# Economic Development Impact of 1,000 MW of Wind Energy in Texas

Sandra Reategui and Stephen Hendrickson

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

**Technical Report**
NREL/TP-6A20-50400
August 2011

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Prepared under Task No. WE11.1121

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## Executive Summary

Texas is a global leader in installed wind energy. If Texas were its own country, it would be ranked sixth in the world in terms of installed wind energy capacity (WWEA 2010). It has approximately 10,135 MW of wind energy capacity installed (through April 2011), followed by Iowa with 3,675 MW and California with 3,179 MW (AWEA 2011). The scale of wind energy deployment in Texas has spurred local supply chain development and various activities that contribute to a diversified energy economy. State and federal policies, market conditions, and economic development priorities support the addition of wind energy capacity.

As a result of the significant investment the wind industry has brought to the state, it is important to better understand the economic development impacts of wind energy in Texas. This report analyzes the jobs and economic impacts of 1,000 MW of wind power generation in the state. The impacts highlighted here can be used in policy and planning decisions and can be scaled to get a sense of the economic development opportunities associated with other wind scenarios. It can also inform stakeholders in other states about the potential economic impacts associated with the development of this scale of new wind power generation and the relationships between different elements in the state economy.

According to this analysis, 1,000 MW of wind power development in the state of Texas does all of the following:

- Generated over 2,100 full-time-equivalent (FTE)[1] jobs within the state of Texas during construction periods
- Currently supports approximately 240 permanent Texas jobs
- Generated nearly $260 million in economic activity for Texas during the construction period
- Generates nearly $35 million in annual Texas economic activity during operating periods
- Generates more than $7 million in annual property taxes[2]
- Generates nearly $5 million annually in income for Texas landowners who lease their land for wind energy projects.

Results above are provided in $2009 real dollars.

[1] FTE represents a full-time position for an entire year, which is 2,080 hours.

[2] Because tax payments vary every year, the annual property tax calculation is based on the average annual payment over a 20-year period using a discount rate of 3%. See Section 3.3 for more information.

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# 1 Introduction

A growing population, increasing demand for energy, and energy price uncertainty have created public support for wind power development in several states. In addition, Texas has sought to diversify its energy mix with wind energy, which can also address some economic development and environmental priorities.

Numerous conditions drive wind energy development in Texas. Texas has excellent wind resources (see Appendix), supportive state and energy market policies, robust transportation infrastructure, and a trained workforce. Moreover, utility-scale wind projects bolster jobs and generate tax revenues that are used to improve schools and other public services, which in turn improve the quality of life in rural areas. In addition, local landowners receive income in the form of land lease payments from wind turbines located on their land.

Estimating the economic development impacts of new energy power plants allows policy and decision makers to assess impacts not just on the cost of energy but also on the state-level jobs and economic growth (Lantz and Tegen 2008). The purpose of this study is to capture the impacts of wind energy projects on the Texas economy. We use 1,000 MW of wind energy as a baseline because it can be readily scaled to get a sense of the economic development opportunities associated with other wind scenarios in the state. Specifically, this paper identifies the impact of five wind energy projects (that altogether add up to approximately 1,000 MW) on the Texas economy during construction and operation.

State-level economic impacts include jobs,[3] land lease payments, property tax revenue, and business activity. Special mention is given to the manufacturing potential. Our research suggests that on average, wind turbine and component manufacturing accounts for approximately 70% of total project cost. Comparing this study's results with three manufacturing scenarios (30%, 50%, and 75% in-state manufacturing) can inform policymakers about the economic opportunities that the turbine manufacturing sector could bring to Texas.

This report first provides a description of the methodology and data used in estimating the economic impacts of 1,000 MW of wind power in Texas. Next, a discussion and interpretation of results are provided. This study does not compare wind to other resources or industries, nor does it present net jobs or net economic data. Moreover, it does not cover costs or benefits to electricity consumers. It addresses the gross state-level jobs and economic activity supported by 1,000 MW of utility-scale wind in Texas.

[3] This research examined gross jobs supported by new wind development—not net jobs. In some cases, workers may have been employed 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 when a worker switches jobs, it is still a new job supported by the wind industry. On the other hand, there could be a net loss if the job in the prior industry is not replaced. The complex relationships that determine net jobs are beyond the scope of the methodology used here.

# 2 Methodology

## 2.1 The Jobs and Economic Development Impact Model

The Jobs and Economic Development Impact (JEDI)[4] model for wind, developed by MRG & Associates for the National Renewable Energy Laboratory, is an input-output tool that estimates the number of jobs, salaries, and overall economic activity that will likely result from the construction and operation of a wind power project. Input-output models like JEDI rely on inter-industry relations in a specific geographic region where the output of one industry serves as input for another. For example, a wind farm project not only increases demand for wind turbines, but it also increases the demand for fabricated metals and other supply inputs. The overall impact in the economy depends on the extent by which wind energy project expenditures are spent locally and on the relationship between suppliers and producers at the local level (Goldberg et al. 2004).

This economic relationship between suppliers and producers and producers and consumers is embedded in the multipliers. JEDI wind multipliers are a measure of the overall change in the economy as a result of building and operating wind power plants. The injection of investment in wind power plants triggers several rounds of spending that will result in an overall increase in output, employment, and income in the economy. As employment and income rise, spending on goods and services also rises (Implan 2004). For instance, for each dollar transferred from a wind power developer to the construction company, the construction company uses part of that dollar to pay its workers. The construction workers then use their income to purchase local goods and services such as food at local restaurants, clothing, and haircuts. In this way, money spent on the wind project creates a series of transactions that benefit suppliers, service providers, restaurants, retail stores, and other sectors of the economy. Consumption patterns, as well as output, income, and employment multipliers, are developed by the Minnesota IMPLAN Group[5] to estimate the economic impact captured by the JEDI model.[6]

The JEDI model also uses data and input related to construction costs, operating costs, and the percentage of goods and services acquired in the state. This information is used to calculate jobs, payroll value, and economic activity level. JEDI estimates economic impact results for two distinct periods: construction (considered to last 1 year) and operation (recurring annual impacts for the life of the project). These impacts are then distributed into three results categories:

1. Project Development and On-Site Labor Impacts: Jobs pertaining to the construction and operation of the wind power plant (e.g., engineers, construction workers, managers, lawyers, administrative staff, and wind technicians) and their corresponding payroll salaries.

