Assessing the Jobs Impacts of Clean Energy

Denise Mulholland

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EPA United States Environmental Protection Agency

State and Local Climate and Energy Program

The **EPA State Climate and Energy Program** has analytical tools, peer exchange, cost-effective best practices, and other resources to help states **every step of the way**.

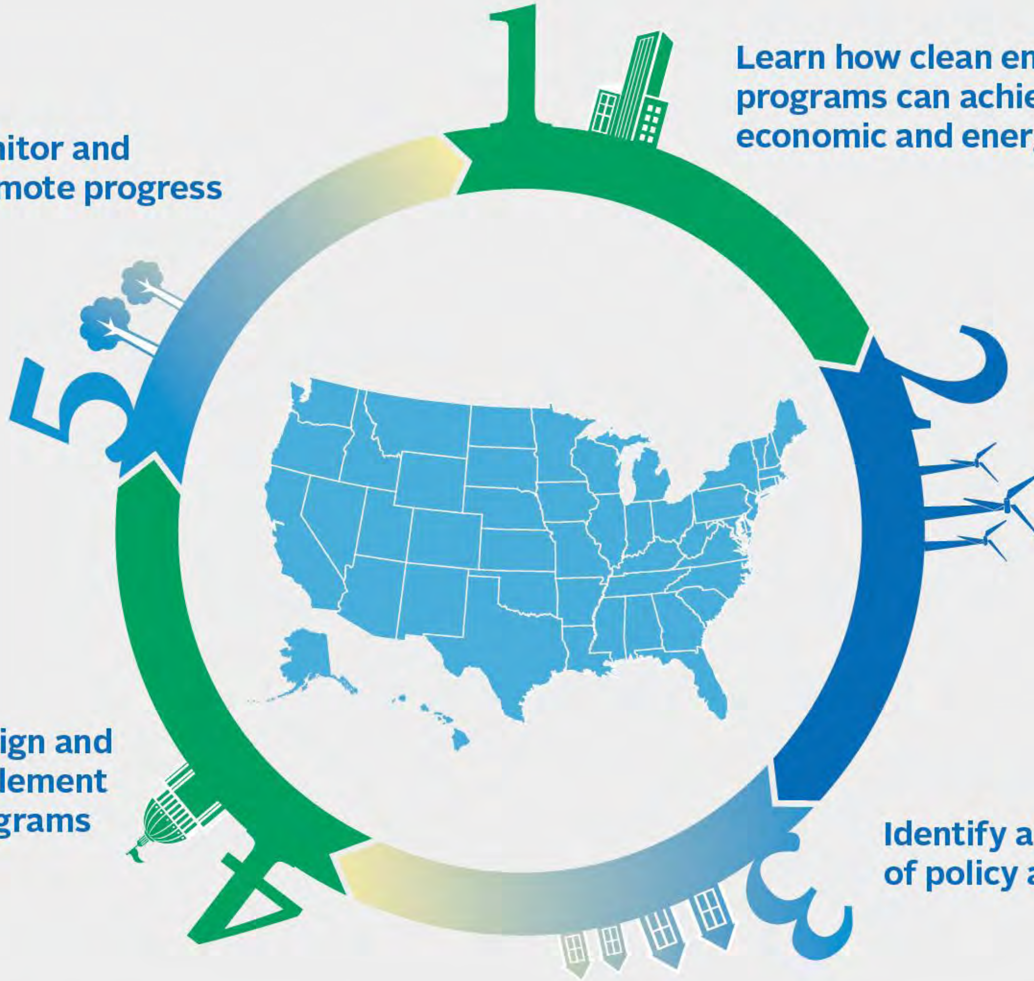
Helping States Get Started

Lowering energy costs

Reducing greenhouse gas emissions

Improving air quality and public health

Encouraging economic development



1. Learn how clean energy policies and programs can achieve environmental, economic and energy goals

2. Engage stakeholders and collaborate

3. Identify and quantify benefits of policy and program options

4. Design and implement programs

5. Monitor and promote progress

Get started today!

Learn more and join the EPA State Climate and Energy Partner Network at

http://epa.gov/statelocalclimate/state/getting-started.html

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 presentation describes how clean energy programs can benefit state economies and how states can learn more about estimating the benefits – especially jobs benefits.

