Assessing the Jobs Impacts of Clean Energy

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EPA United States Environmental Protection Agency

State and Local Climate and Energy Program

State & Local
Climate & Energy Program

Provides ***technical assistance*** *to state and local governments to reduce GHGs.*

- Use **multiple benefits** strategies to achieve GHG and policy goals
  - Environmental, energy, economic, health
  - Developing guidance and analysis on clean energy (CE) strategies to support CE as part of compliance strategy for air standards
- Foster inter-agency collaboration
  - States – air offices, energy offices, PUCs
  - Locals – planning, environmental services, energy and other related departments
- Help state and local governments make the case for action using:
  - Best practice-based policy approaches
  - Analytical tools and information
  - Communications resources including peer exchanges, lessons learned

Clean Energy & Benefits

- Clean energy initiatives encourage energy efficiency, renewable energy or clean distributed generation.

- People typically quantify the costs of clean energy programs and investments … Just don't forget the **benefits**!
  - Environmental and human health benefits
  - Electricity system & reliability benefits
  - **Economic benefits, including job creation**

- Quantifying these benefits can help policymakers:
  - Assess the *full* value of clean energy investments
  - Strengthen how benefits are incorporated in cost-benefit analyses
  - Show how clean energy programs can help achieve multiple goals
  - Build support for their clean energy initiatives

- This webinar focuses on how states are estimating the economic benefits of clean energy

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How Does Clean Energy Affect the Economy?

Investments in clean energy result in costs and benefits that change the flow of goods, services and income throughout the economy

Examples of **Economic COSTS:**

- *Program Administrative costs*
  - E.g. paid for by surcharge on electricity bill or diverted from other program funds
- *Equipment Purchase, Operation & Maintenance Costs*
  - Consumers, companies, utilities
- *Decreased demand, revenue and jobs:*
  - Companies that provide fossil-based electricity, non-clean energy technologies and services
    - & their suppliers
      - Local establishments where workers spend their paychecks (groceries, eating out, entertainment)

Examples of **Economic BENEFITS:**

- *Increased demand, revenue and jobs* for:
  - Companies that provide the clean energy equipment, technologies and services
    - & their suppliers
      - Local establishments where workers spend their paychecks (groceries, eating out, entertainment)
- *Lower energy/fuel costs* for
  - Consumers, companies, utilities
- *Deferred costs* for new power plants
- *Reduced health care costs and increased labor productivity* from better air quality and public health.
- *Enhanced property values* from improved environmental quality, water, etc

