

DOE OFFICE OF INDIAN ENERGY

Tribal Webinar Economic Development Impacts from Energy Projects

Gail Mosey, National Renewable Energy Laboratory

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Golden, CO



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Why Complete a Renewable Energy Project?

Economic

- Jobs
- Income
- Cost savings
- Cost stabilization
- Industry exposure
- Economic independence

Social

- Energy reliability (diversification)
- Energy independence
- Quality of life
- Community and stakeholder participation
- Educational Benefits

Environment

- Air quality
- Avoided Emissions
- Climate change
 - Mitigation
 - Adaptation
 - Resiliency
- Demonstrated Environmental Leadership

Benefits vary based on the type and scale of projects

Project Scale

Facility: single-building system

Primary goals: offset building energy use, costs

Development timeline: 1 month to 1 year



NC Solar Center, NREL 09373

Community: multiple buildings/campus

Primary goals: Offset community energy costs, promote energy self-sufficiency

Development timeline: 6 months to 2 years

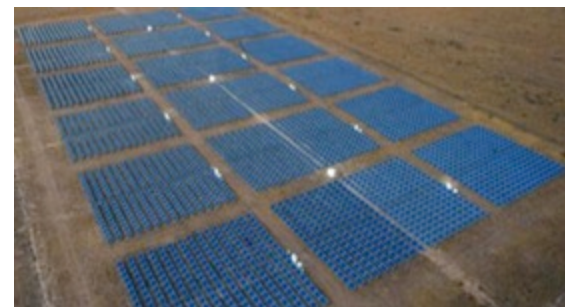


Orange County Convention Center, NREL 18077

Commercial: stand-alone project

Primary goals: sale of power generation, financial benefits

Development timeline: 3 to 5 years



Tucson Electric Power, NREL 13327

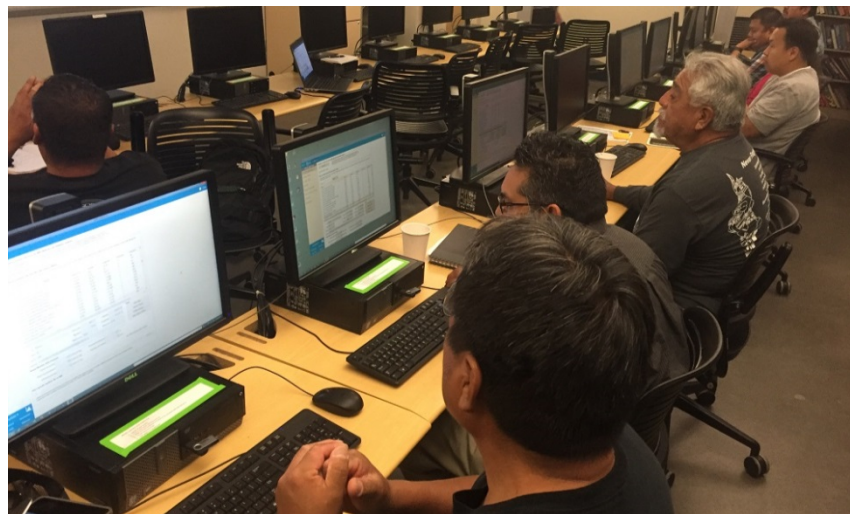
Investing Returns (Energy Savings or Sales Revenue)

- Community Reinvestment
- Social Programs
- Fiscal Stimulus
- Renewable Energy Programs
- Job Creation



Photo by Josh Bauer, NREL

Job Training and Skills Development



Project Development & Onsite Labor Impacts

Sample job types:

- Truck driving
- Crane operation, hoisting, rigging
- Earth moving
- Pouring cement
- Management, support
- Siting



Workers installing the racking for the Blue Lake Rancheria's 500-kW solar system in California. Photo from Blue Lake Rancheria

Supply Chain Impacts

- Equipment manufacturing and sales
- Property taxes
- Financing, banking, and accounting



Ruth Gilila and Norma Williams of Akiak Power Utilities. Photo from Connie Fredenberg, Marsh Creek

Induced Impacts

Money spent in the local area on goods and services from increased revenue:

- Restaurants
- Child care
- Grocery stores
- Clothing
- Medical services



Solar PV arrays installed at a low-income housing complex for tribal elders in the Confederated Tribes of the Grand Ronde Community of Oregon. Photo from the Grand Ronde Tribal Housing Authority

JOBS AND ECONOMIC DEVELOPMENT MODEL (JEDI)

Jobs and Economic Development Impact Models (JEDI) Overview

- About JEDI
- Methodology
- Limitations
- Interpretation
- Examples
- Questions? Ask!



