Climate Change and the Clean Power Plan

Brent Sohngen
Outline

• Climate change summary

• Ohio’s contribution to climate change

• The Supreme Court and the Social Cost of Carbon

• The Clean Power Plan

• The UNFCCC Conference of Parties – Paris.
Carbon dioxide levels are increasing

![Graph showing increasing CO2 Concentrations and CO2 Emissions over time from 1900 to 2010. CO2 Concentrations rise sharply after 1950, while CO2 Emissions show a gradual increase.](image-url)
Debate about climate change

• The theory of climate change is that rising concentrations of CO2 in the atmosphere will cause the average temperature of the earth to rise, leading to many other potentially negative consequences including sea level rise, droughts, floods, hurricanes, et.

• There is discussion about the science where supposedly 97% of scientists really believe in climate change.....
  • But who really cares, if only one or two scientists are correct then future generations have a problem on their hands...

• The most important debate is really about the economic costs and benefits of reducing carbon dioxide emissions.
Ohio temperature and precipitation have increased.

Temperature

Precipitation

+ 1.5 degrees F since 1900

+ 4” per year since 1900
How will climate change affect Ohio’s agriculture?

• Ohio farmers have already benefited from higher temperatures and greater precipitation, mixed with more CO2 in the atmosphere.

• In the future, Ohio farmers likely will continue benefiting from climate change – at least over the next 30 years. Why?

• Ohio yields increase
  • Ohio is slightly cooler than the optimal temperature for agriculture, so rising temperatures help, at least for some period of time.
  • Precipitation has historically increased in summer, and likely will continue.

• Yields globally fall ➔ prices rise.
# Ohio Corn Yields

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter (p-value)</th>
<th>Average 2010</th>
<th>2050 no CC</th>
<th>2050 with CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-29.237 (0)</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Winter Temp</td>
<td>-0.004 (0.33)</td>
<td>31.9</td>
<td>31.9</td>
<td>32.8</td>
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<tr>
<td>Spring Temp</td>
<td>0.009 (0.3)</td>
<td>61.6</td>
<td>61.6</td>
<td>60.7</td>
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<tr>
<td>Summer Temp</td>
<td>-0.027 (0.01)</td>
<td>69.7</td>
<td>69.7</td>
<td>69.3</td>
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<tr>
<td>Fall Temp</td>
<td>0.01 (0.09)</td>
<td>42.6</td>
<td>42.6</td>
<td>43.1</td>
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<tr>
<td>Winter Prec</td>
<td>-0.017 (0.41)</td>
<td>2.5</td>
<td>2.5</td>
<td>2.4</td>
</tr>
<tr>
<td>Spring Prec</td>
<td>-0.03 (0.09)</td>
<td>4.3</td>
<td>4.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Summer Prec</td>
<td>0.066 (0)</td>
<td>3.6</td>
<td>3.6</td>
<td>3.8</td>
</tr>
<tr>
<td>Fall Prec</td>
<td>-0.003 (0.84)</td>
<td>3.2</td>
<td>3.2</td>
<td>3.1</td>
</tr>
<tr>
<td>Year</td>
<td>0.018 (0)</td>
<td>2010</td>
<td>2050</td>
<td>2050</td>
</tr>
<tr>
<td>Real Corn P</td>
<td>0.002 (0.85)</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
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<tr>
<td>Predicted Yield</td>
<td></td>
<td>172</td>
<td>349</td>
<td>355</td>
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<tr>
<td>% Change</td>
<td></td>
<td></td>
<td></td>
<td>2%</td>
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</table>
Ohio’s contribution to climate change has been falling
Why have Ohio’s CO2 emissions fallen?

- Renewable energy standards have caused renewable energy to increase to about 1.7% of total electric power production.

US DOE Energy Information Administration
Why have Ohio’s CO2 emissions fallen?

- Coal has been replaced with natural gas.
  - This has not cost us much because natural gas prices have remained low.
Why have Ohio’s CO2 emissions fallen?

• Consumption has fallen, due to higher electricity prices, recession and demand side regulation.
  • Average retail prices increase in the US by around 2 cents per Kwh for each 1% increase in renewable energy.

US DOE Energy Information Administration
Why is the federal government regulating carbon dioxide?

• The Supreme Court in 2007 required the US Environmental Protection Agency to regulate CO2 as a pollutant using the Clean Air Act (Massachusetts versus USEPA).

• The Obama administration believes the science that carbon dioxide emissions lead to climate change and the damages from climate change are large enough to justify action.