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

Economic Costs + **Economic Benefits** = **Net Economic effects**

Costs can include:

- *Program Administrative costs*
- *Equipment Purchase, Operation & Maintenance Costs*
- *Decreased demand, revenue and jobs*

Benefits can include:

- *Increased demand, revenue and jobs*
- *Lower energy/fuel costs*
- *Deferred costs* for new power plants
- *Reduced health care costs - Increased labor productivity*
- *Enhanced property values*

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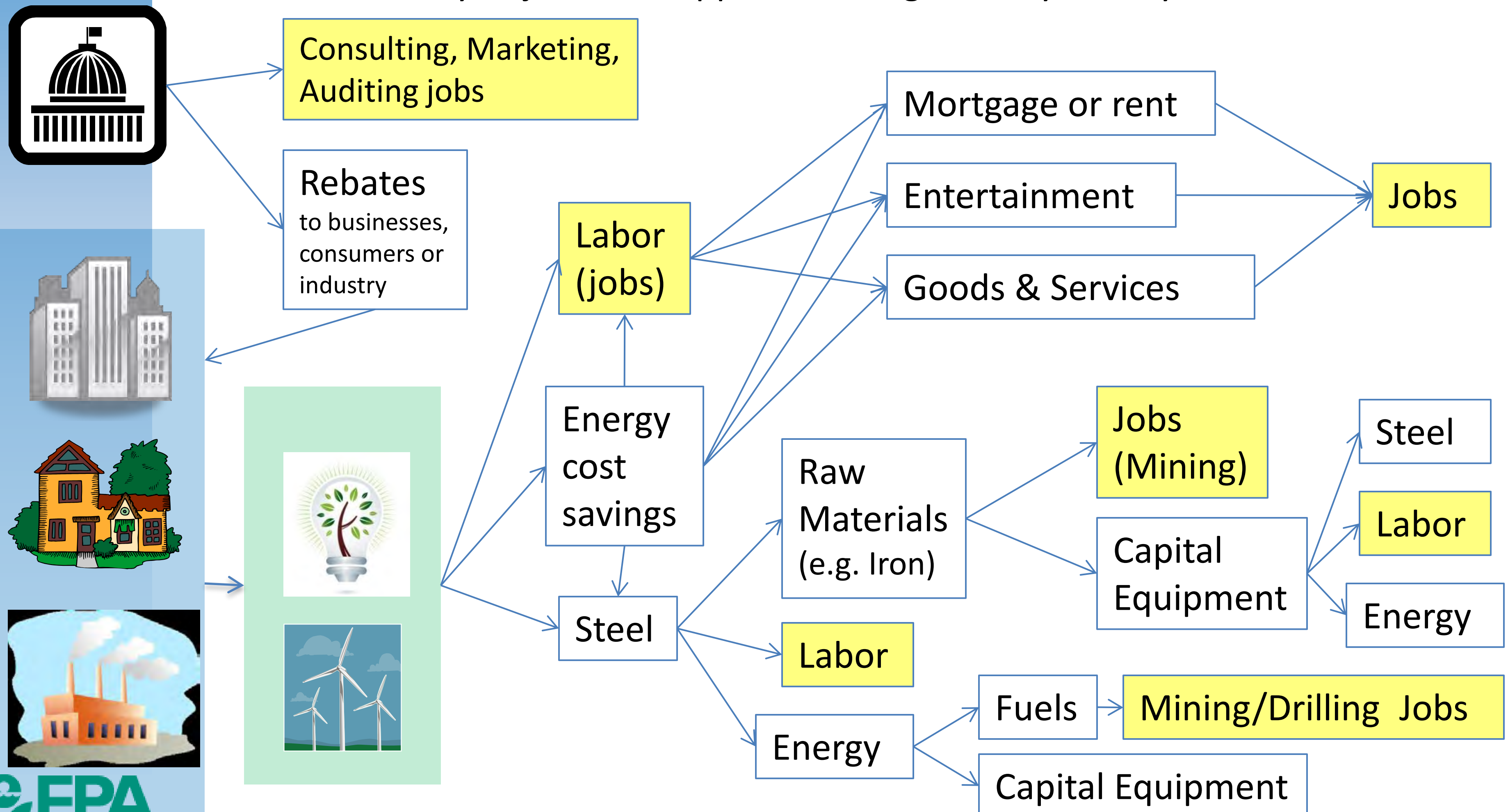
How do clean energy investments flow through the economy & support jobs? A (simplified?) illustration.