Economic Costs + Economic Benefits = Net Economic effects

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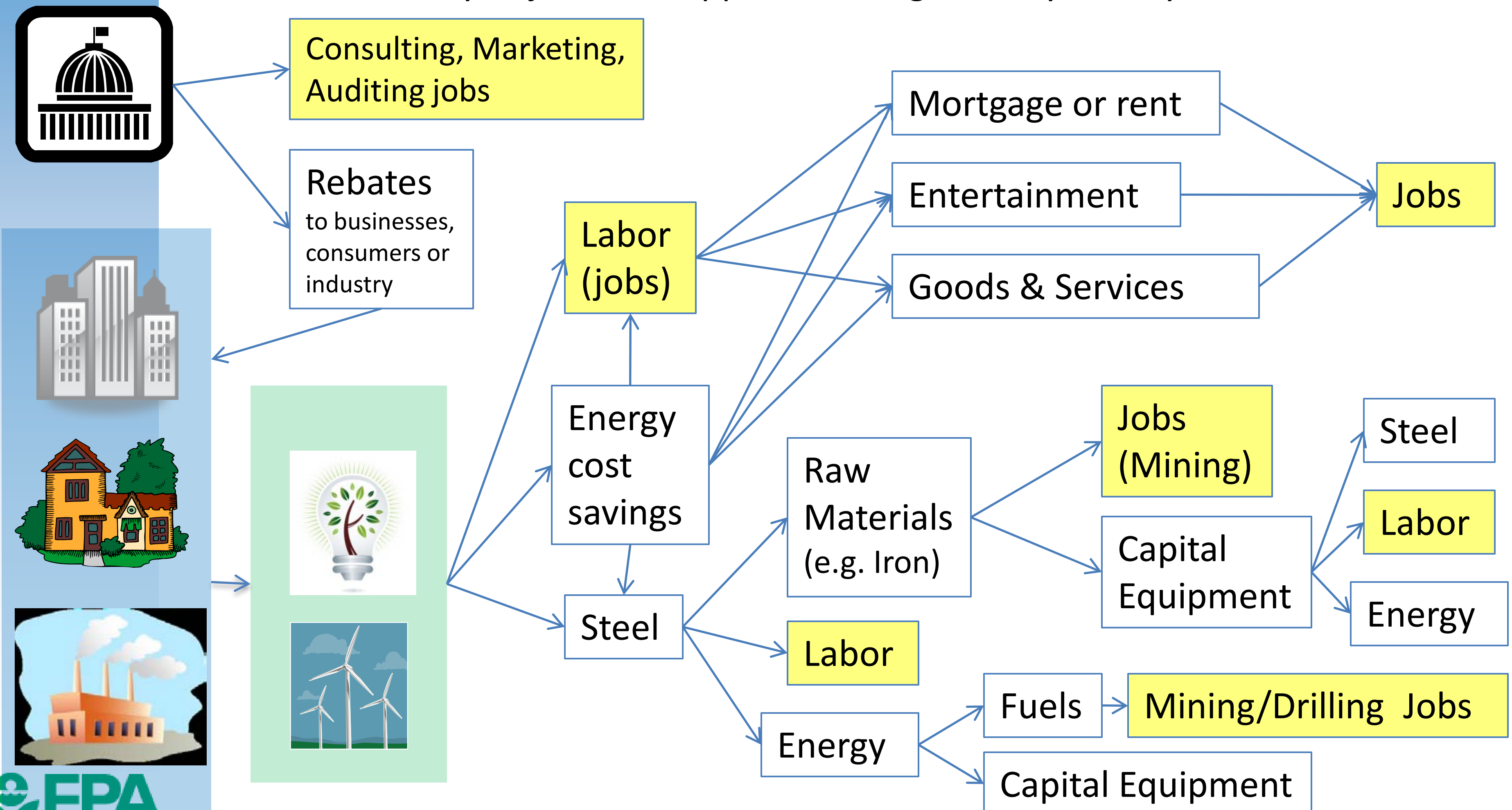
How do clean energy investments flow through the economy & support jobs? A (simplified?) illustration.

- Imagine a government launches a rebate program
  - A variety of jobs are supported along the way – see yellow



How Can States Estimate the Jobs Impacts of Clean Energy?

- States use a range of basic to sophisticated approaches to estimate how the changes in the flow of money, goods and services are likely to affect jobs
  - **Basic Methods**:
    - Screening approaches to get a ballpark estimate
  - **Sophisticated Methods:**
    - Include static and/or dynamic modeling tools

- Let's start with the more complicated and work our way easier…

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Sophisticated methods

Sophisticated methods are (defined here as): well-established, comprehensive analytic tools that can quantify the nature and magnitude of the macroeconomic effects of policies.

- **Examples**(include static and dynamic modeling tools)
  - Input-Output
  - Econometric
  - Computable General Equilibrium (CGE) Models
  - Hybrid Economic Models
- **Use When:**
  - Policy options are well-defined;
  - A high degree of rigor or precision is needed
  - Sufficient data, time and money are available
- **General Pros**
  - Can be robust; perceived as credible
  - Provide detailed results
  - May be able to model over a long period of time
  - May account for dynamic interactions within the local economy
- **General Cons**
  - May lack transparency
  - Can require extensive data, time, technical expertise and labor and funding
  - Requires detailed assumptions that can significantly influence results
  - Typically not created for energy analysis - need to understand how energy is reflected in the models

Sophisticated Methods 1: Input-Output

Input-Output models estimate relationships among industries in a state, regional or national economy based on an input-output table that describes the flow of goods and services to intermediate and final consumers.

