U.S. Science & Technology Policy:
Challenges, Opportunities, & the Role of Academia

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Jerome B. Wiesner Symposium
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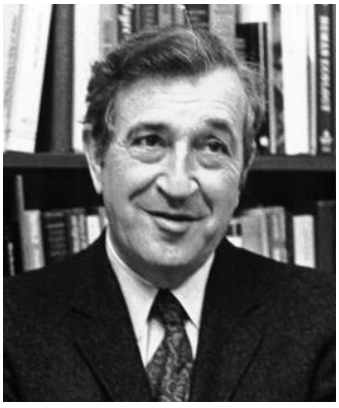
In memory of the incomparable Jerry Wiesner



Jerome B. Wiesner
1915-1994
U of Mich College of Engineering: BS 37, MS 38, PhD 50
Science Advisor to President John F. Kennedy
President of MIT
Mentor in science & technology policy to me & many more

Outline of the talk

- Roles and responsibilities for science & technology policy (STP) in the Federal government
- Current challenges and opportunities in U.S. STP
- Obama Administration actions and outlook
- The role of the academic community in STP
- University of Michigan leadership in this domain

Federal Government Roles and Responsibilities in STP

The role of S&T in national well-being

S&T are central to meeting key challenges of

- economic development & sustainable growth
- biomedicine & health-care delivery
- clean, safe, reliable, & affordable energy
- climate-change mitigation & adaptation
- competing uses of land & water
- the health & productivity of the oceans
- national & homeland security

as well as lifting the human spirit through discovery, invention, & expanded understanding.

The role of the Federal government in STP

- Funding R&D
  - The Federal government pays for 30% of all R&D but for more than 50% of basic research.
  - Colleges & universities perform 55% of all basic research; the Feds pay for 62% of that.
- Shaping the environment for S&T and innovation
  - Tax policy, IPR policy, regulatory policy, & high-skills immigration policy, are all important.
  - So are gov't investments in S&T-relevant infrastructure: high-speed computing, broadband, space assets…

The role of the Federal gov't (continued)

- STEM education & workforce training
  - K-12 STEM-ed is part of the overall education responsi-bilities residing mainly with states & local school boards, but Federal programs & incentives play a role.
  - STEM education & training at the undergraduate, graduate, & postdoctoral levels are influenced by Federal grants, programs, & policies.
  - The Federal gov't can encourage & broker partnerships among colleges/universities, schools, and corporations to improve STEM-ed, worker training, lifelong learning.

Responsibilities for STP in the Federal gov't

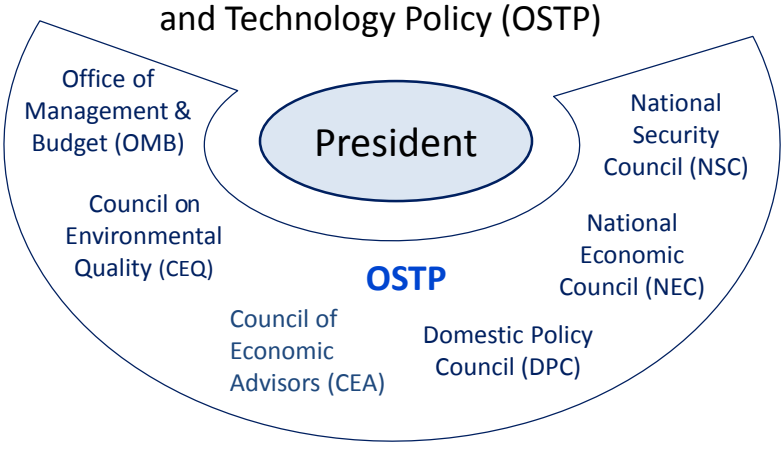
- Responsibility for STP is shared between the Congress and the Executive Branch.
- Key Congressional committees are House Science, Space, & Technology and Senate Commerce, Science, & Transportation, and of course the relevant appropriations committees & subcommittees.
- There's a long history of bipartisan agreement and cooperation on many S&T issues.