Big Horn Wind Farm, Oregon. Photo from Iberdrola Renewables, Inc., NREL 15193

About JEDI Models

- Freely available input-output tool to estimate gross employment and economic impacts that result from an investment in new power generation or fuel production
- JEDI default inputs are from developers and industry experts, based on existing projects
- User input can be minimal with defaults or be very detailed for more precise results



eSolar Sierra SunTower power tower plant in California. Photo by David Hicks, NREL 18397

Downloading the JEDI Models

JEDI:
Jobs & Economic Development Impact Models



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JEDI Models

The Jobs and Economic Development Impact (JEDI) models are user-friendly screening tools that estimate the economic impacts of constructing and operating power plants, fuel production facilities, and other projects. JEDI results are intended to be estimates.

- [Biofuels](#)
- [Coal](#)
- [Conventional Hydropower](#)
- [Concentrating Solar Power](#)
- [Geothermal](#)
- [International](#)
- [Marine & Hydrokinetic Power](#)
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www.nrel.gov/analysis/jedi



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What technologies are available in JEDI?

- Wind
 - Distributed wind
 - Land based wind
 - Offshore wind
- Biofuels
 - Biopower
 - Biorefinery sugars to hydrocarbon
 - Cellulosic ethanol
 - Corn ethanol
 - Fast Pyrolysis
- Solar
 - Concentrating solar power (CSP) trough
- Hydroelectric
 - Marine and hydrokinetic
- Geothermal
- Transmission Line
- Natural gas (combined cycle)
- Coal (pulverized coal)
- Petroleum refining



The Menominee Tribal Enterprises biomass combined heat and power district energy plant in Wisconsin. Photo from Menominee Tribal Enterprises.

Why impact modeling?

- Evaluate potential scenarios
 - current or future
- Inform population, decision makers
- Assist businesses
 - Identify potential customers
 - Evaluate economic development efforts
- Assist government
 - Representing public interest
 - Planning and evaluating
 - Community development



Red Hills Wind Farm in Oklahoma. Photo by Todd Spink, NREL 16509

Who uses the JEDI Models?

- Governments
 - Public utility commissions
 - State or Governors' energy offices
 - Many federal agencies including the U.S. Department of Energy, Bureau of Land Management ,U.S. Department of the Treasury, and U.S. Department of Agriculture
 - National laboratories
- International analysts
- Developers and others in industry
- Universities
- Consultants
- Stakeholders
- Economic development groups
- Consumer advocates

Input-Output Models

- Snapshot of the relationships between sectors of an economy at a single point in time
 - Industries, labor, households, capital, investments, government, imports/exports
- Expenditures in an economy
 - Inputs: goods/services from other industries, payments for labor, capital, taxes, imports
 - Outputs: goods/services to other industries, households, governments, exports
- Captures impacts (multipliers) within a region, i.e., an increase in demand for electricity might increase demand for turbines, which will further increase demand for electricity

JEDI Results

- Jobs (full-time equivalents [FTEs])
 - Number of people working the equivalent of 40 hour weeks, 52 weeks/year
- Earnings
 - Income from work
 - Includes wages, salaries, employer provided supplements (retirement, health)
- Gross output
 - Measure of total economic activity
 - Revenue plus expenditures on inputs
 - Not the same as gross domestic product (GDP)

JEDI Phases

- Results presented in two phases
- Construction
 - Equivalent of one year, regardless of how long the project actually takes to build
 - Example: JEDI reports an impact of 600 jobs – this is an annual average of 300 if the project takes 2 years to build
- Operating
 - Annual, ongoing results

JEDI Strengths and Weaknesses

- Strengths
 - Widely accepted
 - Utilized by private companies, international organizations, foreign entities, and government agencies in the United States at the federal, state, and local levels
 - Can use available data from many different sources
 - Can give detailed sector-specific impact information
- Weaknesses
 - Gross impacts – not net (e.g., What about the coal mining jobs that are lost when adopting renewables?)
 - Assumes infinite supply of inputs
 - Assumes fixed prices – does not consider changes in electric rates, wages, or taxes
 - Does not evaluate the feasibility or profitability of a project

Explaining Variability in Economic Development Impacts

- Size and cost of the project
 - Higher costs often results in increased impact for both construction and operations and maintenance (O&M)
- Size and diversity of the local economy
 - Level of analysis
 - Multiplier effect
- Developer preferences
 - Local share/local purchase coefficient
- Magnitude and allocation of project revenues
 - Example: distributed wind



Native village of Shishmaref 2.4-kilowatt wind project.
Photo by Jared Temanson, NREL.



