

Economic Development Impacts of Colorado's First 1000 Megawatts of Wind Energy

S. Reategui and S. Tegen
National Renewable Energy Laboratory

*Presented at WINDPOWER 2008
Houston, Texas
June 1-4, 2008*

Conference Paper
NREL/CP-500-43505
August 2008

NREL is operated by Midwest Research Institute • Battelle Contract No. DE-AC36-99-GO10337



NOTICE

The submitted manuscript has been offered by an employee of the Midwest Research Institute (MRI), a contractor of the US Government under Contract No. DE-AC36-99GO10337. Accordingly, the US Government and MRI retain a nonexclusive royalty-free license to publish or reproduce the published form of this contribution, or allow others to do so, for US Government purposes.

This report was prepared as an account of work sponsored by an agency of the United States government. Neither the United States government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or any agency thereof.

Available electronically at <http://www.osti.gov/bridge>

Available for a processing fee to U.S. Department of Energy and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
phone: 865.576.8401
fax: 865.576.5728
email: <mailto:reports@adonis.osti.gov>

Available for sale to the public, in paper, from:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
phone: 800.553.6847
fax: 703.605.6900
email: orders@ntis.fedworld.gov
online ordering: <http://www.ntis.gov/ordering.htm>



Acknowledgements

The authors would like to thank the wind power developers, local lawyers, county commissioners, and industry experts who participated in this project for taking the time to answer our questions and for reviewing our results. Although their names will remain confidential, we acknowledge that this report would not have been possible without their support. We are also grateful for the valuable suggestions and thorough review from Michael Milligan and Marshall Goldberg.

Table of Contents

Acknowledgements	1
Executive Summary	3
Introduction	4
Methodology	5
Results	8
Manufacturing Potential	12
Concluding Remarks	17
References	18
Appendices	20

Executive Summary

A confluence of events has ignited a soaring growth in the number of wind power installations in Colorado in recent years. State and federal incentives, growing environmental concerns, and economic development opportunities are among the motives that spurred wind power installations from 291 megawatts (MW) of nameplate capacity in 2006 to 1,067 MW (nameplate capacity) in 2007.

According to the *Annual Rankings Report* by the American Wind Energy Association (AWEA), Colorado is the second-fastest-growing wind energy producer in the United States (Texas is first). In terms of resource potential, Colorado currently ranks 11th out of all 50 states (AWEA, January 2008). A report of the Task Force on Renewable Resource Generation Development Areas has identified eight wind generation development areas in Colorado, with the combined potential to generate 96,000 MW or 96 gigawatts (GW) of capacity (Renewable Resource Generation Development Areas Task Force, 2007).

Colorado Wind Power Statistics, January 2008 Source: AWEA (as of 01/16/2008)

COLORADO	
Power Capacity - Existing Projects (MW):	1,066.75
U.S. Rank (by Existing Capacity):	6
U.S. Rank (by Potential Capacity):	11

Due to the vast resource capacity and the sudden wind power development, it is pertinent to analyze the economic impact that 1,000 MW have already generated in Colorado. These impacts can be scaled to obtain a sense of the economic development opportunities associated with other new wind scenarios, including the 20% Wind Energy by 2030 scenario (U.S. Department of Energy, 2008). Furthermore, this report can be used by interested parties in other states that currently lack a Renewable Portfolio Standard (RPS) as an example of the potential economic impacts if they were to adopt 1,000 MW of wind power development. Of course, each state has unique resource constraints, characteristics, and policies. Information such as property tax values, land leases, and manufacturing bases would have to be substituted depending on local information.

According to this analysis, 1,000 MW of wind power development in the state of Colorado:

- Generates electricity to power more than 248,000 homes (11.8% of Colorado housing units in 2006¹)
- Generated approximately 1,700 full-time-equivalent jobs during construction periods with a total payroll of more than \$71.3 million (2008 dollars)

¹ According to the U.S. Census Bureau

- Supports approximately 300 permanent jobs in rural Colorado areas with a total annual payroll of \$14.7 million (2008 dollars)
- Generated \$226.4 million in economic activities from the construction period only (2008 dollars)
- Generates \$34.9 million in annual local economic activities (2008 dollars)
- Generates \$4.6 million in annual property taxes² (2008 dollars)
- Generates more than \$2.5 million annually in extra income for farmers and ranchers who lease their land to developers (2008 dollars).

Introduction

Due to a growing U.S. population, an increased demand for energy, recent water shortages, migration trends from rural areas, and energy price uncertainty, it is imperative that each state takes the necessary steps toward a more secure energy future that can provide an affordable and dependable energy supply while meeting society's economic development and environmental expectations.

In taking some of the steps toward a secure energy future, Colorado has enacted state incentives and a Renewable Portfolio Standard (RPS), which foment the production of renewable sources. Currently, wind power is the fastest-growing renewable resource. In fact, large utility-scale wind projects are thought to ameliorate some of the national concerns previously mentioned because they not only bolster new jobs in the nation, but they also do so in rural communities where there is a need for job retention and diversification amid an economic slump intensified by high levels of rural migration. Wind power projects also generate tax revenues that are used to improve schools and other public services, which in turn improve the quality of life in rural areas. Local landowners also receive extra income in the form of land lease payments from wind turbines located on their land.

This report attempts to supply the reader with information on the economic benefits that 1,000 MW brings to the state of Colorado. The focus is on jobs³, land lease payments, tax revenue, payroll, and business activities that are spurred as a result of constructing and operating 1,000 MW of wind power in Colorado.

The report begins with a description of the methodology and the data used in calculating the economic impacts of 1,000 MW of wind power in Colorado. Next, it discusses and interprets results of the analysis. The report does not compare wind to other resources or

² Because tax payments vary every year, the annual property tax calculation is based on the average annual payment over a 20-year period. See the Property Tax Revenue Impact section.

³ This report did not analyze net jobs; it examined gross jobs supported by new wind development. In some cases, workers may have worked in another industry and switched to the wind industry, or they may have had a job in a wind-related industry. As long as the previous industry replaces that person, if a worker switches jobs it is still a new job supported by the wind industry. There is only a "net" loss if the previous industry doesn't replace that person.

industries, nor does it present net jobs or net economic data. It simply addresses the jobs and economic activity supported by the first 1,000 MW of utility-scale wind in Colorado. This report does not cover costs or benefits to electricity consumers. Instead, it is based on the impact specific wind projects have had on the state's economy.

Methodology

The Jobs and Economic Development Impact (JEDI) Model

The Jobs and Economic Development Impact (JEDI) model, developed by Marshall Goldberg for the National Renewable Energy Laboratory, calculates the number of jobs and the amount of money spent on salaries and economic activities generated in a specific location from the construction and operation of a wind power plant. The JEDI Wind Energy Model can be downloaded at <http://www.nrel.gov/analysis/jedi>.