- **Examples of Input-Output models:**
  - IMPLAN
  - RIMS II

- **Use when:**
  - Seeking results for the short term
  - Need to analyze detailed impacts by sector

- **Pros:**
  - Quantifies the total economic effects of a change in demand
  - Provides rich detail about industries, sectors
  - Can be inexpensive relative to other sophisticated tools

- **Cons**
  - Static; multipliers represent only a snapshot based on history
  - Generally assumed fixed prices
  - Does not account for some real world conditions
    - Substitution effects, labor constraints, changes in competitiveness
  - Renewable energy and energy efficiency don't exist within tables as discrete "industries"

Sophisticated Methods 2: Econometric

Econometric models use mathematical and statistical techniques to find/use past and current relationships in the economy to forecast the impacts of policies.

- **Examples of Econometric models:**
  - RAND Science and Technology
  - Often state universities may have them
- **Use when:**
  - Seeking results for the short or long term
- **Pros:**
  - Usually dynamic, can estimate and/or track changes in policy impacts over time
  - Coefficients are based on historical data and relationships, and statistical relationships can be used to assess model credibility
- **Cons**
  - Historical patterns may not be the best indicator or predictor of future relationships.
  - Some econometric models do not allow "foresight."

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Sophisticated Methods 3: Computable General Equilibrium Models

Computable General Equilibrium (CGE) models are based on microeconomic general equilibrium theory and use economic data to trace the flow of goods and services throughout an economy and solve for the levels of supply, demand and price that satisfy or balance (equilibrium) existing constraints.

- **Examples of CGE models:**
  - Typically national, some states and universities have state-specific ones (BEAR)
- **Use when:**
  - Seeking results for the long term
  - Highly aggregated results are desired
- **Pros:**
  - Accounts for substitution effects, supply constraints and price adjustments (missing from previous ones)
- **Cons**
  - Not widely available at state level and those that are, are dynamic.
  - If not available, may be costly to develop

Sophisticated Methods 4: Hybrid Economic Models

Hybrid Economic Models incorporate aspects of two or more of the previous approaches with most linking an I-O model to an econometric model.

- **Examples of Hybrid Economic models:**
  - REMI Policy Insight
- **Use when:**
  - Seeking results for the short or long term

- **Pros:**
  - Combines advantages from other models;
  - Dynamic, can be used for short and long term analysis;
  - Can be used to model regional interactions
  - Offers flexibility in number of industries or sectors to explore
- **Cons**
  - Can be (most) expensive, especially if analyzing sub-regions (multiple counties)
  - Inputs may require a fair amount of modification before entering into model
  - Often lack transparency ("Black Box")

