: The JEDI Model allows an analyst to use either state-level IMPLAN data (as a default) or to incorporate regional- or county-level IMPLAN (or other) multiplier data to determine localized economic impacts. IMPLAN data for Utah County was used for this analysis.

Project Size: Five wind project size scenarios were selected for analysis: 5 MW, 10 MW, 14.7 MW, 20 MW, and 25 MW. These scenarios were deemed appropriate given a Utah Energy Office wind resource map (undated) that reported approximately 10 to 20 MW of wind power was potentially harvestable with existing technology and the county's infrastructure. As a result, a 14.7-MW project was approved for the Spanish Fork Canyon in Utah County. A scenario of 25 MW was also included to show the economic effects if another increment of wind resources could be harvested given rapidly improving wind technology and reported interest from other parties in Utah County. For example, in 2004, the Nebo School District in Utah County tentatively approved a plan to develop wind on school property to generate electricity (Warnock 2004). Although no further plans for the development have been reported, it justified our projecting potential economic impacts of additional wind projects beyond the current Spanish Fork Canyon project.

Turbine Size: For computational purposes, a 2.1-MW turbine size was used to be consistent with the turbine sizes proposed for the Spanish Fork Canyon project.

Project Construction Costs: Construction costs were compiled and aggregated from data provided by two local wind developers who will remain anonymous.

Annual Operations and Maintenance Costs: As with construction costs, operations and maintenance costs were compiled and aggregated from data provided by two local wind developers who will remain anonymous.

Current Dollar Year: 2005 was selected as the year of analysis.

Other Parameters: In addition to the above input parameters, the JEDI Model allows users to input *Local Taxation Parameters*, *Local Ownership Percentages*, *Land Lease Easement Payments*, and *County Multipliers*, among other inputs.

JEDI Evaluation Results

The results of the JEDI evaluation are presented in a series of tables below. Table 1, Project Scenario Summary, provides a summary of the five wind development scenarios that were analyzed. The 14.7-MW scenario reflects the project proposed for Spanish Fork.

Based on 2005 dollar values, the total construction cost for the Spanish Fork project is approximately $17.3 million, of which about $2.8 million will be spent in Utah County. Direct annual operating and maintenance costs for the 14.7-MW project are projected to total about $170,000, of which about $105,000 will be spent in Utah County**.** Annual property taxes for the project are projected to be about $24,000, and leases paid to landowners will total $52,500.

Table 1: Project Scenario Summary

Project Size (MW)	**5.0**	**10.0**	**14.7**	**20.0**	**25.0**
Year of Construction	2005	2005	2005	2005	2005
Project Location	Utah County	Utah County	Utah County	Utah County	Utah County
Turbine Size (KW)	2100	2100	2100	2100	2100
Construction Cost ($/KW)	$1,177	$1,177	$1,177	$1,177	$1,177
Annual Direct O&M Cost ($/KW)	$11.45	$11.45	$11.45	$11.45	$11.45
Money Value (Dollar Year)	2005	2005	2005	2005	2005
Project Construction Cost	$5,885,000	$11,770,000	$17,301,900	$23,540,000	$29,425,000
Local Spending	$942,127	$1,884,254	$2,769,854	$3,768,508	$4,710,635
Total Annual Operation Expenses	$973,040	$1,938,580	$2,847,088	$3,877,160	$4,842,700
Direct Operating and Maintenance Costs	$57,250	$114,500	$168,315	$229,000	$286,250
Local Spending	$35,798	$71,597	$105,247	$143,193	$178,992
Other Annual Costs	$915,790	$1,824,080	$2,678,773	$3,648,160	$4,556,450
Local Spending	$30,686	$53,872	$76,567	$107,744	$130,930
Property Taxes	$8,186	$16,372	$24,067	$32,744	$40,930
Land Lease	$22,500	$37,500	$52,500	$75,000	$90,000

Table 2 details projected construction costs with the percentages (in the extreme right column) of how much of those costs will be spent locally in Utah County based on our interviews with wind developers and labor statistics and local industry profiles provided by EDCU. For example, because of the presence of the construction industry in Utah County, most of the project construction costs will be spent locally. Finally, because ownership information and financial arrangements can vary widely for wind development, we did not assume any local ownership in our economic projections. However, if local ownership does occur, it will increase total economic benefit for Utah County.