JEDI EXAMPLE

JEDI - DISTRIBUTED WIND

Jobs and Economic Development Impact Model

This demonstration model is designed to estimate the statewide economic impacts associated with developing distributed wind power electric generation systems. The economic impacts identified include annual jobs, earnings, output and value added for the installation period and once the systems are up and running. A user defined "add-in" location (e.g., county or region) option is also available. Please read the Frequently Asked Question (FAQ) section before using the tool for the first time.

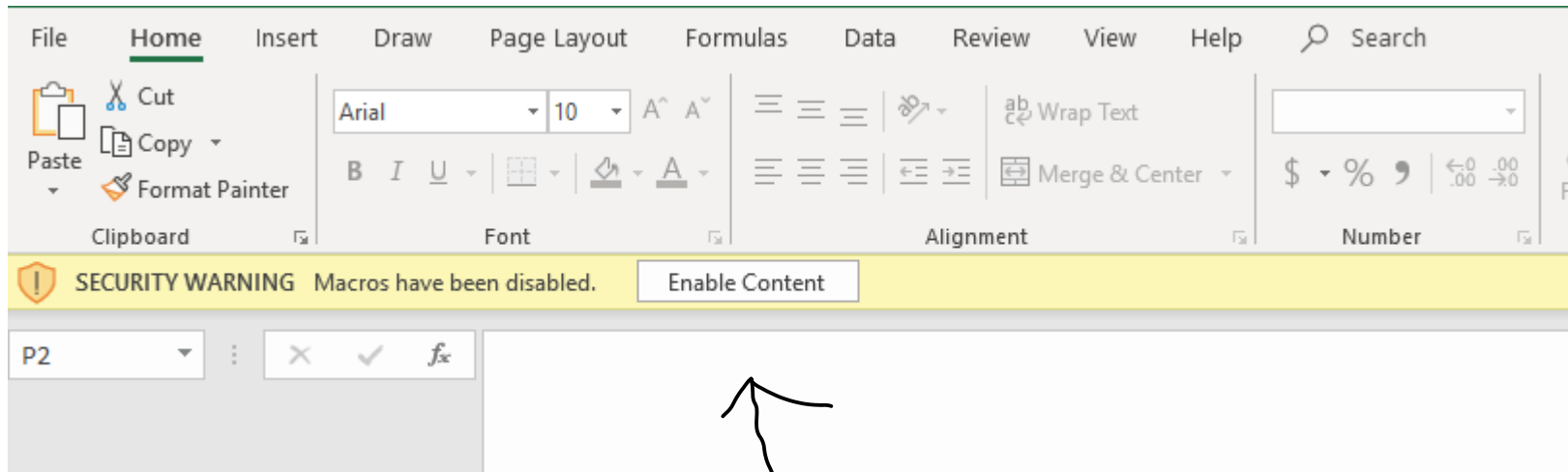
Steps to complete an economic impact analysis:

1. Enter project descriptive data.
2. Choose to perform a simple analysis, to accept default project cost data (based on project descriptive data entered), or an advanced analysis, to review and enter new project data.
3. If you choose simple analysis, after entering project descriptive data, go directly to SUMMARY RESULTS to view, save and/or print results.
4. If you choose advanced analysis, after entering project descriptive data, review and edit detailed project cost data before going to SUMMARY RESULTS.

