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An Analysis of the Economic Impact on Box Elder 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 viable coal reserves in Utah, wind power development has been proposed as an alternative to diversify Utah's sources for 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 (e.g., creation of local jobs, generation of lease income for land owners, enhanced tax revenues for local schools and community services, etc.) 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 and political support.

The purpose of this report is to provide information for decision-makers by quantifying the likely economic impact of wind development in Box Elder 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 Box Elder County was conducted for four feasible wind project size scenarios by their capacity in megawatts (MW): (1) 10 MW, (2) 20 MW, (3) 30 MW, and (4) 50 MW. This analysis may interest city, county, and state government officials; wind developers; renewable energy advocates; landowners and members of the agricultural community; and other stakeholders contemplating decisions about Utah's and Box Elder County's energy, environmental, 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 are affecting the state of Utah's energy market. Part II describes our evaluation methods and results, and Part III draws conclusions about the economic impacts for Box Elder County based on the construction and operation of commercial wind parks of different sizes, especially for local landowners and businesses. The Appendices contain background on the mechanics of the JEDI Model as a projection tool.

PART I: WIND POWER TRENDS

Wind Power Trends—Industry Wide

Wind power is the world's fastest-growing energy source, averaging about 15.8% growth annually over the past 5 years (Halperin 2005). Wind, nevertheless, generates less than 1% 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% of the nation's electricity supply comes from natural gas. Because of a warmer-than-usual winter, however, natural gas prices have subsided since the mid-December 2005 record high. The National Gas Supply Association warns, nevertheless, that an unusually warm summer, cool fall, or intense hurricane season could deplete inventories and exert new price pressures by year's end (Foss 2006). In the long-term, natural gas prices are expected to escalate.

The cost competitiveness of wind has become increasingly evident. For the first 6 months of 2006, for example, it was actually cheaper for Xcel Energy (based in Colorado) customers to sign up for "green" energy programs that provided electricity from wind turbines than it was to buy "standard" electricity from gas- or coal-fired generation units (Raabe 2006). Xcel Energy experienced significant growth in its voluntary "Windsource" program as subscribers enjoyed electric rates as much as $10 a month lower than their neighbors who paid regular rates for conventional power from coal and natural gas (Raabe 2006). The recent drop in coal and natural gas prices, however, has reversed this trend and, as of June 2006, Xcel's conventional power users are now paying about $5 per month less than Windsource subscribers. **Because wind power's cost is derived primarily from construction costs of wind parks (with comparatively minimal operating costs), it is not subject to volatile fuel costs, and wind power's cost is stable and predictable.** Consequently, many Xcel Windsource subscribers say they will continue to buy wind energy because they expect fossil fuel prices to rise again, and Xcel maintains a waiting list for customers to join the "Windsource" program.

Austin Energy's "Green Choice" program in Texas has led the nation in renewable energy sales for the past 3 years (Ottman, Stafford, and Hartman 2006). In 2006, demand for wind power outpaced supply so that the utility resorted to selecting new "Green Choice" subscribers by lottery! Although priced at a premium, Austin Energy offers a fixed price that is locked in for 10 years, making it particularly attractive to commercial users. In sum, many utilities and power users find wind power's price stability an attractive alternative to volatile fossil fuel-fired power.

State policy makers across the country are also recognizing the price competitiveness, economic development opportunities, and environmental benefits of wind power and, as of November 2005, 20 states plus the District of Columbia have implemented "renewable portfolio standards" (RPS) mandating that regulated utilities operating in those states diversify their energy supplies to include non-fossil-fuel sources[1] (Department of Energy 2006). RPS is an effective policy tool because despite the economic feasibility of wind power, utilities have been reluctant to add wind (or other renewable resources) to their energy portfolios as a result of a lack of awareness or experience with wind power, perceived risks, financial interests in fossil fuel sources, and long-term contracts with existing fossil-fuel power suppliers.

