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

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## Introduction

According to the American Wind Energy Association (AWEA), wind power development across the United States grew 50% in 2008, adding 8,358 megawatts (MW) of new generating capacity (enough to serve more than 2 million homes) and channeling approximately $17 billion of investment into the U.S. economy (AWEA Press Release 2009). That investment has resulted in job creation, lease payments to landowners, and increased tax revenues for local communities and schools. The current economic slowdown, however, has reduced prices for fossil fuels and curbed financing availability for wind energy (Strassel 2009). Consequently, the industry's growth is expected to slow in 2009 but still continue to grow.

Emerging national and state policies, nevertheless, are expected to foster wind energy's growth in Utah for the long term. Specifically, President Obama has called to double 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, Governor Jon M. Huntsman, Jr. has made a commitment to reduce Utah's carbon dioxide emissions and declared his desire to establish Utah as a renewable energy "hub" (KSL News 2009). During the 2009 legislative session, state lawmakers approved the creation of 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 select 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, but the businesses are anticipated to provide a return on this investment in the form of significant economic development for Utah. Additionally, lawmakers also approved the creation of a renewable energy authority that will have the power to issue bonds 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. Although a relatively small project of 18.9 MW of capacity, a Utah State University/U.S. Department of Energy study estimated that during construction, the wind power plant generated more than $4 million in economic activities to the state of 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 approximately $84,000 will support the Nebo School District (these tax revenue amounts represent a 70% reduction offered by the city of Spanish Fork as an incentive to procure the project granted for the first 10 years of operation). A second 203-MW wind project, called the Milford Wind Project, is now under construction in Beaver and Millard Counties and is expected to be online by year's end. The developer, First Wind, has

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

plans to expand the Milford Wind Project to incorporate 1,000 MW of capacity over the next few years (www.firstwind.com/projects/#ut 2009), and several additional wind projects by other developers have been proposed 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 (wind power is price stable and it reduces demand for other higher-cost fossil fuels, such as natural gas; additionally, wind energy will not be subject to carbon taxes or carbon restriction costs), and mitigate fossil fuels' environmental impacts (e.g., air and water quality, climate change) 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 have 20% of electricity derived from renewable resources by 2010, along with a policy calling for the reduction of carbon dioxide emissions by 25% by 2020 (Anderton 2006). The Milford Wind Project, for example, is exporting its electricity output to southern California markets. In short, federal and state investments and incentives are expected to foster wind power development in Utah, and state, county, and city policy makers are interested in understanding how wind power development may impact the state and their communities economically. This report attempts to address this issue for Summit County.

The economic analysis contained in this report focuses on the Porcupine Ridge site in Summit 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 National Renewable Energy Laboratory (NREL) to estimate the total economic impacts (labor, supply chain, and induced) that could result from the development of Porcupine Ridge. Findings detail how the Porcupine Ridge wind power plant could benefit the state in terms of job opportunities (during 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 four 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 provides an overview of considerations unique to Porcupine Ridge for wind power development. Part III includes the JEDI analysis for potential wind projects at Porcupine Ridge. Part IV describes some important implications and conclusions. An appendix provides details for the IMPLAN multipliers utilized by the JEDI model.

# Part I: Wind Power Trends in 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). Market and policy forces are likely to make wind energy increasingly more cost-competitive as emerging federal and regional policies to limit carbon emissions are likely to result in carbon taxes and/or cap-and-trade programs, increasing the cost of coal-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).

While the price of electricity from fossil-fueled generators varies according to the market cost of the fuel consumed, the main driver determining the price of wind power is the upfront capital cost of construction. Consequently, wind power 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). These factors make wind power's cost significantly more stable and predictable than the cost of power generated from fossil fuels. Consequently, power purchase agreements for wind power generation 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 a 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, 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 hard hit 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 West 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 the Porcupine Ridge site could impact Utah and Summit County economically.

