

Jobs and Economic Impacts from Wind Power Development: NREL's JEDI model



Suzanne Tegen

**National Renewable
Energy Laboratory**

August 4, 2011

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 model and results



NREL's JEDI Model Overview

- 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

Who uses the JEDI model?

State Energy Offices

Governors

Public Utility Commissions

Consumer Advocates

Local governments

- Municipal
- County Commissioners

Developers

Academia

Industry

Downloading the free 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 links: "ABOUT NREL", "SCIENCE & TECHNOLOGY", "TECHNOLOGY TRANSFER", "APPLYING TECHNOLOGIES", and "LEARNING ABOUT RENEWABLES". A secondary navigation bar includes "Energy Analysis" and "Jobs & Economic Development Impact Models". On the right side of this bar is a search box with "More Search Options" and "Site Map" links, and a "Search" button. A left sidebar contains a menu with items: "About JEDI", "Download JEDI", "Methodology", "Interpreting Results", "Advanced Users", "Publications", and "Help". The main content area features a heading "Jobs & Economic Development Impact Models" and a descriptive paragraph about the JEDI models. To the right of the text is a "JEDI Fact Sheet" thumbnail with a "Download Acrobat Reader" link. At the bottom of the page is the URL "http://www.nrel.gov/analysis/jedi/".

omic Developm...

NREL National Renewable Energy Laboratory
Innovation for Our Energy Future

NREL HOME

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

Energy Analysis

Jobs & Economic Development Impact Models

More Search Options Search
Site Map

About JEDI

Download JEDI

Methodology

Interpreting Results

Advanced Users

Publications

Help

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/>

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)
- Marine and Hydrokinetic

JEDI Under Development

- Geothermal
- Hydropower
- Offshore Wind and Small/Mid-sized Wind
- Transmission



