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An Analysis of State-Level Economic Impacts from the Development of Wind Power Plants in San Juan County, Utah

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Contents

Introduction

According to the American Wind Energy Association (AWEA), wind power development across the United States increased 39% in 2009, adding 9,922 megawatts (MW) of new generating capacity (enough to serve more than 2.4 million homes) and breaking all previous records of annual growth (AWEA Press Release 2010). The significant growth in wind power development is attributed in part to the Recovery Act of 2009, which extended the Investment Tax Credit (ITC) to 2012 and created new incentives for renewable energy development. Although growth in the wind industry resulted in new jobs in wind project construction and operations, lease payments to landowners, and increased tax revenues for local communities and schools, continuing policy uncertainty for wind energy resulted in decreased investments in the wind turbine manufacturing sector and a net loss of manufacturing jobs compared to 2008 (AWEA Press Release 2010). Many wind projects relied on imported wind turbine components rather than domestically produced equipment, and AWEA is calling for a national Renewable Electricity Standard to create the market pull to foster more investment in domestic wind turbine manufacturing and job creation.

In Utah, other emerging national and state policies are expected to advance wind energy's growth for the long term. Specifically, President Obama called for doubling national renewable energy production by 2012, and $34 million from the federal stimulus package is designated for clean energy projects in Utah (Henetz 2009). Additionally, former Governor Jon M. Huntsman, Jr. committed Utah to reduce the state's carbon dioxide emissions and establish the state as a renewable energy "hub" (KSL News 2009). During the 2009 legislative session, state lawmakers approved financial incentives for renewable energy businesses and projects located in designated "renewable energy development zones." The Governor's Office of Economic Development will provide these incentives for business relocation and expansion to companies that support high-paying jobs, increase the tax base, attract and retain top-level management, and diversify the state economy. Analysts anticipate the state will eventually issue about $9.6 million in economic development incentives each year and that the businesses will provide a return on this investment in the form of significant economic development for Utah. Additionally, lawmakers approved the creation of a renewable energy authority that will issue bonds for transmission to connect alternative sources of energy to the state's power grid (Vergakis 2009).

Commercial wind development has increased significantly in Utah over the past year. Utah's first commercial wind power plant, situated at the mouth of Spanish Fork Canyon in Utah County, commenced operations in June 2008. A Utah State University/U.S. Department of Energy study estimated that during construction, the relatively small 18.9-MW wind power plant generated more than $4 million in economic activities to Utah and supported 38 jobs[1] with a total payroll of $1.4 million (Reategui, Stafford, and Hartman 2009). In 2009, the wind power plant is expected to generate more than $74,000 in lease payments to Spanish Fork landowners. It will also generate more than $112,000 in local property taxes for Utah County, of which

[1] The figure includes direct, indirect, and induced jobs.

approximately $84,000 will support the Nebo School District (these tax revenue amounts represent a 70% reduction for the first 10 years of operation, offered by the city of Spanish Fork as an incentive to procure the project). A second 203.5-MW wind project, the Milford Wind Corridor Project, is now online in southern Utah. Developer First Wind plans to expand the Milford Wind Corridor Project to incorporate 1,000 MW of capacity over the next few years (www.firstwind.com/projects/#ut 2009), and other developers have proposed additional wind projects across the state.

Aside from federal and state policies, momentum for wind power development in Utah is driven by several additional factors, including the desire to bolster rural economies, stabilize energy costs[2], mitigate fossil fuels' environmental impacts (e.g., air and water quality, water usage, climate change), and meet renewable energy policy standards (Reategui, Stafford, and Hartman 2009). Wind developers are seizing some of Utah's best wind resources, for example, to export clean energy to California, which has a state policy to derive 20% of electricity from renewable resources by 2010 (Anderton 2006). California lawmakers are currently working on legislation to expand its renewable energy target to 33% by 2020 (http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/33implementation.htm 2010). The Milford Wind Corridor Project exports its electricity output to southern California markets. In short, federal and state policies, investments, and incentives are expected to foster wind power development in Utah. Consequently, state, county, and city policy makers are interested in understanding the economic potential of wind power development in the state and their communities. This report addresses this issue for San Juan County.

The economic analysis in this report focuses on a Monticello site in San Juan County that has been identified as a potential site for wind power development by the Utah State Energy Program's anemometer loan program (details to be discussed later in this report). This analysis draws on information from local wind developers and utilizes the Jobs and Economic Development Impact (JEDI) model (version W1.09.03) developed by the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) to estimate the total economic impacts (labor, supply chain, and induced) that could result from the development of a wind power plant in San Juan County. Findings detail how the Monticello wind power plant could benefit the state in terms of job opportunities (during both construction and operations), lease payments to landowners, property tax revenues for local schools and communities, and overall economic output for the state.

