Cooling a Warming Planet?
Public Forums on Climate Intervention Research

Results Report Launch
Consortium for Science, Policy & Outcomes
November 6, 2019
Agenda

11:30 am  Welcome, project introduction, and lunch
11:45 pm  Participant data and forum results
12:15 pm  Panel discussion and Q&A
1:30 pm   Adjourn
Uncertainty

Lock-in

Moral hazard

Governance
Project Team

Daniel Sarewitz (PI)       Jason Lloyd
Mahmud Farooque (Co-PI)    Kimberly Quach
Ariel Anbar (Co-PI)        David Tomblin
Stephen Romaniello        David Sittenfeld
John Nelson               Emily Hostetler
Leah Kaplan               Mark Neff
Ira Bennett               Bjorn Bedsted

Project Funding from:

Alfred P. Sloan FOUNDATION

CCAST - Expert and Citizen Assessment of Science and Technology

Consortium for Science, Policy & Outcomes at Arizona State University

Museum of Science

ASU PlanetWorks

Arizona State University
ECAST Network

Deliberative decision-making for more informed, inclusive and desirable outcomes

60 deliberations across 16 cities
What is Participatory Technology Assessment (pTA)?

- Diverse representation
- Deliberative multi-directional learning
- Informed lay public participants
- Clear, comparable, and usable outputs, formats, outcomes
**Project Timeline**

### Design & Development
- **Jan - April**
  - Literature Review & Focus Groups
- **May**
  - Expert-Stakeholder Workshop 1
- **May - June**
  - Deliberation Design
- **July**
  - Test Forum
  - Deliberation Materials
  - Participant Packets
  - Multimedia
  - Expert Review & Finalized Content

### Recruitment & Implementation
- **June - July**
  - Program Design
  - Recruitment Design
- **July**
  - Staff Recruitment & Facilitator Training
  - IRB Approval & Participant Recruitment
- **July - Aug**
  - Public Forums in Phoenix and Boston
- **Sep**
  - Data and Results Tabulation

### Analysis & Amplification
- **Oct - Nov**
  - Data & Results Analysis
  - Nov
  - Expert Review
  - Expert-Stakeholder Workshop 2
- **Dec**
  - Evaluation and Assessment
- **Jan-Mar**
  - Reports
  - Papers
  - Presentations

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*ASU Arizona State University*
Forum Sessions

**What research topics?**

- Cirrus Cloud Thinning
- Stratospheric Aerosols
- Marine cloud brightening
- Ocean Surface Microbubbling
- Sea Ice Thickening
- Cool Infrastructure

**Who should fund research?**

- Nongovernmental Organizations (NGOs)
- Federal Government
- Military
- Corporations
- Philanthropies

**Who should make decisions?**

- Researcher Self-Governance
- Independent Advisory Committees
- Local & Regional Government
- Federal Government
- International Negotiation

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**Forum Sessions**

**Who should fund research?**

- Nongovernmental Organizations (NGOs)
  - Who are they? Research more similar to the local, collaborative
  - What types of NGOs exist? Many (NGO, Management, Advocates, Environmental)

- Federal Government
  - Who are they? Federal agencies (NSF, NASA, DOE, EPA, etc.)
  - How much does the public want federal research? How much do federal agencies fund?

- Military
  - Who are they? Department of Defense (DOD)
  - How much research does the military fund?

- Corporations
  - Who are they? Private companies
  - How much research does the corporate sector conduct?

- Philanthropies
  - Who are they? Foundations, private nonprofit organizations
  - How much do philanthropies fund research?

**Who should make decisions?**

- Researcher Self-Governance
  - What is the role of the research community?

- Independent Advisory Committees
  - What is the role of advisory committees?

- Local & Regional Government
  - How do local and regional governments fund research?

- Federal Government
  - How does the federal government fund research?

- International Negotiation
  - How do international negotiations influence research funding?
Data Collection Methods

Group Boards/Activities
Individual Response Sheets
Table Observer Notes
Table Recordings
Who Were the Participants?
Who Attended