The model relies on region-specific data pertaining to existing industries and inter-industry relations at the local level, where the output of one industry serves as input for another. Data are supplied by Minnesota Implan Group Inc. and are state-specific multipliers. Multipliers are economic indicators of the number of times a dollar circulates in an economy (Silverstein, 2006). For instance, one dollar is transferred from the hands of a wind power developer to the construction company when a construction contract is signed; the construction company uses part of that dollar to pay construction workers. Finally, construction workers use their payroll checks to purchase local goods and services such as food at local restaurants, clothing, haircuts, etc. Therefore, money spent initially by the developer ripples through the economy in a series of transactions, creating a "ripple effect."

In addition to the multipliers, the model uses construction cost data, operating cost data, and data pertaining to the percentage of goods and services acquired in the state. Jobs, payroll value, and economic activities are calculated using this information. These results are divided into two periods: construction (considered to last 1 year) and operation (recurring annual impacts for the life of the project) and are placed within the framework of the direct, indirect, and induced impacts.

Direct Impacts:

The direct impacts are the on-site and off-site effects pertaining to the construction and operation of the wind power plant. These impacts include the number of jobs (e.g., engineers, construction workers, managers, lawyers, etc.), their corresponding payroll salaries, and economic activities (generated from purchasing materials and equipment for the road construction, wind turbine foundation, electrical collection, installation, and turbine manufacturing) supported by the initial spending of the wind farm.

Indirect Impacts:

The initial spending on the construction and operation of the wind farm creates a second layer of impacts. For instance, when the construction company purchases input materials, it uses the outputs of other companies. These other companies in turn pay their workers and purchase goods and services from other industries. An example of an indirect impact

is the job of a steel company employee who works on the materials needed by the wind plant construction worker. Wind power projects indirectly support these types of jobs, their corresponding salaries, and economic activities, providing the indirect impacts of the wind power project.

Induced Impacts:

The initial spending on the construction and operating activities along with the indirect business activities support jobs and provide payroll to employees. Employees then spend their paychecks on local goods and services, such as at restaurants and clothing stores. This is local spending induced from employees working directly or indirectly on the wind power project who were able to receive and spend their paychecks. Their consumption supports local jobs and local economic activities above and beyond what they would have purchased without the extra income from the jobs related to the wind installation. Employee spending on local goods and services is considered an induced effect.

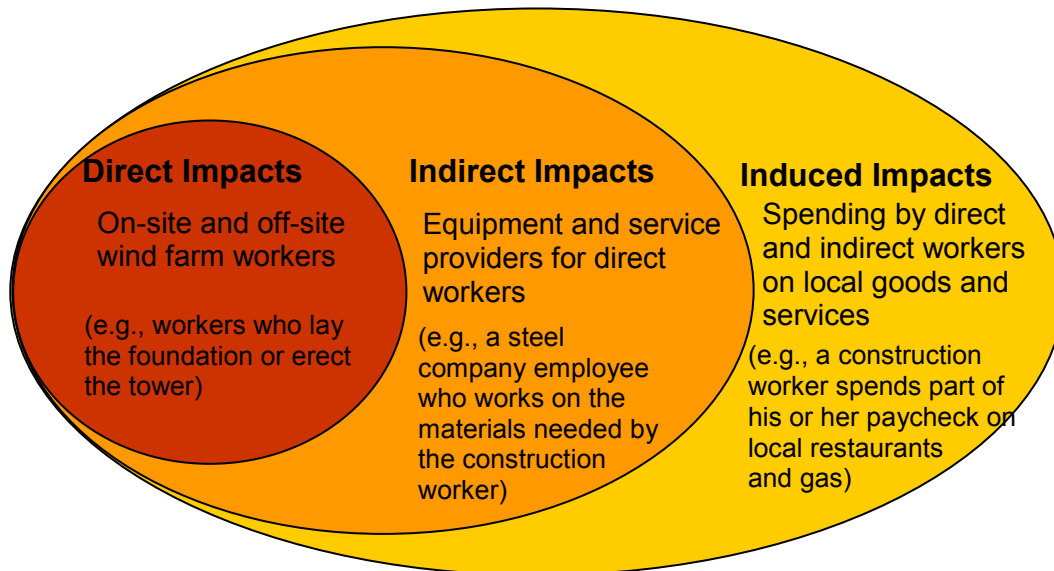


Figure 1: Ripple Effect as portrayed by the Jobs and Economic Development Impacts (JEDI) Model

Although the JEDI model default data include construction cost figures, operating cost figures, and percentages of goods and services acquired in the state, project-specific data were gathered to attain more localized impact results.

Research Data

We obtained a list of Colorado’s wind power projects from the American Wind Energy Association (AWEA) and the Global Energy Concepts (GEC) databases. The project lists contained information regarding wind project location, completion status, year online,

size, turbine manufacturer, owner, number of turbines, and turbine size. Data were collected for nine wind projects, but only Colorado's six largest projects adding up to nearly 1,000 MW of wind (998 MW to be exact) were the focus of this study.

Preliminary background research for each of the projects consisted of collecting media information and corporate press releases. This provided an indication of the construction cost and the economic impacts some of these projects generate in Colorado. Developers and others later verified the information from the media.

Extensive interviews were conducted with developers, lawyers, county commissioners, stakeholders, and other industry experts. Data gathered from interviews included construction cost, operation and maintenance cost, percentage of goods and services acquired in-state, job generation during the construction period, job generation during the operating period, land lease payments, tax information, payroll parameters, and cost breakdown of different categories based on project cost percentages.

It is important to note, however, that because JEDI model inputs consist of detailed information considered proprietary, the amount and quality of the information obtained varied from project to project. Thus in some instances, we used anecdotal information, data extrapolation, and literature reviews.

The JEDI model was used to calculate economic impacts of each of Colorado's six largest wind power projects. Appropriate adjustments to the model (cost information, local share values, and job creation numbers) were made to mirror verified data obtained from interviews. Individual economic impacts were then aggregated to reflect combined impacts from 1,000 MW.