Wind Energy's Economic Impacts

JEDI Model Version W1.09.03e

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

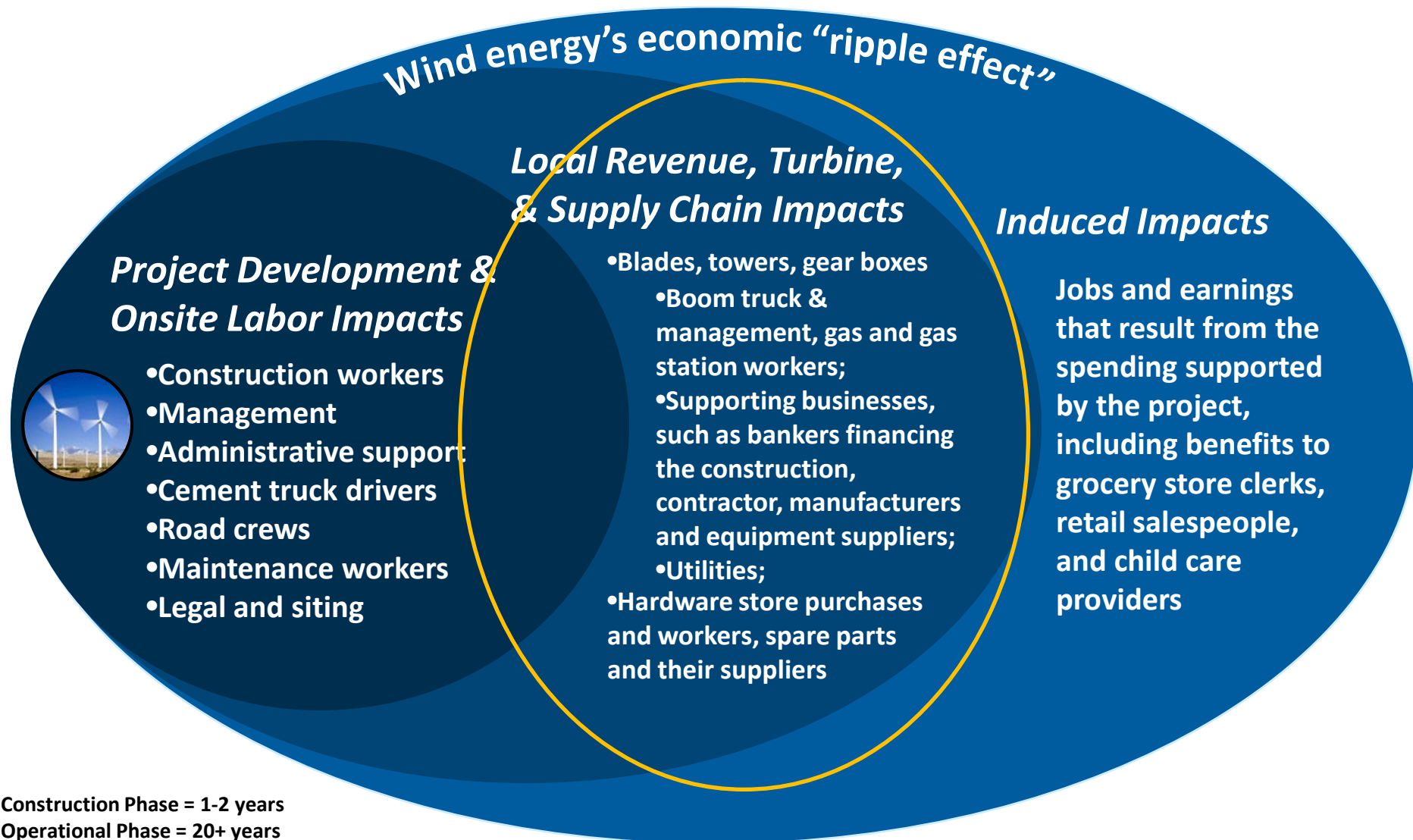


Sample Jobs:
Truck Drivers
Crane Operators
Earth Moving
Cement Pouring
Management
Support



Jobs and Economic Impacts from the JEDI Model

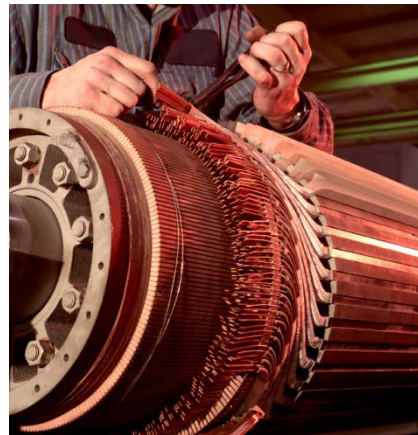
Wind Energy's Economic Impacts



Local Revenues, Turbine, & Supply Chain



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



Property taxes - Financing, banking, accounting

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

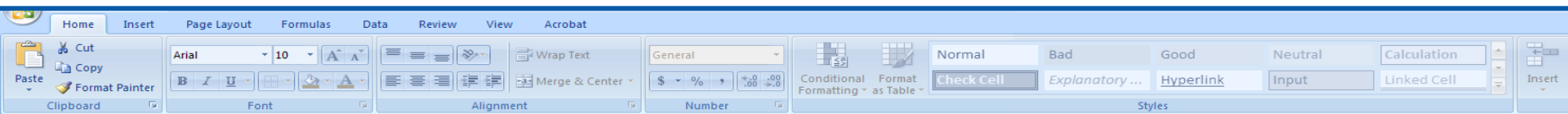
Induced Impacts



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*



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.

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



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.