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



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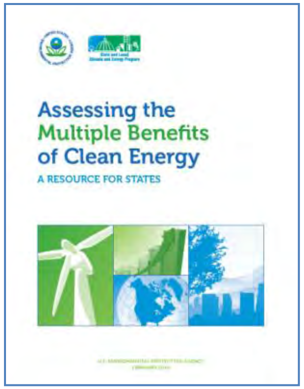
How Can States Estimate the Jobs Impacts of Clean Energy?



EPA's ***Assessing the Multiple Benefits of Clean Energy: A Resource For States***

- Developed to help state energy, environmental, and economic policy makers identify and quantify the multiple benefits of clean energy goals, policies, programs including:
  - Direct energy, air, greenhouse gas, health, energy system and **economic** benefits
- Provides:
  - A framework for evaluating the potential costs and benefits of clean energy
  - Simple and more sophisticated methods for assessing these benefits.
  - Guidance on how to choose among methods.
  - Examples of how states are analyzing and using multiple benefits analysis to promote clean energy
  - A wealth of resources, including links to analytical tools, guidance, and studies.

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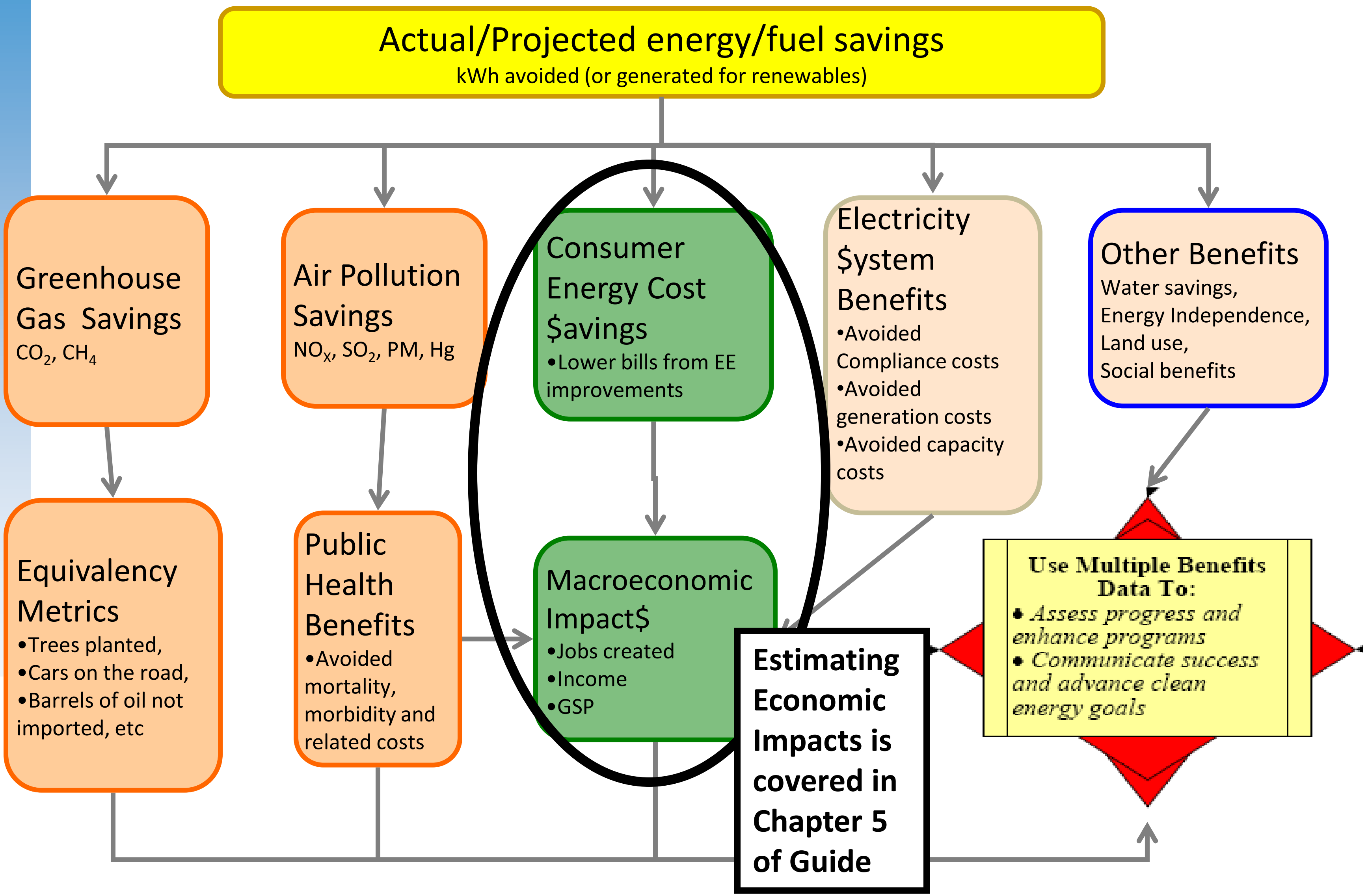
A Framework for Quantifying the Multiple Benefits of Clean Energy



