



NREL

National Renewable Energy Laboratory

Innovation for Our Energy Future

Jobs and Economic Impacts from Wind Power Development



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**National Renewable
Energy Laboratory**

September 1, 2010

In other words...

How many jobs will be supported by wind in my community?

What kinds of jobs will there be?

What other economic impacts will occur due to new wind development?

- Land revenue?
- Increase in local business?

Today: Overview of NREL tool and results





“It seems only natural for rural utilities to do everything they can to advance both farm-based renewable energy development and rural economic development in a cost-effective way. In my opinion, **wind energy is the next great chapter in the rural electrification story.”**

*Aaron Jones, Washington Rural Electric Cooperative Association;
Olympia, WA*



BLM and Renewable Energy

Section 211 of the Energy Policy Act established a goal that the BLM would approve 10,000 megawatts of non-hydropower renewable energy projects on the public lands by 2015. The development of wind energy will be an important contribution to that goal. The BLM Energy and Mineral Policy, signed by the Director on August 26, 2008, also recognizes that the public lands are an important source of the Nation's renewable energy resources, including wind energy.

From BLM website: BLM.gov



BLM working with wind developers

Form SF-299, Application for Transportation and Utility Systems on Federal Land.

Applicants are encouraged to work with BLM to:

- Assist in the preparation and processing of applications,
- Identify potential issues and conflict areas,
- Identify visual resource issues and define the viewshed area of the proposed project for visual resources modeling,
- Identify any environmental or cultural resource studies that may be needed,
- **Assess public interest and concerns,**
- Identify other authorized uses,
- Identify other general recreation and public uses in the area,
- Discuss potential alternative site locations, and
- **Discuss potential financial obligations (cost recovery fees, rental, and bonding) that the applicant must be willing to assume.**

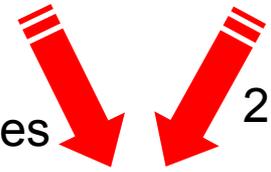
Defining Economic Development Impacts



1. On-site Labor and Professional services



2. Turbine Production and Supply Chain Impacts



3. Induced Impacts (Household purchases due to injection of income)

Jobs and Economic Impacts from the JEDI Model

Wind Energy's Economic Impacts

Wind energy's economic "ripple effect"

Project Development & Onsite Labor Impacts



- Construction workers
- Management
- Administrative support
- Cement truck drivers
- Road crews
- Maintenance workers
- Legal and siting

Local Revenue, Turbine, & Supply Chain Impacts

- Blades, towers, gear boxes
- Boom truck & management, gas and gas station workers;
- Supporting businesses, such as bankers financing the construction, contractor, manufacturers and equipment suppliers;
- Utilities;
- Hardware store purchases and workers, spare parts and their suppliers

Induced Impacts

Jobs and earnings that result from the spending supported by the project, including benefits to grocery store clerks, retail salespeople, and child care providers