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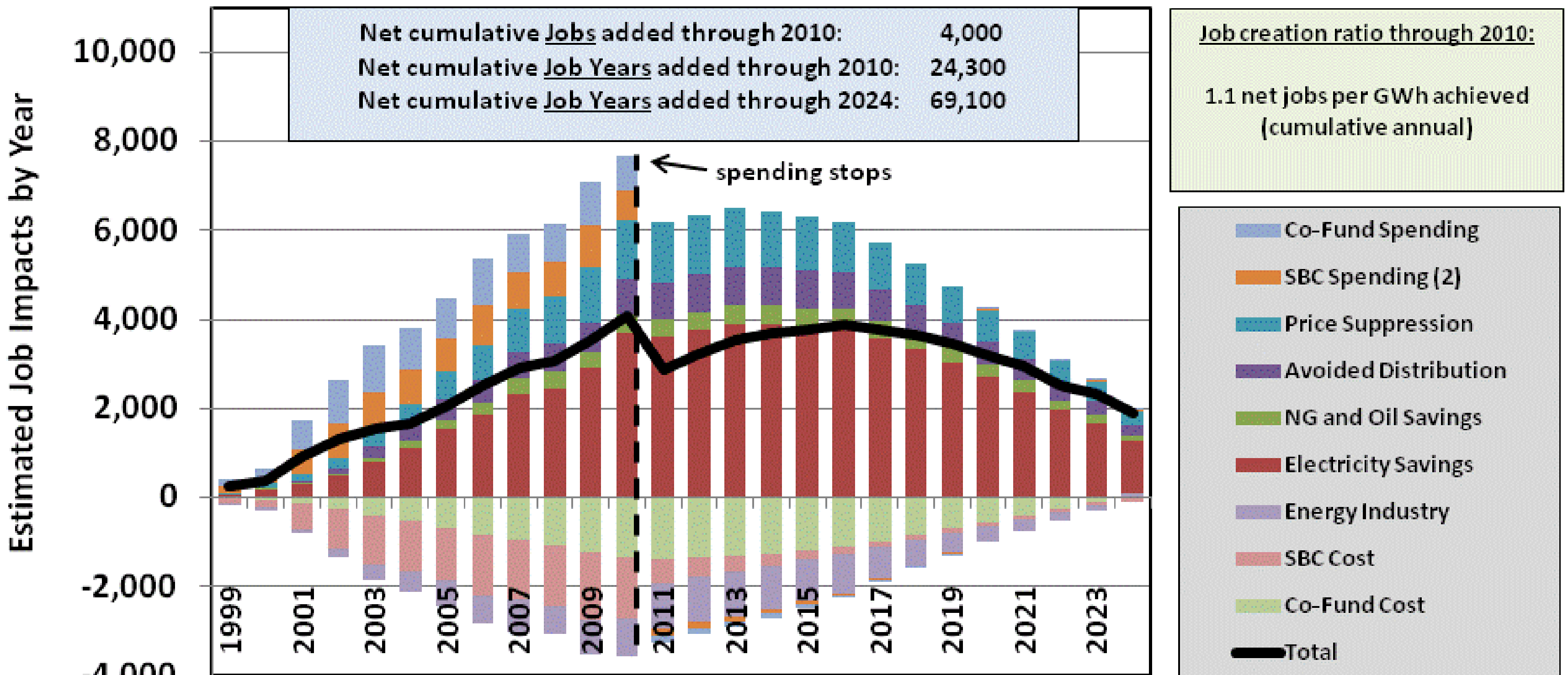
Employment Impacts of New York Energy $mart^{SM}

Estimated Job Impacts due to Program Spending through 2010 (1)



Notes:

(1) Efficiency measures are assumed to carry a 15 year life. Results are truncated to end within 15 years after program spending stops.

(2) Includes program spending for the the full portfolio of New YorkEnergy $mart^{SM} programs but does not take account for all possible program benefits.

Basic methods

Basic methods provide rough estimates of impacts plus give a sense of the direction (i.e., positive or negative) and magnitude of the impacts upon the economy.

- **Examples**:
  - Rule-of-thumb estimates, multipliers
  - Simple (easy-to-use) Calculators (JEDI)
- **Use When:**
  - Time and resources are short
  - A high-level preliminary analysis is needed
  - Seeking quick estimates of employment, output and price changes
  - Screening a large number of policy options to a shorter list for further analysis
- **General Pros**
  - Enable quick analyses of policies
  - Require less precise data and technical expertise than for a rigorous, advanced analysis
  - Inexpensive, often free!
- **General Cons**
  - May use/generate overly simplified assumptions/results
  - Results are approximate
  - May be inflexible

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Basic Method 1: Rules of Thumb

Rules of thumb or multipliers are generic economic factors states and others can use to estimate the potential economic impacts of their own clean energy measures.

- Can be used to express number of jobs created per a specific investment.
  - For every dollar spent on X, Y jobs are created or for every kWh saved/generated, Z jobs are created

- Pros
  - Often these are derived from more sophisticated analyses or tools (NY).
  - May be transparent
  - Requires minimal data, time, expertise and money
  - Often free!
- Cons
  - Data used to develop rules of thumb may rely on outdated or unclear conditions (prices, source of program funds)
  - Can be easily misapplied (Need to understand if net vs gross, jobs vs. job years
    - 15 job years = 15 jobs in one year or one job for 15years.