[4] The JEDI Wind Energy Model can be downloaded at http://www.nrel.gov/analysis/jedi/download.html. Accessed January 2011.
[5] Minnesota IMPLAN Group. www.implan.com. Accessed January 2011.
[6] For further information on JEDI model methodology, please visit http://www.nrel.gov/analysis/jedi/methodology.html. Accessed January 2011.

2. Local Revenue, Turbine, and Supply Chain Impacts: The purchase of a wind turbine and its components, construction and electrical materials, and parts and their second layer of supplier impacts. For instance, when the construction company purchases input materials, it uses the outputs of other companies. These other companies in turn provide payroll salaries and wages for their workers and purchase goods and services from other industries. An example of Local Revenue, Turbine, and Supply Chain Impacts is the work of a steel company employee who manufactures the materials needed by a wind plant construction worker. Wind power projects indirectly support these types of jobs, their salaries, and related economic activity.
3. Induced Impacts: Household income expenditures. Income paid to wind industry workers is spent on local goods and services that in turn support jobs and provide payroll to employees in other sectors. For example, wind industry workers spend their paychecks at restaurants and clothing stores, and their consumption supports local jobs and local economic activity above and beyond what they would have purchased without the extra income from the wind industry.

Figure 1 shows the ripple effect of wind energy projects based on the three results categories of the JEDI model.

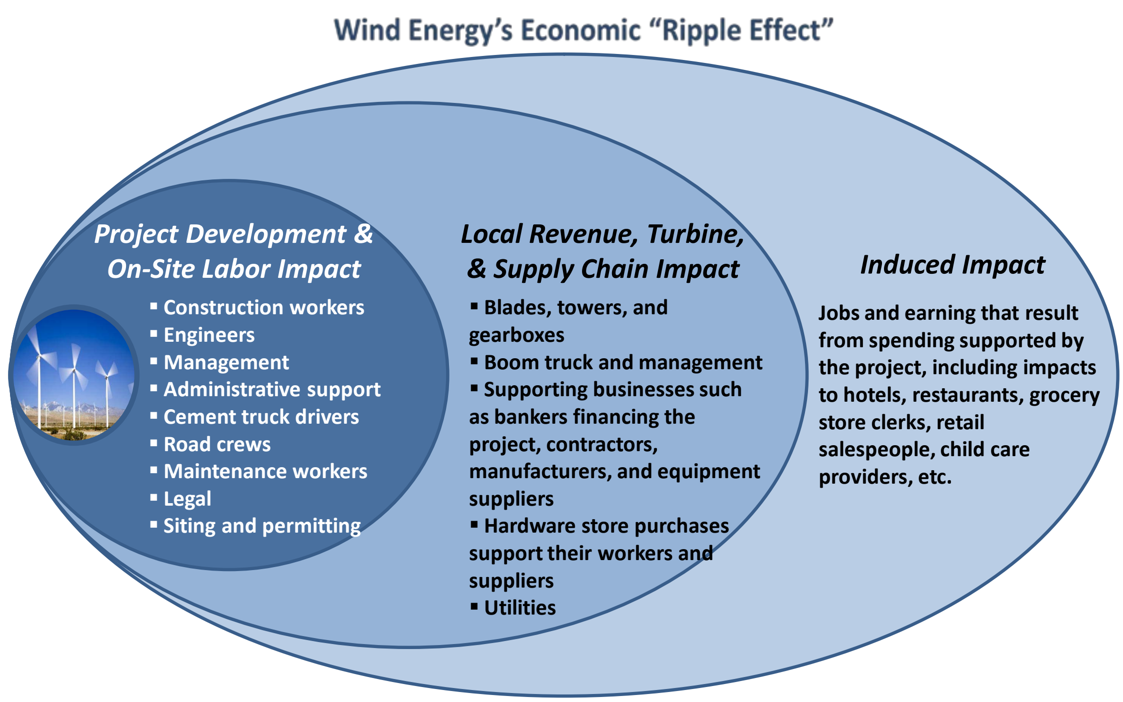


**Figure 1. Wind energy ripple effect categories from the JEDI model**

The JEDI wind model contains default data including construction and operating costs and the percentage of goods and services acquired in the state (local share) based on national averages. However, project-specific data were gathered to attain more localized estimates of the economic impact of current wind energy projects in Texas.

## 2.2 Research Data and Assumptions

Lists of Texas wind power projects were obtained from the American Wind Energy Association (AWEA) and DNV (Det Norske Verita)[7] databases. These lists contained information regarding wind project location, completion status, project size, turbine manufacturer, project owner, number of turbines, and turbine size. Using these lists, five of the largest recent utility-scale wind projects adding up to 1,000 MW (nameplate capacity) were selected for this study. These projects were chosen based on the level of information obtained from public sources as well as from interviews with developers and other wind industry stakeholders. These wind projects are listed in Table 1

**Table 1. Utility-Scale Wind Energy Projects Selected for this Study**

| | Gulf Wind | Hackberry | Penascal | Pyron | S. Trent Mesa |
|---|---|---|---|---|---|
| Year of Construction | 2009 | 2008 | 2009 | 2009 | 2009 |
| Nameplate Capacity (MW) | 283.2 | 165.6 | 201.6 | 249.0 | 101.2 |
| Turbine Size (KW) | 2,400 | 2,300 | 2,400 | 1,500 | 2,300 |
| Number of Turbines | 118 | 72 | 84 | 166 | 44 |