Project Development & Onsite Labor

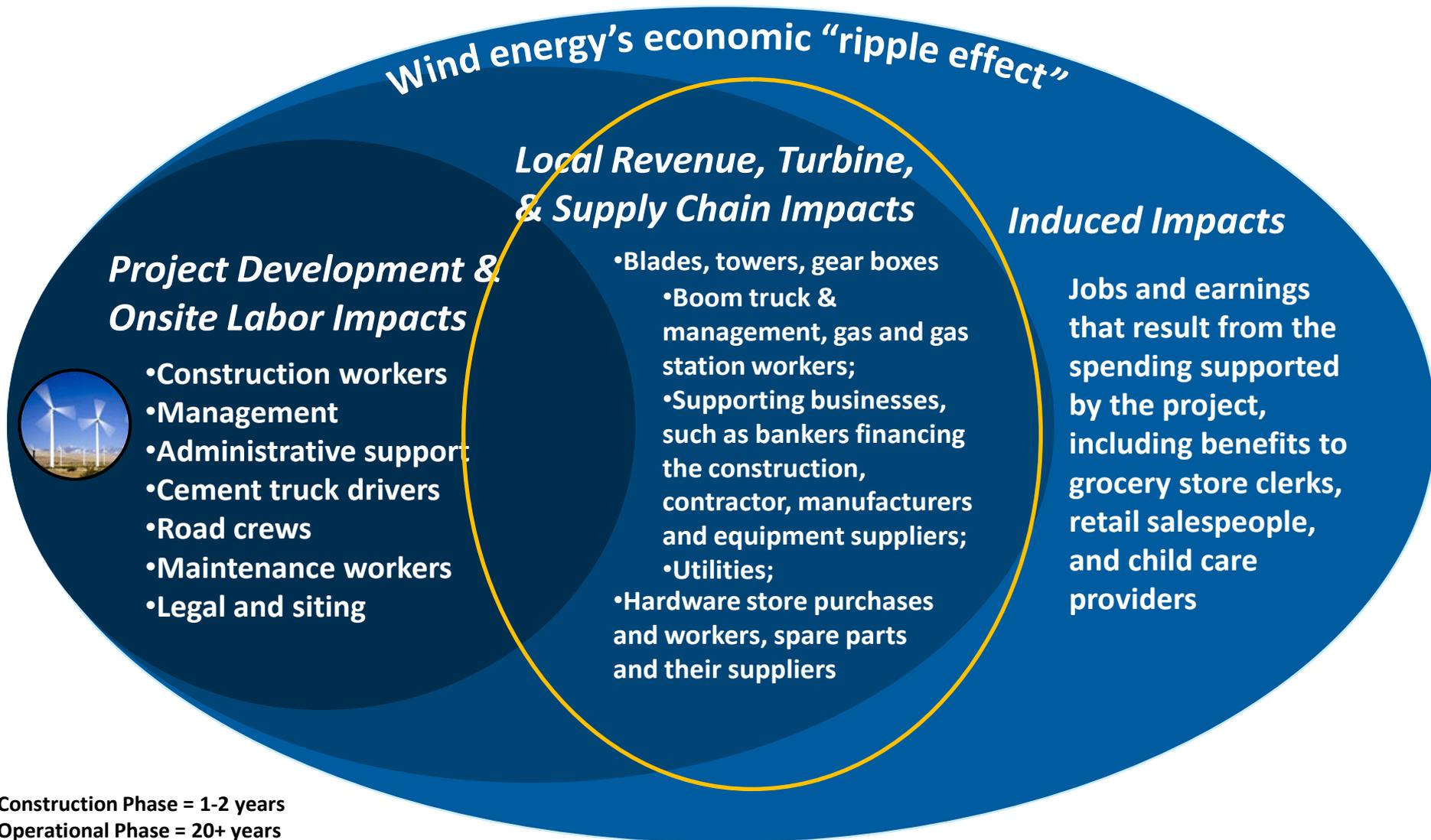


Sample Jobs:
Truck Drivers
Crane Operators
Earth Moving
Cement Pouring
Management
Support



Jobs and Economic Impacts from the JEDI Model

Wind Energy's Economic Impacts



Local Revenues, Turbine, & Supply Chain



Steel mill jobs, parts, services - Equipment manufacturing and sales - Blade and tower manufacturers



Property taxes - Financing, banking, accounting

Jobs and Economic Impacts from the JEDI Model

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Induced Impacts



Money spent on local area goods and services from increased revenue: *sandwich shops, child care, grocery stores, clothing, other retail, public transit, new cars, restaurants, medical services*



Challenges to modeling Renewables

Renewables represent a new industry

- Not isolated as an industry in conventional I/O tables

Requires knowledge of project costs and industry specific expenditures

- Equipment, Engineering, Labor, Permitting, O&M, etc.

JEDI

- Provides a project basic project recipe for specific RE technologies
- Applies Industry Specific Multipliers derived from IMPLAN



JEDI Caveats

- Not intended to provide a precise forecast, but an estimate of overall economic impacts
- Inputs need your context!
- Size of project
- Gross jobs vs. net jobs
- Local sourcing levels have significant impact
- Full-Time Equivalent (FTE) jobs
- Simplicity/complexity trade-off