Table 2: Construction Costs

Project Size	**5.0**	**10.0**	**14.7**	**20.0**	**25.0**	**Local Share**
Construction Costs						
Materials						
Construction (concrete rebar, equip, roads and site prep)	$172,392	$344,783	$506,831	$689,566	$861,958	90%
Transformer	$91,636	$183,272	$269,410	$366,545	$458,181	0%
Electrical (drop cable, wire,)	$73,205	$146,409	$215,221	$292,818	$366,023	100%
HV line extension	$70,509	$141,019	$207,298	$282,038	$352,547	100%
Materials Subtotal	$407,742	$815,483	$1,198,760	$1,630,967	$2,038,708	0%
Labor						
Foundation	$19,041	$38,083	$55,981	$76,165	$95,206	100%
Erection	$28,204	$56,408	$82,919	$112,815	$141,019	75%
Electrical	$103,299	$206,598	$303,699	$413,196	$516,495	75%
Management/supervision	$25,502	$51,003	$74,975	$102,007	$127,509	0%
Labor Subtotal	$176,046	$352,091	$517,574	$704,183	$880,228	0%
Construction Subtotal	$583,787	$1,167,575	$1,716,335	$2,335,149	$2,918,937	0%
Equipment Costs						0%
Turbines	$3,093,353	$6,186,706	$9,094,458	$12,373,412	$15,466,765	0%
Blades	$1,030,800	$2,061,599	$3,030,551	$4,123,198	$5,153,998	0%
Towers	$648,067	$1,296,135	$1,905,318	$2,592,270	$3,240,337	0%
Equipment Subtotal	$4,772,220	$9,544,440	$14,030,327	$19,088,880	$23,861,100	0%
Other Costs						0%
HV Sub/Interconnection	$518,161	$1,036,322	$1,523,393	$2,072,643	$2,590,804	100%
Engineering	$3,400	$6,800	$9,997	$13,601	$17,001	0%
Legal Services	$5,732	$11,463	$16,851	$22,926	$28,658	100%
Site Certificate	$1,700	$3,400	$4,998	$6,800	$8,501	100%
Other Subtotal	$528,993	$1,057,985	$1,555,238	$2,115,971	$2,644,963	0%
Total Project Costs	$5,885,000	$11,770,000	$17,301,900	$23,540,000	$29,425,000	0%

Table 3 overviews projected operating and maintenance costs for the different scenarios. Based on 2005 dollar values, the 14.7-MW Spanish Fork Project is expected to generate approximately $134,000 in annual salaries and benefits for field workers, administrators, and managers affiliated with the wind park's operations. All personnel are assumed to be hired locally.