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Sampling of Clean Energy Rules-of-Thumb

Rule of Thumb	Source
TYPE OF IMPACT: Income/Output	
1 MW of wind generated requires $1 billion investment in wind generator components.	REPP, 2005[1]
$1 spent on concentrated solar power in California produces $1.40 of additional GSP.	Stoddard et al., 2006[2]
$1 spent on energy efficiency in Iowa produces $1.50 of additional disposable income.	Weisbrod et al., 1995[3]
$1 million in energy savings in Oregon produces $1.5 million of additional output.	Grover, 2005[4]
TYPE OF IMPACT: Employment	
$1 million in energy savings in Oregon produces about $400,000 in additional wages per year.	Grover, 2005[4]
$1 billion investment in wind generator components creates 3,000 full-time equivalent (FTE) jobs.	REPP, 2005[1]
$1 million invested in energy efficiency in Iowa produces 25 job-years.	Weisbrod et al., 1995[3]
$1 million invested in wind in Iowa produces 2.5 job-years.	Weisbrod et al., 1995[3]
$1 million invested in wind or PV produces 5.7 job-years vs. 3.9 job-years for coal power.	Singh and Fehrs, 2001[5]
1 GWh of electricity saved through energy efficiency programs in New York yields 1.5 sustained jobs.	NYSERDA, 2008[6]
$1 million of energy efficiency net benefits in Georgia produces 1.6-2.8 jobs.	Jensen and Lounsbury, 2005[7]

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Basic Method 2: Clean Energy & Jobs Calculators

- **Calculators** typically:
  - repackage elements of more sophisticated tools or
  - automate simple calculations via spreadsheets to produce approximations of jobs impacts.
- **Examples**:
  - DOE/NREL's JEDI (Job and Economic Development Impact) Model , for Renewables
- **Pros**
  - Typically easy-to-use, user friendly
  - Inexpensive, often free!
  - May be transparent
  - Requires minimal data, time, expertise and money
- **Cons**
  - May use/generate overly simplified assumptions/results
  - May be inflexible, outdated
  - Often lack dynamic policy interactions

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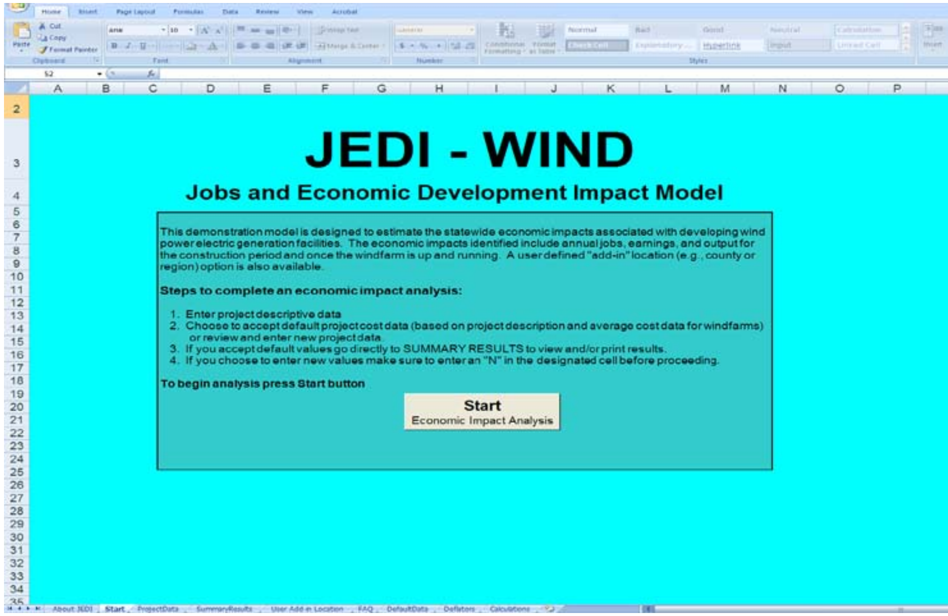
Example: JEDI