To begin analysis press Start button

Start
Economic Impact Analysis

The JEDI Model



Note: be sure to 'enable content' at the top of your screen so that macros can run



JEDI INPUTS

Project Scenario

| | A | B | C | D | E | F | G |
|----|--|---|---|------------|---|---|-------------------------------|
| 1 | Distributed Wind Project Data | | | | | | |
| 2 | | | | | | | |
| 3 | INSTRUCTIONS: | | | | | | |
| 4 | 1. Begin by entering Project Descriptive Data. Choose Project <i>Location</i> (from pull-down list) and other parameters relevant to your project. | | | | | | |
| 5 | 2. Once Project parameters are entered (lines 13-27), you may choose to perform a "Simple" analysis or an "Advanced" analysis. | | | | | | |
| 6 | Choosing "Simple" Analysis indicates use of Model defaults, no editing of detailed cost data and other inputs. | | | | | | |
| 7 | Choosing "Advanced" Analysis allows user to review and edit detailed cost data and other inputs. | | | | | | |
| 8 | 3. Once Descriptive Data is complete, if Simple Analysis is chosen, go to Summary Results; if Advanced Analysis is chosen, | | | | | | |
| 9 | cursor down to review/edit detailed cost data and inputs below. | | | | | | |
| 10 | NOTE: Additional information is available by pointing to the red triangles located in cell corners. Only those cells with a white | | | | | | |
| 11 | background can accept new values. | | | | | | |
| 12 | Project Descriptive Data | | | | | | |
| 13 | Project Location | | | COLORADO | | | |
| 15 | Project Sector | | | Commercial | | | |
| 16 | Year of Construction | | | 2020 | | | |
| 17 | Construction Period (months) | | | 6 | | | |
| 18 | Turbine Size - DC Nameplate Capacity (kW) | | | 100.0 | | | |
| 19 | Number of Turbines Installed | | | 4 | | | |
| 20 | Total Project Size - DC Nameplate Capacity (kW) | | | 400.0 | | | |
| 21 | | | | | | | |
| 22 | System Cost (\$/kW) | | | \$5,749 | | | |
| 23 | Annual Operations and Maintenance Cost (\$/kW) | | | \$42.24 | | | |
| 24 | | | | | | | |
| 25 | Money Value (Dollar Year) | | | 2014 | | | |
| 26 | | | | | | | |
| 27 | Select Model Analysis Type (Simple or Advanced) | | | Advanced | | | Review/Enter New Values below |
| 28 | | | | | | | |
| 29 | | | | | | | |
| 30 | If desired, default values (in cells below - based on <i>Project Descriptive Data</i> entered above) may be restored by pressing the | | | | | | |
| 31 | 'Restore Default Values' button. <i>Note: it is not necessary to restore defaults to incorporate default Project Cost Data in system</i> | | | | | | |
| 32 | <i>analysis. Choosing "Simple" analysis in cell B27 above will direct model to utilize default cost data in the analysis.</i> | | | | | | |
| 33 | | | | | | | |



Project Scenario

| 34 Project Cost Data - Default Values | | | | | |
|---|-------------|-------------|-----------------------|-----------------------|--------------------------|
| 35 Construction Costs | | | | | |
| | Cost | Cost Per kW | Percent of Total Cost | Purchased Locally (%) | Manufactured Locally (%) |
| 36 Site Preparation and Erection Materials | | | | | |
| 37 Foundation Materials (concrete, rebar, etc.) | \$69,288 | \$173 | 3.0% | 75% | 100% |
| 38 Electrical (wire, conduit, etc.) | \$43,882 | \$110 | 1.9% | 75% | 0% |
| 39 Tower wiring kit | \$45,037 | \$113 | 2.0% | 100% | 100% |
| 40 Materials Subtotal | \$158,208 | \$396 | 6.9% | | |
| 41 Labor | | | | | |
| 42 Trenching and Pipe Installation | \$76,491 | \$191 | 3.3% | 100% | |
| 43 Foundation, Erection, and Electrical | \$174,837 | \$437 | 7.6% | 50% | |
| 44 Labor Subtotal | \$251,328 | \$628 | 10.9% | | |
| 45 Construction Subtotal | \$409,535 | \$1,024 | 17.8% | | |
| 46 Equipment Costs | | | | | |
| 47 Turbine | \$1,200,992 | \$3,002 | 52.2% | 0% | 0% |
| 48 Tower | \$346,440 | \$866 | 15.1% | 0% | 0% |
| 49 Special Tooling (bolts, wrenches) | \$18,477 | \$46 | 0.8% | 0% | 0% |
| 50 Equipment Subtotal | \$1,565,909 | \$3,915 | 68.1% | | |
| 51 Other Balance of System Costs | | | | | |
| 52 Tower Raising Kit | \$17,322 | \$43 | 0.8% | 50% | 0% |
| 53 Misc. Electrical | \$2,310 | \$6 | 0.1% | 0% | 0% |
| 54 Shipping Freight | \$69,288 | \$173 | 3.0% | 50% | |
| 55 Professional Services | \$131,237 | \$328 | 5.7% | 75% | |
| 56 Other Services | \$69,288 | \$173 | 3.0% | 75% | |
| 57 Site Permits/Fees | \$23,096 | \$58 | 1.0% | 100% | |
| 58 Miscellaneous | \$11,548 | \$29 | 0.5% | 50% | 0% |
| 59 Other Subtotal | \$324,088 | \$781 | 14.1% | | |
| 60 Subtotal | \$2,299,533 | \$5,749 | 100.0% | | |
| 61 Sales Tax | \$0 | \$0 | 0.0% | 100% | |
| 62 Total | \$2,299,533 | \$5,749 | 100.0% | | |