Table 3: Operating and Maintenance Costs

Project Size (MW)	5.0	10.0	14.7	20.0	25.0	Local Share
Personnel						
Field Salaries	$22,199	$44,398	$65,265	$88,796	$110,995	100%
Adminstrative	$5,842	$11,684	$17,175	$23,367	$29,209	100%
Management	$17,526	$35,051	$51,525	$70,102	$87,628	100%
Personnel Subtotal	$45,566	$91,133	$133,965	$182,265	$227,832	0%
Materials and Services						
Vehicles	$818	$1,636	$2,405	$3,271	$4,089	100%
Misc. Services	$2,337	$4,673	$6,870	$9,347	$11,684	80%
Fees, Permits, Licenses	$818	$1,636	$2,405	$3,271	$4,089	100%
Misc. Materials	$2,337	$4,673	$6,870	$9,347	$11,684	100%
Insurance	$3,505	$7,010	$10,305	$14,020	$17,526	0%
Fuel (gasoline)	$584	$1,168	$1,718	$2,337	$2,921	100%
Tools and Misc. Supplies	$935	$1,869	$2,748	$3,739	$4,673	100%
Spare Parts Inventory	$351	$701	$1,031	$1,402	$1,753	2%
Materials and Services Subtotal	$11,684	$23,367	$34,350	$46,735	$58,418	0%
Debt Payment (average annual)	$682,660	$1,365,320	$2,007,020	$2,730,640	$3,413,300	0%
Equity Payment - Corporate	$202,444	$404,888	$595,185	$809,776	$1,012,220	0%
Property Taxes	$8,186	$16,372	$24,067	$32,744	$40,930	100%
Land Lease	$22,500	$37,500	$52,500	$75,000	$90,000	100%
Total Annual Operating and Maintenance Costs	$973,040	$1,938,580	$2,847,088	$3,877,160	$4,842,700	0%
Financial Parameters						
Debt Financing						
Percentage financed	80%	80%	80%	80%	80%	0%
Years financed (term)	10	10	10	10	10	
Interest rate	10%	10%	10%	10%	10%	
Equity Financing						
Percentage equity	20%	20%	20%	20%	20%	
Individual Investors (percent of total equity)	0%	0%	0%	0%	0%	100%
Corporate Investors (percent of total equity)	100%	100%	100%	100%	100%	0%
Return on equity (annual interest rate)	16%	16%	16%	16%	16%	
Repayment term (years)	10	10	10	10	10	
Tax Parameters						
Local Property/Other Tax Rate (percent of taxable value)	0.1391%	0.1391%	0.1391%	0.1391%	0.1391%	
Assessed value (percent of construction cost)	100%	100%	100%	100%	100%	
Taxable Value (percent of assessed value)	100%	100%	100%	100%	100%	
Taxable Value	$5,885,000	$11,770,000	$17,301,900	$23,540,000	$29,425,000	
Local Taxes	$8,186	$16,372	$24,067	$32,744	$40,930	100%
Land Lease Parameters						
Land Lease (per turbine)	$7,500	$7,500	$7,500	$7,500	$7,500	
Land Lease (total cost)	$22,500	$37,500	$52,500	$75,000	$90,000	100%
Lease Payment recipient (F = farmer/household, O = Other)	F	F	F	F	F	
Payroll Parameters	Base Wage per I	Base Wage per I	Base Wage per I	Base Wage per I	Base Wage per Hour	
Field Salaries (technicians, other)	$13.72	$13.72	$13.72	$13.72	$13.72	
Adminstrative	$9.80	$9.80	$9.80	$9.80	$9.80	
Management	$19.40	$19.40	$19.40	$19.40	$19.40	

Table 4 provides the estimates number of full-time equivalent new jobs for Utah County for each of the five wind park scenarios. The Spanish Fork project is projected to directly create 26 local jobs during construction, 23 of which will be from the construction industry. Adding indirect and induced effects, the Spanish Fork project's construction phase should create about 46 new jobs for Utah County. Once the wind park is in operation, the Spanish Fork project should create four full-time equivalent new jobs, three of which will be related to plant workers.

Table 4: Estimated Number of Full-Time Equivalent New Jobs for Utah County

Project Size (MW)	**5.0**	**10.0**	**14.7**	**20.0**	**25.0**
During construction period					
Direct Impacts	9	18	26	35	44
Construction Sector Only	8	16	23	32	40
Indirect Impacts	4	7	11	15	18
Induced Impacts	3	6	9	13	16
Total Impacts (Direct, Indirect, Induced)	**16**	**31**	**46**	**62**	**78**
During operating years (annual)					
Direct Impacts	1	3	4	6	7
Plant Workers Only	1	2	3	4	5
Indirect Impacts	0	0	1	1	1
Induced Impacts	0	0	1	1	1
Total Impacts (Direct, Indirect, Induced)	**2**	**4**	**5**	**7**	**9**

Table 5 overviews the estimated total annual wage and salary earning in Utah County. The proposed Spanish Fork project is expected to generate more than $1.2 million in direct, indirect, and induced wage and salary earnings during the construction phase. Once in operation, the Spanish Fork project should generate about $140,000 total in direct, indirect, and induced wage and salary earnings annually.