What the Multiple Benefits Resource Economics Chapter Includes

Chapter 5 Organization

- **Section 5.1**: How clean energy initiatives affect state macroeconomics and can achieve multiple benefits
  - Direct, indirect, and induced effects
- **Section 5.2**: Steps, methods, and issues states can use to conduct an analysis of the potential macroeconomic benefits of clean energy programs.
  - **Step 1**: Determine the method of analysis and level of effort.
  - **Step 2:** Quantify expenditures and savings from the clean energy initiative.
  - **Step 3:** Apply the method to quantify macroeconomic effects.
- **Section 5.3**: Case studies of state macroeconomic analyses.

Clean Energy and the Economy: Assessing the Many Benefits of State and Local Clean Energy Initiatives

Multiple Benefits of Clean Energy Initiatives

Reducing energy demand and increasing renewable energy generation from state and local clean energy initiatives—such as goals, standards, codes, funds, and programs—generate many benefits including:

- Security, diversity, and overall reliability improvements for the electric system.
- Improved environmental quality, human health, and quality of life.
- **Increased economic prosperity.**

This brochure is part of a series and focuses on **economic benefits.**

What are the economic benefits of clean energy?

Clean energy initiatives, including those that advance energy efficiency, renewable energy and clean distributed generation can:

- Lower energy costs.
- Increase personal disposable income.
- Increase revenue for businesses.
- Increase income, employment, and output.
- Reduce fuel costs and new electric power plant construction costs.
- Reduce health care costs as a result of better air quality and public health.

How do clean energy initiatives benefit the economy?

- **Direct Economic Benefits:** Companies that provide the equipment, technologies, and services needed to implement an initiative benefit from increased demand, which increases their revenue and their ability to hire more people. In the case of energy efficiency, consumers and companies both benefit by spending less money on electricity.
- **Indirect Economic Benefits:** Suppliers to clean energy equipment and service providers benefit as demand for their inputs and revenues increase. With higher demand, these suppliers may also hire more workers.
- **Induced Economic Benefits:** Income generated from the direct and indirect effects is spent in the regional economy, such as when employees use their paychecks to buy groceries, eat out, and entertain themselves, all of which support jobs in those sectors.

What's Inside:

- Why assess the economic benefits of clean energy?
- How can policy makers estimate the macroeconomic benefits of clean energy?
- A Benefits Flash with quantitative examples of how clean energy initiatives result in economic, air quality, and public health benefits.
- Where to go for more information.

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Direct economic benefits of a wind initiative could increase:

- Sales of wind turbines.
- Revenue of local turbine manufacturers.
- Manufacturing jobs at the local turbine manufacturing plant.

Indirect economic benefits of an increase in production of wind turbines could raise:

- Sales of steel to supply the turbine manufacturers.
- Revenue of supplier companies.
- Jobs of workers who supply materials to the turbine assemblers.

Induced economic benefits of a wind initiative could enhance:

- Sales of groceries or entertainment in the towns where turbine assembly workers live.
- Revenue for local businesses, such as restaurants, stores, and movie theaters, in the towns where turbine assembly workers live and spend their money.
- Jobs for workers at local establishments that expand or open because turbine assemblers create increased demand for their products and services.

NOTE: Intended for non-specialists

Methods and Tools Described

- There are a range of basic to sophisticated approaches states can use to estimate how the changes in the flow of money, goods and services are likely to affect jobs
  - **Basic Methods**: Rules of Thumb, Screening approaches to get a ballpark estimate, including:
    - ***Job and Economic Development Impact (JEDI) Model for Wind Projects***
      Web Site: http://www.energyfinder.org/
    - ***REPP Labor Calculator***
      Web Site: http://www.repp.org/index.html
  - **Sophisticated Methods:** Static and/or dynamic modeling tools including:
    - ***IMPLAN® input-output model (IMPLAN)***
      Web Site: http://www.implan.com/
    - ***RAND***
      Web Site: http://www.rand.org/
    - ***REMI Policy Insight model (REMI)***
      Web Site: http://www.remi.com/
    - ***Berkeley Energy and Resources model (BEAR)***

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Resource Includes Lots of Tables!