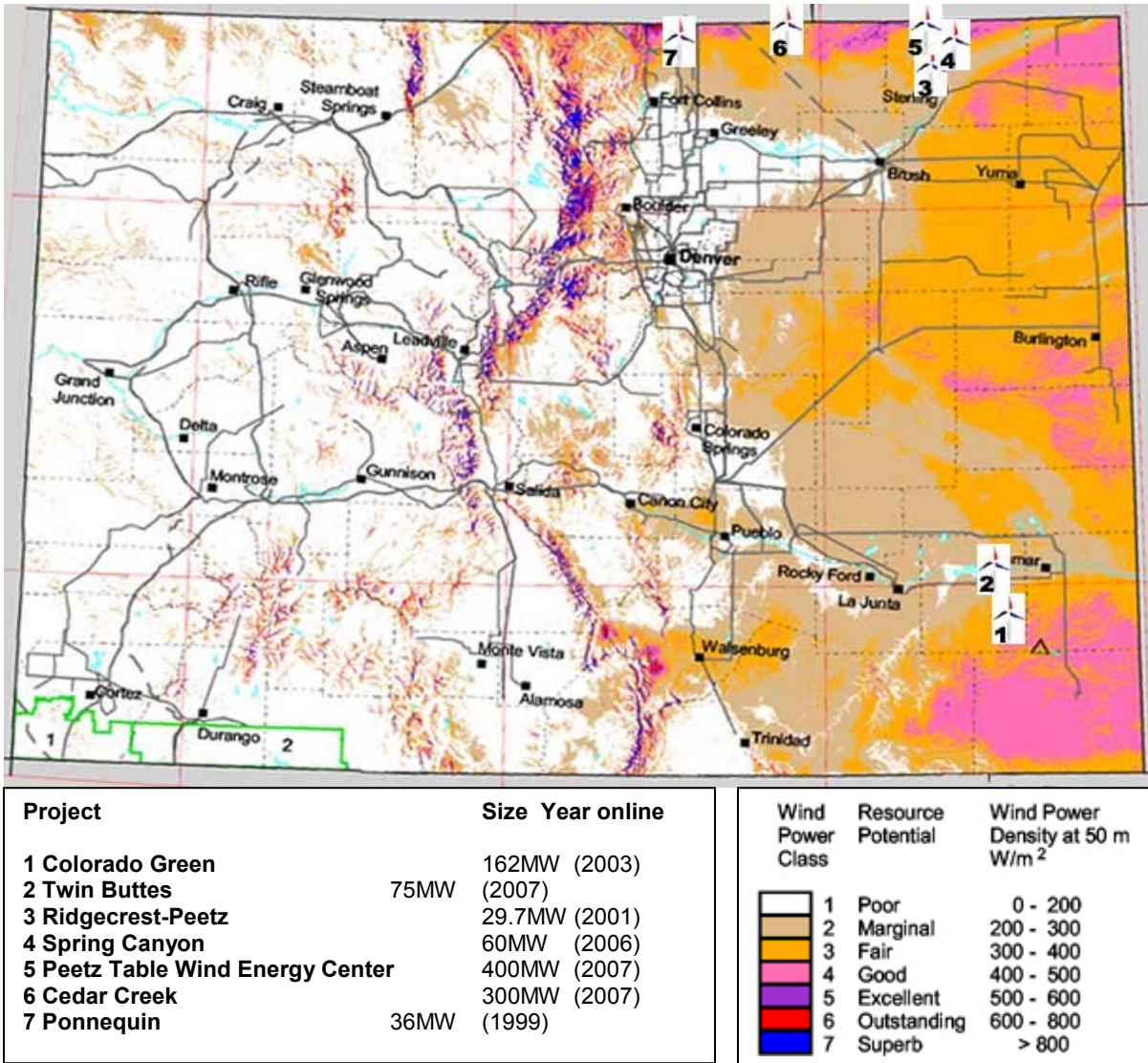


Figure 2: Colorado Wind Project Locations

Results

The study results show significant economic impacts from 1,000 MW of wind energy development. We show the impacts on employment, property tax, landowner revenue, and local economic activities during the construction and operational periods.

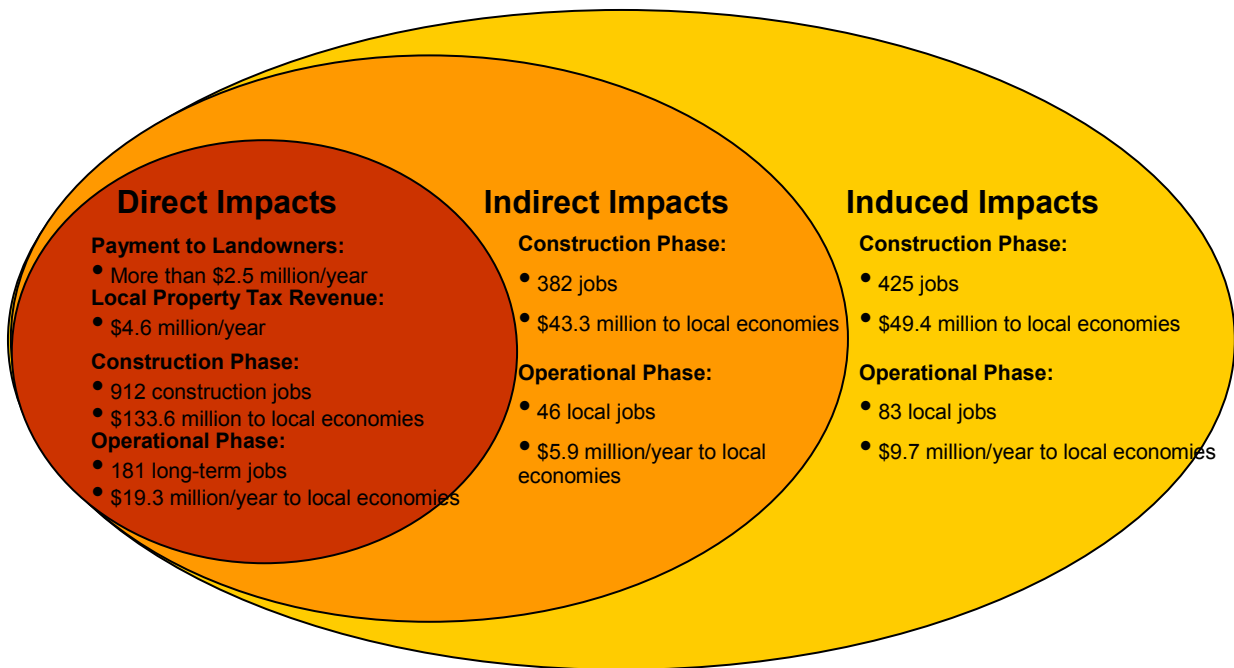


Figure 3: Economic Ripple Effect from 1,000 MW of Wind Energy Development in Colorado

Employment Impacts

Most of the direct jobs related to the construction and operation of wind power plants require skilled professionals in the fields of engineering, construction, management, and manufacturing. These are well-paid positions that boost economic development in rural communities where new employment opportunities are welcome due to economic downturns.

This analysis showed that most positions related to the construction and operation of wind power plants in Colorado currently offer salaries ranging from \$29,000 to \$90,000. These are competitive payroll earnings, especially in areas such as Bent County (home to one of the wind power projects in this study), where more than 20% of the population is considered to live below poverty levels⁴.

Construction Jobs

A typical wind farm construction period lasts between 6 to 12 months. During that period, a number of construction workers, engineers, administrative employees, and managers move to town, boosting local economic activities. Locally employed workers may work directly on the new wind project, depending on the skill set in the area. According to our interviews with developers, certain contracts require that a percentage of workers be hired from the area where the wind power project is developed. For the six wind farms analyzed, 75% to 85% of construction workers were Colorado residents. Certain positions related to electrical collection system and management require labor

⁴ According to the U.S. Census Bureau (2004 data). State and County Quickfacts: Bent County, CO

outsourcing from other states such as California and Wyoming, or even from other countries, such as Denmark.

This research suggests that 1,000 MW of wind power development supports approximately 1,700 full-time-equivalent jobs in Colorado rural areas with a total payroll of more than \$70 million during the construction phase of new wind projects.

Operation and Maintenance Jobs

When the wind farm goes online, it needs permanent employees to operate and maintain the facility during its 20- to 30-year expected life. These permanent positions are also well-paid positions, the majority of which are filled by Coloradoans or by people who relocate to Colorado.

