Science and Public Policy

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...that among these are Life, Liberty and the Pursuit of Happiness...

*Declaration of Independence – 1776*

**Life requires**
- Health → Medicine
- Food → Agriculture

**Liberty**
- Physical Security → Defense

**Pursuit of Happiness**
- Leisure Time → Electronics, etc

*All require Science*
Definitions

- **Science**
  - Systematic pursuit of knowledge using the *Scientific Method*
    - Hypothesis, Model, and Theory

- **Politics**
  - The process of bargaining, negotiation, and *compromise* that determines who gets what, when, and how

- **Policy**
  - Commitment to a particular course of action
Science

- Most reliable understanding of the natural world
- Best possible basis for public policy on subjects involving the natural world
- Can tell us if a problem is real or not
- Often also finds problems that need to be addressed
Science and Policy – Early History

- Early federally sponsored scientific research
  - Smithsonian Institution, the U.S. Geological Survey, Agricultural experiment Stations

- Scientists at research universities involved in advanced scientific research
  - Private donors, philanthropic foundations, state legislatures, and student tuitions

- Between WWI and WWII, *skepticism* and even *antagonism* towards the idea of Federal Funding of research
World War II

- A war of science and technology
- Effectiveness of the alliance between science and government transformed the two
- Vannevar Bush was tasked by President Roosevelt to see how this wartime relationship could be utilized in peacetime
Science – The Endless Frontier

- Intellectual road map
  - Focused on science
  - In balance with the humanities, social sciences, etc.

- Policy model for knowledge creation and application
Science – The Endless Frontier

- Posits two points
  - Basic science is performed without thought of practical use
  - Basic research discoveries will be converted via technology transfer to technological innovation
- New paradigm for relationship between basic science, technological innovation, and enterprise creation
  - Linear Model
Linear Model

Federal Government Funders Performers Legislation

Federal Investment

Research & Development

Intellectual Property

Prototype

Product

Commercialization

Private Sector Inventors Entrepreneurs Venture Capitalists Industry Consumers

Valley of Death

Importance of Basic Research

A nation which depends upon others for its new basic scientific knowledge will be slow in its industrial progress and weak in its competitive position in world trade, regardless of its mechanical skill.

Vannevar Bush

Basic research is essentially non-commercial
Funding in Response

- Cold War Funding
  - Support for research for defense, space, nuclear and particle physics with support for the education of students
- Great Society
  - Social priorities and public-sector needs, research for social and behavioral sciences
- National Economic Competitiveness
  - Global concerns with regards to engineering and manufacturing
- Recent Paradigm Shift
  - Greater public accountability, Less discretionary funding, and *Narrower focus on short-term outcomes*
Science and Policy

- Scientists are being asked by policy makers
  - To contribute more directly to the needs of society
  - To evaluate problems as to their reality
  - To help differentiate and/or evaluate policy alternatives
Science’s 5 Tasks for Policy

- Identify Problems
- Measure their magnitude and seriousness
- Review alternative policy interventions
- Systematically Assess Consequences of policy actions
  - Intended and Unintended Consequences
- Evaluate what in fact results from policy
Science Faces Many challenges

- **External**
  - Questions of
    - Junk Science, Settled Science, and Sound Science
    - “Scientists” or “Non-scientists” expounding
  - Questioning of the Scientific Method
  - Distortion of the scientific enterprise
    - Due to ignorance
    - Deliberately
  - Rejection of Science
Science Faces Many challenges

- **Internal**
  - Embellishment
    - Over promising results
    - Outlandish statements
  - Over Eagerness
    - Quick dissemination of results that challenge previous understanding
  - Rejection of science in favor of bias, political or otherwise
    - Debate is then really political in the guise of science
Science as Political Battlefield

- When debate is played out in popular media and on the Internet rather in technical journals, this implies that it is not a battle over findings, etc. but a battle over who should have authority and power to decide

- The debate is then about politics and not policy
Linear Relationship between Science and Policy

- Scientific facts should be first established
- This will then lead to policy response
  - Science dictates which policies make sense and which do not
  - But are all inputs properly taken into account
- Reality is different
- Linear model cannot correctly explain the relationship between science and policy
  - Continuing to follow the linear model, brings politics into science rather than science into politics
Politics and Policy

- The politicization of science by scientists
  - Puts at risk the positive contributions science offers to politics and policy
  - Presents a threat to the institution of science and democracy