• US EPA issue an Endangerment Finding in 2009, with climate change damages estimated to range from $12-$39 per ton CO2.
  • $10-$22 per year per Ohio driver (1-4 cents per gallon of gasoline)
  • $1-$4 per year per Ohio household for electricity consumption.
  • But note that each ton of CO2 provides $2300 in economic output in Ohio.
What is the Clean Power Plan?

• Federal regulation of electricity production through the Clean Air Act.

• Intended to reduce carbon dioxide emissions by around 15% by 2020 and 28% by 2030 in the electricity sector.

• Each state has a different federally mandated CO2 reduction goal.

• Ohio’s current emissions from the electricity sector are around 102 million tons CO2. They are required to fall to around 74 million tons CO2 by 2030.

• A mass-based option paves the way for carbon trading/Cap-and-Trade.
Nationwide Effects of Clean Power Plan

• Study by Jeff Hopkins (2015) that evaluated 6 different model results.
• Continued shift to natural gas, although coal remains a large part of the energy mix through 2030.
• Higher electricity prices: +3 to +13%.
• Higher natural gas prices: 40% to 70%.
• Annual costs of compliance: $5 to $30 billion per year.
• Rely importantly on energy efficiency and reduced consumption, which cost less than renewables.
• Renewables play a small part because they are fairly expensive.
## Levelized Costs of Electricity

<table>
<thead>
<tr>
<th>Method and rate</th>
<th>Pounds CO2/Kwh</th>
<th>cents per Kwh</th>
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</thead>
<tbody>
<tr>
<td>Conventional Coal</td>
<td>2100-2400</td>
<td>9.5</td>
</tr>
<tr>
<td>Conventional Natural Gas</td>
<td>1000-1200</td>
<td>7.3</td>
</tr>
<tr>
<td>Low/No Emission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>0</td>
<td>7.3</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>0</td>
<td>8.0</td>
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<tr>
<td>Nuclear</td>
<td>0</td>
<td>9.5</td>
</tr>
<tr>
<td>Geothermal</td>
<td>0</td>
<td>10.0</td>
</tr>
<tr>
<td>Natural Gas – CCS</td>
<td>&lt;1000</td>
<td>10.2</td>
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<tr>
<td>Solar</td>
<td>0</td>
<td>12.5</td>
</tr>
<tr>
<td>Coal – CCS</td>
<td>&lt;2000</td>
<td>14.4</td>
</tr>
</tbody>
</table>
Ohio’s Renewable Energy Standards

• Requires 12.5% of electricity production in Ohio be produced with renewable energy

• Requires significant energy efficiency investment

• Frozen in 2014 and under consideration by committee.

• Committee has recommended to continue the freeze.

• Having more wind power in the system with the Clean Power Plan will stabilize electricity prices and provide cost-certainty, which is not available if the Clean Power Plan is implemented entirely with natural gas and reduced consumption.
UN Framework Convention on Climate Change

• US signed and ratified in 1992 under President George HW Bush

• The meeting in Paris going on now (the “Conference of the Parties”) is convened under this treaty.

• No new treaty is anticipated in Paris; countries will agree to implement what they are already planning to implement or what they are legally bound to implement.
US Indicated Nationally Determined Contribution

**U.S. EMISSIONS UNDER 2020 AND 2025 TARGETS**

- **2020 Target:** 17% below 2005 levels
- **2025 Target:** 26% - 28% below 2005 levels
US Indicated Nationally Determined Contribution

- US goal includes all sectors, not just electricity
US Indicated Nationally Determined Contribution

• US goal includes all sectors, not just electricity

• Large ramp up in fuel efficiency standards: Cars achieve 54.5 mpg in average fuel efficiency by 2025.
  • Means many more hybrids, CNG, and diesel cars

• Reduce other gasses

• Maintain or enhance the forest sink.
Nationally Determined Contributions.

• What is everybody else doing?

  • U.S.- 2025: 26-28% Reduction below 2005 levels
  • China-2030: 60-65% Carbon Intensity Red. below 2005
  • EU (28 Nations)- 2030: 40% Reduction Below 1990
  • India-2030: 33-35% Carbon Intensity Red. Below 2005
  • Japan- 2030: 26% below 2013 levels
  • Indonesia- 2030-29%(Unconditional)-41%(Conditional) Below Business As Usual (BAU) Levels
  • Brazil-2030: Emissions 43% below 2005, with large share from reduced deforestation