In counties such as Bent, where the population is estimated at 5,551 inhabitants⁵ (2006) and population declined by 7.5% between 2000 to 2006⁶, the number of permanent jobs generated by the wind industry sector contributes significantly to combat depopulation trends.

This research shows that 1,000 MW of wind energy capacity in the state of Colorado supports approximately 300 permanent jobs in Colorado rural areas with a total annual payroll of more than \$14 million.

Although most operation and maintenance jobs are 100% local, at least one developer alleged to outsource some of the wind project's routine maintenance operations from out-of-state by bringing in a technician to Colorado twice a year.

Property Tax Revenue Impacts

Wind energy projects also increase the property tax revenue base in local counties, which in turn is used to improve local schools, parks, recreational facilities, community programs, fire departments, and other public services in rural communities.

So far, Colorado's six largest projects have generated approximately \$23.8 million in property taxes (2008 dollar value) from the time these projects came online. In 2008 alone, these projects generated approximately \$9.6 million in property tax revenue.

In Colorado, property taxes vary dramatically from year to year, and the highest burden of taxation is borne during the first years of project operation (especially for projects that went online prior to 2006, which are not subject to the new taxation procedure). Using the average annual tax payments over the life of the wind farm project (assumed to be 20 years) offers a more accurate picture of the potential annual impacts in Colorado.

⁵ U.S. Census Bureau

⁶ U.S. Census Bureau

This research shows that across Colorado, the average annual tax payment over a 20-year expected project life period is \$4,800 per MW per year (in current 2008 dollar value)⁷. Colorado's six largest projects alone generate \$4.6 million in average annual property taxes (in 2008 dollars)⁸.

In certain counties, an increased tax base may not always increase the funds allocated to public services such as the local school district. If that is the case, then the tax generated from the wind power project may lower the local mil levy, which can result in substantial savings for taxpayers in the district where the wind farm is located.

Landowner Revenue Impacts

Land leases provide a stable source of income for farmers and ranchers who lease their land to wind developers. Most of the land leases in Colorado are negotiated as a percentage of revenue (royalty) based on power purchase agreements (PPAs). There are different types of payment schemes, but according to this research, most of the land lease payments in Colorado are paid at 2.5% - 3.5% of revenue, which escalates annually, potentially reaching up to 6% by the 25th year the project is in operation.

Although wind power projects occupy several acres of land, the actual footprint of the wind turbine is small, allowing farmers to continue to grow their crops or graze their cattle even though turbines are on the land. Furthermore, there are other economic opportunities for landowners in the form of road access payments (land easements), and land lease revenues for O&M buildings and substations. These could be one-time payments or annual payments that could represent \$2,000 per year or as much as \$200 per acre per year.

This research suggests that across Colorado, land lease revenue is on average \$2,400 per MW per year, which is between \$1,800-\$4,800 per turbine. Colorado's six largest projects (totaling 1,000 MW) generate more than \$2.5 million annually in extra income for farmers and ranchers who lease their land to developers.

Some projects in Colorado are sited on land owned by the government. In these cases, land lease revenue is used to improve public services. A report by the U.S. Government Accountability Office found that Colorado received \$40,763 in 2003 from the lease of 942 acres of land, where 23 of the 44 turbines belonging to the Ponnequin wind power plant are located.

Economic Activities Impacts

As previously mentioned, the construction and operation of a wind power plant is the catalyst for several economic activities in Colorado. From the houses that are rented in town to host the influx of construction workers, to the suppliers and transportation

⁷ \$5,676 in nominal dollars

⁸ \$5.3 million in nominal dollars

companies that provide services to the wind farm, wind power development generates a benefit to the state economy.⁹

This research found that 1,000 MW of wind power developed in Colorado generated approximately \$225 million in economic activities (\$133.6 million in direct economic activities) during the construction phase and approximately \$35 million in annual recurring local economic activities (of which \$19.3 million relate to direct economic activities).

Other Impacts

New wind power installations offer other benefits, such as use tax generation, sales tax generation, transmission line impacts, water savings, price stability, and environmental benefits. Despite their importance, this report does not focus on these additional outcomes.

Manufacturing Potential

Although Colorado did not benefit from wind-related manufacturing jobs until recently, it is pertinent to analyze the potential economic impacts associated with local wind component manufacturing, especially now that Colorado is experiencing growth in this sector.

Based on the number of megawatts installed, manufacturing company General Electric has the greatest market share in Colorado (73.5%), followed by Mitsubishi (20.7%), NEG Micon (5%), and Vestas (0.9%). However, none of these companies manufactured turbines in Colorado until March 2008, when Vestas opened a blade facility in Windsor. Therefore, any jobs related to turbine manufacturing represent economic leakages for the first 1,000 MW in Colorado. In all cases, the economic benefit from manufacturing went to foreign countries such as India, China, Denmark, Germany and Brazil, or states other than Colorado. This may not be the case in the future because blades are currently being manufactured in the state. Vestas has announced it will expand its manufacturing facilities in Colorado in the coming years.¹⁰

⁹ This report did not analyze net jobs; it examined gross jobs supported by new wind development. In some cases, workers may have worked in another industry and switched to the wind industry, or they may have had a job in a wind-related industry. As long as the previous industry replaces that person, if a worker switches jobs it is still a new job supported by the wind industry. There is only a “net” loss if the previous industry doesn’t replace that person.

¹⁰ Vestas announcement, 2008

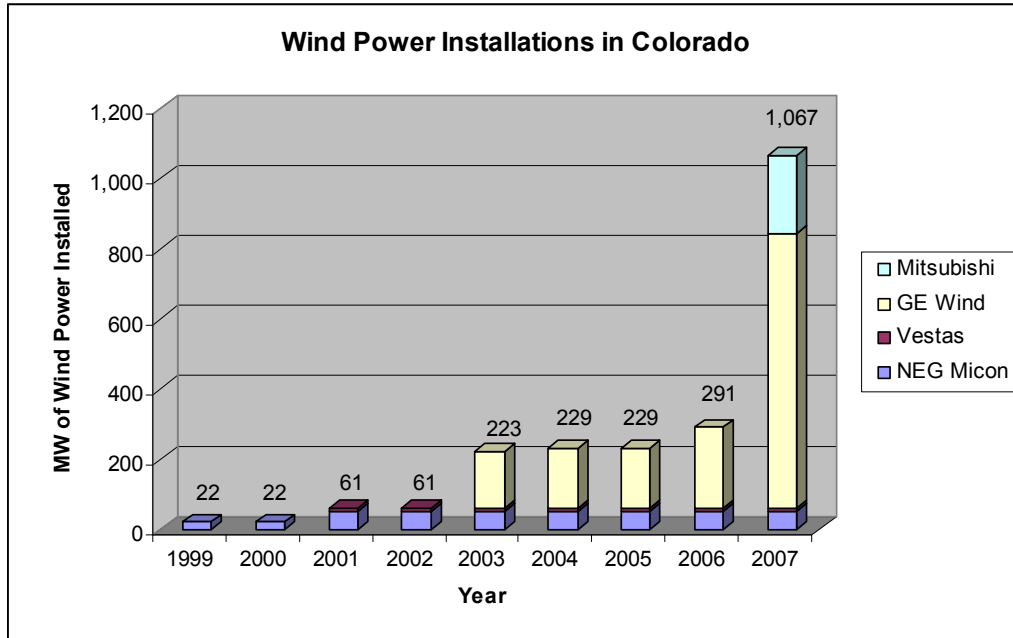


Figure 4. Colorado Wind Power Installation

Source: AWEA (as of 01/16/2008)

According to a Renewable Energy Policy Project (REPP) study, approximately 70% of potential job creation is attributed to manufacturing jobs, 17% is attributed to the installation of the turbines, and 13% is attributed to operation and maintenance jobs (Sterzinger and Svrcek, 2004).