Preliminary research for each project consisted of collecting media information and corporate press releases. This set of background information provided an indication of the construction cost and the economic impacts some of these projects generated in Texas. This effort was complemented with a literature review. Then, extensive interviews were conducted with developers, manufacturers, construction company workers, lawyers, county commissioners, farmers, farmer's union members, industry experts, and other stakeholders to provide further depth to the analysis. Data from interviews included construction cost, operation and maintenance (O&M) cost, percentage of goods and services acquired in-state, job generation during the construction period, job generation during the operation period, land lease payments, tax information, payroll parameters, and cost breakdown of different installation and operation categories.

It is important to note, however, that because JEDI model inputs consist of detailed information, often considered proprietary, the amount and quality of the information obtained varied from project to project and from interview to interview. Thus, this analysis also relies on data extrapolation and literature review. In the absence of project data we made general cost assumptions (Table 2), detailed construction cost assumptions (Table 3), operating costs assumptions (Table 4), and other parameters (Table 5).

[7] Formerly Global Energy Concepts (GEC).

**Table 2. Overall Cost Assumptions**

| Overall Cost Assumptions | |
|---|---|
| Installed Project Cost ($/kW) | $1,650–$2,200 |
| Operations and Maintenance Cost ($/kW) | $25–$30 |
| Money Value (Dollar Year) | 2009 |

**Table 3. Construction Cost Assumptions**

| Construction | % of Total Cost | Local Share |
|---|---|---|
| *Equipment Costs* | | |
| Turbines (excluding blades and towers) | 47.1% | 0% |
| Blades | 11.0% | 0% |
| Towers | 12.2% | 0% |
| Transportation | 8.4% | 0% |
| Equipment Total | 78.8% | |
| *Materials* | | |
| Construction (concrete, rebar, equip, roads, site prep) | 9.4% | 50%–60% |
| Transformer | 1.3% | 0% |
| Electrical (drop cable, wire) | 1.4% | 10% |
| HV Line Extension | 1.1% | 0% |
| Materials Subtotal | 13.2% | |
| *Labor* | | |
| Foundation | 0.7% | 95% |
| Erection | 0.6% | 75% |
| Electrical | 1.0% | 60% |
| Management/Supervision | 0.6% | 30%–50% |
| Misc. | 2.5% | 0% |
| Labor Subtotal | 5.5% | |
| *Other Costs* | | |
| HV Sub/Interconnection Materials | 0.9% | 10% |
| HV Sub/Interconnection Labor | 0.3% | 50% |
| Engineering | 0.6% | 75% |
| Legal Services | 0.4% | 85% |
| Land Easements | 0.0% | 100% |
| Site Certificate/Permitting | 0.2% | 100% |
| Other Subtotal | 2.5% | |
| **Total** | **100.0%** | |

Note: Totals may not add due to rounding.

Local share refers to the percentage of resources (e.g., labor, materials, supplies, and equipment) purchased or acquired in Texas. As we can see from Table 3, this analysis assumes that wind turbine manufacturing was imported into the state[8] and that transportation services were contracted out of the state (reason why local share for equipment and transportation is zero). Since manufacturing and transportation are assumed to represent 78.8% of total project cost (Figure 2), this would represent a leakage of almost 80% in potential job generation and subsequent economic benefits to Texas, according to the assumptions made in this study.

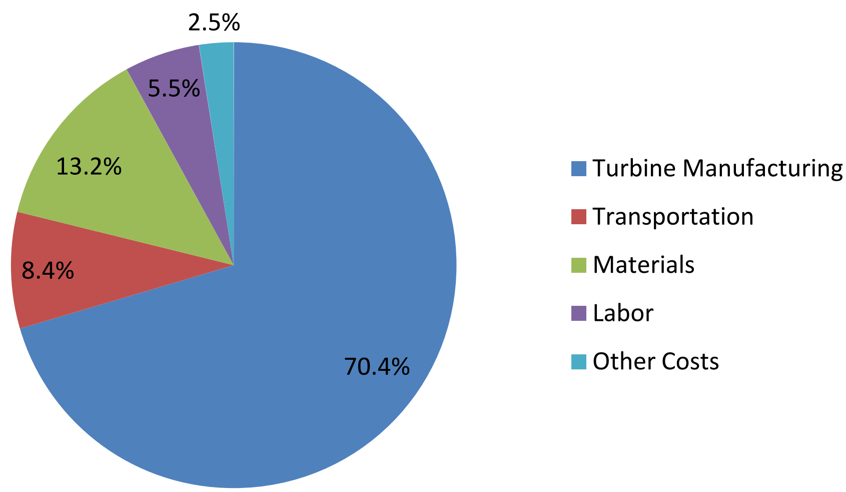


**Figure 2. Construction cost breakdown assumptions**

[8] This might not be the case of current and future projects in the state.

**Table 4. Operating Cost Assumptions**

| Wind Farm Annual Operating and Maintenance Costs | % of Total Cost | Local Share |
|---|---|---|
| *Labor* | | |
| Field Salaries | 9.8% | 98% |
| Administrative | 1.6% | 100% |
| Management | 2.7% | 100% |
| Labor/Personnel Subtotal | 14.1% | |
| *Materials and Services* | | |
| Vehicles | 2.5% | 100% |
| Site Maint/Misc. Services | 1.0% | 80% |
| Fees, Permits, Licenses | 0.5% | 100% |
| Utilities | 1.9% | 100% |
| Insurance | 18.4% | 0% |
| Fuel (motor vehicle gasoline) | 1.0% | 100% |
| Consumables/Tools and Misc. Supplies | 6.2% | 100% |
| Replacement Parts/Equipment/Spare Parts | 54.5% | 2% |
| Materials and Services Subtotal | 85.9% | |
| **Total O&M Cost** | **100.0%** | |

Note: Totals may not add due to rounding.