Key executive branch S&T actors

- Department of Defense, including DARPA
- Department of State
- Dept of HHS: National Institutes of Health, CDC
- Dept of Commerce: NOAA, NIST
- Dept of Interior: USGS
- Department of Energy, including ARPA-E
- Department of Agriculture: ARS, NIFA
- Department of Homeland Security
- National Science Foundation
- NASA
- Environmental Protection Agency

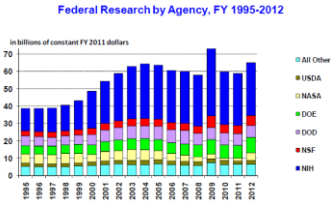
STP in the White House…

…is centered in the Office of Science and Technology Policy (OSTP)



EOP also includes Offices of: Vice President, Chief of Staff, Cabinet Affairs, Communications, Intergovernmental Relations, Public Engagement, Social Secretary, US Trade Representative, and more. The Office of Energy & Climate Change sits in DPC.

OSTP: two major responsibilities



1. Policy for science and technology

   Analysis, recommendations, & coordination with OMB and other White House offices on R&D budgets & related policies, S&T education & workforce issues, interagency S&T initiatives, open government, scientific integrity ...

2. Science and technology for policy

   Ensuring that the President and his other senior advisors have all the S&T information they may need relevant to the full range of policy issues on their plates.

OSTP's specific responsibilities also include…

- providing White House oversight for NSF and NASA;
- support of National Security & Emergency Preparedness Communications;
- coordinating & overseeing US cooperation in S&T with other countries
- chairing and managing the interagency National Science & Technology Council (NSTC);
- providing administrative and analytical support for the President's Council of Advisors on Science & Technology (PCAST).

OSTP-managed entities

- The NSTC…
  - comprises Deputy Secretaries & Agency Administrators from all Federal dep'ts & agencies with S&T responsibilities;
  - coordinates S&T activities that cross agency boundaries, including such major initiatives as the USGCRP, the National Nanotechnology Initiative, the Networking and Information Technology R&D program, & the STEM-Education Strategy.
- PCAST…
  - currently has 19 members, of whom 18, including one Co-Chair, are part-time, uncompensated Special Government Employees, appointed by the President;
  - provides an additional high-caliber source of S&T advice for the President and helps link OSTP to the outside S&T community.

The members of the 2nd-term Obama PCAST

Current Challenges and Opportunities in U.S. STP

Tough challenges and big opportunities

THE TOUGHEST CHALLENGES

- Sustaining & growing support for R&D under existing constraints on the Federal budget
- Advancing an adequate energy-climate policy
- Reconciling Administration & Congressional priorities for NASA with each other and with budget realities
- Addressing systemic weaknesses in STEM-education

Challenges and opportunities (continued)

THE BIGGEST OPPORTUNITIES

- Harnessing the full potential of partnerships (local/ state/federal, public/private/academic/civil-society, international) to address the foregoing challenges.
- Creating & building businesses, jobs, economic growth, and societal well-being by facilitating the translation of discovery into application.
- Exploiting recent advances in biomedical sciences & "big data" to drastically improve healthcare.
- Applying current infotech & digital tech to improve the effectiveness & accessibility of government.

Obama Administration STP Actions and Outlook

What he's done to elevate S&T

Presidential appointments

- 5 Nobel Laureates in science
- another 25+ members of the NAS, NAE, and IOM
- first-ever CTO, CIO, CDS for the US government

Highlighting S&T and STEM-education in speeches

- Both inaugural addresses & every State of the Union
- Two addresses to annual meetings of the NAS
- Major speeches on space policy, advanced manufacturing, etc.

White House Events

- 5 White House Science Fairs + WH Astronomy Night for Kids
- Annual ceremonies for winners of Nat'l Medals of Science and of Technology & Innovation, plus for US Nobelists & Kavli winners
- Meet-and-greets for Intel finalists, astronauts, winners of Presidential awards for STEM teaching, STEM mentoring, early-career achievement in science and engineering.