TABLE 5.2.2 RULES OF THUMB FOR ESTIMATING INCOME, OUTPUT, AND EMPLOYMENT IMPACTS OF CLEAN ENERGY ACTIVITIES

Rule of Thumb	Source
TYPE OF IMPACT: Income/Output	
1 MW of wind generated requires $1 billion investment in wind generator components.	REPP, 2005 *http://www.repp.org/articles/static/1/binar*
$1 spent on concentrated solar power in California produces $1.40 of additional GSP.	Stoddard et al., 2006 *http://www.nrel.gov/docs/fy06osti/39291.*
$1 spent on energy efficiency in Iowa produces $1.50 of additional disposable income.	Weisbrod et al., 1995 *http://www.edrgroup.com/library/energy-*
$1 million in energy savings in Oregon produces $1.5 million of additional output.	Grover, 2005 *http://www.oregon.gov/ENERGY/CONS/d*
TYPE OF IMPACT: Employment	
$1 million in energy savings in Oregon produces about $400,000 in additional wages per year.	Grover, 2005 *http://www.oregon.gov/ENERGY/CONS/d*
$1 billion investment in wind generator components creates 3,000 full-time equivalent (FTE) jobs.	REPP, 2005 *http://www.repp.org/articles/static/1/binar*
$1 million invested in energy efficiency in Iowa produces 25 job-years.	Weisbrod et al., 1995 *http://www.edrgroup.com/library/energy-*
$1 million invested in wind in Iowa produces 2.5 job-years.	Weisbrod et al., 1995 *http://www.edrgroup.com/library/energy-*
$1 million invested in wind or PV produces 5.7 job-years vs. 3.9 job-years for coal power.	Singh and Fehrs, 2001 *http://www.repp.org/articles/static/1/binai*
1 GWh of electricity saved through energy efficiency programs in New York yields 1.5 sustained jobs.	NYSERDA, 2008 *http://www.nyserda.org/pdfs/Combined R*
$1 million of energy efficiency net benefits in Georgia produces 1.6-2.8 jobs.	Jensen and Lounsbury, 2005 *http://www.gefa.org/Modules/ShowDocur*

TABLE 5.2.4 COMPARISON OF MODELS FOR ESTIMATING MACROECONOMIC BENEFITS

General Model Category	Input-Output	Econometric	CGE	Hybrid
Example*	IMPLAN	RAND	BEAR	REMI Policy Insight
Model Characteristics				
I-O Component	Yes	Modified I-O	Social Accounting Matrix	Yes
CGE Component	No	Varies	Yes	Yes
Econometric Component	No	Varies	Limited	Yes
Open/Closed Economy	Both	Varies	Yes	Open
Dynamic Modeling Capability	No	Yes	Certain Models	Yes
State and County Level Modeling	Yes	Certain Models	Varies	Yes
Major Data Sources	BEA, BLS, CBP, and Census	Varies	Varies	BEA, BLS, CBP, EIA and Census
Industry Characteristics				
SIC/NAICS Classifications	Yes	Varies	Varies	Yes
Sector Aggregation Options	Yes	Yes	Yes	Yes
Other Features				
Trade Flows	Yes	Certain Models	Most	Yes
Substitution Effects	No	Varies	Yes	Yes
Price and Wage Determination	No	Yes	Yes	Yes
Feedbacks on Competitiveness	No	Yes	Yes	Yes
Migration, Demographic Changes	No	Varies	Varies	Yes
Impacts Measured				
Employment	Yes	Yes	Yes	Yes
Income	Yes	Yes	Yes	Yes
Output	Yes	Yes	Yes	Yes
Value Added	Yes	Yes	Yes	Yes
Proprietary	Yes	Some	Some	Yes
Overall Cost, Complexity, and Capability	Medium	High	High	High

** Models names are included for illustrative purposes only, and do not imply an endorsement by EPA.*

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Need Help Choosing A Method?