Under this scenario, because there were no manufacturing facilities in Colorado until the beginning of 2008, that would represent a leakage of 70% in potential job generation. In addition, since this research suggests that 75% of the installation jobs are local (a leakage of 25%), it can be implied that Colorado realizes approximately 25% of the potential job creation from wind power development (see figures below).

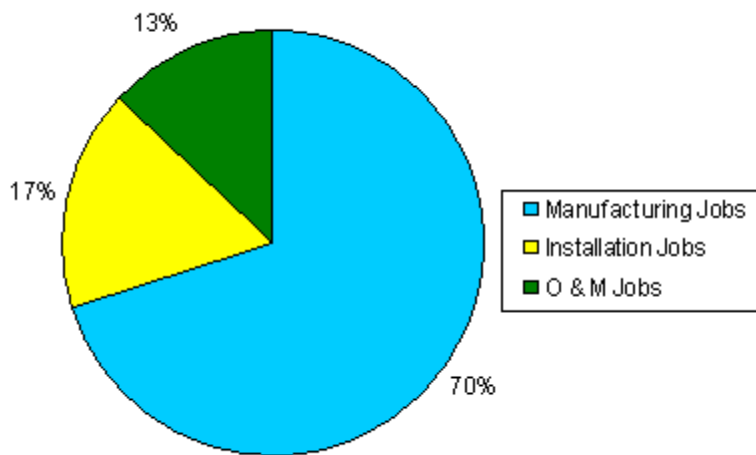


Figure 5: Potential manufacturing, installation, and O&M jobs as a percentage of total job generation (according to REPP studies)

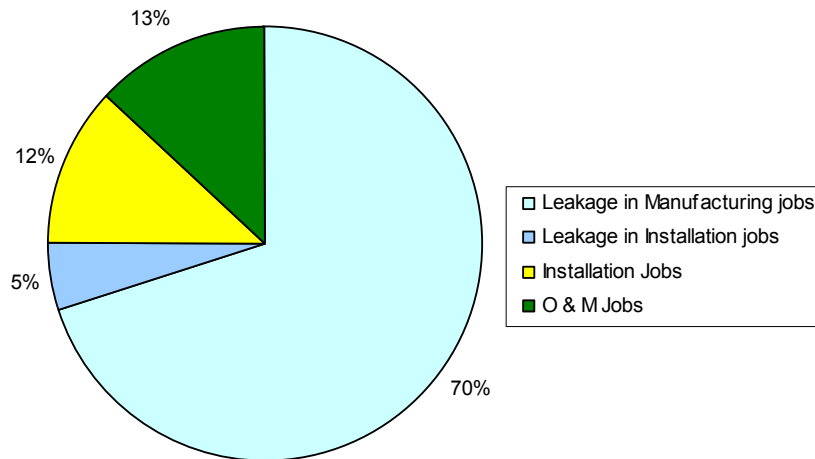


Figure 6: Real job creation (in yellow and green) in Colorado, as a percentage of potential job creation from a wind power plant

In March 2008, Vestas (a Denmark-based turbine manufacturing company) opened a blade facility in Windsor, Colorado due in part to the state’s commitment to renewable energy and its transportation infrastructure. This is one example of how wind power is expanding businesses and attracting companies to relocate to Colorado.

The Vestas facility in Windsor is expected to produce 1,800 blades per year (when the plant is entirely operational in the summer of 2009), which will create approximately 700 jobs for Coloradoans (Peif, 2008) with salaries ranging from \$45,000-\$60,000 (Rebchook and Fillion, 2007). Having a local manufacturing company also benefits in-state businesses that provide goods and services to the manufacturing facility, thus boosting economic activities.



Figure 7. Groundbreaking of the new Vestas facility in Windsor

The following graphs compare the impacts of two hypothetical scenarios in which a 100-MW wind farm is built using local blades vs. a scenario in which the blades are from out of state.

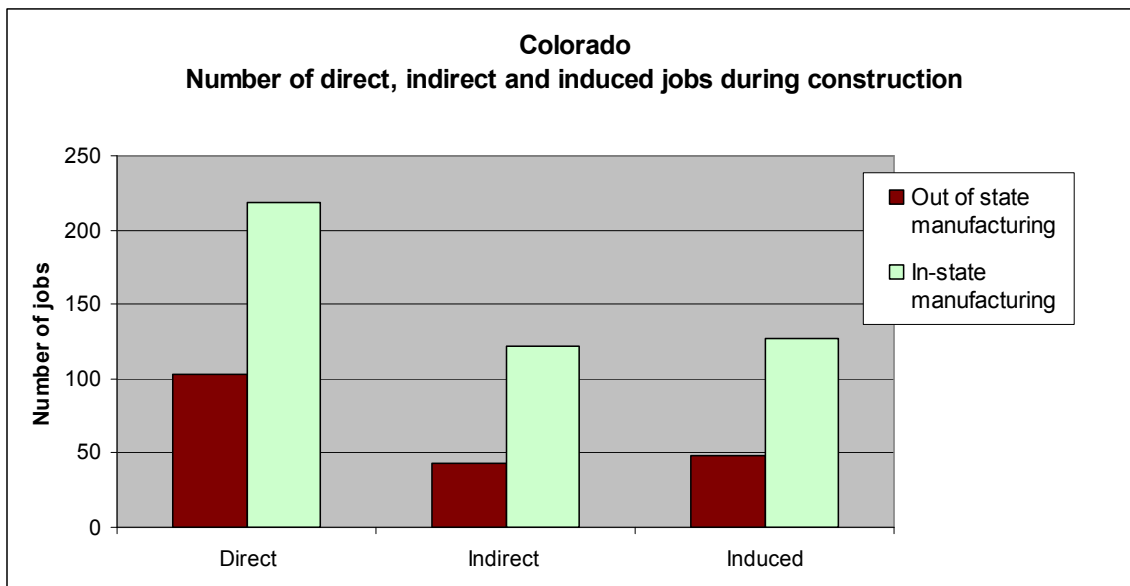


Figure 8: Job creation from 100 MW of wind power in Colorado: In-state blade manufacturing vs. out-of-state blade manufacturing