Report Overview

This report is comprised of three sections. Part I briefly discusses wind development trends in the United States and Utah, including how U.S. rural communities are benefiting economically from wind power development. Part II includes the JEDI analysis for two potential wind projects at

[2] Wind power is price stable, and it reduces demand for other price-volatile fossil fuels, such as natural gas; additionally, wind energy is not subject to carbon taxes or carbon restriction costs.

the Monticello site. Part III discusses some important implications and conclusions. An appendix provides details for the IMPLAN multipliers utilized by the JEDI model.

Part I: Wind Power Trends in the United States and Utah

Despite the past 3 years of record-setting gains in wind energy capacity across the country, wind energy provides less than 2% of U.S. total electricity production (Wiser and Bolinger 2008), and Utah is just now beginning to tap its wind resources for electricity. Because wind power costs have been slightly higher than Utah's average electricity costs (derived primarily from existing coal-fired power plants), there has been little motivation to diversify into wind energy (Reategui, Stafford, and Hartman 2009).

In 2009, 82% of Utah's electricity generation came from coal-fired power plants. Natural gas-fired power plants accounted for 15%, and petroleum contributed 0.1% (mainly used as start-up fuel at coal-burning plants). Renewable resources, mostly hydroelectric (1.2%) and geothermal (0.7%), provided 2% of Utah's total electric generation. Wind and solar made up the balance of approximately 0.1% of Utah's electricity generation (*Economic Report to the Governor* 2010). Over-reliance on fossil-fuel-based sources for electricity makes Utah ratepayers economically vulnerable in the face of emerging federal and regional policies to limit carbon emissions that will result in carbon taxes and/or cap-and-trade programs, increasing the cost of coal- and gas-generated power (*Salt Lake Tribune* 2009). To help mitigate this threat, Utah has joined the Western Climate Initiative, a partnership of 10 Western states and four Canadian provinces working to constrain greenhouse gas emissions through the creation of the world's largest carbon-trading systems (Yi 2008). The Western Climate Initiative program is expected to begin in 2012. Nationally, President Obama is also calling for restrictions on greenhouse gas emissions and a mandate for increasing amounts of renewable energy from electric utilities (Mulkern 2009).

Wind power development in Utah can help curb future energy costs as wind-generated electricity is price-stable and predictable. The main driver of the price of wind power is the upfront capital cost of construction. Consequently, wind power cost is not impacted by fuel price volatility. Further, because it involves no fossil fuels, wind energy will not be subject to carbon regulations, taxes, or fees (which most analysts predict). Consequently, power purchase agreements for wind-generated electricity often offer long-term "locked-in" wholesale rates for utilities. As concerns regarding environmental impact, greenhouse gas legislation, and depletion of coal reserves increase, wind energy becomes an even more valuable, price-stable addition to Utah's energy production portfolio.

Utah policymakers also are committed to preserving and revitalizing the state's agricultural economic base. Wind development contributes to this goal in several ways. First, wind projects require a small land footprint, so farmers and ranchers can continue using the land around wind turbines for existing agricultural uses. The additional energy production and lease payments to landowners increase the dollar-per-acre output of the farmland with negligible impact on farm output. Second, unlike coal- and natural gas-fired electricity, wind generation does not require water to compete with agricultural use. Third, wind projects support relatively high-paying jobs. Even though the economic downturn has slowed growth in renewable energy, there is unmet demand for skilled technicians to maintain the tens of thousands of wind turbines already installed (Dickerson 2009). The best candidates for these jobs are workers laid off from construction and building industries in rural communities. Highly skilled technicians can command six-figure annual salaries (Dickerson 2009).

Wind development in rural communities can also boost tax revenues for public services and schools. The Spanish Fork Wind Project in Utah County is expected to generate more than $112,000 in local property taxes, of which about $84,000 will support the local school district; these figures include a 70% tax rebate approved by the city as an incentive for the project (Reategui, Stafford, and Hartman 2009). Communities with large wind development projects, such as those in western Texas, have derived significant economic benefit for local schools from the increase in the property tax base, as reported in a recent CBS news story:

> Tiny Trent, Texas, has only 60 students in its high school, what used to be one of the poorest schools in the state. It is now state of the art. "We've got two computer labs — one for the elementary and one for high school," Trent school superintendent Greg Priddy said. "We're getting projectors for every class room." Priddy says none of this would have been possible without a healthy new tax base fueled by the turbines on the mesa behind the school (CBS, 2007).

On balance, wind power is increasingly seen as an important industry that can bolster Utah's rural communities, creating jobs and generating lease payments for rural landowners and tax revenues for government services and schools. This report offers projections on how development of a Monticello site could impact Utah and San Juan County economically.

