Renewable Portfolio Standard Benefits

Montana Energy and Telecommunications Interim Committee, November meeting

Lori Bird, NREL

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Potential RPS Benefits and Costs

**Potential Benefits**
- Fuel diversity
- Economic development
- Electricity price stability
- Emissions reductions/health benefits
- Water savings
- Distributed resources
  - line loss savings
  - transmission & distribution deferrals
  - grid security and reliability

**Potential Costs**
- Higher electricity prices and impacts
  - Generation costs
  - Transmission upgrades
  - Integration costs
- Distributed resource interconnection costs
Renewable Portfolio Standard Policies

www.dsireusa.org / March 2013

29 states, Washington DC and 2 territories have Renewable Portfolio Standards. (8 states and 2 territories have renewable portfolio goals)
Some States Have Estimated RPS Benefits

<table>
<thead>
<tr>
<th>State</th>
<th>Emissions and Health</th>
<th>Economic Impacts</th>
<th>Savings, Avoided Costs</th>
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<tbody>
<tr>
<td>California</td>
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<td>Connecticut</td>
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<td>Ohio</td>
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The states above have developed quantitative estimates of RPS benefits, while others have assessed them qualitatively.
Approaches to Benefits Estimation

1. **Description of costs and benefits.** Discussing various benefits qualitatively.

2. **Assessing electricity rate impacts.** Examining how an RPS impacts electricity rates provides a partial estimate of benefits by excluding other benefit categories.

3. **Economic modeling.** Using a model to calculate the direct and indirect economic impacts.

4. **Assessing multiple benefits.** Using appropriate methods to assess individual benefit and cost types. Different data sources and methods may be used for each type.

Source: CESA 2012
Emissions and Human Health Benefits

• Calculate emissions of carbon dioxide (CO$_2$), sulfur oxides (SO$_x$) and nitrogen oxides (NO$_x$)
  o Production cost models
  o Estimating displaced emissions of marginal power generating units

• Quantify the avoided human health effects
  o Estimating monetary savings of avoided health impacts

Credit: Warren Gretz / NREL
Emissions Impacts of Cycling Fossil Plants

<table>
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<tr>
<th>Emission</th>
<th>Emission Reduction Due to Renewables</th>
<th>Cycling Impact</th>
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</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>260–300 billion lbs 29%–34%</td>
<td>Negligible Impact</td>
</tr>
<tr>
<td>NOₓ</td>
<td>170–230 million lbs 16%–22%</td>
<td>3–4 million lbs</td>
</tr>
<tr>
<td>SO₂</td>
<td>80–140 million lbs 14%–24%</td>
<td>3–4 million lbs</td>
</tr>
</tbody>
</table>

- Higher penetrations of wind and solar can change the operation of fossil fuel plants: turn on and off or ramp up and down more frequently.
- NREL examined impacts of cycling fossil fuel plants with 33% wind and solar energy in the West and found cycling has small impact on emissions.

Source: Western Wind and Solar Integration Study (2013)
Examples of State Emissions Benefits Estimates

- **Illinois**
  - Annual report required by legislature; IL Power Agency contracted with consultant
  - Modeled electricity market with and without RE to estimate emissions
  - 5,481,327 tons of CO$_2$ and 4,765 tons of NO$_x$ avoided in 2011
  - Total emission cost reduction of approximately $75 million (using allowance prices)

- **Ohio**
  - Ohio PUC study used PROMOD IV, an electricity market simulation tool
  - Compared no renewables case with cases assuming a) operational RE plants, and b) RE plants approved
    - CO$_2$ emissions reduced 0.17% to 0.5%, or 222,718 to 576,640 tons from the two scenarios in 2014

Sources: IPA 2013; PUCO 2013
Water consumption impacts for electricity generation technologies range widely

Economic Impacts

• Number of jobs
• Direct, indirect and induced economic activity
• Effects on gross state product
  o Can be estimated with economic input-output models
  o Gross vs. net impacts
  o Examples: REMI, RIMS, IMPLAN, JEDI
Examples of State Economic Impact Estimates

• Illinois
  o Center for Renewable Energy at Illinois State University used NREL’s JEDI model
    – JEDI is simplified tool to estimate gross jobs and other economic development benefits
  o Total gross economic benefit of $5.98 billion from 23 largest wind farms in Illinois (3,335 MW) over lifetime.
  o Construction impacts:
    – Approximately 19,047 FTE jobs, total payroll of $1.1 billion
  o Operations impacts (25 years):
    – 814 permanent jobs, annual payroll of $48 million
    – $28.5 million in annual property taxes
    – $13 million annually for landowners who lease their land

Sources: IPA 2013
Savings, Costs Avoided

- Fuel costs avoided
- Deferred or delayed capacity construction
- Effects on wholesale electricity prices
  - Avoided cost methods
  - Modeling electric system

Credit: Warren Gretz / NREL
Examples of State Cost Savings Estimates

• California
  o Avoided cost approximation method
    – Compared RE costs to Market Price Referent (MPR), which is cost to own, operate a baseload combined cycle gas turbine (LT energy and capacity)
    – Avoided costs of RE contracts compared to MPR alternatives of approximately $1,410 million for PG&E, $1,560 million for SCE, and $330 million for SDG&E

• Illinois
  o MarSi model estimated that renewables lowered average LMPs by $1.30 per MWh, from $36.40 to $35.10 per MWh, or $176.85 million in total load payment for generation in 2011.

• Ohio
  o Modeled electricity market with and without renewables.
    o Wholesale prices reduced by approximately 0.15% ($32.25 to $32.20/MWh) in scenario 1 (RE online) and 0.51% ($32.25 to $32.08/MWh) in scenario 2 (RE approved) in 2014.

Sources: IPA 2013; PUCO 2013; CPUC 2013
Benefits of Distributed PV

Benefits

- Generation and capacity value
- T&D deferrals
- Line loss savings
- Fuel price hedge
- Environmental benefit
- Grid security and reliability

- Benefits estimates vary by study; methodologies vary

Source: Rocky Mountain Institute, Review of Solar PV Benefit and Cost Studies, 2013
References


3. 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 at the local (usually state) level. [http://www.nrel.gov/analysis/jedi/about_jedi.html]

4. COBRA Model. Co-Benefits Risk Assessment Screening Tool. Estimate and map the air quality, human health, and related economic benefits (excluding energy cost savings) of clean energy policies or programs. Approximate the outcomes of clean energy policies that change emissions [http://www.epa.gov/statelocalclimate/resources/cobra.html#what]
References (cont.)