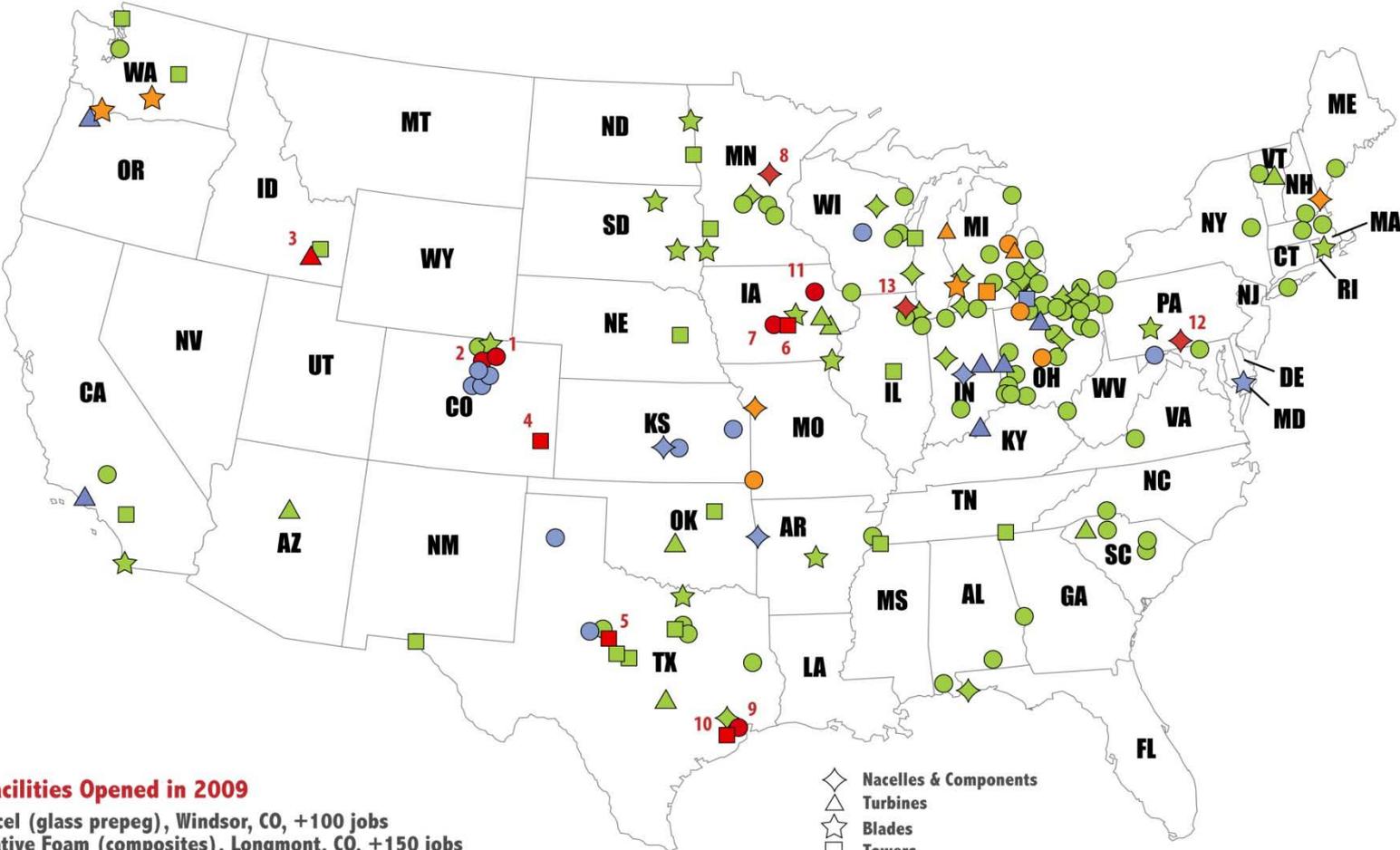
JEDI based on actual projects: Iowa

240-MW Iowa wind project

- \$640,000/yr in lease payments to farmers
- \$2M/yr in property tax revenues
- \$5.5M/yr in O&M income
- **40 long-term jobs**
- **200 short-term construction jobs**
- **Manufacturing...**