**Table 5. Other Parameters**

| Other Parameters | |
|---|---|
| *Financial Parameters* | |
| Percentage Financed | 75%–80% |
| Years Financed (term) | 10 |
| Interest Rate | 9%–10% |
| Percentage Equity | 20%–25% |
| Corporate Investors (percent of total equity) | 100% |
| Return on Equity (annual interest rate) | 16% |
| *Tax Parameters* | |
| Taxes Per MW | $7,000-7,300 |
| *Land Lease Parameters* | |
| Lease Payment per MW | $5,000 |
| *Payroll Parameters* | |
| Construction Labor | Wage per Hr |
| Foundation | $20–$25 |
| Erection | $20–$22 |
| Electrical | $25–$28 |
| Management/Supervision | $45–$50 |
| O&M Labor | |
| Field Salaries (technicians, other) | $22–$26 |
| Administrative | $14–$18 |
| Management/Supervision | $36–$40 |

# 3 Results

The JEDI model was used to estimate the economic impacts of Texas 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 of wind energy.

Study results show significant economic impacts from 1,000 MW of wind energy development in Texas (see Figure 3). Impacts are centered on JEDI model results, which include employment, property taxes, landowner revenue, and local economic activity during the construction and operation periods (see Table 6). Although no further elaboration on additional economic impacts will be provided, it is important to acknowledge that new wind power installations offer other tangible (e.g., use tax generation, sales tax generation, vendor profits, worker's taxable income, and transmission line impacts) and intangible (e.g., water savings, price stability, and environmental benefits) benefits that are outside the scope of this study.

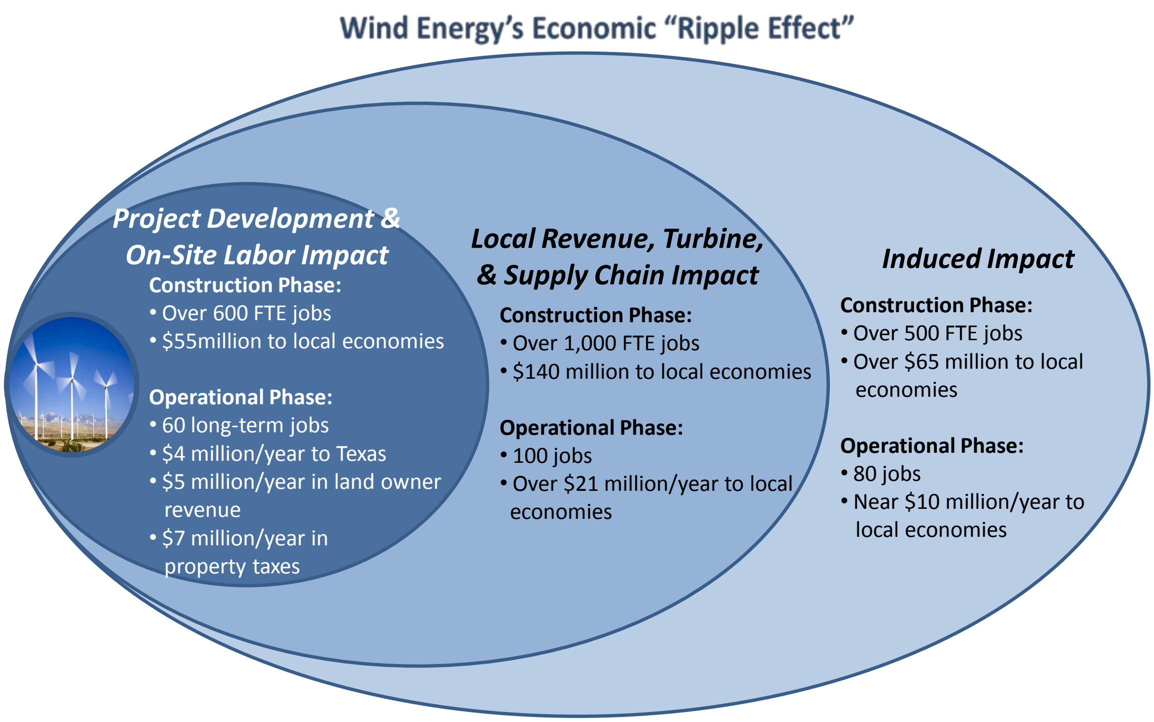


**Figure 3. Economic ripple effect from 1,000 MW of wind energy in Texas**

**Table 6. Texas Summary Impacts[9] from 1,000 MW of Wind Energy Development**

| Texas Economic Impacts | |
|---|---|
| **During Construction** | • Generated over 2,100 FTE jobs within the State of Texas during construction periods<br>• Generated nearly $260 million in economic activity for Texas during the construction period |
| **During Operating Periods** | • Currently supports approximately 240 permanent Texas jobs<br>• Generates nearly $35 million in annual Texas economic activity during operating periods<br>• Generates more than $7 million in annual property taxes[10]<br>• Generates nearly $5 million annually in income for Texas landowners who lease their land for wind energy projects |

## 3.1 Gross Economic Activity

As previously mentioned, the construction and operation of a wind power plant is the catalyst for economic activity in Texas. From rented accommodations that host the influx of construction workers to the suppliers and transportation companies that provide services to the wind farm, wind power development generates a significant impact to the state economy.