AGE

MA
- 18-25: 22%
- 25-44: 25%
- 45-64: 39%
- 65+: 14%

AZ
- 18-25: 18%
- 25-44: 35%
- 45-64: 14%
- 65+: 33%

EDUCATION

MA
- No HS: 40%
- HS: 20%
- S Coll: 7%
- B Deg: 12%
- G/P Deg: 16%

AZ
- No HS: 39%
- HS: 33%
- S Coll: 16%
- B Deg: 12%
- G/P Deg: 12%

ETHNICITY

MA
- White: 60%
- Hispanic: 12%
- Black: 8%
- Mixed/Other: 9%
- Asian: 11%

AZ
- White: 49%
- Hispanic: 18%
- Black: 10%
- Mixed/Other: 5%
- Asian: 4%

AZ: 88
MA: 83
## Influence of Participation

<table>
<thead>
<tr>
<th>Pre/Post Survey Comparison Questions</th>
<th>Combined Pre Average</th>
<th>Combined Post Average</th>
<th>Combined Pre vs. Post T-Test p</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am familiar with the topic of SRM research.</td>
<td>4.4</td>
<td>2.0</td>
<td>8.5E-34</td>
</tr>
<tr>
<td>I know the issues, arguments and perspectives related to climate change.</td>
<td>3.2</td>
<td>2.3</td>
<td>1.2E-07</td>
</tr>
<tr>
<td>Generally speaking, I think that climate change is happening.</td>
<td>1.5</td>
<td>1.4</td>
<td>0.45</td>
</tr>
<tr>
<td>I believe that climate change is mostly human-caused.</td>
<td>2.1</td>
<td>1.9</td>
<td>0.18</td>
</tr>
</tbody>
</table>

5 participants rate disagreement (5, 6, 7)

7 participants rate disagreement (5, 6, 7)

| 1 | Absolutely agree |
| 4 | Neither agree nor disagree |
| 7 | Absolutely disagree |
## Climate Change Research Attitudes

<table>
<thead>
<tr>
<th>Pre/Post Survey Comparison Questions</th>
<th>Combined Pre</th>
<th>Combined Post</th>
<th>Combined Pre vs. Post T-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRM research is crucial to understanding how to battle the effects of climate change.</td>
<td>2.7</td>
<td>2.4</td>
<td>0.027</td>
</tr>
<tr>
<td>Experts and science in general will help solve most climate change problems.</td>
<td>3.4</td>
<td>2.9</td>
<td>0.0074</td>
</tr>
<tr>
<td>Technology generally causes more problems than it solves.</td>
<td>4.7</td>
<td>4.9</td>
<td>0.37</td>
</tr>
<tr>
<td>It is important to collect data on the public’s ethical concerns about SRM research.</td>
<td>2.3</td>
<td>1.8</td>
<td>0.0019</td>
</tr>
<tr>
<td>It is important to collect public opinion data on decisions about SRM research directions.</td>
<td>2.4</td>
<td>1.9</td>
<td>0.00068</td>
</tr>
</tbody>
</table>

1. Absolutely agree
2. Neither agree nor disagree
3. Absolutely disagree
## Influence of Participation – Regional Differences

<table>
<thead>
<tr>
<th>Participation in the forum…</th>
<th>AZ Average</th>
<th>MA Average</th>
<th>AZ vs. MA p</th>
</tr>
</thead>
<tbody>
<tr>
<td>significantly increased my knowledge about climate change.</td>
<td>1.65</td>
<td>2.55</td>
<td>1.3E-04</td>
</tr>
<tr>
<td>significantly influenced my opinion about climate change.</td>
<td>2.27</td>
<td>3.34</td>
<td>4.1E-04</td>
</tr>
<tr>
<td>significantly influenced my knowledge about SRM research.</td>
<td>1.55</td>
<td>1.74</td>
<td>0.27</td>
</tr>
<tr>
<td>significantly influenced my opinion about SRM research.</td>
<td>1.80</td>
<td>2.22</td>
<td>0.03</td>
</tr>
<tr>
<td>enhanced my understanding of alternative perspectives to my personal opinion on climate change.</td>
<td>2.01</td>
<td>2.41</td>
<td>0.07</td>
</tr>
</tbody>
</table>

1. Absolutely agree
2. Neither agree nor disagree
3. Absolutely disagree

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1. Participation in the forum significantly increased my knowledge about climate change. The average rating in AZ is 1.65 compared to 2.55 in MA, indicating a significant difference (p = 1.3E-04).

2. Participation in the forum significantly influenced my opinion about climate change. The average rating in AZ is 2.27 compared to 3.34 in MA, also indicating a significant difference (p = 4.1E-04).

3. Participation in the forum significantly influenced my knowledge about SRM research. The average rating in AZ is 1.55 compared to 1.74 in MA, but the difference is not statistically significant (p = 0.27).

4. Participation in the forum significantly influenced my opinion about SRM research. The average rating in AZ is 1.80 compared to 2.22 in MA, indicating a significant difference (p = 0.03).