Domestic wind manufacturing facilities



New Facilities Opened in 2009

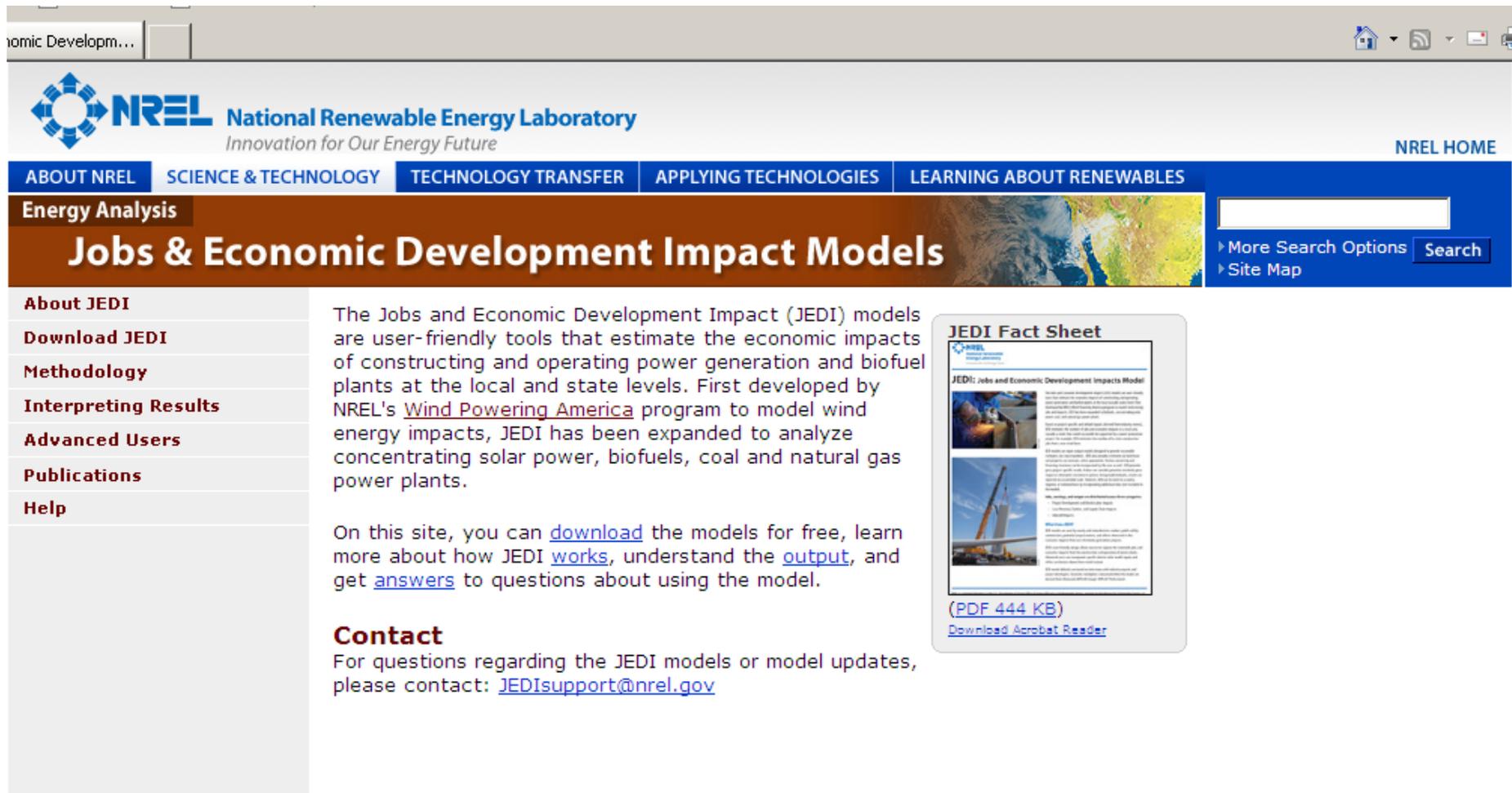
- 1. Hexcel (glass prepreg), Windsor, CO, +100 jobs
- 2. Creative Foam (composites), Longmont, CO, +150 jobs
- 3. Nordic Windpower (turbines), Pocatello, ID, +160 jobs
- 4. Dragon Wind (towers), Lamar, CO, +60-80 jobs
- 5. Tower Tech (towers), Abilene, TX, +150 jobs
- 6. Trinity Structural Towers (towers), Newton, IA, +140 jobs
- 7. Goian North America (elevation systems), Ankeny, IA, +12 jobs
- 8. Mille Lacs Band of Ojibwe (generators), Mille Lacs Reservation, MN, +7 jobs
- 9. RLTC Wind Towers (towers), MacGregor, TX, +75-250 jobs
- 10. RBC Bearings (bearings), Houston, TX, +35 jobs
- 11. Sector 5 Technologies (components), Oelwein, IA, +99 jobs
- 12. Vacon Inc (AC drives), Chambersburg, PA, +94 jobs
- 13. Winergy (gear drives), Elgin, IL, +300 jobs

- ◇ Nacelles & Components
- △ Turbines
- ☆ Blades
- Towers
- Other
- New facilities opened in 2009
- Newly branched into wind in 2009
- New facilities announced in 2009
- Existing facilities online prior to 2009

Figure includes wind turbine and component manufacturing facilities, as well as other supply chain facilities, but excludes corporate headquarters and service-oriented facilities. The facilities shown here are not intended to be exhaustive. Those facilities designated as "Turbines" may include turbine assembly and/or turbine component manufacturing, in some cases also including towers, nacelles and blades.