> *One thousand megawatts of wind power developed in Texas generated approximately $260 million in economic activity during the construction phase and approximately $35 million in annual recurring local economic activity.*

The figures reported include only the portion of transactions that took place in Texas. For example, equipment and components that were purchased from other states or other countries are treated as monetary leakages and are not included in these figures. This study assumes that 1,000 MW of wind energy represents approximately $2 billion in investment, which supports nearly $260 million at the state level (without counting for manufacturing). This represents approximately $55 million in labor, $140 million in construction materials and supply chain equipment, and $65 million in induced activities (Figure 4).

[9] Results are provided in $2009 real dollars.
[10] See Section 3.3 for more information.

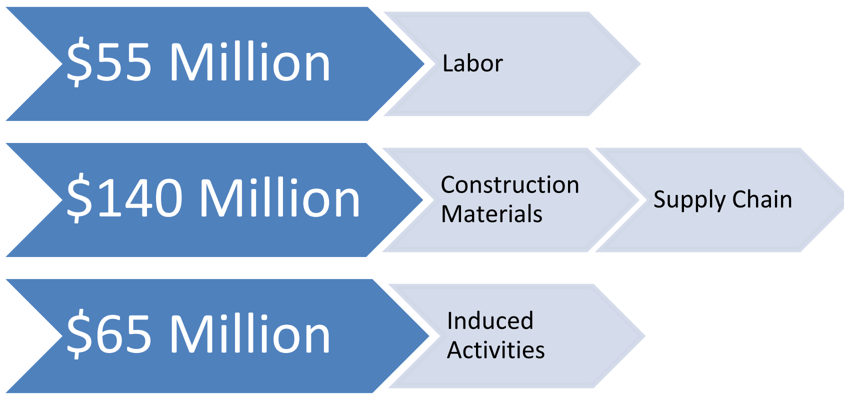


**Figure 4. Estimated local spending supported by 1,000 MW of wind energy in Texas during project construction**

Texas could continue to benefit from these economic development impacts. However, the financial crisis has slowed wind project development in the state. Investment and infrastructure are needed to continue expansion of wind energy generation. Since wind resources are often located at a significant distance from the demand load, new transmission capacity is needed to support the growth of wind power generation. For this reason, Texas has implemented specific policies that seek to expedite transmission line development. State Senate Bill 20 required the designation of Competitive Renewable Energy Zones (CREZ) (PUC of Texas—CREZ 2010). These zones would be fast-tracked to obtain electrical transmission infrastructure to facilitate the expansion of wind energy generation in the state (SECO 2010). This initiative supports the state's renewable portfolio standard of 10 GW of renewable energy by 2025 (Texas Legislature 2005). In fact, the Electric Reliability Council of Texas (ERCOT) is investing $8.2 billion in transmission capacity in the state. Of this investment, $5 billion is intended to support approximately 18,000 MW of wind energy (ERCOT 2010). This development has the potential to attract economic opportunities including further manufacturing development in the state. While beyond the scope of this paper, further analysis into the impact of CREZ may prove useful both to further development of wind power generation in Texas and in other states.

## 3.2 Employment Impacts

Most jobs depicted in the first JEDI category (project development and on-site labor) require skilled professionals in the fields of engineering, construction, management, and manufacturing. These well-paid positions boost economic development in the state.

### *3.2.1 Construction Jobs*

During the construction period (which could take more or less than a year depending on the project size, location, and weather conditions), construction workers, engineers, surveyors, turbine installers, electrical contractors, administrative employees, and managers move to town, boosting local economic activity. Local workers may be employed directly on the new wind project, depending on the talent pool and skill set in the area.

According to this research, approximately 75%–80% of construction workers for the projects studied were Texas residents. These workers boost Texas economic activity by virtue of spending their salary in activities such as mortgage payments, insurance, childcare, education, bills, tax payments, family recreation, and clothing. Workers from out of state that come to Texas temporarily to build a wind farm generate a different set of economic benefits to the state. Compared to in-state workers, temporary out-of-state workers support a lower ripple effect in the Texas economy because a greater portion of their labor income is sent back to where they are from and does not re-circulate throughout the Texas economy as most of in-state workers' compensation does. Most of the impacts from out-of-state workers are reduced to lodging, food, beverages, and transportation, which are paid for in many cases by the construction company. Hence, this analysis does not include out-of-state workers.[11]

The number of employees working on a wind project depends on the stage of construction. The number of workers needed during the initial phase may be significantly different from the number of workers needed during peak construction and final stages. Thus, this analysis uses a FTE basis to estimate more accurate employment figures. Data were obtained on the number of employees and hours worked, and these data were translated into FTE[12] units.

> *This research suggests that construction of 1,000 MW of wind power development during 2008-2009 supported over 2,100 FTE jobs in Texas.*

Of the near 2,100 in-state jobs, over 600 jobs were on-site workers (project development, engineering, construction, and electrical), over 1,000 jobs belonged to the supply chain sector (including construction materials and supplies), and over 500 jobs belonged to induced sectors of the economy (sectors that benefited from the salary spending of construction and supply chain workers, such as restaurant workers, child care providers, and retail store workers).

### 3.2.2 Operation and Maintenance Jobs

When the wind farm goes online, permanent employees are needed to operate and maintain the facility during its 20- to 30-year expected life. Technicians can service approximately two to three wind turbines per day replacing components, troubleshooting electrical and mechanical malfunctions, repairing the hydraulic system, and changing fluids. The majority of these positions are filled by Texans, or in some cases, by people who relocate to Texas.

> *According to this study, 1,000 MW of wind energy capacity installed in the state of Texas supports approximately 240 permanent jobs.*

Of the 240 permanent jobs (during operating periods), approximately 60 were on-site positions, 100 were equipment and supply chain sector jobs, and nearly 80 were positions in other sectors (e.g., restaurant, hotels, and retail stores).

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[11] If out-of-state workers were accounted for, then we would be overestimating the impacts.