Table 5: Estimated Total Annual Wage and Salary Earnings in Utah County

Project Size (MW)	5.0	10.0	14.7	20.0	25.0
During construction period					
Direct Impacts	$250,062	$500,125	$735,184	$1,000,251	$1,250,314
Construction Sector Only	$226,653	$453,307	$666,361	$906,614	$1,133,267
Indirect Impacts	$95,431	$190,861	$280,566	$381,723	$477,154
Induced Impacts	$77,261	$154,522	$227,148	$309,044	$386,305
Total Impacts (Direct, Indirect, Induced)	**$422,754**	**$845,508**	**$1,243,734**	**$1,691,018**	**$2,113,773**
During operating years (annual)					
Direct Impacts	$38,040	$73,613	$107,347	$147,225	$182,798
Plant Workers Only	$28,431	$56,861	$83,586	$113,722	$142,153
Indirect Impacts	$5,237	$9,785	$14,143	$19,570	$24,119
Induced Impacts	$6,093	$11,564	$16,781	$23,128	$28,599
Total Impacts (Direct, Indirect, Induced)	**$49,370**	**$94,962**	**$138,271**	**$189,923**	**$235,516**

Table 6 overviews the estimated total economic output from wind park development in Utah County. Taking into account direct, indirect, and induced impacts, the 14.7-MW Spanish Fork project is expected create about $4.2 million of economic output during construction, and once operational, an annual economic output of more than $240,000.

Table 6: Estimated Total Economic Output from Wind Park Development

Project Size (MW)	5.0	10.0	14.7	20.0	25.0
During construction period					
Direct Impacts	$940,427	$1,880,854	$2,764,855	$3,761,708	$4,702,135
Construction Sector Only	$861,491	$1,722,982	$2,532,783	$3,445,963	$4,307,454
Indirect Impacts	$251,755	$503,510	$740,160	$1,007,020	$1,258,776
Induced Impacts	$230,069	$460,137	$676,402	$920,275	$1,150,344
Total Impacts (Direct, Indirect, Induced)	**$1,422,251**	**$2,844,501**	**$4,181,417**	**$4,782,685**	**$7,111,254**
During operating years (annual)					
Direct Impacts	$57,204	$107,001	$154,699	$214,002	$263,799
Plant Workers Only	$28,431	$56,861	$83,586	$113,722	$142,153
Indirect Impacts	$14,461	$27,008	$39,031	$54,015	$66,562
Induced Impacts	$18,143	$34,435	$49,972	$68,870	$85,163
Total Impacts (Direct, Indirect, Induced)	**$89,808**	**$168,444**	**$243,702**	**$336,887**	**$415,524**

PART III: CONCLUSION

Although our discussion of our analyses has centered on the likely economic outcomes of the proposed 14.7-MW Spanish Fork project, Utah County has other promising locations for additional wind development. Further, because of the infrastructure available in Utah County to support the construction and operation of wind parks, commercial development of wind offers promising economic opportunities. Also, since the Spanish Fork project may reach 18.9 MW, our projections for 20-MW and 25-MW projects may be of interest to decision makers. Other wind developments may also be proposed in Utah County.

In 2004, for example, the Nebo School District tentatively approved a plan to situate a wind turbine on school property to generate electricity (Warnock 2004). According to the Utah Energy Office, the Nebo School District is located in the path of one of the best wind resources in the nation. The plan's intent was, in part, to be an educational demonstration about renewable energy for students but also a potential hedge against escalating energy costs facing the school district via Utah's net-metering laws, which require utilities to purchase excess energy generated by utility customers.