# Part II: Porcupine Ridge

On February 29, 2008, a large group of Summit County and Park City officials, community leaders, and citizens (including Park City Mayor Dana Williams and County Commissioner Sally Elliott) attended Utah State University's "Sustainable Energy Research and Climate Initiatives Conference," sponsored by the Jon M. Huntsman School of Business's Renewable Energy for Rural Economic Development project (now named the Center for the Market Diffusion of Renewable Energy and Clean Technology). Prior to the conference, Park City set a community goal of having 15% of residents and business signed up to Rocky Mountain Power's renewable energy "Blue Sky" program, and approximately 10% of residents and businesses were Blue Sky subscribers as of March 31, 2008.[2] Discussions at the conference spurred Park City and Summit County officials' interest in the economic opportunities posed by Porcupine Ridge. This report is an outcome of that interest.

The Utah State Energy Program's anemometer loan program tested the wind resources at the Porcupine Ridge site. The Utah State Energy Program notes that the industry standard for commercial wind sites is generally a minimum speed of 12 miles per hour (mph) or greater when measured at 20 meters. According to the anemometer data, the average wind speed at the Porcupine Ridge site is approximately 13.75 mph at 20 meters and generally peaks between 10 a.m. and 9 p.m. (Brown 2009).

Utah's daily electricity consumption peaks in the afternoon and evening. Consequently, the characteristics of the wind at the Porcupine Ridge site are of particular interest because they correlate with the typical demand for power within the western transmission system. Further, wind power available during peak loads could help reduce the need for natural gas-fired power generation, one of the most price-volatile sources of electricity. One Utah wind developer estimates that up to 130 MW of wind capacity could be developed in the region. We used this size as an upper-limit scenario for our economic analysis.

Also of note for Porcupine Ridge, additional transmission lines would be required for this development, and the amount of transmission line required depends on the installation size. Because transmission costs would be incurred for any type of power plant, they are not included in this JEDI analysis.[3]

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[2] Information was provided via personal communication from Lori Hansen, Customer and Community Manager, Rocky Mountain Power, June 12, 2008.

[3] Significant transmission costs would impact both costs and benefits of a power project. First, they increase the overall cost of construction, potentially decreasing the profitability of the project. Second, they provide more income for the state for labor and materials, potentially increasing the economic impact projections reported here.

# Part III: Economic Evaluation Using JEDI

This section highlights the estimated state-level economic impact attributed to the development of the Porcupine Ridge in Summit 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 in spring 2008 from three sources: (1) the Summit 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).

**General overview of the JEDI model.** 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 and is considered the standard when analyzing the economic impacts of constructing and operating wind projects (Goldberg, Sinclair, and Milligan 2004). Users have the flexibility to enter either detailed or basic information about a wind project (i.e., state, construction year, and facility size) to estimate project impacts as they relate to costs (i.e., specific expenditures), income (i.e., wages and salaries), economic activity, and number of job opportunities that will accrue to the state or local region from the project. The more project-specific the data, the more localized the analysis.

JEDI enables users with limited experience with 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 base 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 2003). 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 base 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 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.[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 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 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 employment, wage and salary income, output (economic activity), and personal expenditures are derived from 2006 IMPLAN data.

The JEDI model contains default data for virtually 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 during the past 12 years. 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

[4] Previous versions of the JEDI model provided direct, indirect, and induced effects.

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:

Construction Cost Data:

- 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).

Operating Cost Data:

- 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 at Porcupine Ridge, Summit County, include:

**Year of Construction**: 2009

**Project Location**: Summit 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 five installation size scenarios: (1) 25 MW; (2) 50 MW; (3) 75 MW; (4) 100 MW; and (5) 130 MW.

**Turbine Size:** 2.5 MW are used for all five installation scenarios

**Project Construction Costs ($/kW):** Varies with installation size, ranging from $1,900 to $2,100 per kW

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

**Current Dollar Year:** 2009

**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 Porcupine Ridge Project

The results of the JEDI analysis are presented in the following series of tables. The following simplifying assumptions and inputs from local wind developers are incorporated into the analysis:

- 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 in jobs, earnings, and output apply to the economy in Utah overall. 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).
- 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 Summit 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 South Summit 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 $1.3 million in local spending would be incurred annually, which is the summation of $363,000 in maintenance costs spent locally, $800,000 in county property taxes (of which $631,000 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 Data Summary** | **Project Size (MW)** | | | | |
|---|---|---|---|---|---|
| | **25** | **50** | **75** | **100** | **130** |
| Project Location | UTAH | UTAH | UTAH | UTAH | UTAH |
| Year of Construction | 2009 | 2009 | 2009 | 2009 | 2009 |
| Total Project Size - Nameplate Capacity (MW) | 25 | 50 | 75 | 100 | 130 |
| Turbine Size (KW) | 2500 | 2500 | 2500 | 2500 | 2500 |
| Number of Turbines | 10 | 20 | 30 | 40 | 52 |
| Installed Project Cost ($/KW) | $2,104 | $2,002 | $1,951 | $1,900 | $1,900 |
| Annual Direct O&M Cost ($/KW) | $20 | $20 | $20 | $20 | $20 |
| Money Value (Dollar Year) | 2009 | 2009 | 2009 | 2009 | 2009 |
| Installed Project Cost | $52,598,330 | $100,091,870 | $146,322,741 | $190,041,243 | $247,053,616 |
| **Local Spending** | **$10,491,549** | **$18,779,356** | **$26,687,008** | **$33,998,026** | **$44,197,434** |
| Total Annual Operational Expenses | $8,906,418 | $17,004,252 | $24,902,083 | $32,401,963 | $42,122,552 |
| Direct Operating and Maintenance Costs | $500,000 | $1,000,000 | $1,500,000 | $2,000,000 | $2,600,000 |
| **Local Spending** | **$218,450** | **$363,287** | **$522,846** | **$667,683** | **$814,397** |
| Other Annual Costs | $8,406,418 | $16,004,252 | $23,402,083 | $30,401,963 | $39,522,552 |
| **Local Spending** | **$495,729** | **$950,435** | **$1,395,143** | **$1,819,760** | **$2,365,688** |
| Debt and Equity Payments | $0 | $0 | $0 | $0 | $0 |
| Property Taxes | $420,629 | $800,435 | $1,170,143 | $1,519,760 | $1,975,688 |
| School Taxes (South Summit School District portion of local taxes) | $331,738 | $631,279 | $922,857 | $1,198,589 | $1,558,166 |
| Land Lease | $75,000 | $150,000 | $225,000 | $300,000 | $390,000 |
| **Total Annual Local Spending** | **$714,079** | **$1,313,722** | **$1,917,989** | **$2,487,443** | **$3,180,085** |

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) | | | | | |
|---|---|---|---|---|---|---|
| **UTAH** | **25** | **50** | **75** | **100** | **130** | **Local Share** |
| **Equipment Costs** | | | | | | |
| Turbines | $22,481,237 | $43,952,481 | $65,010,863 | $85,089,829 | $110,616,777 | 0% |
| Blades | $5,263,166 | $10,289,879 | $15,219,935 | $19,920,696 | $25,896,904 | 0% |
| Towers | $5,827,077 | $11,392,366 | $16,850,642 | $22,055,056 | $28,671,573 | 0% |
| Transportation | $4,022,563 | $7,864,407 | $11,632,379 | $15,225,103 | $19,792,634 | 0% |
| **Equipment Subtotal** | **$37,594,042** | **$73,499,132** | **$108,713,818** | **$142,290,683** | **$184,977,888** | |
| **Balance of Plant** | | | | | | |
| Materials | | | | | | |
| Construction (concrete rebar, equip, roads, and site prep) | $5,432,339 | $10,620,625 | $15,709,147 | $20,561,004 | $26,729,305 | 90% |
| Transformer | $614,510 | $1,201,413 | $1,777,030 | $2,325,876 | $3,023,639 | 0% |
| Electrical (drop cable, wire) | $647,735 | $1,266,370 | $1,873,110 | $2,451,630 | $3,187,119 | 100% |
| HV line extension | $1,183,196 | $2,313,236 | $3,421,547 | $4,478,311 | $5,821,804 | 70% |
| Materials Subtotal | $7,877,781 | $15,401,644 | $22,780,834 | $29,816,821 | $38,761,867 | |
| Labor | | | | | | |
| Foundation | $803,784 | $1,002,162 | $1,124,170 | $1,165,298 | $1,514,887 | 95% |
| Erection | $910,399 | $1,135,091 | $1,273,282 | $1,319,865 | $1,715,825 | 75% |
| Electrical | $1,326,726 | $1,654,169 | $1,855,555 | $1,923,441 | $2,500,473 | 70% |
| Management/supervision | $688,441 | $858,352 | $962,851 | $998,077 | $1,297,500 | 0% |
| Misc. | $1,995,000 | $3,800,000 | $5,557,500 | $7,220,000 | $9,386,000 | 50% |
| Labor Subtotal | $5,724,350 | $8,449,774 | $10,773,357 | $12,626,681 | $16,414,686 | |
| Development/Other Costs | | | | | | |
| HV Sub/Interconnection | | | | | | |
| Materials | $373,344 | $729,951 | $1,079,630 | $1,413,079 | $1,837,003 | 90% |
| Labor | $114,363 | $223,587 | $330,712 | $432,854 | $562,710 | 10% |
| Engineering | $508,028 | $993,232 | $1,469,106 | $1,922,847 | $2,499,701 | 0% |
| Legal Services | $276,875 | $541,311 | $800,663 | $1,047,952 | $1,362,337 | 100% |
| Land Easements | | | | | | 100% |
| Site Certificate | $129,547 | $253,274 | $374,622 | $490,326 | $637,424 | 100% |
| Other Subtotal | $1,402,156 | $2,741,319 | $4,054,732 | $5,307,058 | $6,899,175 | |
| **Balance of Plant Subtotal** | **$15,004,287** | **$26,592,737** | **$37,608,923** | **$47,750,560** | **$62,075,728** | |
| **Total Project Costs** | **$52,598,330** | **$100,091,870** | **$146,322,741** | **$190,041,243** | **$247,053,616** | |