Action on the budget challenge

- Huge boost (>$100B) for S&T in the Recovery Act.
- S&T investment goals: make the Research & Experimentation Tax Credit permanent; help lift public + private investment in R&D to ≥ 3% of GDP.
- The President's 2010 Budget put us on track to meet the goals, and FY2011 would have continued the trend.
- There were setbacks in 2011-2015 appropriations because of Budget Control Act spending caps.
- Despite setbacks, S&T has fared better in 2011-2015 appropriations than most other sectors.

Action on the budget challenge (continued)

Budget authority in billions of current dollars	FY14 actual	FY15 actual	FY16 POTUS	Change FY15-16
Total R&D	136.3	138.1	145.7	5.5%
defense	*71.0*	*72.2*	*76.9*	*6.5%*
nondefense	*65.4*	*65.8*	*68.8*	*4.5%*
Research	64.7	64.8	66.9	3.2%
defense	*9.8*	*10.0*	*9.8*	*-2.1%*
nondefense	*54.9*	*54.8*	*57.1*	*4.1%*
Development	69.0	70.7	76.0	7.5%
defense	*60.8*	*62.0*	*66.7*	*7.6%*
nondefense	*8.2*	*8.7*	*9.3*	*6.7%*

Action on the budget challenge (continued)

Highlights of the FY16 Obama Budget: departments & agencies

- $12.6 billion at DOE (+7.3%)
- $6.3 billion at NSF (+5.2%)
- $924 million at NOAA (+31.8%)
- $887 million at NIST (+32.8%)
- $761 million at USGS (+14.4%)

More highlights: cross-cutting initiatives

- $2.9 billion for Networking and Infotech R&D (+2.7%)
- $2.7 billion for the USGCRP (+9.1%)

(Increases are relative to FY2015 appropriation)

Action on the energy-climate challenge

- $80 billion for clean & efficient energy in the Recovery Act
- funding for Advanced Research Projects Agency – Energy (ARPA-E) and six new Energy Innovation Hubs
- first-ever fuel-economy/CO_2 tailpipe standards for light-duty vehicles, plus fuel-economy standards for trucks
- re-invigoration of US Global Change Research Program
- sustained budget increases for clean-energy & energy-efficiency R&D
- Quadrennial Technology Review QTR (2011, 2015) and Quadrennial Energy Review (phase 1 2014-15)
- Climate Action Plan (June 2013 to present)

The President's Climate Action Plan

- Cutting carbon pollution in America

  cutting CO_2 from power plants; promoting renewable energy & other cleaner energy options; increasing fuel-economy standards; cutting energy waste in buildings & industry; reducing emissions of HFCs and methane; managing forests for C sequestration

- Preparing the USA for the impacts of climate change

  directing agencies to support climate-resilient investment; establishing national task force on climate preparedness; managing flood, drought, & wildfire risks; mobilizing science & data for climate resilience

- Leading international efforts on global climate change

  enhancing bilateral & multilateral engagement on mitigation & adaptation; mobilizing clean-energy & preparedness finance