[12] An FTE of 1 assumes that a person is working full-time (40 hours per week) for an entire year. If three different people work 4 months each during a year, that is also considered 1 FTE.

### 3.3 Property Tax Revenue Impacts

Wind energy projects 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.

Estimating the tax revenue generated by a wind project over its lifetime requires certain assumptions and estimates. For instance, it is impossible to know with certainty what a given county's tax rate will be 10 years from now. To discount future tax revenue cash flows to present day values also requires an estimate on the time value of money. To assess the tax revenue generated by the projects analyzed in this report, we relied on input from county tax assessors and tax auditors. To ensure a consistent analysis, we assumed a straight-line depreciation of the wind farm over a 20-year period. We then held the county tax rate fixed over that time period. Finally, future cash flows were discounted to the present using a discount rate of 3% to obtain an estimate of all future cash flows in $2009 real dollars. Based on these assumptions and methodology, we concluded that:

> *One thousand megawatts of wind energy generates approximately $7 million in property tax revenue.*

Property taxes assessed to wind projects vary on a case-by-case basis. Some projects are treated similarly to any other new construction while others are assessed under an abatement agreement. The projects analyzed for this report received both standard and special case treatment by their county tax assessors.

### 3.4 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 Texas are negotiated as a percentage of revenue (royalty) based on power purchase agreements.

Although wind power projects occupy several acres of land, the actual footprint of the wind turbine is small, and because they are spaced far apart, wind energy projects generally allow farmers to continue to grow their crops or graze their cattle while the turbines are in operation. The actual footprint of land that is disturbed for wind power projects ranges from 2% to 5% of total land (DOE 2008). 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.

> *Land lease revenue vary widely in the state, but the average is approximately $5,000/MW/year. One thousand megawatts of wind energy in Texas generates more than $5 million annually in income for farmers and ranchers who lease their land to wind developers.*

# 4 Manufacturing Potential

Although Texas currently has a number of wind manufacturing facilities, as shown in Figure 5, this study does not account for local turbine manufacturing. We assumed that the projects selected for this study imported their turbines, blades, and towers from other states and other countries.  It is difficult to attribute changes in in-state manufacturing activity to in-state project development if in-state manufacturers also sell their products in other states. Only material manufacturing (e.g., cement for foundations and electrical equipment) for wind plant construction was considered part of the Local Revenue, Turbine and Supply Chain Impact category.

Nevertheless, analysis of the potential economic impacts associated with the production of local wind turbines and components provides further insight into the wind industry in Texas. Future projects may utilize this Texas-based manufacturing, resulting in an incremental increase in economic development impacts.