Downloading the JEDI model



The screenshot shows the NREL website interface. At the top left is the NREL logo with the text "National Renewable Energy Laboratory" and "Innovation for Our Energy Future". To the right is a "NREL HOME" link. Below the logo is a navigation bar with tabs for "ABOUT NREL", "SCIENCE & TECHNOLOGY", "TECHNOLOGY TRANSFER", "APPLYING TECHNOLOGIES", and "LEARNING ABOUT RENEWABLES". The "Energy Analysis" section is highlighted in a dark blue bar, containing the text "Jobs & Economic Development Impact Models". To the right of this bar is a search box with "More Search Options" and "Site Map" links. On the left side, there is a vertical menu with links: "About JEDI", "Download JEDI", "Methodology", "Interpreting Results", "Advanced Users", "Publications", and "Help". The main content area contains a paragraph describing the JEDI models, a "Contact" section with an email address, and a "JEDI Fact Sheet" preview box with a "Download Acrobat Reader" link.

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NREL HOME

ABOUT NREL SCIENCE & TECHNOLOGY TECHNOLOGY TRANSFER APPLYING TECHNOLOGIES LEARNING ABOUT RENEWABLES

Energy Analysis

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The Jobs and Economic Development Impact (JEDI) models are user-friendly tools that estimate the economic impacts of constructing and operating power generation and biofuel plants at the local and state levels. First developed by NREL's [Wind Powering America](#) program to model wind energy impacts, JEDI has been expanded to analyze concentrating solar power, biofuels, coal and natural gas power plants.

On this site, you can [download](#) the models for free, learn more about how JEDI [works](#), understand the [output](#), and get [answers](#) to questions about using the model.

Contact
For questions regarding the JEDI models or model updates, please contact: JEDIsupport@nrel.gov

JEDI Fact Sheet

[\(PDF 444 KB\)](#)
[Download Acrobat Reader](#)

<http://www.nrel.gov/analysis/jedi/>

The JEDI Model



JEDI - WIND

Jobs and Economic Development Impact Model

This demonstration model is designed to estimate the statewide economic impacts associated with developing wind power electric generation facilities. The economic impacts identified include annual jobs, earnings, and output for the construction period and once the windfarm is up and running. A user defined "add-in" location (e.g., county or region) option is also available.

Steps to complete an economic impact analysis:

1. Enter project descriptive data
2. Choose to accept default project cost data (based on project description and average cost data for windfarms) or review and enter new project data.
3. If you accept default values go directly to SUMMARY RESULTS to view and/or print results.
4. If you choose to enter new values make sure to enter an "N" in the designated cell before proceeding.

To begin analysis press Start button

Start
Economic Impact Analysis

The models contain state multipliers, but county or regional multipliers can be acquired and input into the model to carry out analysis on entities other than states

Basic User Inputs

Wind Farm Project Data

INSTRUCTIONS: Begin by entering Project Location (from pull-down list) and other Descriptive Data. After inserting required data press enter (or cursor to the next cell) to continue. Once Descriptive Data is complete, choose "Y" or "N" on Line 24 to continue. Choose "Y" to accept Project Cost and Local Share defaults or "N" to review/modify values. To utilize new values in analysis you must choose an "N" in "Utilize Model Default Values (below)?" - Line 24. Additional information is available by pointing to the red triangles located in cell corners and in the *FAQ* tab. Only those cells with a white background can be changed (accept new values).

Project Descriptive Data

Project Location	COLORADO
Population (only required for County/Region analysis)	
Year of Construction	2009
Total Project Size - Nameplate Capacity (MW)	100
Number of Projects (included in Total Project Size)	1
Turbine Size (KW)	1,500
Number of Turbines	67
Installed Project Cost (\$/KW)	\$2,043
Operations and Maintenance Cost (\$/kW)	\$20.00
Money Value - Current or Constant (Dollar Year)	2008

The user chooses the state where the project will be located from a drop down menu and provides basic project level information.

