Policy Pathways to an Advanced Energy Economy

Marilyn A. Brown
Brook Byers Professor of Sustainable Systems,
School of Public Policy, Georgia Institute of Technology

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The Southeastern U.S. is no longer an "anomaly".
$180 billion of new power plants to meet this load, or can we better manage our demand?
The Paris Accord is an important first step, but it is not strong enough to limit the global temperature increase to 2°C above the pre-industrial revolution.

Source: Adapted from the International Energy Agency’s World Energy Outlook
• IEA: Energy efficiency and renewables will likely dominate the “Second Pivot”

Adapted from: IEA (2015) *Energy and Climate Change: A Special Report*
The LCOE metric is incomplete:
--the hourly shape of supply and demand,
--the need for frequency and voltage control and support,
--reactive power planning and other locationally variable resource issues.

How can the answer not be energy efficiency & renewables?

Source: *Green Savings*, Figure 2.10
The U.S. has about 75,000 jobs in coal mining. Automation has had a major impact on this workforce: autonomous trucks work the Powder River Basin....

See: 30-minute CNN discussion: 175,000 live “hits”

https://www.facebook.com/cnn/videos/10156318782866509/?hc_ref=NEWSFEED
Nearly 1 million U.S. workers spend a majority of their time installing energy-efficient equipment and services.

Technologies include:
- Advanced windows & insulation
- High efficiency HVAC
- Smart thermostats
- Efficient lighting and controls
- Energy Star appliances, etc.

The U.S. has about 250,000 workers in the solar industry. One out of every 50 new jobs added in the U.S. in 2016 was created by the solar industry.

Job Coefficients for Different Types of Energy Investments

- Commercial EE
- Residential EE
- Industrial EE
- Biomass
- All other
- Hydroelectric
- Geothermal
- Nuclear
- Solar
- Fossil fuel
- Transmission and distribution
- Wind

Jobs per 1 million investment (in $2015)
- Direct
- Indirect
- Induced

Created by GT-CEPL
Under Review

Forum and Celebration of Energy Transitions
Types of Jobs Generated by Investments in Energy Efficiency and New Solar

Jobs per 1 million investment in energy efficiency (in $2015)

- Residential: 12.55
- Commercial: 12.64
- Industry: 12.15
- New Solar: 13.77

- Architecture and Engineering Services
- Insurance and Finance
- Industrial machinery manufacturing
- Motors, Drives and back-up generators
- Lighting
- Program Administration
- Energy and Environmental Management and Smart Controls
- Other Electrical Equipment
- Material for Envelope
- Water Heating
- Construction

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Conventional energy jobs are forecast to shrink, but jobs in the new energy economy will grow:

Jobs in the U.S. are forecast to continue to grow, especially service sectors:

Source: GT-NEMS modeling results
Co-optimizing demand- and supply-side resources can cut carbon and save money

Smart climate policies are needed:

– Carbon caps: “Clean Power Plan”

– Carbon taxes: “Carbon Dividends Plan”
  – redistribute taxes on a per capita basis vs
  – redistribute per source of CO₂.

Cumulative policy costs in 2015–2030 per cumulative tons of CO₂ avoided

<table>
<thead>
<tr>
<th>Climate Policy</th>
<th>Cost per ton of CO₂ Reduction</th>
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<tbody>
<tr>
<td>Carbon Cap</td>
<td>$39.13</td>
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<tr>
<td>Carbon Cap + EE</td>
<td>-$26.30</td>
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<tr>
<td>$10 Carbon Tax</td>
<td>$8.11</td>
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<tr>
<td>$10 Carbon Tax + EE</td>
<td>-$28.63</td>
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Cost of climate policy = utility resource costs + EE costs + administrative costs − carbon tax recycling (in $2013)
Policy design matters!

- How carbon tax revenues are recycled creates different regional winners and losers.

![Map of Electricity Market Module Regions]

**Cost of Climate Policy in 2030**

- **Winner**
  - Long Island
  - Upstate New York
  - Georgia-Alabama
  - Great Lakes

- **Loser**
  - Low Coal Regions
  - High Coal Regions

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*Net present value (in $2013) using a 7% discount rate*
The clean power transformation can grow the economy, create jobs with livable wages, improve human health, and protect the environment.

A great deal is at stake, and policy design matters.

Winners and losers are inevitable at all geographic scales.

Blending the engineering and natural sciences with economics, social sciences, and policy analysis can reveal new possibilities and avoid undesirable futures.
Dr. Marilyn A. Brown
Brook Byers Professor of Sustainable Systems
School of Public Policy
Georgia Institute of Technology
Atlanta, GA 30332-0345
Marilyn.Brown@gatech.edu
Climate and Energy Policy Lab:
www.cepl.gatech.edu