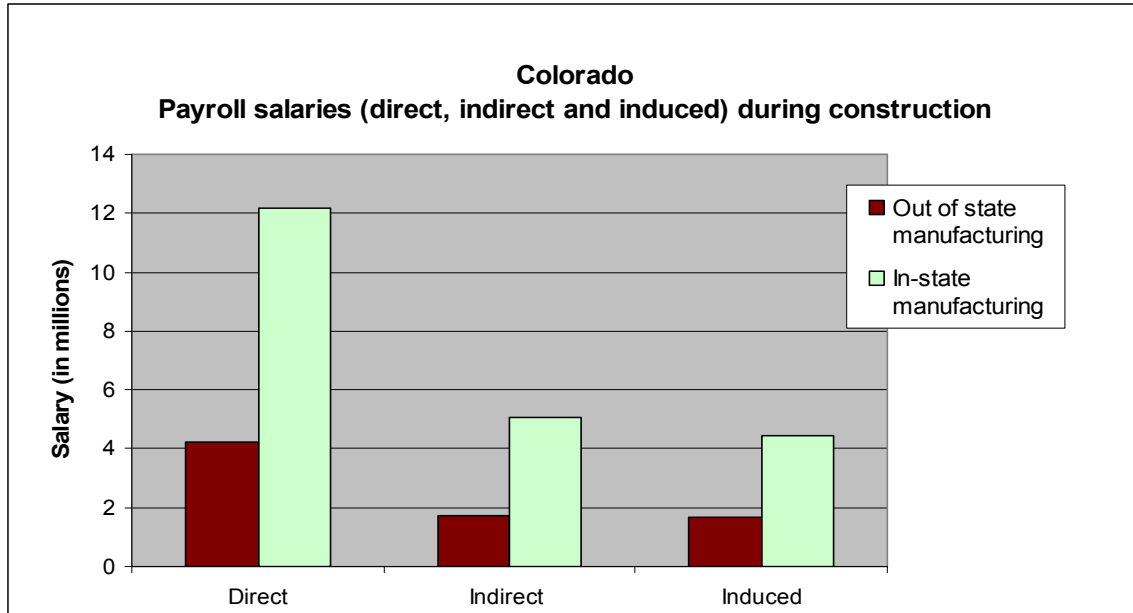


Figure 9: Payroll creation from 100 MW of wind power in Colorado: In-state blade manufacturing vs. out-of-state blade manufacturing

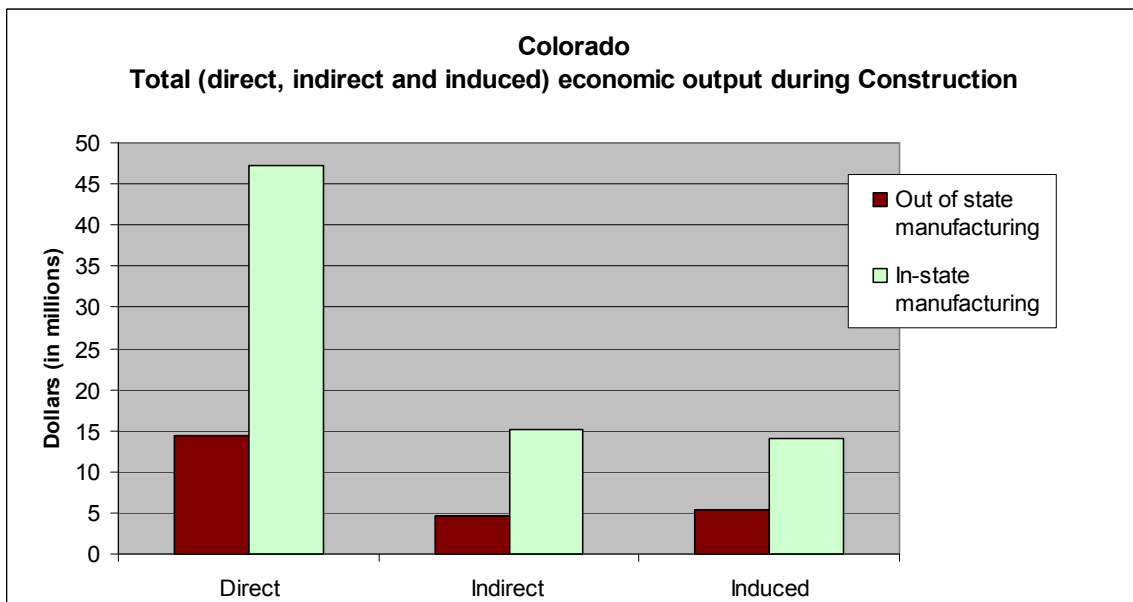


Figure 10: Economic activities from 100 MW of wind power in Colorado: In-state manufacturing vs. out-of-state manufacturing

Based on the graphs above, it is obvious that states with manufacturing facilities will experience the largest increase in job numbers compared to those states without manufacturing facilities.

Concluding Remarks

This analysis showed that 1,000 MW of wind energy benefits Colorado — and particularly rural communities in the state — by supporting jobs, generating tax revenue, generating land lease revenue, and stimulating economic activities.

The new Vestas blade facility is one example of how wind power has contributed to a healthier and more diversified business climate in the state as it has marked the beginning of an emerging manufacturing industry in Colorado. Two other manufacturing companies plan to open factories in Colorado in the near future. Dragon Wind, a Texas-based manufacturing company, seeks to open a steel tower facility in Lamar (Raabe, 2008), and Woodward Governor is planning to produce turbine inverters in Fort Collins or Loveland (Beahm, 2008). These two facilities will add 200 manufacturing jobs to Colorado (Beahm, 2008).

Recognizing the value of local ownership as a driver for economic development is paramount for the enactment of sound state and federal policies that can expand the wind industry sector. The wind industry is now facing obstacles related to the uncertainty about the Production Tax Credit (PTC), rising commodity prices, the weakness of the dollar, transmission access and capacity, and shortage of turbine supply. Overcoming some of these obstacles is critical for enhancing Colorado's energy portfolio. The results from Colorado's 1,000 MW of wind energy attest to Colorado's potential in meeting society's economic development expectations while providing a more secure energy future.

References

- American Wind Energy Association (2008). *Annual Rankings Report*. April, 2008.
- American Wind Energy Association (2008). *U.S. Wind Energy Projects – Colorado* (As of January 16, 2008). Retrieved January 21, 2008.
<http://www.awealorg/projects.Projects.aspx?s=Colorado>
- Beahm, Marisa. (2008). *Woodward Governor to add 100 jobs*. The Reporter- Herald. March 25, 2008.
- Colorado Department of Local Affairs, Division of Property Taxation. (2007). *Valuation of Wind Farms, Wind Energy Facilities and other State Assessed Renewable Energy Facilities for 2007*. June 12, 2007.
- Peif, Sherrie. (2008). *Door opens at Vestas Blades*. The Tribune. March 6, 2008.
- Raabe, Steve. (2008). *Tracks help Lamar land wind-tower factory*. The Denver Post. May 3, 2008.
- Rebhook, John and Roger Fillion. (2007). *Factory expansion a windfall for state*. Rocky Mountain News. Nov 2007.
- Renewable Resource Generation Development Areas Task Force. (2007). *Connecting Colorado's Renewable Resources to the Markets*. Report of the Colorado Senate Bill 07-091. December, 2007.
- Silverstein, Patricia. (2006). *The Economic and Fiscal Impact of the Peetz Wind Farm*. Development Research Partners. February 2006.
- Sterzinger, George and Matt Svrcek. (2004). *Wind Turbine Development: Location of Manufacturing Activity*. Technical Report. September 2004. Renewable Energy Policy Project (REPP).
- United States Government Accountability Office - Renewable Energy. (2004). *Wind Power's contribution to Electric Power Generation and Impact on Farms and Rural Communities*. Report to the Ranking Democratic Member, Committee on Agriculture, Nutrition and Forestry, U.S. Senate. September 2004. GAO -04-756.
- U.S. Census Bureau. (2008). *State and County Quickfacts: Bent County, CO*. (As of January 2, 2008) Retrieved January 24, 2008.
<http://quickfacts.census.gov/qfd/states/08/08011.html>

U.S. Census Bureau. (2008). *State and County Quickfacts: Logan County, CO*. (As of January 2, 2008) Retrieved January 24, 2008.