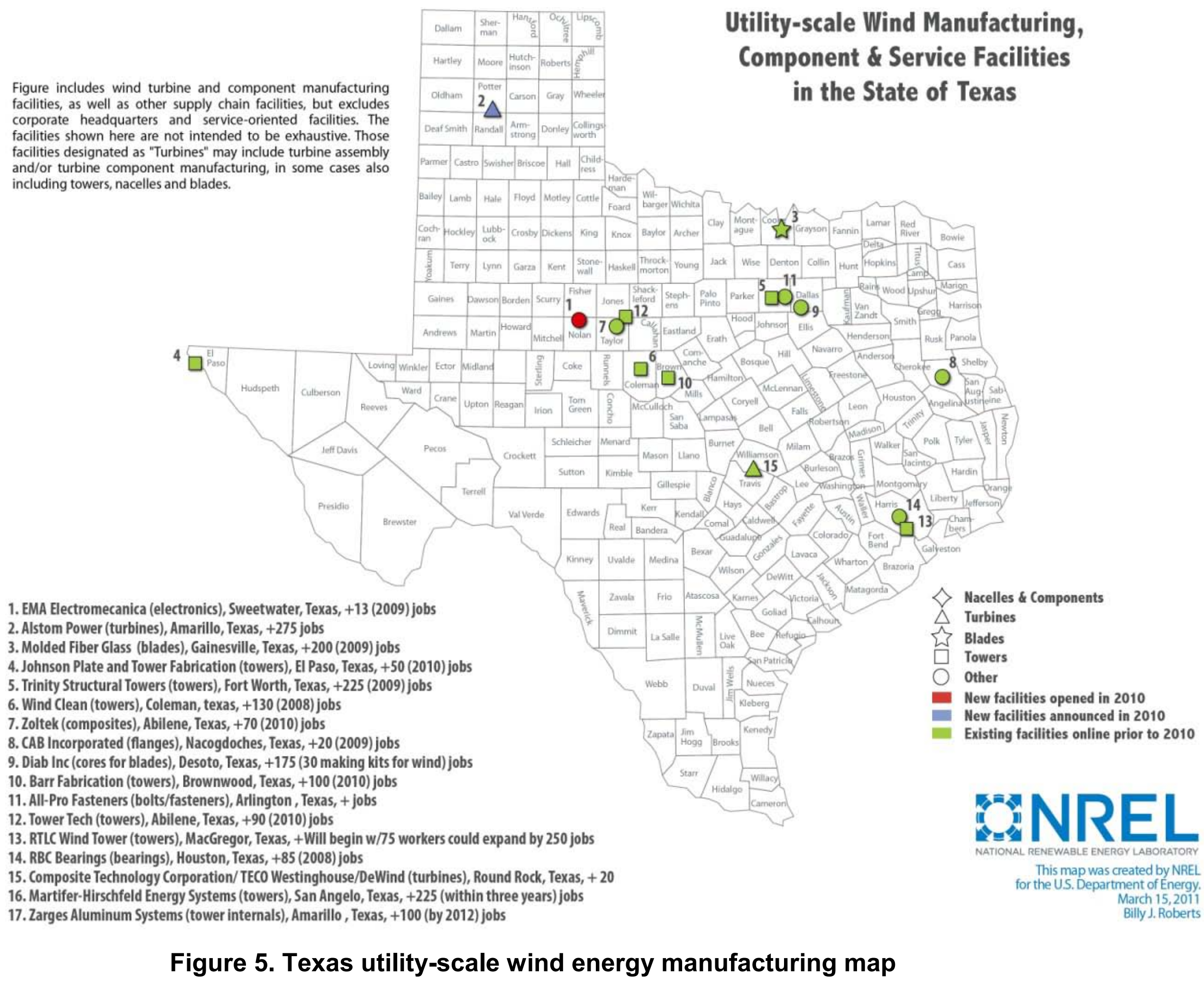


**Figure 5. Texas utility-scale wind energy manufacturing map**

## 4.1 Texas Wind Turbine and Component Manufacturing

Texas is now a leader in wind energy manufacturing. A variety of manufacturers (including six tower facilities, one blade facility, and a turbine manufacturer) and component suppliers support over 1,000 manufacturing jobs in the state. Table 7 provides information on current Texas wind manufacturing facilities and the estimated number of people employed by these companies.

**Table 7. Texas Utility-Scale Wind Manufacturing Facilities (Not Exhaustive)**

| Company | Component | Category | City | Jobs |
|---|---|---|---|---|
| All-Pro Fasteners | Bolts/fasteners | Other | Arlington | |
| Alstom Power | Turbines | Turbines | Amarillo | 275[13] |
| Barr Fabrication | Towers | Towers | Brownwood | 100 (2010)[14] |
| CAB Incorporated | Flanges | Other | Nacogdoches | 20 (2009)[15] |
| Composite Technology Corporation/TECO Westinghouse/DeWind | Turbines | Turbines | Round Rock | 20 (2010) (will employ approx. 150)[16] |
| Diab Inc. | Cores for blades | Other | Desoto | 175 (30 making kits for wind)[17] |
| EMA Electromecanica | Electronics | Other | Sweetwater | 13 (2009)[18] |
| Johnson Plate and Tower Fabrication | Towers | Towers | El Paso | 50 (2010)[19] |
| Martifer-Hirschfeld Energy Systems | Towers | Tower | San Angelo | 225 within three years[20] |
| Molded Fiber Glass | Blades | Blades | Gainesville | 200 (2009)[21] |
| RBC Bearings | Bearings | Other | Houston | 85 (2008)[22] |
| RTLC Wind Tower | Towers | Towers | MacGregor | 75 (could expand to 250)[23] |
| Tower Tech | Towers | Towers | Abilene | 90 (2010)[24] |
| Trinity Structural Towers | Towers | Towers | Fort Worth | 225 (2009)[25] |
| Wind Clean | Towers | Towers | Coleman | 130 (2008)[26] |
| Zarges Aluminum Systems | Tower internals | Other | Amarillo | 100 by 2012[27] |
| Zoltek | Composites | Other | Abilene | 70 (2010)[28] |

Data provided by Frank Oteri, NREL

[13] McBride 2010
[14] Sheilds 2010
[15] Public Citizen 2009
[16] Copelin 2010
[17] Previty 2009
[18] Grainnet 2009
[19] Kolenc 2010
[20] Collier 2010
[21] LaFrance 2009
[22] Dawson 2008
[23] Morris 2011
[24] Adame 2010
[25] Public Citizen 2009
[26] Northcott 2008
[27] Zarges Aluminum Systems 2009
[28] Adame 2010

## 4.2 Manufacturing Scenarios

Since this analysis assumes zero local wind turbine manufacturing, we developed a sensitivity analysis that compares three manufacturing scenarios with the results from this study (Figure 6). All three manufacturing scenarios assume cost and local share parameters indicated in Table 3, with the exception of equipment local share information. The first manufacturing scenario assumes that Texas suppliers provide 30% of turbine parts and components needed to support the installation of 1,000 MW of wind energy in the state. This scenario also assumes 30% of local transportation. Similarly, the second and third scenarios assume 50% and 75% of local turbine manufacturing and transportation services, respectively.