- Science, politics and policy are inextricably intertwined
Policy and Science

- Science has often been used as a basis for competing political or moral claims
  - Science offers advice as to choices

- In policy decisions, *values* always come into play
  - *How do you put values into an equation?*
    - Lee Riedinger

- Care must always be taken not to dismiss the concerns and values of others

- No policy discussion is ever purely scientific
Various Roles for Scientists

- Roger A. Pielke, Jr., in his book “The Honest Broker,” classifies scientists into four *ideal* categories:

  - **Pure Scientist** - No Interest in Decision-Making, Only shares information
  - **Science Arbiter** - Resource for Decision-Maker, answering factual questions
  - **Issue Advocate** - Tries to limit the choices for the Decision-Maker
  - **Honest Broker** - Tries to expand the choices for the Decision-Maker
How roles correlate

- **Pure Scientist and Science Arbiter**
  - Not concerned with a specific decision
  - Information sources

- **Issue Advocate and Honest Broker**
  - Explicit engagement of decision alternatives
  - You cannot be both at the same time
Pure Scientist - Beware

- Provides guidelines
  - Guidelines may seem to provide objective science
  - *Guidelines may have come from previous decisions that were in fact influenced*
- There may be alternative guidelines
- Which guidelines you use or share are a *value* decision
Beware of Role Choice

- Claiming to focus only on the science
  - Can easily become a "Stealth Issue Advocate"
- Scientists can no longer remain above the fray
- Scientists have to choose a role!
- But
  - An attempt by the scientist to simultaneously be a science information provider and a position advocate is an inherent conflict of interest
Intertwined Roles

- **Science Affects Policy**
  - Science and politics have become inseparable
    - Funding and regulation policies
- **Policy Affects Science**
  - Politicians often intervene in the practice of science
# The Relationship Between Science and Technology and Policymaking

<table>
<thead>
<tr>
<th>Science</th>
<th>Policy for Science</th>
<th>Science for Policy</th>
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<tbody>
<tr>
<td>e.g., Should the U.S. federal government support embryonic stem cell research?</td>
<td></td>
<td>e.g., Should the United States take action on climate change?</td>
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<td>e.g., Should the emerging field of nanotechnology be supported and regulated?</td>
<td></td>
<td>e.g., Should policy actions be taken to enhance the implementation of new vehicle technologies that might reduce the nation’s fossil fuel consumption?</td>
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</tbody>
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**Source:** Congressional Research Service Report RL34454.
Can science compel action?

- It is rare that science can compel action
- Situations are often accompanied by uncertainty
- More than one outcome can be consistent with the current situation
- Information at hand may be insufficient to reduce uncertainty
The sole purpose of decision-making is to reduce uncertainty about the future in a preferred direction.

Multitude of interests and perspectives:
- Rarely consensus on desired outcomes and the means to achieve those outcomes is obtained.

When there is conflict in the decision making process, the political process must be engaged:
- Policy-making has politics.
- Policy and politics are not one and the same.
What is Uncertainty

- Usual scientific definition of uncertainty
  - Uncertainty is quantified and reduced through knowledge
  - Science tries to advance knowledge thereby reducing uncertainty

- For a particular situation, more than one outcome is consistent with expectations
- Decisions must necessarily be made under conditions of uncertainty
- Often there are calls for more study or data to reduce uncertainty
Uncertainty is an issue for policy and politics

How we frame the uncertainty is extremely important

In pursuit of desired outcomes through policies, different peoples and groups seek to shape perceptions of uncertainty in ways that lend advantage to their perspectives

Struggles over scientific uncertainty can easily become very political
The search for certainty reduces us to dealing with emergencies, not preventing them

Henry Kissinger
Subjective and Objective Uncertainty

- **Subjective Uncertainty**
  - Refers to our judgments about how to characterize the entire set of outcomes associated with a particular set of expectations.

- **Objective Uncertainty**
  - Refers to a complete and accurate characterization of the entire set of outcomes associated with a particular set of expectations.
Science and Risk Assessment

- Risk assessment is the process for examining the links between risks and potential harms.

- Assertions of risk do not have to withstand tests.

  - "Just because we don’t have the evidence doesn’t mean there are no effects.”