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) | | | | | |
|---|---|---|---|---|---|---|
| | 25 | 50 | 75 | 100 | 130 | Local Share |
| **Labor Costs** | | | | | | |
| **Personnel** | | | | | | |
| Field Salaries | $109,259 | $131,702 | $197,552 | $263,403 | $342,424 | 100% |
| Administrative | $10,536 | $21,072 | $31,608 | $42,144 | $36,525 | 100% |
| Management | $43,901 | $87,801 | $105,361 | $105,361 | $91,313 | 100% |
| Labor/Personnel Subtotal | $164,188 | $240,575 | $334,522 | $410,909 | $470,262 | |
| **Materials and Services** | | | | | | |
| Vehicles | $9,593 | $21,695 | $33,295 | $45,396 | $60,841 | 100% |
| Misc. Services | $3,741 | $8,461 | $12,985 | $17,704 | $23,728 | 80% |
| Fees, Permits, Licenses | $1,871 | $4,230 | $6,492 | $8,852 | $11,864 | 100% |
| Misc. Materials | $7,483 | $16,922 | $25,970 | $35,409 | $47,456 | 100% |
| Insurance | $71,949 | $162,711 | $249,710 | $340,471 | $456,307 | 0% |
| Fuel (motor vehicle gasoline) | $3,741 | $8,461 | $12,985 | $17,704 | $23,728 | 100% |
| Tools and Misc. Supplies | $24,319 | $54,996 | $84,402 | $115,079 | $154,232 | 100% |
| Spare Parts Inventory | $213,114 | $481,949 | $739,640 | $1,008,475 | $1,351,582 | 2% |
| Materials and Services Subtotal | $335,812 | $759,425 | $1,165,478 | $1,589,091 | $2,129,738 | |
| **Debt Payment (average annual)** | $6,101,406 | $11,618,376 | $16,973,438 | $22,044,784 | $28,658,219 | 0% |
| **Equity Payment – Individuals** | $0 | $0 | $0 | $0 | $0 | 100% |
| **Equity Payment – Corporate** | $1,809,383 | $3,443,160 | $5,033,502 | $6,537,419 | $8,498,644 | 0% |
| **Property Taxes** | $420,629 | $800,435 | $1,170,143 | $1,519,760 | $1,975,688 | 100% |
| **School Taxes** (South Summit School District portion of local taxes) | $331,738 | $631,279 | $922,857 | $1,198,589 | $1,558,166 | 100% |
| **Land Lease** | $75,000 | $150,000 | $225,000 | $300,000 | $390,000 | 100% |
| **Total Annual Operating and Maintenance Costs** | $8,906,418 | $17,011,971 | $24,902,083 | $32,401,963 | $42,122,552 | |

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 Summit 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 .7997%. Total construction cost for a 50-MW installation is about $100 million. Assessed at 100% taxable value, total projected annual county revenues is about $800,000, of which $631,000 would be directed to the local school district.