Utilize *Project Cost Data* default values in analysis? Choose "Y" to accept default values below or "N" to over-ride default values and utilize new user defined values as entered below. See *FAQ* for related topics.

The user can then accept the default descriptive data or enter their own project specific data.

If desired, default values (in cells below - based on *Project Descriptive Data* entered above) may be restored by pressing the 'Restore Default Values' button. Note: it is not necessary to restore defaults to incorporate default *Project Cost Data* in system analysis - simply choose "Y" in cell B24 above.

Restore Default Values

Detailed User Inputs

	Cost	Cost Per KW	Percent of Total Cost	Local Share
Project Cost Data				
Construction Costs				
Equipment Costs				
Turbines (excluding blades and towers)	\$91,451,104	\$915	44.8%	0%
Blades	\$21,409,957	\$214	10.5%	0%
Towers	\$23,703,882	\$237	11.6%	0%
Transportation	\$16,363,325	\$164	8.0%	0%
Equipment Total	\$152,928,268	\$1,529	74.8%	
Balance of Plant				
Materials				
Construction (concrete, rebar, equip, roads and site prep)	\$22,098,135	\$221	10.8%	90%
Transformer	\$2,499,757	\$25	1.2%	0%
Electrical (drop cable, wire,)	\$2,634,913	\$26	1.3%	100%
HV line extension	\$4,813,107	\$48		
Materials Subtotal	\$32,045,912	\$320		
Labor				
Foundation	\$1,266,243	\$13		
Erection	\$1,434,200	\$14		
Electrical	\$2,090,061	\$21		
Management/Supervision	\$1,084,537	\$11		
Misc.	\$7,762,202	\$78		
Labor Subtotal	\$13,637,243	\$136		
Development/Other Costs				
HV Sub/Interconnection				
Materials	\$1,518,720	\$15		
Labor	\$465,214	\$5		
Engineering	\$2,066,598	\$21		
Legal Services	\$1,126,296	\$11		
Land Easements	\$0	\$0		
Site Certificate/Permitting	\$526,983	\$5		
Development/Other Subtotal	\$5,703,811	\$57		
Balance of Plant Total	\$51,386,966	\$514	25.2%	
Total	\$204,315,234	\$2,043	100.0%	

Local share values allow the user to adjust the percentage of local labor that is used in the project

Line item cost inputs are shown here. In addition to **construction** cost inputs, default values are provided for **operating and maintenance** and **financial** parameters or the user can choose to enter their own project specific data.

Results Summary

	A	B	C	D	E
1	Wind Farm - Project Data Summary based on model default values				
2	Project Location		COLORADO		
3	Year of Construction		2009		
4	Total Project Size - Nameplate Capacity (MW)		100		
5	Number of Projects (included in total)		1		
6	Turbine Size (KW)		1500		
7	Number of Turbines		67		
8	Installed Project Cost (\$/KW)		\$2,043		
9	Annual O&M Cost (\$/KW)		\$20.00		
10	Money Value (Dollar Year)		2008		
11	Installed Project Cost		204,315,234		
12	Local Spending		\$36,581,782		
13	Total Annual Operational Expenses		\$33,598,101		
14	Direct Operating and Maintenance Costs		\$2,000,000		
15	Local Spending		\$697,527		
16	Other Annual Costs		\$31,598,101		
17	Local Spending		\$869,090		
18	Debt and Equity Payments		\$0		
19	Property Taxes		\$567,590		
20	Land Lease		\$301,500		
21					
22	Local Economic Impacts - Summary Results				
23		Jobs	Earnings	Output	
24	During construction period				
25	Project Development and Onsite Labor Impacts	67	\$4.2	\$4.9	
26	Construction and Interconnection Labor	60	\$3.8		
27	Construction Related Services	7	\$0.5		
28	Turbine and Supply Chain Impacts	306	\$12.0	\$41.5	
29	Induced Impacts	122	\$4.3	\$14.6	
30	Total Impacts	495	\$20.5	\$61.0	
31					
32	During operating years (annual)				
33	Onsite Labor Impacts	6	\$0.4	\$0.4	
34	Local Revenue and Supply Chain Impacts	8	\$0.3	\$1.7	
35	Induced Impacts	7	\$0.2	\$0.8	
36	Total Impacts	20	\$1.0	\$2.9	

JEDI then estimates the annual economic impact on jobs earnings and output during facility construction and operation.