Utah County schools would not be the first to take advantage of such educational and economic opportunities. In 1993, for example, Iowa's Spirit Lake Community School District launched a similar initiative by erecting a small 250-kW wind turbine on school property, initially as an educational demonstration (ICLEI Energy Services 2005). The project was funded partly with a U.S. Department of Energy grant and a low interest loan approved by the Energy Council of the Iowa Department of Natural Resources (IDNR). Considered outlandish at the time, Spirit Lake's turbine has generated $20,000 to $25,000 in revenues annually since 1998 from electricity sales to the local utility via Iowa's net-metering law. A second larger 750-kW turbine was added in 2002, financed in part with a zero-interest loan from the Iowa Energy Center and a low-interest loan from IDNR. Once paid off in 2007, the two turbines are expected to offset about $120,000 in energy cost annually. The savings will be used for improvements at school facilities (ICLEI Energy Services 2005). Although some local residents opposed Nebo School District's plans to erect a wind turbine in 2004, given the impact of soaring energy prices on school budgets across the state, Nebo and other schools in prime wind locations in Utah County may consider the economic opportunities of generating their own electricity.

Despite some recent hurdles regarding the siting of the proposed Spanish Fork project, it is expected to be built and operational by spring 2007 (Twitchell 2006). Wind advocates hope it will become a model for future wind development across the state. The economic projections overviewed in this report will aid decision makers in evaluating the economic, job, and local tax revenue opportunities posed by wind power development.

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Appendix A: How the JEDI Model Works

The JEDI Model was developed by Marshall Goldberg (Goldberg, Sinclair, and Milligan 2004) to enable spreadsheet users with limited economic modeling experience to identify county-level, regional, and/or statewide economic impacts associated with constructing and operating wind power generation facilities (i.e., "wind farms" or "wind parks"). JEDI's "user add-in" feature allows researchers to conduct county-specific analyses using county IMPLAN (Impact Analysis for PLANning) multipliers, while state-level multipliers are contained within the model as default values for all 50 states. IMPLAN was developed by the U.S. Forest Service to perform regional economic analyses. Presently, the IMPLAN software and data are managed and updated by the Minnesota IMPLAN Group, Inc., using data collected at federal, state, and local levels (Minnesota IMPLAN 2003).

JEDI is an "input-output" model, an analytical tool developed to trace supply linkages in the economy (Goldberg, Sinclair, and Milligan 2004). JEDI attempts to measure spending patterns and location-specific economic structures that reflect expenditures supporting varying levels of employment, income, and output. For example, JEDI reveals how purchases of wind project materials, such as wind turbines or other materials, not only potentially benefit local turbine manufacturers but also the local fabrication metals industry, concrete rebar, drop cable, wire, etc., given that such industries exist in the county and expenditures will be made locally.

Input-output analysis is a method of evaluating and summing three economic impacts: (1) Direct effects; (2) Indirect effects; and (3) Induced effects. These are defined below with respect to wind park development.

> **Direct effects:** *Direct effects are the on-site or immediate economic impacts created by expenditures.* In the construction of wind parks, they refer to the on-site jobs of contractors and crews hired, as well as the jobs at turbine, tower, and blade factories.
>
> **Indirect effects:** *Indirect effects are the increases in economic activity that occur when a directly affected business involved in the wind project (e.g., a contractor or manufacturer) receives payment for goods and services and buys goods and services that support their business.* This could include a banker who finances the contractor or an accountant who maintains a manufacturer's books. Other indirect effects may include steel manufacturers that supply towers, legal firms that write contracts for the project developer, hardware stores that provide building supplies for construction crews, or electric-utility suppliers that procure goods, such as high-voltage transmission lines (Costanti 2004).
>
> **Induced effects:** *Induced effects are the change in wealth and income that are induced by the spending of those businesses and persons directly and indirectly*

employed by the wind project. Induced effects would include spending by those directly or indirectly employed by the project on food, clothing, retail services, public transportation, gasoline, vehicles, property and income taxes, medical services, and the like.