The value of a wind resource depends on the timing of system demand and wind production, consistency, and strength. In general, a 12 mile-per-hour (mph) wind speed at 20 meters is needed for a commercially viable speed at a turbine hub height of 80 meters. Two sites in Monticello have been tested by the state anemometer program using 20-meter towers. Winds at the site called Monticello I were measured from November 2001 to November 2002, and the average wind speed was 11.9 mph (for details, see http://geology.utah.gov/SEP/wind/anemometerdata/20mtower/sites2001/monticello1/index.htm 2010). At the site called Monticello II, the average wind speed measured between November 2002 and May 2005 was 11.1 mph (for details, see http://geology.utah.gov/SEP/wind/anemometerdata/20mtower/sites2002/monticello2/index.htm 2010). Although these average wind speeds indicate that these sites may not be competitive in the Utah market currently due to Utah's low energy prices, the sites could be considered viable for development if transmission to higher-price energy markets (e.g., California) becomes available or other incentives materialize. Elise Brown, Renewable Energy Coordinator of the Utah State Energy Program, asserts that these sites warrant further testing with 50- or 60-meter towers to better understand wind shear and other wind resource characteristics.[3] The economic analysis described next centers on the impacts associated with developing the Monticello I site.

Part II: JEDI Economic Evaluation of Monticello I

This section highlights the estimated state-level economic impact attributed to the development of the Monticello I site in San Juan County, Utah. Estimates were generated using the Job and Economic Development Impact (JEDI) model, an economic projection tool developed by the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). The results of this analysis are presented in three sections. The first section provides an overview of the JEDI model. The second and third sections provide details of the expected economic impacts during **construction** and **operations**, respectively. For this evaluation, economic data were obtained from three sources: (1) the San Juan County Government, (2) IMPLAN (IMpact Analysis for PLANning) multipliers for Utah supplied by NREL (details discussed below), and (3) wind developers working in Utah (who will remain anonymous for proprietary reasons).

JEDI Model Overview

The JEDI model has been used extensively by the U.S. Department of Energy, state economic development departments, and wind researchers and analysts throughout the United States. Users must enter basic project information (state, construction year, and facility size) and are encouraged to enter more detailed information about a wind project such as costs, income (i.e., wages and salaries), land leases, and percentage of jobs related to the project that will accrue to the state or local region from the project. The more project-specific the data, the more localized the results.

JEDI enables users with limited experience in economic modeling or spreadsheets 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"). The default model contains state-specific industry multipliers derived from IMPLAN. These multipliers serve as the default multiplier values for all 50 states. IMPLAN was developed by the U.S. Forest Service to perform regional economic analyses. Presently, IMPLAN software and data are managed and updated by the Minnesota IMPLAN Group, Inc., using data collected at federal, state, and local levels (IMPLAN 2006). The JEDI model also includes a "user add-in" feature that allows researchers to conduct county-specific analyses using county-level multipliers (not included in the default model).

JEDI, an "input-output" model, is an analytical tool developed to trace supply linkages in the economy (Goldberg, Sinclair, and Milligan 2004). JEDI measures 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 and wind turbines not only potentially benefit local turbine manufacturers but also

[3] Information provided via personal communication from Elise Brown, Renewable Energy Coordinator, Utah State Energy Program, September 17, 2009.

other industries that may exist in the county or state, such as the local fabrication metals industry, concrete rebar, drop cable, wire, etc. (given that money is spent locally).

Input-output analysis is a method of evaluating and summing three economic impacts: (1) project development and on-site labor, (2) turbine and supply chain impacts, and (3) induced effects.[4] These are defined below with respect to wind park construction and operation:

> **Project development and on-site labor effects:** During the *construction* of wind parks, this refers to the on-site jobs of contractors and crews and project development. During *operations*, this refers to on-site labor only.
>
> **Turbine, supply chain, and local revenue effects:** During the *construction* of wind projects, this category refers to the jobs and impacts of expenditures made for turbines and the supply chain (e.g., steel manufacturers that supply towers, hardware stores that provide building supplies for construction crews, or electric-utility suppliers that procure goods, such as high-voltage transmission lines [Costanti 2004]). During *operations*, this category refers to local revenues generated by the project (e.g., land lease payments) and expenditures in the supply chain (e.g., spare parts, fuel for on-site vehicles, materials and services, etc.).
>
> **Induced effects:** During *construction*, induced effects are the change in wealth and income that are induced by the spending of businesses and persons related to the project development, on-site labor, turbine, supply chain, and local revenues by the wind project. During *operation*, induced effects refer to changes in wealth and income related to on-site labor and local revenues. During both construction and operation, induced effects would include spending 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 resulting from expenditures on the construction and operation of a wind park. In determining economic effects, the model considers 14 aggregated industries 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 miscellaneous services, professional service, retail trade, transportation/communication/public utilities, and wholesale trade). Estimates are made using state- and county-level multipliers and personal expenditure patterns. Multipliers for