Wind Power Trends—State of Utah

Utah ranks 26th in the nation with regard to wind energy potential, according to a 1991 Pacific Northwest Laboratory report (American Wind Energy Association 2006). While seemingly modest, other states with comparable rankings have developed their wind resources for commercial electricity generation and continue to grow their capacity. For example, as of December 31, 2005, the state of Washington (ranked 24th in the nation for wind energy potential) had developed 390 MW of wind capacity and has approved another 230 MW for 2006. Likewise, the state of Oregon (ranked 23rd) has developed 338 MW of wind capacity, and another 140 MW are proposed for development (American Wind Energy Association 2006). The total current wind power generation capacity in Washington and Oregon equals about the amount of electricity used for 180,000 homes, and when the new wind proposed projects come online, total capacity will serve approximately 275,000 homes.[2]

By contrast, Utah's current installed wind power capacity is less than 1 MW. Camp Williams, a National Guard Training Site operated by the Utah Army National Guard located 26 miles south of Salt Lake City, maintains two small wind turbines with a total capacity of 0.885 MW (equal to the electricity use of approximately 220 homes) for use on its facility (American Wind Energy Association 2006). To date, no Utah wind sites have been developed for commercial electricity generation, though an 18.9-MW wind park has been approved for the Spanish Fork Canyon in Utah County and is slated to be completed by December 2007 (Hollingshead 2006).

Potential wind sites in Utah have been mapped by TrueWind Solutions for the U.S. Department of Energy (DOE) and validated with available surface data by NREL and wind-energy meteorological consultants (DOE 2003). The map, published in September 2003, reported that Utah had wind resources to generate approximately 5,000 MW of electricity capacity (Mims 2003), and locations northwest of the Great Salt Lake in Box Elder County may have good potential wind resources near transmission. Local wind developers, utility representatives, and

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[1] Two states, Illinois and Vermont, have set voluntary goals for adopting renewable energy that do not include legally binding target goals.

[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% (American Wind Energy Association [AWEA] Wind Web Tutorial 2004). A megawatt of wind generates enough electricity to power 225 to 300 households. Thus, the "number of homes served" is commonly used to translate a quantity of electricity into a familiar term that people can understand.

wind advocates in Utah whom we interviewed during the fall of 2005 conservatively estimate the overall state of 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, and the American Wind Energy Association reports Utah could have 2770 MW of "average power output" (American Wind Energy Association 2006).

Currently, about 95% 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 viable 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). Interviews we conducted with Utah coal and utility executives in fall 2005 indicate that they too concur that Utah's accessible and economically viable coal reserves are dwindling, and the situation could pose a crisis if Utah does not diversify its portfolio of electricity-generating resources. If Utah needs to import coal from Wyoming in the near future, railroad reliability and rising diesel fuel transportation costs will greatly impact future electricity prices for Utah consumers.

In addition to dwindling coal reserves, Utah faces increasing demand for electricity because of population growth, increasing use of air conditioning, larger new home sizes, and proliferation of electronic devices, such as cell phones, flat-screen televisions, and iPods. Dave Eskelsen, Rocky Mountain Power (formerly Utah Power) spokesperson, said in a recent KSL news report, "Non-industrial energy use has gone up a solid 1.7% a year, but peak load power demand in the heart of the summer is rising at 5% percent annually" (Daley 2006). In sum, in the face of increasing demand, dwindling accessible coal reserves, and volatile natural gas prices, Utah must expand and diversify its portfolio of electricity sources. The development of wind power plants can contribute significantly to Utah's energy future.

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, Rocky Mountain Power, offers a voluntary program called "Blue Sky," where for $1.95 customers can buy 100-kilowatt-hour blocks of wind power generated outside of the state. As of February 2006, Rocky Mountain Power reported that more than 16,727 residential and business customers in Utah (approximately 2% of Rocky Mountain Power's customers in the state) participated in the Blue Sky program (Rocky Mountain 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

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

power usage with voluntary purchases; Moab achieved that status by buying Blue Sky wind energy from Rocky Mountain Power (Rocky Mountain Power Press 2005). Blue Sky ranks second nationally in voluntary participation. The University of Utah was recently recognized by the U.S. Environmental Protection Agency as one of the nation's Top Ten University Green Power Purchasers for its voluntary purchase of 25 million kilowatt hours of wind power annually (University of Utah Press Release 2006).