The sum of these three effects yields the total economic effect that result from expenditures on the construction and operation of a wind park (Goldberg, Sinclair, and Milligan 2004). In determining economic effects, the model considers 14 aggregated industries that are impacted by the construction and operation of a wind park (agriculture, construction, electrical equipment, fabricated metals, finance/insurance/real estate, government, machinery, mining, other manufacturing, other services, professional services, retail trade, transportation/communication/public utilities, and wholesale trade). Estimates are made using state- and county-level multipliers and personal expenditure patterns; these multipliers for employment, wage and salary income and output (economic activity), and personal expenditure come from IMPLAN (Minnesota IMPLAN 2003).

Appendix B: Applying the JEDI Model

The model is programmed in Microsoft Excel, and it requires four sets of inputs: (1) Project Descriptive Data, (2) Project Cost Data, (3) Annual Wind Plant Operating and Maintenance Costs, and (4) Other Parameters.

The Project Descriptive Data consists of eight parameters:

- Project location (county location)
- Year of construction
- Project size (nameplate capacity)
- Turbine size (kilowatt or kW size)
- Number of turbines
- Project construction cost (dollars per kilowatt capacity or $/kW)
- Annual operation and maintenance cost ($/kW)
- Money value – current dollar year.

The Project Cost Data consists of 16 parameters organized into three categories:

- Construction costs
- Equipment costs
- Other miscellaneous costs.

Annual Wind Plant Operating and Maintenance Costs consist of 11 parameters organized into two categories:

- Personnel
- Materials and services.

The Other Parameters section is the last section of inputs, consisting of 17 inputs organized into five categories:

- Debt financing
- Equity financing/repayment
- Tax parameters
- Land lease parameters
- Payroll parameters.

Regarding the expenditure pattern and the local share of expenditures for a particular county or region, assumptions play a significant role in determining the economic impact of a wind project. The JEDI Model provides two options: (1) default values or (2) new values entered by the analyst.

The default values represent a "reasonable expenditure pattern for constructing and operating a wind power plant in the United States and the share of expenditures spent locally … based on a review of numerous wind resource studies" (Goldberg, Sinclair, and Milligan 2004, p. 3). Not every wind project, however, will follow this exact "default" pattern for expenditures. Consequently, analysts are encouraged to incorporate project-specific data and the likely share of spending in a given county or region to reflect localized economic impacts. In our analysis, we've consulted with local wind developers to determine reasonable local spending levels for specific costs.

Appendix C: JEDI Model Outputs

The JEDI Model generates the following outputs for a given set of inputs:

- Jobs: Refers to the full-time equivalent employment for a year
- Output: The economic activity or "project value" in the state, region, or county economy
- Earnings: Refers to annual wage and/or salary compensations paid to workers involved with direct, indirect, and induced effects
- Local Spending: Refers to the actual annual dollars spent on goods and services in the area being analyzed (state, regional, or county economy where the wind park is being built)
- Annual Lease Payments: Provides an annual total of lease/easement payments to landowners
- Property Taxes: Represents the annual property taxes that the project will generate, exclusive of any property tax exemptions that may be available.

Specific model outputs for Utah County will be discussed in detail later in this report.

Appendix D: JEDI Model Limitations

As with other economic forecasting tools, JEDI has several assumptions and limitations (Costanti 2004). For example, JEDI is not intended to be a precise forecasting tool. Rather, it provides a reasonable profile of how investment in a wind park may affect a given economy. Additionally, JEDI offers a *gross analysis* rather than a *net analysis*; that is, the model does not account for the net impacts associated with alternate spending of project funds or replacement of existing electricity generation facilities that may exist within a given local economy (e.g., electricity generated by wind replacing electricity generated by an existing gas-fired generation plant). JEDI also assumes that adequate revenue exists to cover all debt and/or equity payments and annual operations and maintenance costs associated with a given project. Specific model outputs for Utah County are discussed in detail in the body of the report.