[4] Earlier versions of the JEDI model used the output categories of direct, indirect, and induced effects. The new output categories, which separate project development and on-site labor effects from turbine, supply chain, and local revenue effects, offer greater insight about the sources of economic impacts.

employment, wage and salary income, output (economic activity), and personal expenditures are derived from 2006 IMPLAN data.[5]

The JEDI model contains default data for nearly every input field and for each of the 50 states. Default values represent average costs and spending patterns derived from a number of sources (including project-specific data published in reports and studies) and research and analysis of renewable resources undertaken by the model developers. However, since not every project follows this exact "default" pattern for expenditures, project-specific information will yield more localized impact results. Project size, location, financing arrangements, and numerous site-specific factors influence construction and operating costs. Similarly, the access to local resources, including labor and materials, and the availability of locally manufactured project components can have a significant effect on the costs and the economic benefits that accrue to a state.

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, and expenditures spent locally, financing terms, and tax rates. Specifically, the model requires the following project inputs:

<u>Construction Cost Data:</u>

- Material and labor for construction, turbine installation, and electrical work
- Equipment costs (turbines, rotors, towers, etc.)
- Other costs (utility interconnection, engineering, land easements, permitting, etc.)
- Payroll parameters (wage per hour).

<u>Operating Cost Data:</u>

- Labor costs
- Materials and services
- Other parameters (financial, debt and equity, taxes, and land lease)
- Payroll parameters (wage per hour).

Input parameters for wind power development in Monticello, San Juan County, include:

Year of Construction: 2010

Project Location: San Juan County, Utah

Project Size: Actual project size may vary with respect to site considerations such as complex terrain or other project variables. This analysis evaluates two installation size scenarios: 50 MW and 100 MW.

[5] The government provides annual multipliers in the fall for the previous year. For example, multipliers for 2007 are available in the fall of 2008. JEDI multipliers are not updated annually; they are updated when priority and budgets permit.

Turbine Size: 2.5 MW are used for both installation scenarios

Project Construction Costs ($/kW): Varies with installation size, ranging from $1,900 to $2,000 per kW

Annual Operations and Maintenance Costs ($/kW): $20 per kW

Current Dollar Year: 2010

Other Parameters: Local Taxation Parameters, Local Ownership Percentages, Land Lease Easement Payments, and County Multipliers

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 "production value" in the state, region, or county economy
- Earnings: Refers to annual wage and/or salary compensation paid to workers involved with on-site labor, supply chain, or induced effects
- Local Spending: Refers to the actual annual dollars spent on goods and services in the area analyzed (state, regional, or county economy where the wind park is built)
- Annual Lease Payments: Provides an annual total of lease payments to landowners
- Property Taxes: Represents the annual property taxes the project will generate, exclusive of any available property tax exemptions.

JEDI Model Results for Monticello I Project

The results of the JEDI analysis are presented in a series of tables that follow. Simplifying assumptions and inputs from local wind developers incorporated into the analysis include:

- Construction costs per kilowatt (kW) experience increasing economies of scale (that is, average cost per kW decreases as project size increases).
- No additional transmission lines are included in the construction-cost projections.
- The impacts on jobs, earnings, and output apply to the overall Utah economy. The results do not, however, account for potential job and economic losses that could occur in other industries or sectors due to the development of wind power (e.g., reduced use of natural-gas-fired electricity). In other words, the JEDI model estimates gross jobs, not net jobs.
- Earnings output assumes no local ownership or local individual equity investment. Local ownership of the installed wind assets increases earnings in Utah as individuals receive returns on their equity invested.

- Tax income (paid by the developer) is for San Juan County only.
- Labor management/supervisory positions will most likely be filled by out-of-state personnel. As Utah develops an adequate supply of trained in-state labor and enough development to attract more experienced personnel, local labor opportunities would increase.

Table 1 (Project Data Summary) provides an overview of the economic impact results including local spending, property taxes (including tax revenues for San Juan County School District), and lease payments for landowners. The average construction cost-per-kilowatt (kW) is expected to decrease as project size increases. The lines in bold type indicate the projected impacts that relate specifically to the state. For example, a modest 50-MW wind power installation could generate approximately $18.8 million in local spending during construction. During operations, about $1.8 million in local spending would be incurred annually, which is the summation of $290,000 in maintenance costs spent locally, $1.39 million in county property taxes (of which $810,000 of those revenues is directed to the local school district), and $150,000 in lease payments made to local landowners. Details for other installation size scenarios are found in the three subsequent tables. Due to rounding, numbers in the tables may not sum accurately.