- Once an agency or politician accepts an assertion, the agency or politician can demand evidence to set the assertion aside, no matter how flimsy the evidence for it.
Consensus Science

- Some risks are politically important and have uncertain science
- Committees are then formed to generate a consensus report
- Provides only an illusion of certainty
Precautionary Principle

- Instead of Consensus Panels some suggest as an alternative the *Precautionary Principle*
- Varies from weak to very strong
  - Weak would result in few changes from current practices
  - Strong would toss science aside and require regulation whenever there is a possible risk even if the evidence is speculative or even if the costs would be high
What to Do?

- Good policy cannot be derived by skipping over the fact that we live in a world of trade-offs and that actions have consequences.

- Far better to emphasize science in the risk assessment process and to examine the process and evaluate how well it works than to chase after lofty aspirations embodied in a principle without definition.
If you are going to be an academic who is involved in the world of policy, you have to be involved in the world that exists.

Austan Goolsbee
Economic Advisor to President Obama

You cannot make policy as if you were living in a theoretical model!

Unknown

If you are among the uneducated, it is hard for others to try to set things straight without their appearing “elite.” That is a painstakingly difficult art that scientists will need to master.

Unknown
BACKUP SLIDES
Revised Dynamic Model

- Improved Understanding
  - Pure Basic Research
  - Existing Understanding

- Improved Technology
  - Use-Inspired Basic Research
  - Purely Applied Research and Development
  - Existing Technology

Donald E. Stokes, *Pasteur’s Quadrant: Basic Science and Technological Innovation*
Who Makes Science Policy

Science & Technology Policy Decision-making

- Congress
- White House
- Judiciary
- Academic Organizations
- Trade Associations
- Advocacy Groups
- Disciplinary Societies
- Professional Organizations
- FFRDCs
- Press
- International S&T Organizations
- Federal Advisory Committees
- Individual Opinion Leaders
- Federal Organizations
- S&T Presidential Appointees
Congressional Committees

House of Representatives
- Agriculture
- Appropriations
- Armed Services
- Budget
- Education and the Workforce
- Energy and Commerce
- Ethics
- Financial Services
- Foreign Affairs
- Homeland Security
- House Administration
- Intelligence (Permanent Select)
- Judiciary
- Natural Resources
- Oversight and Government Reform
- Rules
- Science, Space, and Technology
- Small Business
- Transportation and Infrastructure
- Veterans' Affairs
- Ways and Means
- (Whole)

Senate
- Aging (Special)
- Agriculture, Nutrition and Forestry
- Appropriations
- Armed Services
- Banking, Housing, and Urban Affairs
- Budget
- Commerce, Science and Transportation
- Energy and Natural Resources
- Ethics (Select)
- Environment and Public Works
- Finance
- Foreign Relations
- Health, Education, Labor, and Pensions
- Homeland Security and Governmental Affairs
- Indian Affairs
- Intelligence (Select)
- Judiciary
- Rules and Administration
- Small Business and Entrepreneurship
- Veterans' Affairs

Joint
- (Conference)
- Economic
- Library
- Printing
- Taxation

(click here for complete list with subcommittees)
HOW A BILL BECOMES A LAW

Speaker of House receives bill
  ↓
  Committee*
  ↓
  Subcommittee*
  ↓
  Hearings Committee markup*†
  ↓
  Rules Committee*
  ↓
  House floor*†
  ↓
  House amends Senate bill
  ↓
  House floor
  ↓
  Conference committee*
  ↓
  Conference report*†
  ↓
  House approves Senate amendment
  ↓
  White House‡
  ↓
  Veto
  ↓
  House and Senate floor*
  ↓
  Veto override
  ↓
  Law

President of Senate receives bill
  ↓
  Committee*
  ↓
  Subcommittee*
  ↓
  Hearings Committee markup*†
  ↓
  Majority Leader*
  ↓
  Senate floor*†
  ↓
  Senate amends House bill
  ↓
  Senate floor
  ↓
  Conference committee*
  ↓
  Conference report*†
  ↓
  Adoption by both houses
  ↓
  Senate approves House amendment
  ↓
  White House‡
  ↓
  Approve

*Points at which a bill can be amended.
†Points at which a bill can die.
‡If the president neither signs nor vetoes a bill within ten days, it automatically becomes law.

See also http://www.votesmart.org/resource_govt101_02.php
Science and the Public Welfare

- National Security
- Science and Jobs
- The Importance of Basic Research
- Centers of Basic Research
- Research within the Government
- Industrial Research
- International Exchange of Scientific Information
- The Special Need for Federal Support