Project Scenario

| | | Cost | Cost Per kW | Percent of Total Cost | Purchased Locally (%) | Manufactured Locally (%) |
|----|---|----------|-------------|-----------------------|-----------------------|--------------------------|
| 64 | Small Wind System Annual Operating and Maintenance Costs | | | | | |
| 65 | | | | | | |
| 66 | Labor | | | | | |
| 67 | Technician | \$11,198 | \$27.99 | 66.3% | 100% | |
| 68 | Travel and Per Diem | \$2,630 | \$6.57 | 15.6% | 100% | |
| 69 | Personnel Subtotal | \$13,828 | \$34.57 | 81.8% | | |
| 70 | Materials and Services | | | | | |
| 71 | Misc. Services | \$657 | \$1.64 | 3.9% | 50% | |
| 72 | Fees, Permits, Licenses | \$0 | \$0.00 | 0.0% | 100% | |
| 73 | Insurance | \$0 | \$0.00 | 0.0% | 0% | |
| 74 | Tools and Misc. Supplies | \$0 | \$0.00 | 0.0% | 50% | 50% |
| 75 | Parts and Consumables | \$2,411 | \$6.03 | 14.3% | 10% | 10% |
| 76 | Materials and Services Subtotal | \$3,068 | \$7.67 | 18.2% | | |
| 77 | Subtotal | \$16,896 | \$42.24 | 100.0% | | |
| 78 | Sales Tax | \$0 | \$0.00 | 0.0% | 100% | |
| 79 | Total | \$16,896 | \$42.24 | 100.0% | | |
| 80 | | | | | | |



Project Scenario

| | | | |
|-----|--|---|--|
| 80 | | | |
| 81 | Other Parameters | | Purchased |
| 82 | Financial Parameters | | Locally (%) |
| 83 | Financing | | |
| 84 | Percentage financed | 80.0% | 0% |
| 85 | Years financed (term) | 10.0 | |
| 86 | Interest rate | 4.5% | |
| 87 | Tax Parameters | | |
| 88 | Local Property/Other Tax Rate (percent of taxable value) | 0.00% | |
| 89 | Assessed value (percent of construction cost) | 0.00% | |
| 90 | Taxable Value (percent of assessed value) | 0.00% | |
| 91 | Taxable Value | \$0 | |
| 92 | Property Tax Exemption (percent of local taxes) | 0.0% | |
| 93 | Local Property Taxes | \$0 | 100% |
| 94 | Local Sales Tax Rate | 2.90% | 100% |
| 95 | Sales Tax Exemption (percent of local taxes) | 100.00% | |
| 96 | Payroll Parameters | | |
| 97 | Construction and Installation Labor | Wage per hour | Employer Payroll Overhead |
| 98 | Trenching and Pipe Installation | \$20.80 | 37.6% |
| 99 | Foundation, Erection, and Electrical | \$22.91 | 37.6% |
| 100 | O & M Labor | Wage per hour | Employer Payroll Overhead |
| 101 | Technicians | \$33.12 | 37.6% |
| 102 | | | |
| 103 | | | |
| 104 | Go To Summary Impacts | Return To Top Project Description and Cost Data | Restore Default Values |
| 105 | | | |
| 106 | | | |
| 107 | | | |