- The JEDI tool provides a *user friendly*, free platform for states or locals to estimate the gross job impacts associated with:
  - project development & onsite labor,
  - local revenue and supply side impacts and
  - induced effects
- Not intended to provide a precise forecast, but an estimate of overall economic impacts

- JEDI is available for several project types:
  - Large Wind
  - Concentrating Solar Power (CSP)
  - Dry Mill Corn Ethanol
  - Lignocellulosic Ethanol
  - Natural Gas (Combined Cycle)
  - Coal (Pulverized Coal)
  - Photovoltaic (PV)
  - Marine and Hydrokinetic

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

Basic User Inputs

	A	B	C	D	E	F
1	**Wind Farm Project Data**					
2						
3	**INSTRUCTIONS: Begin by entering Project Location (from pull-down list) and other Descriptive Data.**					
4	**After inserting required data press enter (or cursor to the next cell) to continue.**					
5	**Once Descriptive Data is complete, choose "Y" or "N" on Line 24 to continue.**					
6	**Choose "Y" to accept Project Cost and Local Share defaults or "N" to review/modify values.**					
7	**To utilize new values in analysis you must choose an "N" in "Utilize Model Default Values (below)?" - Line 24**					
8	**Additional information is available by pointing to the red triangles located in cell corners and in the *FAQ* tab.**					
9	**Only those cells with a white background can be changed (accept new values).**					
10						
11						
12	**Project Descriptive Data**					
13	**Project Location**	**COLORADO**				
14	**Population (only required for County/Region analysis)**					
15	**Year of Construction**	**2009**				
16	**Total Project Size - Nameplate Capacity (MW)**	**100**				
17	**Number of Projects (included in Total Project Size)**	**1**				
18	**Turbine Size (KW)**	**1,500**				
19	**Number of Turbines**	**67**				
20	**Installed Project Cost ($/KW)**	**$2,043**				
21	**Operations and Maintenance Cost ($/kW)**	**$20.00**				
22	**Money Value - Current or Constant (Dollar Year)**	**2008**				
23						
24	**Utilize *Project Cost Data* default values in analysis?**	**Y**				
25–26	**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.***					
27	**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
28						

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

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

About JEDI | Start | ProjectData | SummaryResults | User Add-in Location | FAQ | DefaultData | Deflators | Calculations

Ready

Detailed User Inputs

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

Row	A	Cost	Cost Per KW	Percent of Total Cost	Local Share
28					
29	**Project Cost Data**				
30					
31	**Construction Costs**	**Cost**	**Cost Per KW**	**Percent of Total Cost**	**Local Share**
32	**Equipment Costs**				
33	Turbines (excluding blades and towers)	$91,451,104	$915	44.8%	0%
34	Blades	$21,409,957	$214	10.5%	0%
35	Towers	$23,703,882	$237	11.6%	0%
36	Transportation	$16,363,325	$164	8.0%	0%
37	Equipment Total	$152,928,268	$1,529	74.8%	
38	**Balance of Plant**				
39	Materials				
40	Construction (concrete, rebar, equip, roads and site prep)	$22,098,135	$221	10.8%	90%
41	Transformer	$2,499,757	$25		
42	Electrical (drop cable, wire,)	$2,634,913	$26		
43	HV line extension	$4,813,107	$48		
44	Materials Subtotal	$32,045,912	$320		
45	Labor				
46	Foundation	$1,266,243	$13		
47	Erection	$1,434,200	$14		
48	Electrical	$2,090,061	$21		
49	Management/Supervision	$1,084,537	$11		
50	Misc.	$7,762,202	$78		
51	Labor Subtotal	$13,637,243	$136		
52	Development/Other Costs				
53	HV Sub/Interconnection				
54	Materials	$1,518,720	$15		
55	Labor	$465,214	$5		
56	Engineering	$2,066,598	$21		
57	Legal Services	$1,126,296	$11		
58	Land Easements	$0	$0		
59	Site Certificate/Permitting	$526,983	$5		
60	Development/Other Subtotal	$5,703,811	$57	2.8%	
61	Balance of Plant Total	$51,386,966	$514	25.2%	
62	**Total**	$204,315,234	$2,043	100.0%	

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.