Table 1: Project Data Summary

	Project Size (MW)	
Project Data Summary	**50**	**100**
Project Location	UTAH	UTAH
Year of Construction	2010	2010
Total Project Size - Nameplate Capacity (MW)	50	100
Number of Projects (included in total)	1	1
Turbine Size (KW)	2500	2500
Number of Turbines	20	40
Installed Project Cost ($/KW)	2002	1900
Annual Direct O&M Cost ($/KW)	20	20
Money Value (Dollar Year)	2010	2010
Installed Project Cost	$100,091,870	$190,041,243
Local Spending	**$18,779,356**	**$33,998,026**
Total Annual Operational Expenses	$17,596,996	$33,527,387
Direct Operating and Maintenance Costs	$1,000,000	$2,000,000
Local Spending	**$289,673**	**$667,683**
Other Annual Costs	$16,596,996	$31,527,387
Local Spending	**$1,543,179**	**$2,945,184**
Debt and Equity Payments	$0	$0
Property Taxes	$1,393,179	$2,645,184
School Taxes (included in Property Taxes)	$809,843	$1,537,624
Land Lease	$150,000	$300,000
Total Annual Local Spending	**$1,832,852**	**$3,612,867**

Table 2 provides a more detailed breakout of projected construction costs. The local share percentages are provided as default values within the model according to the economic resources available in Utah and are used to derive the local spending projections in the previous table. The rows in bold type in the table below sum to the Project Construction Cost listed in the table above. Using the 50-MW scenario as an example, the materials, labor, equipment, and other subtotals add up to about $100 million listed above as Total Project Cost (bottom of Table 2). Due to rounding, numbers in the tables may not sum accurately.

Table 2: Construction Costs

	Project Size (MW)		
Construction Costs	**50**	**100**	**Local Share**
Equipment Costs			
Turbines	$43,952,481	$85,089,829	0%
Blades	$10,289,879	$19,920,696	0%
Towers	$11,392,366	$22,055,056	0%
Transportation	$7,864,407	$15,225,103	0%
Equipment Subtotal	$73,499,132	$142,290,683	
Balance of Plant			
Materials			
Construction (concrete rebar, equip, roads and site prep)	$10,620,625	$20,561,004	90%
Transformer	$1,201,413	$2,325,876	0%
Electrical (drop cable, wire)	$1,266,370	$2,451,630	100%
HV Line Extension	$2,313,236	$4,478,311	70%
Materials Subtotal	$15,401,644	$29,816,821	
Labor			
Foundation	$1,002,162	$1,165,298	95%
Erection	$1,135,091	$1,319,865	75%
Electrical	$1,654,169	$1,923,441	70%
Management/Supervision	$858,352	$998,077	0%
Misc.	$3,800,000	$7,220,000	50%
Labor Subtotal	$8,449,774	$12,626,681	
Development/Other Costs			
HV Sub/Interconnection			
Materials	$729,915	$1,413,079	90%
Labor	$223,587	$432,854	10%
Engineering	$993,232	$1,922,847	0%
Legal Services	$541,311	$1,047,952	100%
Land Easements			100%
Site Certificate	$253,274	$490,326	100%
Other Subtotal	$2,741,319	$5,307,058	
Balance of Plant Total	$26,592,737	$47,750,560	
Total Project Costs	$100,091,870	$190,041,243	

Table 3 (Operating and Maintenance Costs) provides details of projected ongoing project expenditures, which form the basis of the estimates displayed in Table 1 in the row titled Total Annual Operational Expenses.

Table 3: Operating and Maintenance Costs

	Project Size (MW)		
Annual O&M Costs	**50**	**100**	**Local Share**
Personnel			
Field Salaries	$79,021	$263,403	100%
Administrative	$21,072	$42,144	100%
Management	$52,681	$105,361	100%
Labor/Personnel Subtotal	$152,774	$410,909	
Materials and Services			
Vehicles	$24,203	$45,396	100%
Misc. Services	$9,439	$17,704	80%
Fees, Permits, Licenses	$4,720	$8,852	100%
Misc. Materials	$18,878	$35,409	100%
Insurance	$181,523	$340,471	0%
Fuel (motor vehicle gasoline)	$9,439	$17,704	100%
Tools and Misc. Supplies	$61,355	$115,079	100%
Spare Parts Inventory	$537,670	$1,008,475	2%
Materials and Services Subtotal	$847,226	$1,589,091	
Debt Payment (average annual)	$11,610,657	$22,044,784	0%
Equity Payment - Individuals	$0	$0	100%
Equity Payment - Corporate	$3,443,160	$6,537,419	0%
Property Taxes	$1,393,179	$2,645,184	100%
School Taxes (included in Property Taxes)	$809,843	$1,537,624	100%
Land Lease	$150,000	$300,000	100%
Total Annual Operating and Maintenance Costs	$17,596,996	$33,527,387	