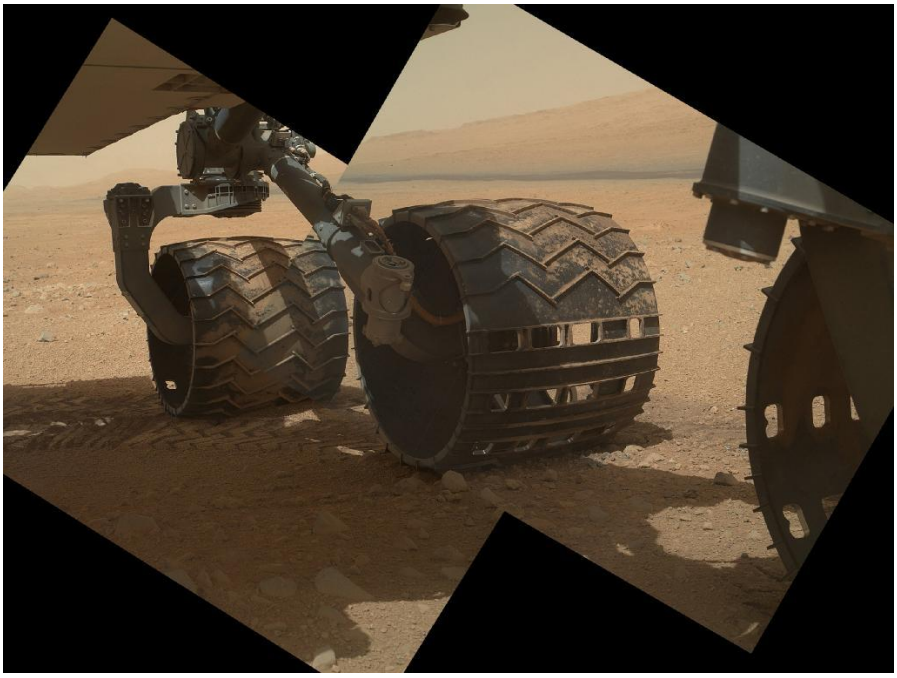
Action on the NASA challenge

- The NASA President Obama inherited
  - "Constellation" human-exploration program hopelessly behind schedule & over budget
  - NASA science, technology, robotic missions, telescopes, Earth observation, aeronautics, and the ISS all imperiled by Constellation's overruns
- The President's re-balanced space policy
  - "Constellation" slimmed down & retargeted, emphasizing visits to a near-Earth asteroid and Mars
  - commercial crew/cargo encouraged for low Earth obit
  - ISS operation extended to 2020 or beyond
  - support for neglected/imperiled programs restored

SpaceX Corporation's Dragon capsule docks w the ISS, May 2012

Science in NASA under President Obama

- NASA under Obama will have spent >$100B through FY14, nearly $30B of it for cutting-edge science
- This funding has
  - launched a mission to Jupiter
  - landed a fourth rover on Mars
  - continued 14 planetary missions (Mercury, Saturn, more)
  - operated 19 missions to study Sun and its effects on Earth
  - maintained 21 astrophysics missions
- FY14 saw an unprecedented 5 Earth Science missions
- Exoplanet search to continue w new mission in 2017
- James Webb Space Telescope is on track for 2018



Curiosity on the Martian surface (self-portrait)

Action on the STEM-education challenge

- Built "all hands on deck" effort that includes business, non-profits, foundations: Launched *Educate to Innovate* in 2009, now with >$1 billion in business & philanthropic commitments toward improving K-12 STEM education.
- Deployed President's personal passion for STEM: Hosted the first-ever White House Science Fairs (5 so far), to celebrate students winners of math, science, and robotics competitions just as we celebrate sports champions. Hosted the first-ever Maker Faire to get more kids and adults making things, not just consuming things.

Action on STEM education (continued)

- Institutionalized cross-agency efforts: Mobilized Federal agencies to work together to produce and now implement the STEM Education 5-Year Strategic Plan (agencies include USDA, Commerce, DOD, Education, DOE, HHS, Interior, DOT, EPA, NASA, NSF, Smithsonian Institution).
- Focused on inclusion of under-represented groups: Worked with White House Council on Women and Girls, Domestic Policy Council, My Brother's Keeper Initiative, & numerous minority-serving institutions on inspiration, preparation, opportunity, support.

Action on the partnership opportunity

- Startup America (launched2011)bolsters entrepreneur-ship by increasing success of high-growth startups that create economic growth and quality jobs
  - creates new opportunities for small business financing and improves regulatory environment for starting and growing new businesses
  - spawned the nonprofit Startup America Partnership, whose private-sector CEOs have raised $1B to help startups
- Jumpstart Our Business Startups (JOBS) Act — signed Spring 2012 — allows crowdfunding, expands mini-public offerings, creates "IPO on-ramp".
- DOE's energy-innovation hubs link national labs, universities, and industry.