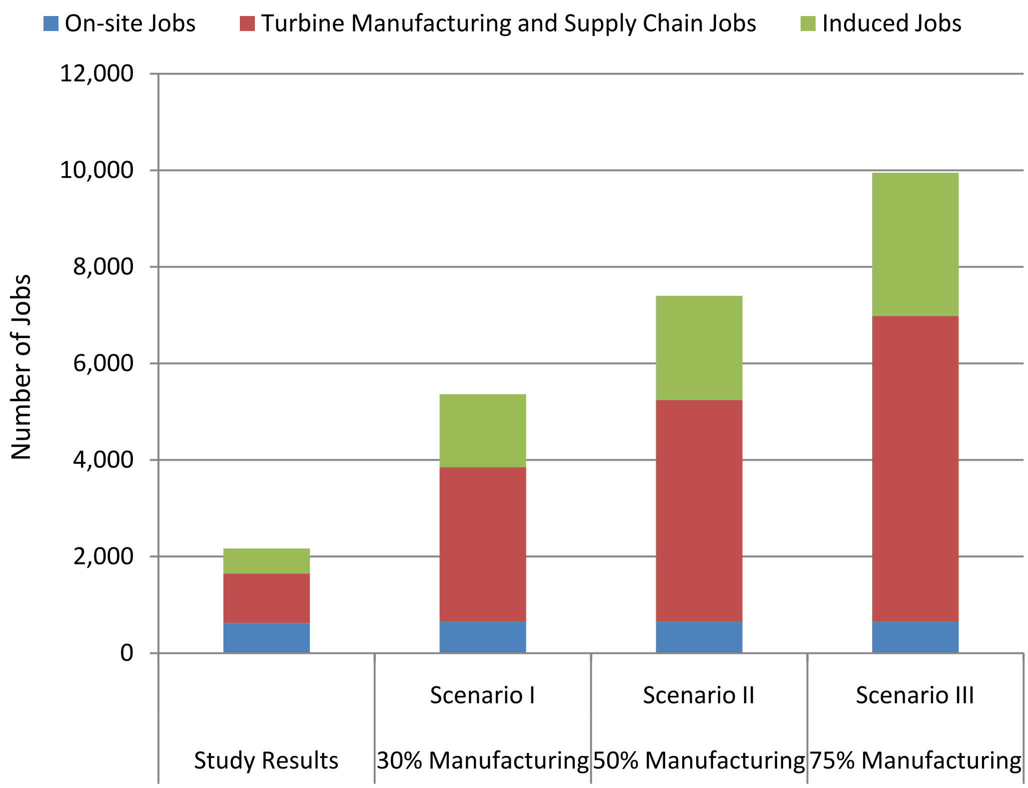


**Figure 6. Manufacturing scenarios and associated job impacts during construction**

As Figure 6 indicates, even 30% of in-state manufacturing has a significant impact on potential job generation in the state's economy. This level of manufacturing not only increases the number of turbine manufacturing and supply chain jobs, but it also supports a higher number of induced jobs[29] because more workers are able to spend their income on a variety of activities that generate and support employment opportunities in a variety of sectors. Hence, the results from this first scenario more than doubles the magnitude of construction period jobs estimated in this study to approximately 5,300. A 50% in-state wind manufacturing scenario would more than triple the total number of jobs reported in

[29] Induced jobs refer to employment in other sectors of the economy, such as restaurants, retail stores, and hospitals.

this study during the construction period to over 7,400 jobs, and a 75% in-state manufacturing scenario more than quadruples our initial job results, providing job opportunities to almost 10,000 Texans.

The largest economic development driver in the wind industry is manufacturing (Lantz and Tegen 2008). That is mainly because wind energy manufacturing accounts for almost 70% of the total project cost (Figure 2). The expanded wind development in the state has lead to an expanded in-state manufacturing, but a stronger wind manufacturing base could provide further economic opportunities to Texas.

# 5 Conclusion

One thousand megawatts of new wind power generation has myriad effects on the Texas economy. Direct and indirect economic impacts ripple through the state economy providing jobs, tax revenue, and land lease payments to communities. Based on this analysis, 1,000 MW of wind energy development supports 2,100 FTE jobs and 240 permanent jobs in the state of Texas. It also supports nearly $260 million in economic activity for Texas during the construction period and approximately $35 million per year during the operating period.

The burgeoning wind sector also stimulates a secondary supply chain ripple as wind industry participants set up shops in the state. While outside the scope of this analysis, this second wave carries with it additional economic benefits associated with training workers, exporting goods outside of the state, fostering research and development facilities, and developing leading edge technologies and capabilities.

Wind energy manufacturing is the largest economic development driver in the wind industry because it has the potential to provide significantly more jobs and associated economic benefits compared to other wind activities. Supporting local ownership of manufacturing facilities, as well as local use of labor and materials, can provide further opportunities for diversification and growth.

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# Appendix

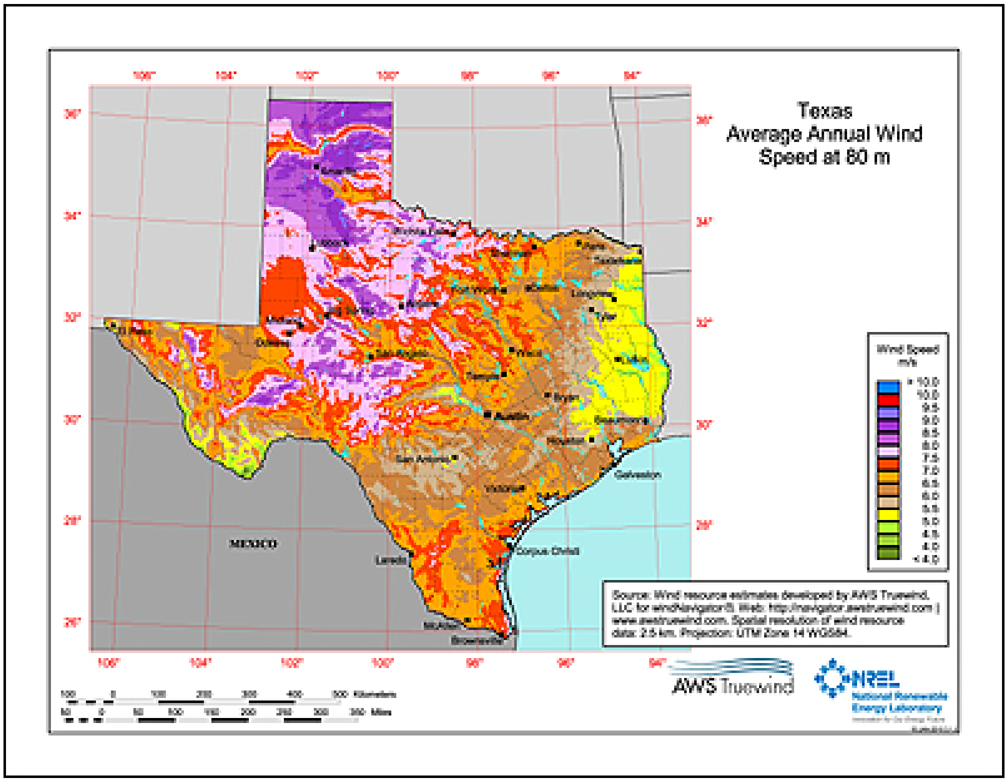


**Figure A-1. Texas average annual wind speed at 80 m**

Source: Wind Powering America 2010