5. Participation in the forum enhanced my understanding of alternative perspectives to my personal opinion on climate change. The average rating in AZ is 2.01 compared to 2.41 in MA, but the difference is not statistically significant (p = 0.07).
Session 1 – Research Directions
**Natural vs. Human-made:**
“They can come up with a lot of experiments that doesn’t need to use a lot of energy and bad chemicals;” “Methods that focus on reflection not on altering the atmosphere.”

**Pragmatic:** “Practical, quick,...” “Ideal for small-scale trials.”

**Reversibility:** “All low risk, easily stopped.”
“Natural” interventions preferred

Stratospheric Aerosol Injection favored by less than 20% of deliberative groups
“Small scale research involves low risk and moderate funding. Less chance of negative ramifications.”

“Modeling & field experiments would have highest payoff. These should be done before considering national or other expensive programs.”

“No Research’ not acceptable (need to ‘gain knowledge’)”
“Computer modeling is a safe way to test without messing things up and a good way to see potential pitfalls. Small scale trials are the next logical step so real world pitfalls can be observed that didn’t happen in the lab.”

[Decentralized/National]: I chose these two because I think they would generate the most diverse results & solutions as quickly as possible (time is no longer a luxury we have with climate change)

“NO research until we have equal world participation: This should be a world wide collective participation to avoid a disadvantage at the world level.”
Issues to Consider

- Improved climate system understanding: 2.6
- Direct risks: 2.7
- SRM knowledge development: 3.1
- Monetary investment: 4.4
- Moral hazard: 4.5
- Technological lock-in: 6.0

Most important

Least important
Three-quarters of participants set some sort of condition on SRM research.
Some sort of SRM research is a good idea

Approval is conditional
Session 2 – Funding
Funders – Group Data

Group Selections for Funder Categories (n=26)

- **Universities**: 10 (AZ) | 10 (MA) - 77%
- **Philanthropies**: 9 (AZ) | 9 (MA) - 69%
- **Federal government**: 6 (AZ) | 8 (MA) - 54%
- **Non-governmental organizations**: 6 (AZ) | 3 (MA) - 35%
- **Corporations**: 2 (AZ) | 3 (MA) - 19%
- **Military**: 1 (AZ) | 3 (MA) - 15%

Legend: AZ groups (n=14) | MA groups (n=12)
Individual Funder Support Ratings

Both strongly positive and strongly negative signals of support

- Corporations: "Very much" (3), "Somewhat" (2), "Not really" (1), "Not at all" (0), "Not sure" (Null)
- Federal Government: "Very much" (3), "Somewhat" (2), "Not really" (1), "Not at all" (0), "Not sure" (Null)
- Military: "Very much" (3), "Somewhat" (2), "Not really" (1), "Not at all" (0), "Not sure" (Null)
- NGOs: "Very much" (3), "Somewhat" (2), "Not really" (1), "Not at all" (0), "Not sure" (Null)
- Philanthropies: "Very much" (3), "Somewhat" (2), "Not really" (1), "Not at all" (0), "Not sure" (Null)
- Universities: "Very much" (3), "Somewhat" (2), "Not really" (1), "Not at all" (0), "Not sure" (Null)
Quotes on Funders

- “The most **objective & public good orientated research** comes from governmental or private philanthropy (who share the same overall public good mission) sources.”

- “I don’t think the federal government is a good funder [because] it depends on who is in office . . . so the **amount of funding wouldn’t be consistent**. Corporations are an okay choice, but there is a lot of risk because the company could go bankrupt.”

- “**Corporate greed** got us here (dangerous climate change being accepted in order to profit elsewhere in the economy) so I do not believe corporations’ **motives would be altruistic** enough for positive funding of any climate research.

- “Philanthropies -people’s **commitment to a cause**, which they do benefit future generations.”

- [Military]: “The tech developed **could be used/seen as a "weapon"** by other countries & discourage international cooperation on the topic.” [Perhaps suggests guidance on which funding entities would make this distinction more difficult]
Funder Themes from Individual Rationales

Themes Most Expressed in Individual Funder Choice Rationales (n=167)

- Funder funding capacity
- Funder motivations
- Funder research capacity
- Funder cooperation
- Research independence
- Funder accountability
- Research uses
- Duty
- Interest inclusivity
- Publicity

AZ responses (n=86)  MA responses (n=81)
Motivations are critical

Public good focus
Funding consistency
Potential for collaboration
Session 3 – Decision Making
## Decision-Makers – Group Data

