Assessing public perceptions of energy tradeoffs with discrete choice analysis

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Motivation

How Much Will the Clean Power Plan Cost?

FACT: The benefits of the EPA's Clean Power Plan far outweigh the costs

Contents
- Climate benefits worth billions >
- Billions in health benefits >
- Minimal upfront costs, with lower electricity bills to follow >
- Cost-effective solutions to cut carbon >
- Share the facts about the Clean Power Plan >
Motivation

What do individuals think about the **tradeoffs** between increased bills and climate or health objectives?

How does information on climate and health benefits affect support for these types of policies?

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**Previous work on tradeoff perceptions**

- Portfolio selection tool with tradeoffs (Fleishman-Mayer et al., 2014)

- Individuals respond more strongly to attributes of energy use than to source (Ansolabehere & Konisky, 2014)

- Health frames can motivate changes to energy use more than economic cost (Asensio & Delmas, 2014)
Research questions

- How do individuals make tradeoffs across the different attributes of electricity generation?
  - climate change
  - health related air pollution
  - economic costs (electricity bills)

- What is the effect of providing climate change and health information when making these tradeoffs?

Discrete choice survey

- Well-established method in marketing, transportation research (Train, 2009)

- Emerging method in the energy & environment space:
  - Climate change and energy security (Longo et. al., 2008)
  - Estimating implicit discount rates for lighting (Min et. al., 2014)
  - Preferences for electric vehicles (Helveston et. al., 2015)
  - Energy efficiency (Davis & Metcalf, 2014)
  - Renewables and electricity bills in Germany (Kaenzig, 2013)

- **Our survey:** Individuals respond to 16 comparisons of discrete electricity “futures” with different attribute levels
### Example choice screen

Which of these scenarios would you prefer for your state? (These are hypothetical scenarios...click here to learn more)

<table>
<thead>
<tr>
<th>Electricity portfolio</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Efficiency 1%</td>
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</tr>
<tr>
<td></td>
<td>Renewables 12%</td>
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</tr>
<tr>
<td></td>
<td>Nuclear 25%</td>
<td>Nuclear 20%</td>
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<tr>
<td></td>
<td>Natural gas 56%</td>
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<tr>
<td></td>
<td>Coal 11%</td>
<td>Coal 41%</td>
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- **Climate change related emissions**: 30% increase in CO₂ from today
- **Health related air pollution**: 30% decrease in SO₂ from today
- **Monthly electricity bill**: 10% increase from current bill

### Electricity portfolio

- **Electricity portfolio** – ways of meeting a state’s generation needs.

  Attribute levels: five “representative” scenarios
  1. coal (41%) (baseline)
  2. renewables (42%)
  3. natural gas (56%)
  4. nuclear (50%)
  5. efficiency (14%)
Example choice screen

**Climate change related emissions** – change in annual CO₂ emissions from baseline (i.e. current emissions levels)

Attribute levels (relative change):
1. 70% decrease
2. 30% decrease
3. no change
4. 30% increase
5. 70% increase

Example choice screen

**Health related air pollution** – change in annual SO₂ emissions from baseline (i.e. current emissions levels)

Attribute levels (relative change):
1. 70% decrease
2. 30% decrease
3. no change
4. 30% increase
5. 70% increase
Example choice screen

Monthly electricity bill – change in monthly electricity bill levels for consumers from baseline i.e. individuals’ current bill payments (as percentages).

Levels:
1. 20% decrease
2. 10% decrease
3. no change
4. 10% increase
5. 20% increase

Effect of emissions information

- Randomized controlled trial with different emissions attributes shown in the task.

<table>
<thead>
<tr>
<th>Experimental Group</th>
<th>Information that respondents see</th>
</tr>
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<tbody>
<tr>
<td>Group 1</td>
<td>All four attributes (portfolio, bill, CO(_2), and SO(_2))</td>
</tr>
<tr>
<td>Group 2</td>
<td>Portfolio, bill, and CO(_2) only (no information on SO(_2))</td>
</tr>
<tr>
<td>Group 3</td>
<td>Portfolio, bill, and SO(_2) only (no information on CO(_2))</td>
</tr>
<tr>
<td>Group 4</td>
<td>Portfolio and bill only (no information on CO(_2) or SO(_2))</td>
</tr>
<tr>
<td>Group 5</td>
<td>All attributes + monetized damages for CO(_2) and SO(_2)</td>
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## Example choice screen

(No SO$_2$ emissions / health information)

### Which of these scenarios would you prefer for your state?
(These are hypothetical scenarios...click here to learn more)

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Which option do you choose?
Modeling and sample

- Random utility mixed logit model (Train, 2009)
  - Linear model based on attribute levels
  - Estimate random effects coefficients for emissions and bills
  - Logit coefficients provide insight on probability and willingness-to-pay

- 1,006 participants from Amazon's Mechanical Turk
  - Recruited proportionally from U.S. states
  - Random assignment to experimental groups

Probability of support

(Group 4: all emissions information)
Less support for renewables if they imply higher electricity bills.

More support for renewables if they bring emissions benefits (offsets increased costs).
Probability of support
(Across groups with different emissions information)

Renewables cost 20% more than baseline

Probability of support for renewables relative to current national baseline

Experimental group

Group 1: no info on CO₂ or SO₂
Group 2: respondents see CO₂ only
Group 3: respondents see SO₂ only
Group 4: info on both CO₂ and SO₂

Less support for renewables without emissions benefits

Prefer renewables

Prefer baseline
Slide 19

J12  I think these figures are way too small, maybe try to think of some ways to maybe show part of each figure so you can make them larger?
Jenna, 10/14/2016

Slide 20

J12  I think these figures are way too small, maybe try to think of some ways to maybe show part of each figure so you can make them larger?
Jenna, 10/14/2016
Experimental group

Probability of support
(Across groups with different emissions information)

- More support when renewables yield climate and health benefits (even in the face of higher bills)

Willingness-to-pay

- Only CO2 reduced by 30%
- Only SO2 reduced by 30%
- Both CO2 and SO2 reduced by 30%
Implicit WTP ($ per ton of emissions reduced):

$100-130 per ton of CO₂
$60,000-110,000 per ton of SO₂

Conclusions

• Preferences for lower bills, emissions
  – Outcomes more important than source
  – Acceptance of higher bills for climate and health
    benefits possibly a form of altruism

• Climate vs. health benefits
  – Comparable increase in support from reducing
    either pollutant, larger increase with both

• Limitations of stated choice studies
  – Hypothetical choices, survey design can affect
    results (Louviere, 2006)
  – Cognitive biases in stated preference studies
    (Fischhoff, 2005)
Policy implications

- Technology “neutral” policies for emissions reductions?
- Communicate information on emissions reductions, particularly health information
- Consider co-optimizing climate mitigation policies across multiple health and climate objectives

Acknowledgements

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