# Table 4: Other Parameters

| | Project Size (MW) | | | | | |
|---|---|---|---|---|---|---|
| | **25** | **50** | **75** | **100** | **130** | **Local Share** |
| **Financial Parameters** | | | | | | |
| **Debt Financing** | | | | | | |
| Percentage financed | 80% | 80% | 80% | 80% | 80% | 0% |
| Years financed (term) | 10 | 10 | 10 | 10 | 10 | |
| Interest rate | 10% | 10% | 10% | 10% | 10% | |
| **Equity Financing** | 0% | 0% | 0% | 0% | 0% | |
| Percentage equity | 20% | 20% | 20% | 20% | 20% | |
| Individual Investors (percent of total equity) | 0% | 0% | 0% | 0% | 0% | 100% |
| Corporate Investors (percent of total equity) | 100% | 100% | 100% | 100% | 100% | 0% |
| Return on equity (annual interest rate) | 16% | 16% | 16% | 16% | 16% | |
| Repayment term (years) | 10 | 10 | 10 | 10 | 10 | |
| **Tax Parameters** | | | | | | |
| Local Property/Other Tax Rate (percent of taxable value) | 0.7997% | 0.7997% | 0.7997% | 0.7997% | 0.7997% | |
| Assessed value (percent of construction cost) | 100% | 100% | 100% | 100% | 100% | |
| Taxable Value (percent of assessed value) | 100% | 100% | 100% | 100% | 100% | |
| Taxable Value | $52,598,330 | $100,158,411 | $146,322,741 | $190,041,243 | $247,053,616 | |
| Taxes Per MW | $11,120 | $11,120 | $11,120 | $11,120 | $11,120 | |
| Local Taxes | $420,629 | $800,435 | $1,170,143 | $1,519,760 | $1,975,688 | 100% |
| School Taxes (included in Property Taxes) | $331,738 | $631,279 | $922,857 | $1,198,589 | $1,558,166 | |
| **Land Lease Parameters** | | | | | | |
| Land Lease Cost (per turbine) | $7,500 | $7,500 | $7,500 | $7,500 | $7,500 | |
| Land Lease (total cost) | $75,000 | $150,000 | $225,000 | $300,000 | $390,000 | |
| Lease Payment recipient (F = farmer/household, O = Other) | F | F | F | F | F | 100% |
| **Payroll Parameters** | | | | | | |
| **Construction Labor (Average Hourly Wage)** | | | | | | **Employer Payroll Costs** |
| Foundation | $16.86 | $16.86 | $16.86 | $16.86 | $16.86 | 37.6% |
| Erection | $19.10 | $19.10 | $19.10 | $19.10 | $19.10 | 37.6% |
| Electrical | $25.30 | $25.30 | $25.30 | $25.30 | $25.30 | 37.6% |
| Management/ Supervision | $34.39 | $34.39 | $34.39 | $34.39 | $34.39 | 37.6% |

| O&M Labor (Average Hourly Wage) | | | | | | Employer Payroll Costs |
|---|---|---|---|---|---|---|
| Field Salaries (technicians, other) | $23.01 | $23.01 | $23.01 | $23.01 | $23.01 | 37.6% |
| Administrative | $14.72 | $14.72 | $14.72 | $14.72 | $14.72 | 37.6% |
| Management | $36.81 | $36.81 | $36.81 | $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 Summit County. This captures some of the broader state-level effects such as manufacturing and construction assets not necessarily available in Summit 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 290. During operating years, the wind park would produce three job opportunities on-site, with a total on-site, supply chain, and induced impact of 15 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) | | | | |
|---|---|---|---|---|---|
| | **25** | **50** | **75** | **100** | **130** |
| **During construction period** | | | | | |
| Project Development & On-Site Labor | 43 | 55 | 63 | 67 | 87 |
| Onsite Construction Labor | 41 | 51 | 58 | 60 | 78 |
| Onsite Construction Related Services | 2 | 3 | 5 | 7 | 9 |
| Turbine & Supply Chain | 87 | 166 | 242 | 314 | 409 |
| Induced Impacts | 39 | 69 | 99 | 125 | 163 |
| **Total Impacts** | **169** | **290** | **404** | **506** | **658** |
| **During operating years (annual)** | | | | | |
| On-site Labor | 2 | 3 | 5 | 6 | 7 |
| Local Revenue & Supply Chain | 3 | 5 | 7 | 9 | 12 |
| Induced Impacts | 4 | 7 | 11 | 14 | 18 |
| **Total Impacts** | **9** | **15** | **23** | **29** | **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 $622,000 during operation. Due to rounding, numbers in the tables may not sum accurately.