In its Integrated Resource Plan (IRP) Rocky Mountain Power's parent company, PacifiCorp (now Mid-American) has called for adding 1,400 megawatts of wind and other renewable energy sources to its portfolio of electricity generating resources across its multi-state service market by 2013. 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 Box Elder County, information obtained by the former Utah Energy Office prior to the publication of the DOE wind resource map suggested that at least 50 MW of wind could be harvested economically. This report attempts to quantify the potential economic impact for modest-sized wind development projects, including (1) 10 MW, (2) 20 MW, (3) 30 MW, and (4) 50 MW facilities.

PART II: THE ECONOMIC EVALUATION USING JEDI

For this evaluation, economic data were obtained in the fall of 2005 from three sources: (1) the Box Elder County Assessor's Office; (2) IMPLAN multipliers for Box Elder 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.

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 Box Elder County was used for this analysis.

Project Size: Four wind project size scenarios were selected for analysis – 10 MW, 20 MW, 30 MW, and 50 MW. These scenarios were deemed reasonable given a Utah Energy Office wind resource map (undated) reported approximately 50 MW of wind power was potentially harvestable with existing technology and the county's infrastructure.

Turbine Size: For computational purposes, a 1.5-MW (1500-kilowatt) turbine size was used based on data provided by two local wind developers who will remain anonymous.

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.[4] Table 1, Project Scenario Summary, provides a summary of the four wind-development scenarios that were analyzed. For illustrative purposes, discussion will center on the economic impact of a moderately sized 30-MW wind park. The analysis suggests that the primary long-term economic benefit of wind development in Box Elder County centers on annual lease payments to landowners and increased property taxes.

Based on 2005 dollar values, the total construction cost for a 30-MW wind park is projected to be $39 million, of which about $316,500 would be spent in Box Elder County because of the limited availability of construction and utility industries in the county.[5] By contrast, direct annual operating and maintenance costs for a 30-MW facility are projected to total about $343,500, of which about $193,500 would be spent in industries located in Box Elder County**.** Property taxes for the first year of the project are projected to be almost $377,000, of which approximately $248,000 would go to local schools.[6] (Note that wind developers, not landowners, usually pay for the new additional property taxes associated with the wind park.) Leases paid to landowners for a 30-MW facility will total $110,000.

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[4] Specific estimates and column totals are rounded.

[5] Because many industries necessary for the development of commercial wind parks in Box Elder County are located in nearby Salt Lake, Weber, and Utah counties (e.g., construction, concrete, electrical, legal services, etc.), construction expenditures would likely be spent in those counties. Projections of specific economic impacts in these counties, however, are beyond the scope of this analysis.

[6] For illustrative purposes, property taxes for the town of Snowville (district 129) in Box Elder County are used. A 20-meter wind-measuring device is currently testing the feasibility of commercial wind in that location. Property taxes include assessments for Snowville, Box Elder County, county library, Box Elder School District and basic school levy, Bear River Water Conservation, and other assessments. The school tax figure includes basic and local levies. Tax revenue streams after the first year may vary depending upon the specific ownership arrangement of the wind project and depreciation schedules of wind equipment.