How To Choose A Method?

In general, analysts consider many factors, including:

- time constraints, cost, data requirements, internal staff expertise and overall flexibility and applicability.

Type of Method	Advantages	Disadvantages	When To Use
Basic Approaches: - Rule-of-thumb estimates - Screening models	- (May be) Transparent - Requires minimal input data, time, technical expertise and labor. - Inexpensive, often free	- Overly simplified assumptions - Approximate results - May be inflexible	When: - time or resources are short - High-level, preliminary analyses are needed - A long list of options needs to be shortened
Sophisticated Approaches: - Input-Output - Econometric -Computable General Equilibrium (CGE) -Hybrid Economic Models	- More robust than basic - May be perceived as more credible - Detailed results - May model impacts over a long period of time - May account for dynamic interactions within the state/regional economy	- May be less transparent - May require extensive input data, time, technical expertise and staff. - May have high software licensing costs. - Require detailed assumptions that can significantly influence results.	When: - Policy options are well-defined - high degree of precision and analytic rigor is desired - sufficient time, data and financial resources are available.

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Things to Consider When Estimating Jobs Impacts

- **<u>All</u>** methods involve predictions, inherent uncertainties and numerous assumptions
  - Need to understand the specific strengths, limitations of the model or method you choose; make sure it's appropriate to your question.

- When planning an analysis, consider how and for how long the money flows through the economy as a result of the program
  - The government pays for a program with money from where? Where does the money come from and go? Households? Businesses?
  - How many people are you likely to reach through your program? 20%? 50%? And how long are the energy savings likely to last? 10 years?
  - Households, businesses and/or utilities are spending money on clean energy equipment that they are no longer spending on something else. What expenses are they cutting back? Where is it now going instead?

- Be very clear in assumptions (and sources) regarding costs ***and*** benefits, what results do and do not include.
  - Is your jobs estimate net or gross? Job Years or Jobs? Is it a rough estimate or a reasonably sophisticated one?

- Invite experts to provide input to the analysis & assumptions, review the final results.

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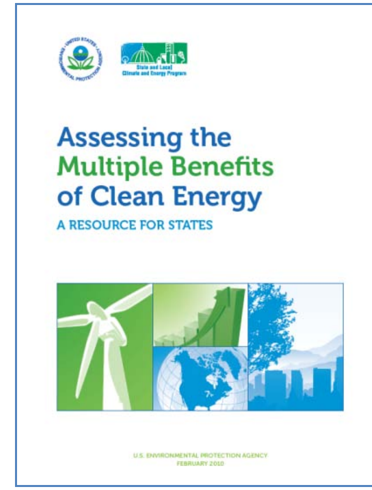
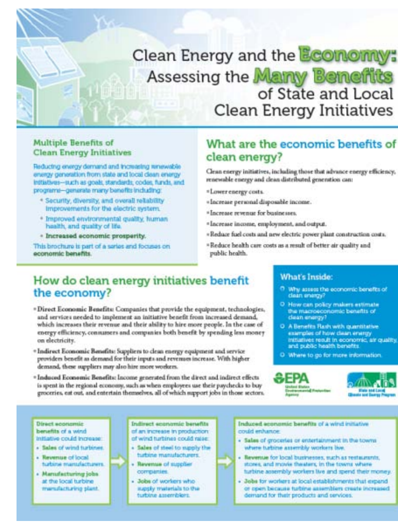
For More On How States (and Locals) Can Assess the Jobs Impacts of Clean Energy

- Check out Economics Chapter (5) of EPA's *Assessing the Multiple Benefits of Clean Energy: A Resource for States* http://www.epa.gov/statelocalclimate/resources/benefits.html
  - Contains more information about and links to available tools



- Review presentations and contact speakers from EPA Tech Forum on Assessing the Jobs Benefits of Clean Energy, August 4, 2011 http://epatechforum.org/documents/2010-2011/2010-2011.html



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