Table 4 utilizes the default values provided by the JEDI model in all fields except the local property tax rate. These results use the local tax rate provided by the San Juan County Assessor to more accurately predict total revenues. Specifically, the county and district tax levy rates from the area to be developed multiplied by the assessed value of the development, which is predicted to be equal to total construction costs. To illustrate, the combined county and district tax levy totals 1.3919%. Total construction cost for a 50-MW installation is about $100 million. Assessed at 100% taxable value, total projected annual county revenues is about $1.39 million, of which $810,000 would be directed to the local school district.

Table 4: Other Parameters

Other Parameters	Project Size (MW) 50	100	Local Share
Financial Parameters			
Debt Financing			
Percentage Financed	80%	80%	0%
Years Financed (term)	10	10	
Interest Rate	10%	10%	
Equity Financing	0%	0%	
Percentage Equity	20%	20%	
Individual Investors (percent of total equity)	0%	0%	100%
Corporate Investors (percent of total equity)	100%	100%	0%
Return on Equity (annual interest rate)	16%	16%	
Repayment Term (years)	10	10	
Tax Parameters			
Local Property/Other Tax Rate (percent of taxable value)	1.3919%	1.3919%	
Assessed Value (percent of construction cost)	100%	100%	
Taxable Value (percent of assessed value)	100%	100%	
Taxable Value	$100,091,870	$190,041,243	
Taxes Per MW	$11,120	$11,120	
Local Taxes	$1,393,179	$2,645,184	100%
School Taxes (included in Local Taxes)	$809,843	$1,537,624	100%
Land Lease Parameters			
Land Lease Cost (per turbine)	$7,500	$7,500	
Land Lease (total cost)	$150,000	$300,000	
Lease Payment Recipient (F = farmer/household, O = Other)	F	F	100%
Payroll Parameters			
Construction Labor (Average Wage Per Hour)			**Employer Payroll Costs**
Foundation	$16.86	$16.86	37.6%
Erection	$19.10	$19.10	37.6%
Electrical	$25.30	$25.30	37.6%
Management/Supervision	$34.39	$34.39	37.6%
O&M Labor (Average Wage Per Hour)			**Employer Payroll Costs**
Field Salaries (technicians, other)	$23.01	$23.01	37.6%
Administrative	$14.72	$14.72	37.6%
Management	$36.81	$36.81	37.6%

Table 5 (Estimated Number of Full-Time Equivalent Jobs Opportunities) includes results for the entire state of Utah, not limited to San Juan County. This captures some of the broader state-level effects such as manufacturing and construction assets not necessarily available in San Juan County. It does not include job opportunities that could result from state education and training programs to promote wind energy professional development and increase the state's economic resource base. According to the table below, construction of a 50-MW installation would support 55 job opportunities from project development and on-site at a wind project, 51 of which are for construction. The total job opportunities, including turbine and supply chain and induced effects, would total 285. During operating years, the wind park would produce two job opportunities on-site, with a total on-site, supply chain, and induced impact of 17 job opportunities. Due to rounding, numbers in the tables may not sum accurately.

Table 5: Estimated Number of Full-Time Equivalent Jobs Opportunities

	Project Size (MW)	
Estimated FTE Jobs	**50**	**100**
During Construction Period		
Project Development & On-Site Labor	55	66
Onsite Construction and Interconnection Labor	51	60
Onsite Construction-Related Services	3	6
Turbine & Supply Chain	162	308
Induced Impacts	68	123
Total Impacts	**285**	**497**
During Operating Years (annual)		
Onsite Labor Impacts	2	6
Local Revenue & Supply Chain Impacts	5	9
Induced Impacts	11	21
Total Impacts	**17**	**36**

Table 6 (Estimated Annual Wage and Salary Earnings) displays the projected wages and salary earnings during the construction period and the annual projected wages and salary earnings during operation. For example, a 50-MW installation would produce total wage and salary earnings of approximately $11.2 million during construction (including $3.1 million from project development and on-site labor, $5.9 million from turbine and supply chain impacts, and $2.2 million from induced impacts), and annual wage and salary earnings of approximately $653,000 during operation. Due to rounding, numbers in the tables may not sum accurately.