Table 1: Project Scenario Summary

Scenario	Project Size (MW) 10	20	30	50
Year of Construction	2005	2005	2005	2005
Project Location	Box Elder	Box Elder	Box Elder	Box Elder
Turbine Size (KW)	1500	1500	1500	1500
Construction Cost ($/KW)	$1,300	$1,300	$1,300	$1,300
Annual Direct O&M Cost ($/KW)	$11.45	$11.45	$11.45	$11.45
Money Value (Dollar Year)	2005	2005	2005	2005
Project Construction Cost	$13,000,000	$26,000,000	$39,000,000	$65,000,000
Local Spending	$105,476	$210,951	$316,427	$527,379
Total Annual Operating Expenses	$2,233,780	$4,467,560	$6,695,840	$11,163,400
Direct Operating and Maintenance Costs	$114,500	$229,000	$343,500	$572,500
Local Spending	$64,503	$129,006	$193,509	$322,515
Other Annual Costs	$2,119,280	$4,238,560	$6,352,340	$10,590,900
Local Spending	$164,080	$328,160	$486,740	$814,900
Debt and Equity Payments	$0	$0	$0	$0
Property Taxes	$125,580	$251,160	$376,740	$627,900
School Taxes	$82,667	$165,334	$248,001	$413,335
Land Lease	$38,500	$77,000	$110,000	$187,000

Table 2 details projected construction costs with the percentages (in the extreme right column) of how much of these costs will be spent locally in Box Elder County based upon our interviews with wind developers and labor statistics and local industry profiles provided by the Economic Development Corporation of Utah (EDCU).[7] Because of the limited availability of the construction industry in Box Elder County, only a small fraction of the project's construction costs will be spent locally (e.g., 6% of construction materials, 3% of foundation, etc.)

[7] 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 state to relocate or expand into Utah.

Table 2: Construction Costs

	Project Size (MW)				
	10	20	30	50	Local Share
Construction Costs					
Materials					
Construction (concrete rebar, equip, roads and site prep)	$400,785	$801,571	$1,202,356	$2,003,926	6%
Transformer	$131,601	$263,202	$394,803	$658,006	0%
Electrical (drop cable, wire)	$150,291	$300,582	$450,873	$751,456	0%
HV line extension	$49,849	$99,698	$149,547	$249,245	0%
Materials Subtotal	***$732,526***	***$1,465,053***	***$2,197,579***	***$3,662,632***	***0%***
Labor					
Foundation	$605,797	$1,211,594	$1,817,392	$3,028,986	3%
Erection	$671,693	$1,343,385	$2,015,078	$3,358,463	1%
Electrical	$116,314	$232,628	$348,942	$581,571	1%
Management/supervision	$244,220	$488,440	$732,659	$1,221,099	0%
Labor Subtotal	***$1,638,024***	***$3,276,047***	***$4,914,071***	***$8,190,118***	***0%***
Construction Subtotal	***$2,370,550***	***$4,741,100***	***$7,111,650***	***$11,852,751***	***0%***
Equipment Costs					
Turbines	$6,298,699	$12,597,397	$18,896,096	$31,493,493	0%
Blades	$2,098,918	$4,197,837	$6,296,755	$10,494,592	0%
Towers	$1,319,598	$2,639,196	$3,958,793	$6,597,989	0%
Equipment Subtotal	***$9,717,215***	***$19,434,430***	***$29,151,644***	***$48,586,074***	***0%***
Other Costs					
HV Sub/Interconnection	$843,326	$1,686,652	$2,529,977	$4,216,629	2%
Engineering	$23,263	$46,526	$69,788	$116,314	0%
Legal Services	$6,647	$13,293	$19,940	$33,233	0%
Land Easements	$0	$0	$0	$0	100%
Site Certificate	$39,000	$78,000	$117,000	$195,000	100%
Other Subtotal	***$912,235***	***$1,824,470***	***$2,736,705***	***$4,561,176***	***0%***
Total Project Costs	$13,000,000	$26,000,000	$39,000,000	$65,000,000	0%

Table 3 overviews projected operating and maintenance costs for the different scenarios. Based on 2005 dollar values, a 30-MW facility would generate approximately $273,400 in annual salaries and benefits for field workers, administrators, and managers affiliated with the wind park's operations (presuming that personnel are hired locally). 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 did occur, it will increase total economic benefit for Box Elder County.