Print Project Data Summary and Summary Results

Print Detailed Project Data

Export All Project Data and Summary Results to a new spreadsheet file

Return to Project Description and Cost Data

Rental fees pre-development

All wind energy right-of-way applications and authorizations are subject to appropriate cost recovery fees for processing and monitoring as well as rental fees as required by 43 CFR 2804.14, 43 CFR 2805.16, and 43 CFR 2806.10.

Wind energy right-of-way authorizations are considered non-linear right-of-way grants and, therefore, are not subject to the requirements of 43 CFR 2806.23 regarding multiyear rental payments.

Site monitoring fee = a minimum of \$100

The rental fee for a project area grant will be based on the total public land acreage of the project area included in the right-of-way grant. The rental fee for the total public land acreage of the grant will be \$1,000/ year or \$1 per acre/ year, whichever is greater.

Rental fees – development & operation

The new rental fee established by this IM is \$4,155 per megawatt of the total anticipated installed capacity of the wind energy project on public land based on the approved POD, a capacity factor of 30 percent, a Federal rate of return of 5.27 percent, and an average purchase price of \$0.03 per kilowatt hour.

The annual rental fee will be phased in as follows:

Year 1- 25 % of the total rental fee or \$1,039/MW

Year 2 - 50 % of the total rental fee or \$2,078/MW

Year 3 – 100 % of the total rental fee or \$4,155/MW

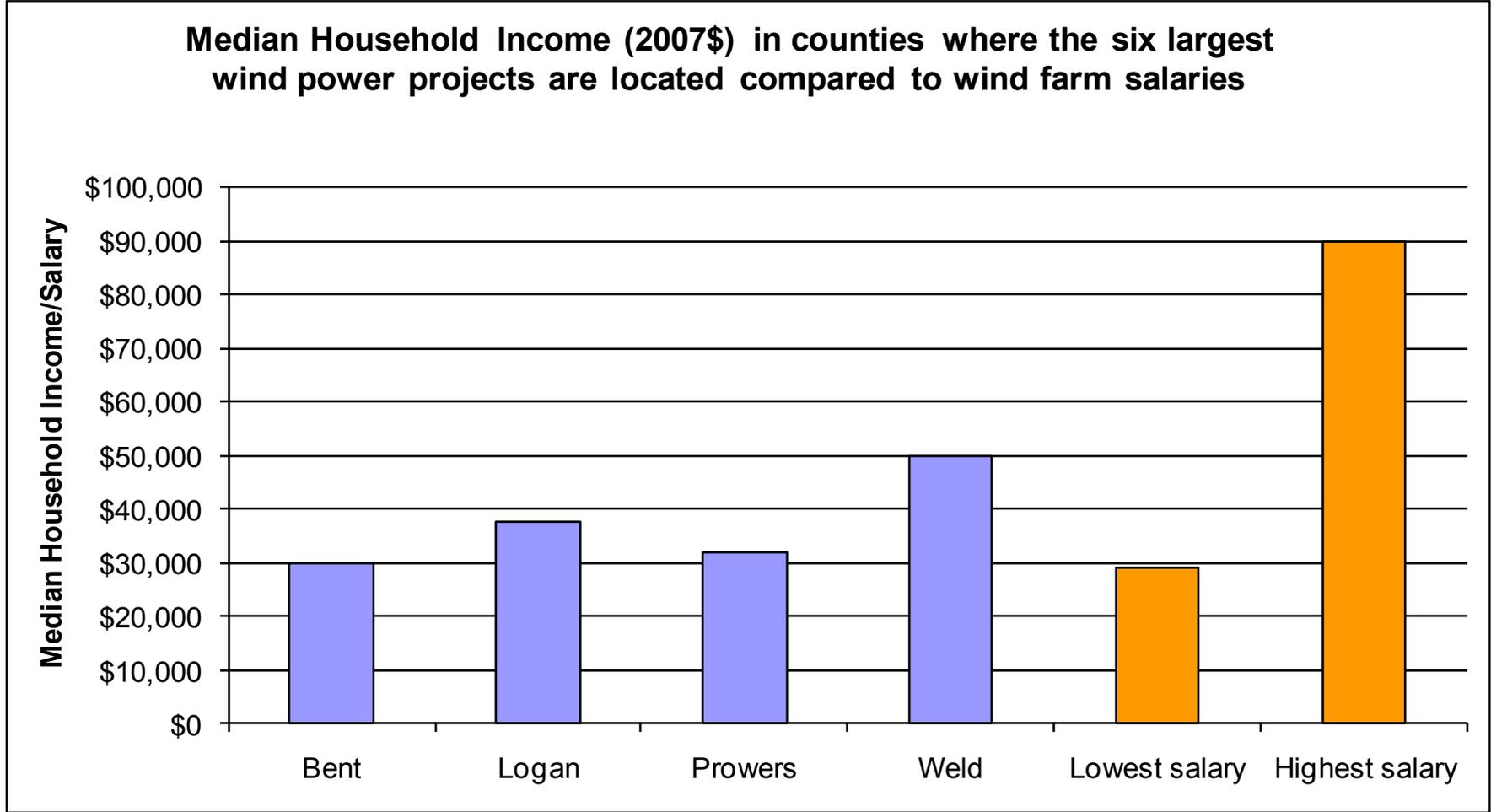
The full annual rental fee will apply at any time prior to 3 years upon the start of commercial operations of the project.