<table>
<thead>
<tr>
<th>Type</th>
<th>AZ groups (n=14)</th>
<th>MA groups (n=12)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local/Regional Government</td>
<td>4</td>
<td>2</td>
<td>23%</td>
</tr>
<tr>
<td>Federal Government</td>
<td>4</td>
<td>6</td>
<td>38%</td>
</tr>
<tr>
<td>International Negotiation</td>
<td>4</td>
<td>7</td>
<td>42%</td>
</tr>
<tr>
<td>Researcher Self-governance</td>
<td>5</td>
<td>7</td>
<td>46%</td>
</tr>
<tr>
<td>Independent Advisory Committee</td>
<td>6</td>
<td>10</td>
<td>61%</td>
</tr>
</tbody>
</table>

Number of Groups

0 2 4 6 8 10 12 14 16

<table>
<thead>
<tr>
<th>Number of Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 2 4 6 8 10 12 14 16</td>
</tr>
</tbody>
</table>

Legend:
- **AZ groups (n=14)**
- **MA groups (n=12)**
“Public is widely affected and should be heard; public should be able to know what is going on in their own backyards.”

“Researchers have control over science. Trust but verify. Non-compromising open access to public.”

“Keeping researchers free to perform their work, while keeping the public abreast of their findings.”
<table>
<thead>
<tr>
<th>GOVERNANCE PRIORITY MAIN CATEGORY/SUB-CATEGORY</th>
<th># of Statements</th>
<th>PRIMARY/SECONDARY THEME</th>
<th># of Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enforcement</td>
<td>72</td>
<td>Governance process</td>
<td>51</td>
</tr>
<tr>
<td>For public accountability</td>
<td>72</td>
<td>Vetting new and untested</td>
<td>32</td>
</tr>
<tr>
<td>Through good rules of science</td>
<td>14</td>
<td>Researcher decision-making</td>
<td>23</td>
</tr>
<tr>
<td>As transparency</td>
<td>7</td>
<td>Generates diverse ideas</td>
<td>8</td>
</tr>
<tr>
<td>On a global scale</td>
<td>2</td>
<td>Undefined</td>
<td>8</td>
</tr>
<tr>
<td>Through the free market</td>
<td>1</td>
<td>Creates bias</td>
<td>2</td>
</tr>
<tr>
<td>Hinders progress</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRANSPARENCY</th>
<th># of Statements</th>
<th>PRIMARY/SECONDARY THEME</th>
<th># of Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness to the public</td>
<td>62</td>
<td>People should have a say</td>
<td>51</td>
</tr>
<tr>
<td>Promotes enforcement</td>
<td>30</td>
<td>Create awareness/education</td>
<td>31</td>
</tr>
<tr>
<td>Fundamental to governance</td>
<td>27</td>
<td>Encourages enforcement of rules</td>
<td>8</td>
</tr>
<tr>
<td>Good science</td>
<td>17</td>
<td>To save the environment</td>
<td>6</td>
</tr>
<tr>
<td>Creates public support</td>
<td>13</td>
<td>Public shouldn’t interfere</td>
<td>13</td>
</tr>
<tr>
<td>Next research steps are flexible</td>
<td>11</td>
<td>Hinders progress</td>
<td>17</td>
</tr>
<tr>
<td>Undefined</td>
<td>9</td>
<td>RESEARCHER INTEREST</td>
<td></td>
</tr>
<tr>
<td>Trust</td>
<td>8</td>
<td>Scientists know best/bring legitimacy</td>
<td>36</td>
</tr>
<tr>
<td>Aids cooperation</td>
<td>6</td>
<td>Helps motivate scientists</td>
<td>23</td>
</tr>
<tr>
<td>Generates clear facts</td>
<td>4</td>
<td>Promotes value free autonomy</td>
<td>11</td>
</tr>
<tr>
<td>Hinders progress</td>
<td>1</td>
<td>Inclusive/serves others</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Detrimental to the public</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not a priority</td>
<td>7</td>
</tr>
</tbody>
</table>
Transparency is required

Ambivalence — Public oversight vs. Expert self-governance

International cooperation
“Keep things small; govern transparently, flexibly, and inclusively; learn from past mistakes and be prepared to reverse course. Proceed—but with caution.”
Panel Discussion

Cooling a Warming Planet?
Public Forums on Climate Intervention Research

Frank Keutsch (Harvard)
Jane Flegal (Spitzer – remotely)
Shuchi Talati (UCS)
Virginia Chanley (GAO)

Moderator: Ivan Amato (AAAS)