Table 3: Operating and Maintenance Costs

	Project Size				
Operation and Maintenance	**10**	**20**	**30**	**50**	**Local Share**
Personnel					
Field Salaries	$44,398	$88,796	$133,194	$221,990	100%
Administrative	$11,684	$23,367	$35,051	$58,418	100%
Management	$35,051	$70,102	$105,153	$175,255	100%
Personnel Subtotal	***$91,133***	***$182,265***	***$273,398***	***$455,663***	
Materials and Services					
Vehicles	$1,636	$3,271	$4,907	$8,179	0%
Misc. Services	$4,673	$9,347	$14,020	$23,367	2%
Fees, Permits, Licenses	$1,636	$3,271	$4,907	$8,179	100%
Misc. Materials	$4,673	$9,347	$14,020	$23,367	100%
Insurance	$7,010	$14,020	$21,031	$35,051	0%
Fuel (gals)	$1,168	$2,337	$3,505	$5,842	100%
Tools and Misc. Supplies	$1,869	$3,739	$5,608	$9,347	4%
Spare Parts Inventory	$701	$1,402	$2,103	$3,505	0%
Materials and Services Subtotal	***$23,367***	***$46,735***	***$70,102***	***$116,837***	
Debt Payment (average annual)	***$1,508,000***	***$3,016,000***	***$4,524,000***	***$7,540,000***	***0%***
Equity Payment – Individuals	$0	$0	$0	$0	100%
Equity Payment – Corporate	$447,200	$894,400	$1,341,600	$2,236,000	0%
Property Taxes	$125,580	$251,160	$376,740	$627,900	100%
School Taxes	$82,667	$165,334	$248,001	$413,335	
Land Lease	$38,500	$77,000	$110,000	$187,000	100%
Total Annual Operating and Maintenance Costs	$2,233,780	$4,467,560	$6,695,840	11,163,400	

Table 3 Continued: Operating and Maintenance Costs

Operation and Maintenance	Project Size 10	20	30	50	Local Share
Financial Parameters					
Debt Financing					
Percentage financed	80%	80%	80%	80%	0%
Years financed (term)	10	10	10	10	
Interest rate	10%	10%	10%	10%	
Equity Financing					***0%***
Percentage equity	20%	20%	20%	20%	0%
Individual Investors (percent of total equity)	0%	0%	0%	0%	100%
Corporate Investors (percent of total equity)	100%	100%	100%	100%	0%
Return on equity (annual interest rate)	16%	16%	16%	16%	
Repayment term (years)	10	10	10	10	
Tax Parameters					
Local Property/Other Tax Rate (percent of taxable value)	0.97%	0.97%	0.97%	0.97%	
Assessed value (percent of construction cost)	100%	100%	100%	100%	
Taxable Value (percent of assessed value)	100%	100%	100%	100%	
Taxable Value	$13,000,000	$26,000,000	$39,000,000	$65,000,000	
Local Taxes	$125,580	$251,160	$376,740	$627,900	100%
School Taxes	$82,667	$165,334	$248,001	$413,335	
Land Lease Parameters	***10***	***20***	***30***	***50***	
Land Lease (per turbine)	$5,500	$5,500	$5,500	$5,500	
Land Lease (total cost)	$38,500	$77,000	$110,000	$187,000	
Lease Payment recipient (F = farmer/household, O = Other)	F	F	F	F	100%
Payroll Parameters	***Base Wage per Hour***	***Base Wage per Hour***	***Base Wage per Hour***	***Base Wage per Hour***	
Field Salaries (technicians, other)	$13.72	$13.72	$13.72	$13.72	
Administrative	$9.80	$9.80	$9.80	$9.80	
Management	$19.80	$19.80	$19.80	$19.80	

Table 4 provides the estimate of the number of full-time equivalent new jobs for Box Elder County for each of the four wind park scenarios. A 30-MW project is projected to directly create about three to four local jobs during construction (again, as a result of the limited availability of construction workers in Box Elder County). However, once operational, a 30-MW wind park should create 10 local full-time equivalent new jobs, five of which will be related to plant workers.

