Overview of the Modeling Process

Overall Assumptions

Inside the Carbon Tax Analysis Model (CTAM)

CTAM Output Into Regional Economic Models Incorporated (REMI) Model

Inside REMI

Output from CTAM and REMI: FINDINGS
Assumptions for Modeling in the Carbon Tax Analysis Model (CTAM)

- Emission reduction targets for 2020 and 2035
- Cap/trade structure with 100% auction of allowances
- No trading of allowances, offsets or other opportunities to reduce compliance costs
- No new innovations (though Energy Outlook data incorporates some)
- Additional complementary policies excluded
- Additional emissions reductions from revenue spending excluded
- Two Scenarios: $12/metric ton first year then:
  - Lower price increasing $.60 per year to 2020 and $2 per year after (CA)
  - Higher price increasing $8 per year
Inside the CTAM Model

CTAM translates emission levels into consumption and prices using...
- Relationship between prices and consumption (called elasticities)
- Energy price and demand forecasts from US Energy Information Administration 2014 Energy Outlook

Allocate energy consumption across industries

Determine carbon emissions per industry

Distribute cost of these emissions per industry

Integrate “Revenue Recycling” into costs and prices

Calculate net revenue and cost due to emissions (used in REMI)
Revenue Recycling Assumptions

- 30% to Working Families Tax Credit
- 15% B&O tax cut to trade exposed industries
- 40% B&O tax cut to construction sector
- 10% Public Utilities Tax cut to electric power generation, transmission, and distribution
- 5% to state General Fund
A More Complete View into the Carbon Tax Analysis Model

Inside the Regional Economic Models Incorporated (REMI) Model

- REMI is an industry-standard econometric model used by many state agencies, private companies, and researchers
- Revenue changes by industry (160 sectors) for baseline, high and low scenarios
- REMI combines spending equations with the input/output table of industry sales and purchases

Changes in Industry and Household Purchases

Resulting Output, Income, and Employment Impacts

CTAM Revenue Output Including B&O Reductions and Household Tax Credits
A More Complete View into REMI Model

Results: Economic Impact

<table>
<thead>
<tr>
<th>Change from 2015-2035</th>
<th>Baseline</th>
<th>Low Price Scenario Change from Baseline</th>
<th>High Price Scenario Change from Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline Prices</td>
<td>21.4%</td>
<td>9.8%</td>
<td>37.5%</td>
</tr>
<tr>
<td>Personal Income</td>
<td>141.7%</td>
<td>.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Employment</td>
<td>16.2%</td>
<td>.3</td>
<td>.8</td>
</tr>
<tr>
<td>Gross State Product</td>
<td>60.3%</td>
<td>.4</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Income, Employment and GSP differences in percentage points.
## Industry Employment Changes: Gainers & Losers

<table>
<thead>
<tr>
<th>Top 5 Job Gainers</th>
<th>Low Price Change from Baseline 2015-2035</th>
<th>High Price Change from Baseline 2015-2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic chemical manufacturing</td>
<td>80</td>
<td>289</td>
</tr>
<tr>
<td>Electric power generation, transmission, and distribution</td>
<td>110</td>
<td>367</td>
</tr>
<tr>
<td>Support activities for mining</td>
<td>9</td>
<td>32</td>
</tr>
<tr>
<td>Iron and steel mills and ferroalloy manufacturing</td>
<td>11</td>
<td>34</td>
</tr>
<tr>
<td>Dairy product manufacturing</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td>Construction</td>
<td>-</td>
<td>7,630</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bottom 5 Job Losers</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas distribution</td>
<td>-8</td>
<td>-19</td>
</tr>
<tr>
<td>Apparel manufacturing; Leather and allied product manufacturing</td>
<td>-2</td>
<td>2</td>
</tr>
<tr>
<td>Pipeline transportation</td>
<td>-1</td>
<td>-18</td>
</tr>
<tr>
<td>Pesticide, fertilizer, and other agricultural chemical manufacturing</td>
<td>0</td>
<td>-43</td>
</tr>
<tr>
<td>Textile mills and textile product mills</td>
<td>-29</td>
<td>-30</td>
</tr>
</tbody>
</table>
Why the Effect on Income, Output and Employment are Relatively Small

Relative Scale of Gasoline and Related Products

**Consumer Expenditures**

- Food and drink: 13.7%
- Housing: 32.8%
- Apparel: 3.4%
- Transportation less fuel and oil: 12.1%
- Gasoline and motor oil: 5.4%
- Health care: 6.9%
- Entertainment: 5.1%
- Personal care products & misc.: 3.5%
- Reading and education: 3.0%
- Cash contributions: 3.7%
- Personal insurance and pensions: 10.9%

**Industrial Output**

- Other services: 9.9%
- Education and health services: 7.3%
- Professional and business services: 6.0%
- Finance and real estate: 10.7%
- Information: 8.8%
- Transportation and warehousing: 4.4%
- Wholesale and retail trade: 11.3%
- Petroleum and coal: 4.8%
- Manufacturing excluding petroleum and coal: 21.7%
- Construction: 11.1%
- Agriculture and Mining: 4.0%

Sources: Consumer Expenditure Survey and Washington I/O Model
Cost of Gasoline and Vehicle Miles Traveled in Washington State

Sources: US Energy Information Administration and Washington Department of Transportation

Price Changes
- Dec 2003 - July 2008: 181.8%
- July 2008 - Dec 2008: -57.5%
- Dec 2008 - June 2012: 129.7%
- June 2012 - Aug 2014: -8.4%
- Dec 2003 - Aug 2014: 152.3%
Technical Lessons Learned from the Modeling

• Revenue recycling choices are key
• Fuel price elasticities ($\Delta$price/$\Delta$gallons) drive a lot of this work
• These models never include dramatic innovation. Need expert panels, specialized models and other ways to highlight these factors.