## Table 6: Estimated Annual Wage and Salary Earnings

| | Project Size (MW) | | | | |
|---|---|---|---|---|---|
| | **25** | **50** | **75** | **100** | **130** |
| **During construction period** | | | | | |
| Project Development & On-site Labor | $2,472,843 | $3,152,379 | $3,604,453 | $3,813,278 | $4,957,262 |
| Onsite Construction Labor | $2,385,332 | $2,981,290 | $3,351,393 | $3,482,059 | $4,526,676 |
| Onsite Construction Related Services | $87,510 | $171,089 | $253,060 | $331,219 | $430,585 |
| Turbine & Supply Chain | $3,096,976 | $5,882,700 | $8,592,922 | $11,154,355 | $14,500,661 |
| Induced Impacts | $1,220,583 | $2,180,537 | $3,095,805 | $3,941,318 | $5,123,713 |
| **Total Impacts** | **$6,790,402** | **$11,215,616** | **$15,293,179** | **$18,908,951** | **$24,581,637** |
| **During operating years (annual)** | | | | | |
| On-site Labor | $152,500 | $223,449 | $310,708 | $381,658 | $436,786 |
| Local Revenue & Supply Chain | $89,452 | $167,427 | $247,390 | $324,856 | $414,460 |
| Induced Impacts | $124,841 | $230,841 | $336,787 | $436,469 | $559,914 |
| **Total Impacts** | **$366,793** | **$621,718** | **$894,886** | **$1,142,982** | **$1,411,159** |

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 $2.4 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) | | | | |
|---|---|---|---|---|---|
| | **25** | **50** | **75** | **100** | **130** |
| **During construction period** | | | | | |
| Project Development & On-site labor | $2,663,414 | $3,524,961 | $4,155,545 | $4,534,578 | $5,894,951 |
| Turbine & Supply Chain | $10,730,315 | $20,449,141 | $29,913,614 | $38,867,961 | $50,528,349 |
| Induced Impacts | $4,002,890 | $7,151,051 | $10,152,662 | $12,925,514 | $16,803,169 |
| **Total Impacts** | **$17,396,619** | **$31,125,152** | **$44,221,820** | **$56,328,053** | **$73,226,469** |
| **During operating years (annual)** | | | | | |
| On-site Labor | $152,500 | $223,449 | $310,708 | $381,658 | $436,786 |
| Local Revenue & Supply Chain | $753,737 | $1,408,761 | $2,064,238 | $2,687,373 | $3,453,115 |
| Induced Impacts | $409,415 | $757,042 | $1,104,491 | $1,431,394 | $1,836,232 |
| **Total Impacts** | **$1,315,652** | **$2,389,253** | **$3,479,437** | **$4,500,425** | **$5,726,133** |

# Part IV: Discussion and Conclusions

## Economic Benefits Summary

In summary, our economic projections indicate that development of Porcupine Ridge's wind resources 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 annually generate $631,000 in property tax revenues for Summit 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 are increasingly encouraging 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.[5] 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 2008). It is important for wind developers and

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

supporters to identify core values of a community such as school funding and frame wind power's benefits to align with those values.

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 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 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 of 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 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 or 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; these multipliers for employment, wage and salary income and output (economic activity), and personal expenditure come from IMPLAN (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 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 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 which will impact the region of interest, and then uses the IMPLAN multipliers from that region to determine how much impact that portion of the spending will have via the labor, supply chain, and induced impacts discussed previously in the introduction to the JEDI model.

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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