Table 6: Estimated Annual Wage and Salary Earnings

	Project Size (MW)	
Economic Impacts – Earnings	**50**	**100**
During Construction Period		
Product Development & On-site Labor	$3,152,379	$3,813,278
Onsite Construction and Interconnection Labor	$2,981,290	$3,482,059
Onsite Construction-Related Services	$171,089	$331,219
Turbine & Supply Chain	$5,882,700	$11,154,355
Induced Impacts	$2,180,537	$3,941,318
Total Impacts	**$11,215,616**	**$18,908,951**
During Operating Years (annual)		
Onsite Labor	$141,898	$381,658
Local Revenue & Supply Chain	$166,636	$343,836
Induced Impacts	$344,616	$672,038
Total Impacts	**$653,151**	**$1,397,532**

Table 7 (Total Estimated Economic Output from Wind Park Development) displays the total projected increase in economic activity due to wind project installation and operation. Total impacts are broken down into total project development and on-site labor, turbine and supply chain impacts, and induced impacts during construction and annual on-site labor, local revenue and supply chain impacts, and induced impacts during operation. To illustrate, a 50-MW installation is projected to generate approximately $31.1 million in economic activity for the state of Utah during construction. During operating years, total economic activity generated is projected to be about $3.25 million. Due to rounding, numbers in the tables may not sum accurately.

Table 7: Total Estimated Economic Output from Wind Park Development

	Project Size (MW)	
Economic Impacts – Output	**50**	**100**
During Construction Period		
Project Development & On-site Labor	$3,524,961	$4,534,578
Turbine & Supply Chain	$20,449,141	$38,867,961
Induced Impacts	$7,151,051	$12,925,514
Total Impacts	**$31,125,152**	**$56,328,053**
During Operating Years (annual)		
On-site Labor	$141,898	$381,658
Local Revenue & Supply Chain	$1,979,307	$3,876,196
Induced Impacts	$1,130,167	$2,203,943
Total Impacts	**$3,251,373**	**$6,461,797**

Part III: Discussion and Conclusions

Economic Benefits Summary

In summary, our economic projections indicate that development of the Monticello I site poses significant economic opportunities for the state, benefiting the construction sector, schools, and landowners. For example, construction of a modest 50-MW wind project would generate about $31.1 million in economic impacts for the state (see Table 7); and once operational, it would generate $810,000 in annual property tax revenues for San Juan County schools and $150,000 in lease payments to landowners (see Table 3). Developing Utah's wind resources, nonetheless, requires addressing some barriers and provisions, including contradictory and/or changing municipal, state, and federal policies; project siting (e.g., zoning, access land leases, wildlife impact assessments, community acceptance); procuring power purchase agreements, turbines, and financing; and cultivating local community support (see Reategui, Stafford, and Hartman 2009). **While federal and state policies increasingly encourage wind power and other renewable energy development in Utah, approval of specific projects hinges on the support of county commissioners, city council members, mayors, local community leaders, and citizens.** Understanding the localized economic impacts created by the construction and operations of wind power plants can help decision makers evaluate the potential opportunities for their communities.

Additionally, to secure ongoing community support for wind power development, the potential economic impacts need to be "visible" in the community. Property tax revenues from wind power, for example, can be substantive. They are often mixed, however, into county coffers where they become "invisible," and local citizens may not recognize how the wind turbines benefit their communities directly. Nancy Jackson, the executive director of the Climate and Energy Project for The Land Institute, recommends that counties can offer tax breaks for wind developers in exchange for payment in lieu of taxes in the form of other high-profile community services and projects. For example, she suggests that developers can sponsor the local library or bookmobile; broadband; a public swimming pool, school playground, or public park improvements; funding for parks and recreation programs; or support for arts, athletics, or other programs that often go unfunded in rural schools.[6] When town and county residents connect visible improvements in their lives to local wind projects, enthusiasm for wind power can grow.

In Utah, because a substantial portion of property tax revenues generated from wind projects go directly to local school districts, wind developers and supporters may publicize a wind project's potential direct tax revenue streams that will benefit rural schools and children. In 2003-4, the Utah Energy Office sponsored an education outreach campaign with the message, "Wind Power Can Fund Schools" (Hartman and Stafford 2010). It is important for wind developers and supporters to identify core values of a community such as school funding and frame wind power's benefits to align with those values.

[6] Information provided via e-mail from Nancy Jackson, executive director of the Climate and Energy Project for The Land Institute, June 18, 2008.

While the JEDI model used in this analysis assumes no local ownership or investment in the wind project, Community-Based Energy Development (C-BED) projects in Minnesota are finding ways to produce greater economic impacts to local communities. In C-BED projects, local landowners and other community members and investors work with developers so that the wind power plant is owned by members of the community rather than large energy companies or outside entities. Thus, the community enjoys not only the increased tax revenue but also long-term returns on equity (www.c-bed.org 2008). Partial local ownership of wind projects not only directs more economic returns and benefits into local communities but can also encourage local support for wind development.