The BLM will not assess a separate turbine installation fee (an additional one-time payment for each turbine installation), a production rental fee, or other fees as part of the wind energy rental fee

Interpreting Wind JEDI Results

- JEDI reports jobs as *full-time equivalents* or 2,080 hour units
 - Projects may take more or less than a year to complete, in these cases construction can be adjusted to reflect the impact during the actual period of construction
 - Example: JEDI reports 100 Construction period jobs. This could be 25 workers supported for 4 years or 200 workers supported for 6 months.
 - Operations period impacts are also FTE's but because they are reported as annual impacts you can interpret these as long-term jobs
- Earnings reflect the actual salaries acquired by laborers
- Output is the sum value of all goods and services provided at each layer of the supply chain – JEDI shows impacts in-state
 - Example: For a wind turbine it is the cost of the iron ore, plus the cost of the rolled steel, plus the cost of the assembly, plus the cost of the final project
 - This is in contrast to metrics like GDP or GSP which reflect only the sum of the value added (i.e. sale price less material input prices) or the market value of *final goods and services*
- JEDI Analyses are a measure of Gross Economic Impacts

Wind projects offer competitive salaries



Reategui, NREL

JEDI Summary

- Analyzing Jobs and Economic Impacts is an important task, and even more so in today's economic and political climate
 - It is not however, the sole metric upon which we can/should evaluate renewable energy projects
- The JEDI tool provides a *user friendly*, free platform to carry out economic impacts analysis for renewable energy projects
- Individual projects vary in key aspects that affect economic development to state and local regions
 - In extreme cases (i.e. local turbine manufacturing) impacts to a state or local region may be 5 to 10 times different.
- Acquiring as much project specific information as possible is critical – the more accurate the inputs, the better the outputs!
- General questions: jedisupport@nrel.gov

JEDI Model Availability

Current JEDI Models

- Large Wind
- Concentrating Solar Power (CSP)
- Dry Mill Corn Ethanol
- Lignocellulosic Ethanol
- Natural Gas (Combined Cycle)
- Coal (Pulverized Coal)
- Photovoltaic (PV)

JEDI Under Development

- Geothermal
- Hydro – Conventional & MHK
- Offshore Wind and Small/Mid-sized Wind
- Transmission



NREL's Existing Information



- Wind Powering America website: www.windpoweringamerica.gov
- Reports
- Fact sheets
- Maps



National Renewable Energy Laboratory

Innovation for Our Energy Future

*A national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy*

Economic Development Impacts of Community Wind Projects: A Review and Empirical Evaluation

Conference Paper
NREL/CP-500-45555
April 2009



Economic Benefits, Carbon Dioxide (CO₂) Emissions Reductions, and Water Conservation Benefits from 1,000 Megawatts (MW) of New Wind Power in Pennsylvania

Wind power is one of the fastest-growing forms of new power generation in the United States. Industry growth in 2007 was an astounding 45%. New wind power installations constituted 30% of all new electric power installations. This growth is the result of many drivers, including increased economic competitiveness and favorable state policies such as Renewable Portfolio Standards. However, new wind power installations provide more than just competitive

cumulative economic benefits from 1000 MW of development in Pennsylvania to be **\$1.2 billion**, annual CO₂ reductions are estimated at **3.4 million tons**, and annual water savings are **1,837 million gallons**.

Economic Benefits

Building and operating 1000 MW of wind power requires a

Thank You



Suzanne Tegen
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