Table 4: Estimated Number of Full-time Equivalent New Jobs for Box Elder County

	Project Size MW			
New Jobs	**10**	**20**	**30**	**50**
During construction period				
Direct Impacts	0.7	1.3	2.0	3.3
Construction Sector Only	0.7	1.3	2.0	3.3
Indirect Impacts	0.2	0.5	0.7	1.2
Induced Impacts	0.3	0.6	0.8	1.4
Total Impacts (Direct, Indirect, Induced)	**1.2**	**2.3**	**3.5**	**5.9**
During operating years (annual)				
Direct Impacts	2.3	4.5	6.7	11.3
Plant Workers Only	1.7	3.4	5.0	8.4
Indirect Impacts	0.4	0.9	1.3	2.1
Induced Impacts	0.7	1.4	2.1	3.5
Total Impacts (Direct, Indirect, Induced)	**3.4**	**6.8**	**10.1**	**16.9**

Table 5 overviews the estimated total annual wage and salary earning in Box Elder County. A 30-MW wind project would generate almost $89,000 in direct, indirect, and induced wage and salary earnings during the construction phase. Once in operation, a 30-MW project would generate approximately $368,000 in direct, indirect, and induced wage and salary earnings annually.

Table 5: Total Annual Wage and Salary Earnings in Box Elder County

	Project Size (MW)			
Wage and Salary Earnings	**10**	**20**	**30**	**50**
During construction period				
Direct Impacts	$18,194	$36,389	$54,583	$90,972
Construction Sector Only	$18,194	$36,389	$54,583	$90,972
Indirect Impacts	$5,625	$11,251	$16,876	$28,126
Induced Impacts	$5,813	$11,625	$17,438	$29,063
Total Impacts (Direct, Indirect, Induced)	***$29,632***	***$59,264***	***$88,897***	***$148,161***
During operating years (annual)				
Direct Impacts	$98,058	$196,116	$292,512	$488,628
Plant Workers Only	$84,645	$169,290	$253,936	$423,226
Indirect Impacts	$10,336	$20,672	$30,667	$51,339
Induced Impacts	$14,960	$29,921	$44,642	$74,562
Total Impacts (Direct, Indirect, Induced)	***$123,354***	***$246,708***	***$367,821***	***$614,530***

Table 6 overviews the estimated total economic output from wind park development in Box Elder County. Taking into account direct, indirect, and induced impacts, a 30-MW wind park is expected to create about $313,000 of economic output during construction, and once operational, an annual economic output of more than $640,000.

Table 6: Estimated Total Economic Output from Wind Park Development

	Project Size (MW)			
Economic Output	**10**	**20**	**30**	**50**
During construction period				
Direct Impacts	$66,476	$132,952	$199,427	$332,379
Construction Sector Only	$66,476	$132,952	$199,427	$332,379
Indirect Impacts	$16,558	$33,116	$49,673	$82,789
Induced Impacts	$21,346	$42,692	$64,038	$106,730
Total Impacts (Direct, Indirect, Induced)	**$104,380**	**$208,759**	**$313,139**	**$521,898**
During operating years (annual)				
Direct Impacts	$128,676	$257,352	$380,595	$637,947
Indirect Impacts	$32,766	$65,532	$97,208	$162,739
Induced Impacts	$54,941	$109,882	$163,941	$273,822
Total Impacts (Direct, Indirect, Induced)	**$216,382**	**$432,764**	**$641,744**	**$1,074,509**

PART III: CONCLUSION

Our analysis indicates that the most promising economic opportunities for commercial wind development in Box Elder County center on the **generation of lease payments to local landowners**, **property tax revenues for local communities and schools**, and **construction/technical jobs** for local residents. Our findings parallel the experiences of wind development in rural agricultural communities in other states (Department of Energy 2004); in short, our analysis shows that commercial wind development and Box Elder County's agricultural community could be a winning combination.