JEDI RESULTS

Jedi Project Summary

| | A | B | C | D | E | F | C |
|----|--|-------------|---|---|---|---|--|
| 1 | Distributed Wind System - Project Data Summary (using User modified values) | | | | | | |
| 2 | Project Location | COLORADO | | | | | Print Project Data Summary and Summary Results |
| 3 | Year of Construction | 2020 | | | | | |
| 4 | Construction Period (months) | 6.0 | | | | | |
| 5 | Turbine/System Size - DC Nameplate Capacity (KW) | 100.0 | | | | | Print Detailed Project Data |
| 6 | Number of Turbines Installed | 4 | | | | | |
| 7 | Project Size - DC Nameplate Capacity (KW) | 400.0 | | | | | Save All Project Data and Summary Results |
| 8 | System Cost (\$/kW) | \$5,749 | | | | | |
| 9 | Annual Operations and Maintenance Cost (\$/kW) | \$42.24 | | | | | |
| 10 | Money Value (Dollar Year) | 2014 | | | | | |
| 11 | Total Construction/Installation Cost | \$2,299,533 | | | | | Return to Project Description and Cost Data |
| 12 | Local Spending | \$512,233 | | | | | |
| 13 | Total Annual Operational Expenses | \$249,385 | | | | | |
| 14 | Direct Operating and Maintenance Costs | \$16,896 | | | | | |
| 15 | Local Spending | \$14,397 | | | | | |
| 16 | Debt Payments (Financing) and Taxes (Annually) | \$232,490 | | | | | |
| 17 | Local Spending | \$0 | | | | | |
| 18 | Debt Payments | \$0 | | | | | |
| 19 | Property Taxes | \$0 | | | | | |
| 20 | | | | | | | |

Jedi Results

| Local Economic Impacts - Summary Results | | | | |
|--|--------------|------------------|------------------|------------------|
| | Jobs | Earnings | Output | Value Added |
| During construction/installation period | | | | |
| Project Development and Onsite Labor Impacts | | | | |
| Construction Sector Only | 2.62 | \$163,909 | | |
| Construction and Installation Related Services | 1.84 | \$135,248 | | |
| Subtotal | 4.46 | \$299,157 | \$262,337 | \$224,029 |
| Turbine and Supply Chain Impacts | | | | |
| Induced Impacts | 1.50 | \$81,113 | \$234,904 | \$137,047 |
| Total Impacts | 8.06 | \$530,276 | \$951,524 | \$598,930 |
| During operating years (annual) | | | | |
| Onsite Labor Impacts | | | | |
| Field Technicians Only | 0.118 | \$6,987 | \$6,987 | \$6,987 |
| Local Revenue and Supply Chain Impacts | 0.048 | \$3,003 | \$8,264 | \$4,897 |
| Induced Impacts | 0.035 | \$1,940 | \$5,617 | \$3,277 |
| Total Impacts | 0.201 | \$11,930 | \$20,867 | \$15,160 |
| Notes: Earnings and Output values are dollars in year 2014 dollars. Construction period jobs are full-time equivalent jobs for one year. | | | | |
| Labor includes field technicians, administration and management. Turbine and Local Revenue and Supply Chain includes jobs related to | | | | |
| goods and services purchased locally. Economic impacts "During operating years" represents impacts that occur annually from system | | | | |
| expenditures. The analysis does not include impacts associated with spending of income from sales of excess electricity | | | | |
| generated and assumes no tax abatement unless noted. Totals may not add up due to independent rounding. | | | | |

- **Jobs** (FTEs): Full time equivalent of 40 hour weeks, 52 weeks/year
- **Earnings**: Income from work; includes wages, salaries, employer provided supplements (retirement, health)
- **Output**: measure of economic activity; or the value of production in the state or local economy
- **Value added**: the difference between the total gross output and the cost of intermediate inputs



Thank You!