In general, analysts consider many factors, including:

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

The Guide describes Pros, Cons and When to Use for each method

TABLE 5.2.3 OVERVIEW OF SOPHISTICATED MODELING APPROACHES AND TOOLS FOR STATE ECONOMIC ANALYSIS

Example of State Tools	Advantages	Disadvantages	Considerations	When to Use
METHOD: Input-Output *(also called multiplier analysis)*				
IMPLAN	▪ Quantifies the total economic effects of a change in the demand for a given product or service. ▪ Can be inexpensive.	▪ Static; multipliers re a snapshot of the ec given point in time. ▪ Generally assumes fi ▪ Typically does not a substitution effects, constraints, and cha competitiveness or demographic factor		
METHOD: *Econometric Models*				
RAND	▪ Usually dynamic, can estimate and/or track changes in policy impacts over time. ▪ Coefficients are based on historical data and relationships, and statistical methods can be used to assess model credibility.	▪ Historical patterns n best indicator or pre future relationships. ▪ Some econometric allow foresight.		
METHOD: Computable General Equilibrium (CGE) Models				
BEAR	▪ Account for substitution effects, supply constraints, and price adjustments.	▪ Not widely available ▪ Most CGE models a state level are static, few are dynamic.		
METHOD: Hybrid				
REMI Policy Insight	▪ Most sophisticated, combining aspects of all of the above. ▪ Dynamic, can be used to analyze both short- and long -term impacts. ▪ Can be used to model regional interactions. ▪ Flexibility of looking at 2-, 3-, or 4-digit NAICS sectors.	▪ Can be expensive, e there is a need to an on multiple sub-regi counties within a sta ▪ Can require a fair an massaging inputs, e energy sector inputs		

TABLE 5.2.1 COMPARISON OF BASIC AND SOPHISTICATED APPROACHES FOR QUANTIFYING MACROECONOMIC EFFECTS OF CLEAN ENERGY INITIATIVES

Type of Method	Sample Tools or Resources	Advantages	Disadvantages	When to Use this Method
Basic Approaches: ▪ Rule-of-thumb estimates and ▪ Screening models	▪ Rule-of-thumb Factors ▪ Job and Economic Development Impact (JEDI) Model ▪ RMI Community Energy Opportunity Finder ▪ Renewable Energy Policy Project Labor Calculator	▪ 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 and resources are short ▪ For high-level, preliminary, analyses ▪ To get quick estimates of employment, output and price changes ▪ When screening a large number of policy options to develop a short list of options for further analysis.
Sophisticated Approaches: ▪ Input-Output; ▪ Econometric; ▪ Computable General Equilibrium; and ▪ Hybrid Models	▪ IMPLAN, ▪ RIMS II ▪ RAND econometric model ▪ BEAR ▪ REMI Policy Insight	▪ More robust than basic modeling methods. ▪ May be perceived as more credible than basic methods. ▪ Provides 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 than spreadsheet methods. ▪ May require extensive input data, time, technical expertise, and labor commitments. ▪ Often high software licensing costs. ▪ Requires detailed assumptions that can significantly influence results.	▪ When policy options are well defined ▪ When a high degree of precision and analytic rigor is desired ▪ When sufficient data, time and financial resources are available.

Quantifying Expenditures & Savings: Tips

The Resource includes things analysts should consider when quantifying expenditures and savings, such as:

- Expected energy savings or costs to consumers over time
- Expected investment and realization rates in the short and long term
- Proportion of investment from individual participants versus program funding
- Amount of initiative-related activity expected to occur locally
- Expected useful life of investment
- Expected persistence of energy savings
- Expected economic benefits associated with energy system, environmental or public health benefits.

It also describes quantification approaches states typically use

- Range from simple, spreadsheet-based models to more rigorous and data-intensive forecasting models
- Involve combination of actual data from existing programs, projections

Many Case Studies & Results Included In Multiple Benefits Resource

Analyzing Conservation Policies in Connecticut

In 2004, Connecticut analyzed the economic impact of oil and natural gas conservation policies in Connecticut. The state wanted to explore the impacts of fully funding a program between 2005 and 2020 to increase the efficiency of oil and natural gas for residential, commercial, and industrial users.