Wind Power as Cash Crop: In recent years, farmers and ranchers have found it increasingly difficult to earn a living from traditional crops and cattle causing them to search for "off-farm" sources of income. Because wind turbines use only a small footprint of land, farmers and ranchers can continue their agricultural operations. Consequently, wind-energy development offers a unique economic benefit as a supplemental "on-farm" source of income. In fact, if the goal of the U.S. Department of Energy's Wind Powering America program for producing 5% of the nation's electricity from wind by 2020 is achieved, it will result in $60 billion of capital investment in rural communities, $1.2 billion of new income for rural landowners, and 80,000 new jobs for rural industry (Department of Energy 2004).

For Box Elder County, wind energy can be a new cash crop for farmers and ranchers. They can benefit directly from the development of wind resources in several ways including leasing their land to wind developers, developing their wind resources to offset energy usage and selling excess electricity to utilities (through Utah's net-metering service that requires local utilities to buy excess energy from users), or forming cooperatives to develop farmer-owned commercial projects. Land leases represent an easy and attractive way for farmers to reap economic benefits from wind power. Income from leases can provide a stable supplement to farmer income that can smooth variability in commodity prices. However, if the level of wind resources is not economically viable for commercial development, farmers may be able to generate their own electricity, just as their ancestors did in earlier times. Finally, as electric companies increasingly buy their power from independent producers rather than generating it themselves, rural landowners become part of the electric utility industry. USDA programs are available to provide grants and loans for farmers and ranchers who install wind projects (http://www.rurdev.usda.gov/rd/energy/).

Wind Power Can Fund Schools: Property tax payments from commercial wind parks, usually paid by the wind developer and not the landowner, can provide much needed revenue to Box Elder County for schools, roads, bridges, parks, and other community infrastructure. Schools in Box Elder County, in particular, can benefit from this increased tax base because approximately 50-70% of property taxes, depending upon the tax district, directly support local schools.

Commercial wind development, however, can benefit schools in other ways as well. Approximately 6% of Box Elder County land is owned by the state under the jurisdiction of the Utah School and Institutional Trust Land Administration. Though warranting anemometer testing, some trust lands may have developable wind resources, and lease payments from those lands would contribute to Utah's permanent school endowment fund.

Additionally, wind turbines on school property could generate power for schools, reduce energy costs, and provide schools new revenue streams. For example, surplus energy (during the summer months when school is not in session) could be sold to the utility grid and "green tags" (i.e., "credits" for generating clean, renewable energy) could be sold to utilities and companies that participate in market-based programs for reducing emissions. [8]

The idea of generating wind power on school property is not new. In 1993, for example, Iowa's Spirit Lake Community School District erected 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). 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 costs annually (ICLEI Energy Services 2005).

Utah County's Nebo School District tentatively approved a similar plan to situate a wind turbine on school property to generate electricity in 2004 (Warnock 2004). According to the former 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. A local advocate we interviewed reported that many local citizens disapproved of the idea of small turbines within the city limits, and the Nebo School District's wind power initiative stalled. However, in light of escalating energy prices, school and community leaders may be more willing to reconsider the project. For full consideration, anemometer testing of potential wind sites on Box Elder County school property is needed.

On balance, Box Elder County schools would benefit directly from local commercial wind development via increased tax revenues. Wind development on school trust lands and school property, however, could also provide new potential revenue streams as well.

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[8] Green tags are compliance accounting devices that show companies have supported the production of sufficient quantities of "clean energy" to off-set their pollution emissions from fossil fuel use. As concerns of climate change encourage public policies and market-based programs for companies and cities to reduce carbon dioxide emissions from the burning of fossil fuels, green tag markets are expected to proliferate in the coming years.

Construction and Technical Jobs: Many rural communities want to preserve their way of life and seek economic opportunities that raise local income levels without some of the environmental changes created by urbanization, such as sprawl and traffic congestion. That is, rural communities prefer to attract industry that offers some quality jobs rather than a large number of lower-paying jobs. Our analysis suggests that wind development in Box Elder County is attractive in that regard as it would create higher-paying construction and technical jobs for local residents.

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 (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 increase 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 (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.

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. 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.

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