<http://quickfacts.census.gov/qfd/states/08/08075.html>

U.S. Census Bureau. (2008). *State and County Quickfacts: Prowers County, CO*. (As of January 2, 2008). Retrieved January 24, 2008.

<http://quickfacts.census.gov/qfd/states/08/08099.html>

U.S. Census Bureau. (2008). *State and County Quickfacts: Weld County, CO*. (As of January 2, 2008) Retrieved January 24, 2008.

<http://quickfacts.census.gov/qfd/states/08/08123.html>

U.S. Department of Energy. (2008). *20% Wind Energy by 2030: Increasing Wind's Contribution to the U.S. Electricity Supply*. May 2008. DOE/GO-102008-2567.

Wiser, Ryan and Mark Bolinger. (2006). *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*. U.S. Department of Energy. Energy Efficiency and Renewable Energy/Lawrence Berkeley National Laboratory.

Appendices

Appendix A: Model Assumptions

We used the following assumptions to calculate the report's results:

- The capacity factor for each of the wind projects is assumed to be 35% for the purpose of tax calculation (see Appendix B) and land lease payments. This percentage is consistent with information provided by developers and literature review (Wiser and Bolinger, 2006).
- Mill levies used pertain to 2007 and are based on the county where the wind farm is located. Even though mill levies will vary every year to reflect budget necessities, they are assumed to remain constant over time for the purpose of this analysis:

County	Mill Levy Used
Bent	70
Logan	70
Prowers	65
Weld	60

Figure 11: Mill levies used for tax calculations

- The life of a wind farm is assumed to be 20 years for the purpose of calculating average annual tax payments.
- The Net Present Value (NPV) of property tax revenue generated over a 20-year period was calculated assuming a discount rate of 3%.
- These calculations also assume that entities financing the wind power projects are located out of state, and therefore Colorado does not benefit from these economic activities.

Appendix B: Tax Calculations

Bill HB 1275 changed the way wind farms are taxed in Colorado. Prior to this bill, wind farms were taxed based on project cost (cost approach). After passing this bill, wind farms operating on or after January 1, 2006 are taxed based on energy sales (income approach).

Cost Approach: According to the Colorado Department of Local Affairs, Division of Property Taxation, "wind farms in operation prior to January 1, 2006 are valued under the cost approach utilizing a replacement cost threshold based on the cost to construct a comparable non-renewable resource facility" (Colorado Department of Local Affairs, Division of Property Taxation, 2007). The replacement cost threshold is described below:

2007 Assessment Cost Threshold	
Facility Size per kW	Factor Used
Up to 100,000	\$627/kW
100,000-250,000	\$533/kW

Figure 12: 2007 Assessment Cost Threshold

The example below illustrates the tax revenue generated from a hypothetical 100-MW wind power plant that came online prior to January 1, 2006. For this hypothetical scenario, it is assumed that the capacity factor of the wind farm is 35%, the energy price is \$45/MWh, and the county mill levy is 65.

Capacity Factor	35.00%
Plant Capacity	100.00 MW
Energy Price	45.00 \$/MWH
Capital Cost Threshold	627 \$/KW
Total Capital Cost Threshold in \$	\$ 62,700,000
Decimal Mill Levy of Facility Location	0.065000
Inflation Assumption	3.00% per year

Figure 13: Assumptions used in calculating property tax revenue generated from a 100-MW wind farm in Colorado under the cost approach

Property tax revenue generated can be calculated as:

	Comparable Cost Basis	Depreciation Factor	Depreciated Value	Assessment Rate	Projected Assessed Value	Prev Year's Mill Levy %	Projected Property Tax
Year 1	\$ 62,700,000	95.00%	\$ 59,565,000	29.00%	\$ 17,273,850	6.5000%	\$ 1,122,800
Year 2	\$ 62,700,000	90.00%	\$ 56,430,000	29.00%	\$ 16,364,700	6.5000%	\$ 1,063,706
Year 3	\$ 62,700,000	85.00%	\$ 53,295,000	29.00%	\$ 15,455,550	6.5000%	\$ 1,004,611
Year 4	\$ 62,700,000	80.00%	\$ 50,160,000	29.00%	\$ 14,546,400	6.5000%	\$ 945,516
Year 5	\$ 62,700,000	75.00%	\$ 47,025,000	29.00%	\$ 13,637,250	6.5000%	\$ 886,421
Year 6	\$ 62,700,000	70.00%	\$ 43,890,000	29.00%	\$ 12,728,100	6.5000%	\$ 827,327
Year 7	\$ 62,700,000	65.00%	\$ 40,755,000	29.00%	\$ 11,818,950	6.5000%	\$ 768,232
Year 8	\$ 62,700,000	60.00%	\$ 37,620,000	29.00%	\$ 10,909,800	6.5000%	\$ 709,137
Year 9	\$ 62,700,000	55.00%	\$ 34,485,000	29.00%	\$ 10,000,650	6.5000%	\$ 650,042
Year 10	\$ 62,700,000	50.00%	\$ 31,350,000	29.00%	\$ 9,091,500	6.5000%	\$ 590,948
Year 11	\$ 62,700,000	45.00%	\$ 28,215,000	29.00%	\$ 8,182,350	6.5000%	\$ 531,853
Year 12	\$ 62,700,000	40.00%	\$ 25,080,000	29.00%	\$ 7,273,200	6.5000%	\$ 472,758
Year 13	\$ 62,700,000	35.00%	\$ 21,945,000	29.00%	\$ 6,364,050	6.5000%	\$ 413,663
Year 14	\$ 62,700,000	30.00%	\$ 18,810,000	29.00%	\$ 5,454,900	6.5000%	\$ 354,569
Year 15	\$ 62,700,000	25.00%	\$ 15,675,000	29.00%	\$ 4,545,750	6.5000%	\$ 295,474
Year 16	\$ 62,700,000	20.00%	\$ 12,540,000	29.00%	\$ 3,636,600	6.5000%	\$ 236,379
Year 17	\$ 62,700,000	20.00%	\$ 12,540,000	29.00%	\$ 3,636,600	6.5000%	\$ 236,379
Year 18	\$ 62,700,000	20.00%	\$ 12,540,000	29.00%	\$ 3,636,600	6.5000%	\$ 236,379
Year 19	\$ 62,700,000	20.00%	\$ 12,540,000	29.00%	\$ 3,636,600	6.5000%	\$ 236,379
Year 20	\$ 62,700,000	20.00%	\$ 12,540,000	29.00%	\$ 3,636,600	6.5000%	\$ 236,379
20 YEAR PROPERTY TAX REVENUE (cost method)							\$ 11,818,950

Figure 14: Tax revenue generated from a 100-MW wind power plant under the cost approach

Because dollars in future years do not have the same values as dollars today, the Net Present Value (NPV) of the tax revenue stream is then calculated. This study used a discount rate of 3%.