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, IMPLAN software and data are managed and updated by the Minnesota IMPLAN Group, Inc., using data collected at federal, state, and local levels. The analysis in this report used JEDI model version W1.09.03, which uses 2006 multiplier data from the Minnesota IMPLAN Group.

JEDI is an "input-output" model, an analytical tool developed to trace supply linkages in the economy (Goldberg, Sinclair, and Milligan 2004). JEDI estimates 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 and wind turbines not only potentially benefit local turbine manufacturers but also other industries that may exist in the county or state, such as the local fabrication metals industry, concrete rebar, drop cable, wire, etc. (given that expenditures will be made locally).

Input-output analysis is a method of evaluating and summing three economic impacts: (1) project development and on-site labor, (2) turbine and supply chain impacts, and (3) induced effects. These are defined below with respect to wind park construction and operation:

> **Project development and on-site labor effects:** During the construction of wind parks, this refers to the on-site jobs (contractors and crews hired) and project development. During operations, this refers to on-site labor only.
>
> **Turbine, supply chain, and local revenue effects:** During the construction of wind projects, this category refers to the impact of expenditures made for turbines and the supply chain (e.g., steel manufacturers that supply towers, hardware stores that provide building supplies for construction crews, or electric-utility suppliers that procure goods, such as high-voltage transmission lines [Costanti 2004]). During operations, this category refers to local revenues generated by the project (e.g., land lease payments) and expenditures in the supply chain (e.g., spare parts, fuel for on-site vehicles, materials and services, etc.).
>
> **Induced effects:** Induced effects are the change in wealth and income that are induced by the spending of businesses and persons related to the project development, on-site labor, turbine, supply chain, and local revenues by the wind project. Induced effects would include spending 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 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 service, retail trade, transportation/communication/public utilities, and wholesale trade). Estimates are made using state- and county-level multipliers and personal expenditure patterns. IMPLAN provides the multipliers for employment, wage and salary income and output (economic activity), and personal expenditure (IMPLAN 2006).

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/state 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, region, or state, 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 expenditure. Consequently, analysts are encouraged to incorporate project-specific data and the likely share of spending in a given county, region, or state to reflect localized economic impacts. In our analysis, we’ve consulted with a local wind developer to determine reasonable local spending levels for specific costs associated with this wind project.

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 on-site labor, supply chain, or 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 located).
- 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.

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 plant 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 generation 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. Consequently, while JEDI can provide analysts with the reasonable benefits associated with a given project, wind developers, utility managers, and government officials need to ensure that a given project is an acceptable investment.

Appendix E. Some Insight into IMPLAN

The JEDI model was developed for the National Renewable Energy Lab by Marshall Goldberg (Goldberg, 2003) to allow individuals with minimal modeling experience to easily model and predict regional economic impacts associated with installation of wind projects. To achieve its results, the JEDI model uses the inputs described in the preceding text, determines the portion of the spending that will impact the region of interest, and then uses the IMPLAN multipliers from that region to determine how much impact that spending portion will have via the labor, supply chain, and induced impacts discussed previously in the JEDI model introduction.

IMPLAN (Impact Analysis for Planning) was developed by Scott Lindall and Doug Olson at the University of Minnesota in close conjunction with the U.S. Forest Service's Land Management Planning Unit. In 1993, a technology transfer agreement with the University of Minnesota allowed the formation of the Minnesota IMPLAN Group, Inc. (MIG, Inc.) which currently manages all IMPLAN products.

The following excerpt from the introduction of "The IMPLAN Input-Output System" provides a brief description of how the IMPLAN multipliers are derived:

> Input-output accounting describes commodity flows from producers to intermediate and final consumers. The total industry purchases of commodities, services, employment compensation, value added, and imports are equal to the value of the commodities produced.
>
> Purchases for final use (final demand) drive the model. Industries produce goods and services for final demand and purchase goods and services from other producers. These other producers, in turn, purchase goods and services. This buying of goods and services (indirect purchases) continues until leakages from the region (imports and value added) stop the cycle.
>
> These indirect and induced effects (the effects of household spending) can be mathematically derived. The derivation is called the Leontief inverse. The resulting sets of multipliers describe the change of output for each and every regional industry caused by a one dollar change in final demand for any given industry (Lindall and Olson, 2008).

In this analysis, the IMPLAN multipliers for the state of Utah were used to calculate the labor, supply chain, and induced impacts of the change in final demand in wind energy and associated industries, based on the cost projections provided in the preceding report.

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