Connecticut used a hybrid model, the REMI Policy Insight model, for their analysis. REMI is a frequently used proprietary model in the US for analyzing state level policy initiatives. Because the model does not have a detailed energy sector module to fully capture the fuel-switching that would occur within the electricity sector, Connecticut used outputs from an energy analysis using an electricity dispatch model—ICF International's IPM—to estimate the energy changes used as inputs to Policy Insight. The direct costs included cost increases resulting from a 3% natural gas-use and oil-use surcharge on residential, commercial, and industrial users to pay for the program; the savings to residential, commercial, and industrial users due to reduced consumption of natural gas and oil; the consumption reallocation of other consumer goods due to an increase in personal income; the loss in sales to natural gas and oil firms due to

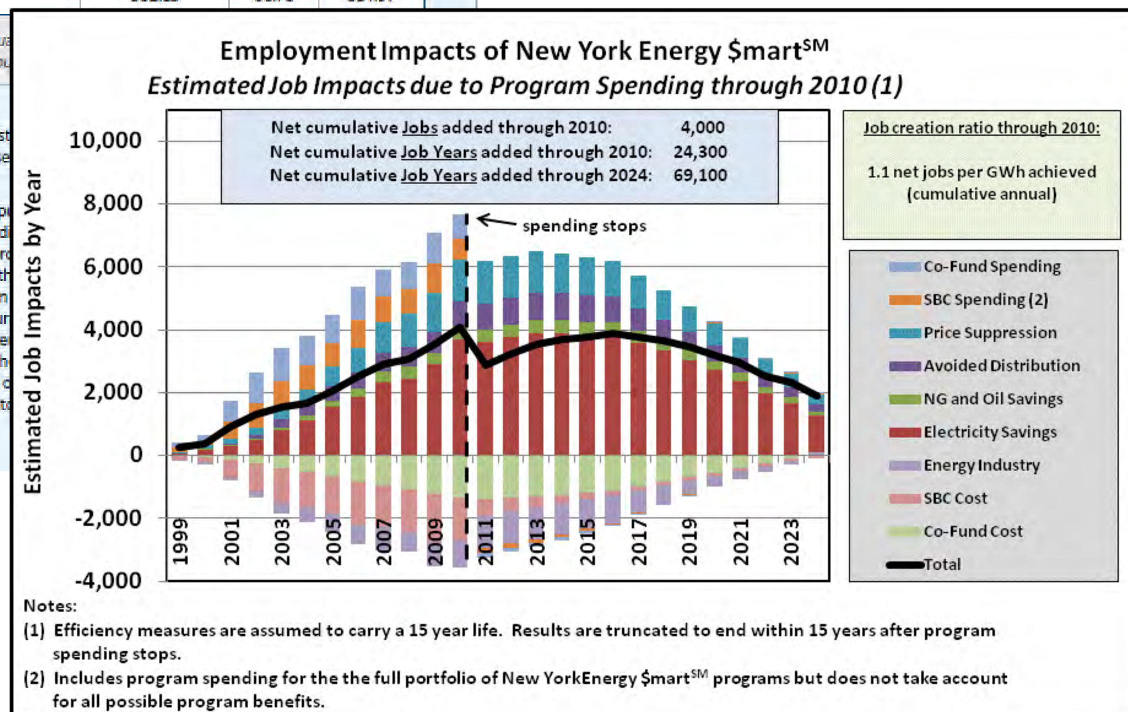
ECONOMIC GROWTH DUE TO CONSERVATION POLICIES IN CONNECTICUT (CUMULATIVE 2005-2020)

	Oil & Natural Gas	Oil	Natural Gas
Employment (Average Annual Increase)*	2,092	430	1,668
Output (Mil '96$)	3,094.90	82.80	3,020.64
GSP (Mil '96$)	2,033.01	266.21	1,773.82
Population	3,604	717	2,894
Real Disposable Personal Income (Mil '96$)	1,749.42	294.81	1,459.35
State Revenues (Mil '01$)	382.13	66.75	314.97

* Employment is the average annu… cumulative and is based on outpu…

reduced consumption; and the invest… in new equipment, construction, rese… and other sectors.

These direct effects were used as inp… the REMI model to determine the indi… induced, and overall effects of the pr… The model was able to break down th… results to determine the contribution… oil conservation efforts and the natur… conservation efforts made to the ove… economic impact. For example, as sh… in the above table, the overall result o… analysis showed economic benefits to…



Overall 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

- Contact:
  - Denise Mulholland
    - 202-343-9274
    - Mulholland.denise@epa.gov
    - U.S. EPA State and Local Climate and Energy Program http://www.epa.gov/statelocalclimate/

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