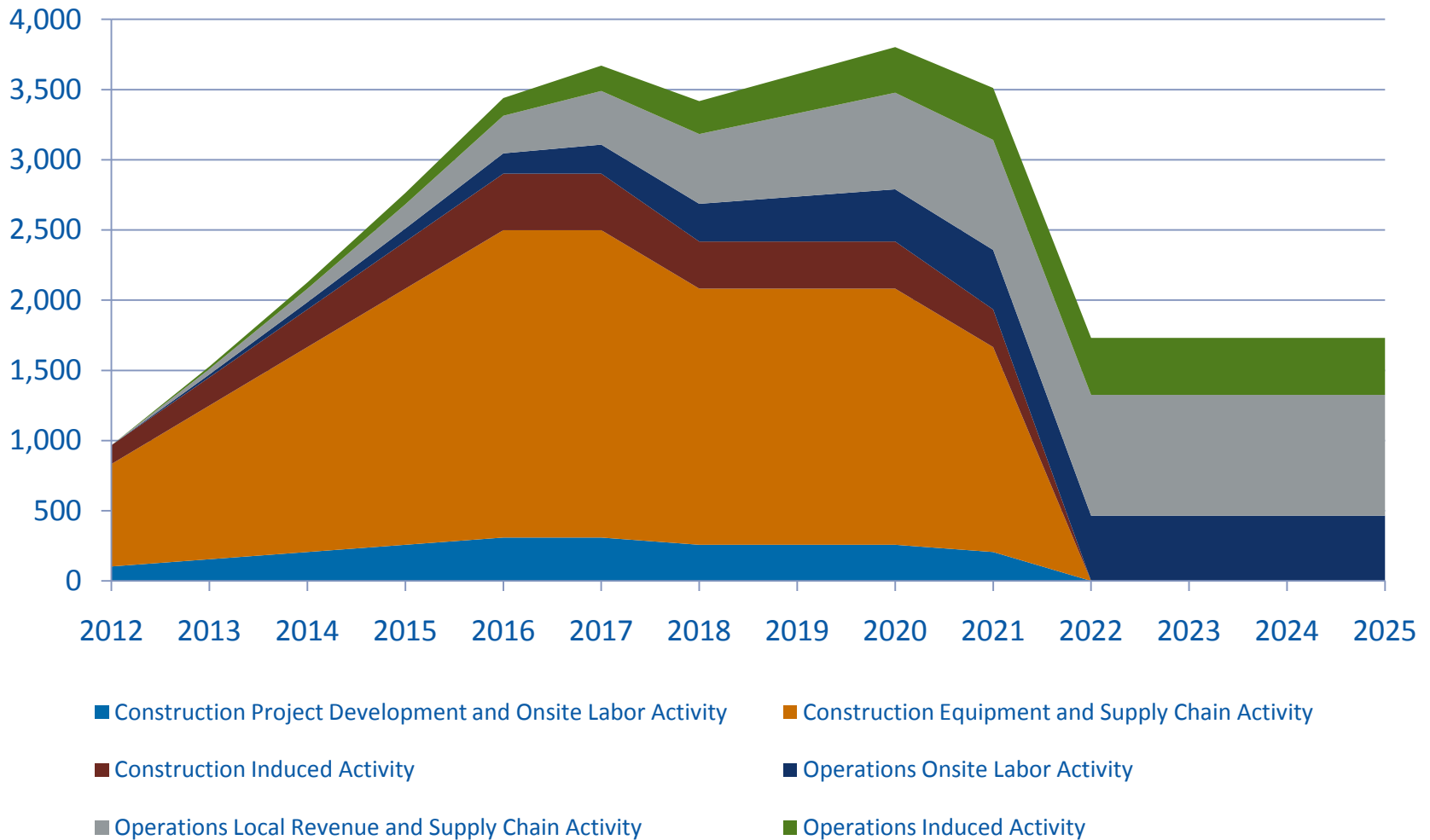
JEDI

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



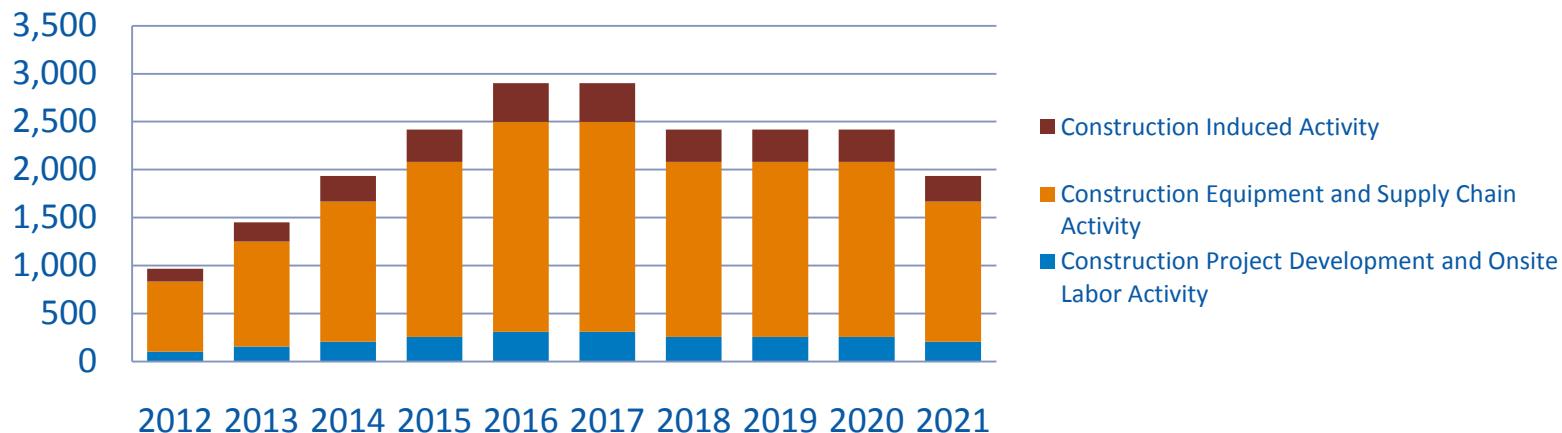
WIA: Base Case for New Wind Over Time

Wyoming Employment (annual) from 9,000 MW of new wind Generation

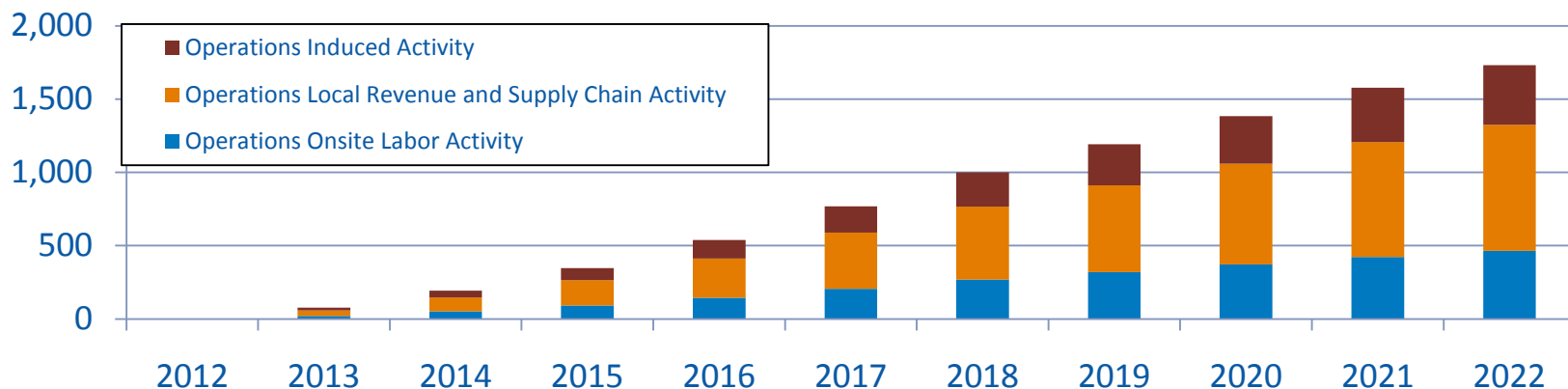


Base Case: Employment from New Wind Development

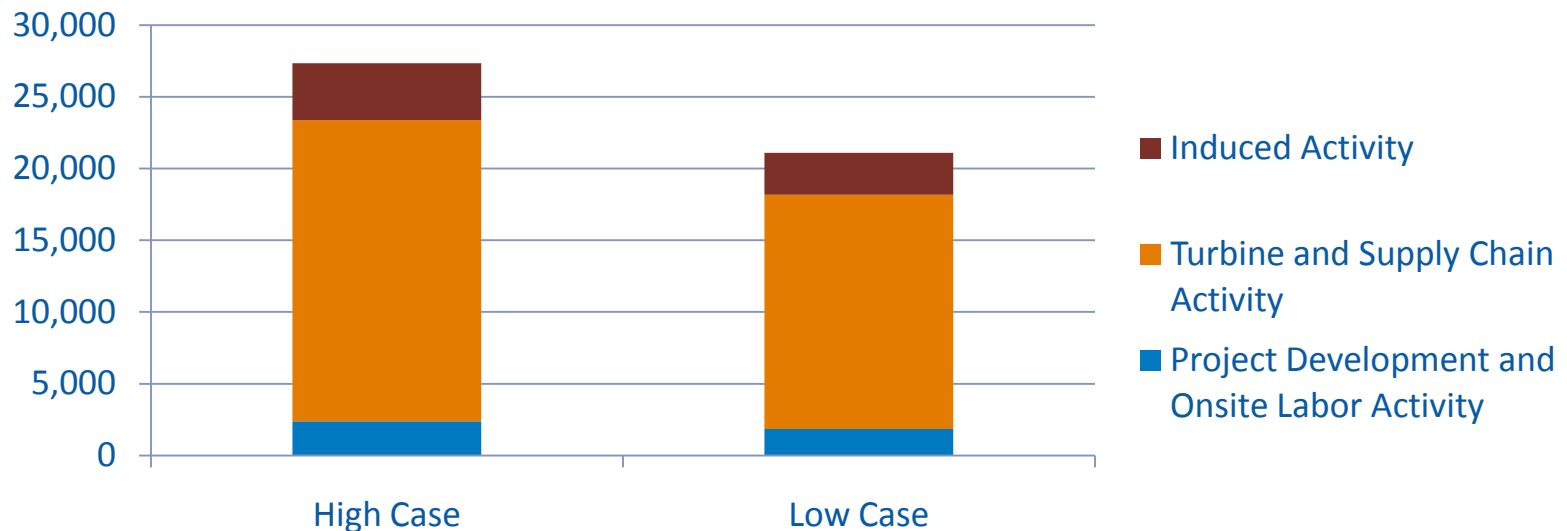
Annual employment during construction



Long-term employment during operations



Wind Power Sensitivities (Construction)



Result: a difference of ~4500 jobs between the base case and high scenario, mostly due to tower manufacturing.

Low Scenario: project management during construction all out-of-state and only 20% of legal services provided by WY firms.

High Scenario: 50% of towers manufactured in WY and 20% of project management during construction based in WY.

- 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
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

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
National Renewable Energy Laboratory
Suzanne.Tegen@nrel.gov