gail.mosey@nrel.gov



Detailed Costs

| | | | | |
|----|--|--------------------|--------------------|-------------------|
| 45 | | | | |
| 46 | Detailed Distributed Wind System Project Data and Costs | | COLORADO | |
| 47 | | | | |
| 48 | Construction/Installation Costs | Cost | Local Share | Local Mfg. |
| 49 | Site Preparation and Erection Materials | | | |
| 50 | Grading and Backfill | \$0 | 0% | 0% |
| 51 | Foundation Materials (concrete, rebar, etc.) | \$69,288 | 75% | 100% |
| 52 | Electrical (wire, conduit, etc.) | \$43,882 | 75% | 0% |
| 53 | Tower wiring kit | \$45,037 | 100% | 100% |
| 54 | Materials Subtotal | \$158,208 | | |
| 55 | Labor | | | |
| 56 | Trenching and Pipe Installation | \$76,491 | 100% | |
| 57 | Foundation, Erection, and Electrical | \$174,837 | 50% | |
| 58 | Subtotal | \$251,328 | | |
| 59 | Construction Subtotal | \$409,535 | | |
| 60 | Equipment Costs | | | |
| 61 | Turbines | \$1,200,992 | 0% | 0% |
| 62 | Towers | \$346,440 | 0% | 0% |
| 63 | Inverter | \$18,477 | 0% | 0% |
| 64 | Subtotal | \$1,565,909 | | |
| 65 | Other Costs | | | |
| 66 | Tower Raising Kit | \$17,322 | 50% | 0% |
| 67 | Misc. Electrical | \$2,310 | 0% | 0% |
| 68 | Shipping Freight | \$69,288 | 50% | |
| 69 | Professional Services | \$131,237 | 75% | |
| 70 | Other Services | \$69,288 | 75% | |
| 71 | Site Permits/Fees | \$23,096 | 100% | |
| 72 | Miscellaneous | \$11,548 | 50% | 0% |
| 73 | Other Subtotal | \$324,088 | 0% | |
| 74 | Subtotal | \$2,299,533 | | |
| 75 | Sales Tax | \$0 | 100% | |
| 76 | Total | \$2,299,533 | | |
| 77 | | | | |

Detailed O&M Costs

| | | | | |
|----|---|-------------|--------------------|-------------------|
| 77 | | | | |
| 78 | Small Wind System Annual Operating and Maintenance Costs | | | |
| 79 | | Cost | Local Share | Local Mfg. |
| 80 | Labor | | | |
| 81 | Technicians | \$11,198 | 100% | |
| 82 | Labor Subtotal | \$11,198 | | |
| 83 | Materials and Services | | | |
| 84 | Misc. Services | \$657 | 50% | |
| 85 | Fees, Permits, Licenses | \$0 | 100% | |
| 86 | Insurance | \$0 | 0% | |
| 87 | Tools and Misc. Supplies | \$0 | 50% | 0% |
| 88 | Parts and Consumables | \$2,411 | 10% | 0% |
| 89 | Subtotal | \$3,068 | | |
| 90 | Subtotal | \$16,896 | 0% | |
| 91 | Sales Tax | \$0 | 100% | |
| 92 | Financing (debt payment) | \$232,490 | 0% | |
| 93 | Property Taxes | \$0 | 100% | |
| 94 | Total | \$249,385 | | |
| 95 | | | | |
| 96 | | | | |

Other Project Parameters

| | | | |
|-----|--|----------------------|----------------------------------|
| 97 | | | |
| 98 | Other Parameters | | |
| 99 | | | |
| 100 | Financial Parameters | | |
| 101 | Debt Financing | | Local Share |
| 102 | Percentage financed | 80% | 0% |
| 103 | Years financed (term) | 10 | |
| 104 | Interest rate | 4.5% | |
| 105 | Tax Parameters | | |
| 106 | Local Property/Other Tax Rate (percent of taxable value) | 0% | |
| 107 | Assessed value (percent of construction cost) | 0% | |
| 108 | Taxable Value (percent of assessed value) | 0% | |
| 109 | Taxable Value (\$) | \$0 | |
| 110 | Property Tax Exemption (percent of local taxes) ▼ | 0.0% | |
| 111 | Local Property Taxes | \$0 | 100% |
| 112 | Local Sales Tax Rate ▼ | 2.9% | 100% |
| 113 | Sales Tax Exemption (percent of local taxes) ▼ | 100% | |
| 114 | Payroll Parameters | Wage per hour | Employer Payroll Overhead |
| 115 | Construction and Installation Labor | | |
| 116 | Trenching and Pipe Installation | \$20.80 | 37.6% |
| 117 | Foundation, Erection, and Electrical | \$22.91 | 37.6% |
| 118 | O & M Labor | | |
| 119 | Technicians | \$33.12 | 37.6% |
| 120 | | | |
| 121 | | | |