Income approach: According to the Colorado Department of Local Affairs, the cost approach was “neither uniform nor just and equal because of wide variations in the production from wind turbines because of the uncertainty of wind available for energy reduction and because the cost of constructing a wind energy facility is significantly more expensive than any other utility production facility” (Colorado Department of Local Affairs, Division of Property Taxation, 2007). Therefore, Bill 1275 was enacted in June 2007 to allow a new form of taxation for wind farms that went online after January 1, 2006.

According to this new income approach method, the gross revenue from a wind project is calculated using the capacity factor of the wind farm, the energy price as determined by the PPA, and the size of the wind facility. Then, a projected 20-year tax revenue stream is calculated. A “trial and error multiplier” factor is then determined so that when it is applied to the projected gross revenue, the result will equal or at least be very close to the 20-year estimate under the cost approach.

	Annual Energy	Energy Price	Energy Revenue	Trial & Error Multiplier	Adjusted Revenue	Assessment Rate	Assessed Value	Prev Year's Mill	Projected Property Tax
Year 1	306,600	\$ 45.00	\$ 13,797,000	1.69	\$ 23,330,589	29.00%	\$ 6,765,871	6.5000%	\$ 439,782
Year 2	306,600	\$ 46.35	\$ 14,210,910	1.69	\$ 24,030,507	29.00%	\$ 6,968,847	6.5000%	\$ 452,975
Year 3	306,600	\$ 47.74	\$ 14,637,237	1.69	\$ 24,751,422	29.00%	\$ 7,177,912	6.5000%	\$ 466,564
Year 4	306,600	\$ 49.17	\$ 15,076,354	1.69	\$ 25,493,965	29.00%	\$ 7,393,250	6.5000%	\$ 480,561
Year 5	306,600	\$ 50.65	\$ 15,528,645	1.69	\$ 26,258,783	29.00%	\$ 7,615,047	6.5000%	\$ 494,978
Year 6	306,600	\$ 52.17	\$ 15,994,504	1.69	\$ 27,046,547	29.00%	\$ 7,843,499	6.5000%	\$ 509,827
Year 7	306,600	\$ 53.73	\$ 16,474,340	1.69	\$ 27,857,943	29.00%	\$ 8,078,604	6.5000%	\$ 525,122
Year 8	306,600	\$ 55.34	\$ 16,968,570	1.69	\$ 28,693,682	29.00%	\$ 8,321,168	6.5000%	\$ 540,876
Year 9	306,600	\$ 57.00	\$ 17,477,627	1.69	\$ 29,554,492	29.00%	\$ 8,570,603	6.5000%	\$ 557,102
Year 10	306,600	\$ 58.71	\$ 18,001,956	1.69	\$ 30,441,127	29.00%	\$ 8,827,927	6.5000%	\$ 573,815
Year 11	306,600	\$ 60.48	\$ 18,542,014	1.69	\$ 31,354,361	29.00%	\$ 9,092,765	6.5000%	\$ 591,030
Year 12	306,600	\$ 62.29	\$ 19,098,275	1.69	\$ 32,294,992	29.00%	\$ 9,365,548	6.5000%	\$ 608,761
Year 13	306,600	\$ 64.16	\$ 19,671,223	1.69	\$ 33,263,841	29.00%	\$ 9,646,514	6.5000%	\$ 627,023
Year 14	306,600	\$ 66.08	\$ 20,261,360	1.69	\$ 34,261,757	29.00%	\$ 9,935,909	6.5000%	\$ 645,834
Year 15	306,600	\$ 68.07	\$ 20,869,200	1.69	\$ 35,289,609	29.00%	\$ 10,233,987	6.5000%	\$ 665,209
Year 16	306,600	\$ 70.11	\$ 21,495,276	1.69	\$ 36,348,298	29.00%	\$ 10,541,006	6.5000%	\$ 685,165
Year 17	306,600	\$ 72.21	\$ 22,140,135	1.69	\$ 37,438,746	29.00%	\$ 10,857,236	6.5000%	\$ 705,720
Year 18	306,600	\$ 74.38	\$ 22,804,339	1.69	\$ 38,561,909	29.00%	\$ 11,182,954	6.5000%	\$ 726,892
Year 19	306,600	\$ 76.61	\$ 23,488,469	1.69	\$ 39,718,766	29.00%	\$ 11,518,442	6.5000%	\$ 748,699
Year 20	306,600	\$ 78.91	\$ 24,193,123	1.69	\$ 40,910,329	29.00%	\$ 11,863,995	6.5000%	\$ 771,160
20 YEAR PROPERTY TAX REVENUE (income method)									\$ 11,817,096

Figure 15: Tax revenue generated from a 100-MW wind power plant under the income approach

The “trial and error multiplier” factor is then applied to the actual gross revenue reported by the wind farm on its annual statement; this is how property tax revenue is calculated.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Executive Services and Communications Directorate (0704-0188). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ORGANIZATION.

1. REPORT DATE (DD-MM-YYYY) August 2008		2. REPORT TYPE Conference Paper		3. DATES COVERED (From - To) June 1 - 4, 2008	
4. TITLE AND SUBTITLE Economic Development Impacts of Colorado's First 1000 Megawatts of Wind Energy				5a. CONTRACT NUMBER DE-AC36-99-GO10337	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) S. Reategui and S. Tegen				5d. PROJECT NUMBER NREL/CP-500-43505	
				5e. TASK NUMBER WER84006	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) National Renewable Energy Laboratory 1617 Cole Blvd. Golden, CO 80401-3393				8. PERFORMING ORGANIZATION REPORT NUMBER NREL/CP-500-43505	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S) NREL	
				11. SPONSORING/MONITORING AGENCY REPORT NUMBER	
12. DISTRIBUTION AVAILABILITY STATEMENT National Technical Information Service U.S. Department of Commerce 5285 Port Royal Road Springfield, VA 22161					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT (Maximum 200 Words) This report analyzes the economic impacts that the installation of 1000 MW of wind power have had in the state of Colorado. These impacts can be scaled to obtain a sense of the economic development opportunities associated with other new wind scenarios, including the 20% Wind Energy by 2030 scenario. This report can also be used by interested parties in other states that currently lack a Renewable Portfolio Standard (RPS) as an example of the potential economic impacts if they were to adopt 1000 MW of wind power development.					
15. SUBJECT TERMS wind; wind energy; economic development; JEDI Model; Jobs and Economic Development Impacts Model; economic model; wind versus coal					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UL	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER (Include area code)

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18