Action on partnerships (continued)

- The Wireless Innovation and Infrastructure Initiative (Wi3) is an ambitious blueprint to connect 98 percent of the US population with 4G wireless.
- The Advanced Manufacturing Partnership, linking research universities, high-tech companies, and the Federal government, is investing in emerging tech-nologies to create high-quality manufacturing jobs. The President's National Robotics Initiative and Materials Genome Initiative reinforce this goal.
- NSF's new Innovation Corps is getting scientists out of the lab to start new companies.

Action on the biomedical opportunity

COMBATTING ANTIBIOTIC-RESISTANT BACTERIA (CARB)

- PCAST Report, Executive Order, and Strategic Plan (2014)
- Goals of National Action Plan (released last week):
  - Slow emergence and spread of resistant bacteria
  - Strengthen national One-Health surveillance
  - Expand research on diagnostics, antibiotics, new therapeutics, and vaccines and accelerate their implementation
  - Improve international collaboration and capacity for prevention, surveillance, management, and research on antibiotic resistance
- The President's FY16 budget proposes doubling support for antibiotic-resistance research and management to $1.2 billion

Action on biomedicine (continued)

PRECISION MEDICINE -- An approach to medical care that uses big data to account for individuals' characteristics in treatment

- **Cancer genomics** – advance basic science, diagnostics, and treatment (particularly pediatric cancers); $70 million in FY16 budget
- **National Cohort** – 1 million volunteers whose health records, genome sequences, microbiome profiles, and other relevant data will be analyzed to predict each person's health trajectory, disease, treatment, and responses to drugs; $130 million in FY16 budget
- **Reimbursement** – redesign to reinforce value, not volume; $5 million in FY16 budget
- **Regulation** – should enable innovation while protecting public safety; $10 million in FY16 budget

Summary of Effort

A 21st Century **Grand Challenge** designed to revolutionize our understanding of the human brain

Supports development and application of **new technologies** that can create a dynamic understanding of **brain function**

Ultimately aims to generate new ways to prevent, treat, and **cure brain disorders**, such as Alzheimer's, epilepsy, and traumatic brain injury

NIH, DARPA, NSF, and **FDA** will support approximately **$100 million** in research and related activities in FY 2014

Private-sector commitments from Kavli Foundation, Allen Institute for Brain Science, and HHMI

Agency Accomplishments

NIH
- Priority research topics identified by an NIH working group composed of leading neuroscientists
- Released $40 million in new solicitations

DARPA
- Supporting development of technologies to improve treatment of neuropsychological illness for veterans/service members
- New program on how neural stimulation could enable recovery of memory following brain injury

NSF
- Supporting the effort across a broad range of scientific disciplines, from psychology through engineering
- Awarded $25 million to MIT's Center for Brains, Minds and Machines

FDA
- Working with medical device developers on how to bring safe and effective technologies to market

Going Forward

Federal investments to increase to around **$200 million** in the proposed FY 2015 budget

White House event this summer to recognize "all hands on deck" commitments, such as:
- Research and shared facilities at universities and private research institutes
- Efforts by patient advocacy organizations to accelerate the development of diagnostics, treatments and cures
- IT infrastructure to store, share, visualize, and analyze the huge volumes of data that will be generated by the BRAIN Initiative
- Pre-competitive collaborations involving industry
- Education and training programs
- Regional "clusters" to accelerate economic growth, job creation, and innovation in commercial neurotechnology domains
- Well-designed incentive prizes

Action on the tech-for-gov't opportunity

- Presidential Innovation Fellows: cohorts of 18-36 high-tech superstars come to DC for 6-12 months to work in teams on IT-linked innovation challenges
- Data.gov: making gov't datasets (100,000+) available in support of innovation, entrepreneurship
- Data-driven culture in government: with key data-savvy personnel at departments & agencies--NIH, Dep'ts of Energy, Commerce, Treasury, Transportation…
- Dashboards to monitor progress on major Federal IT investments (for the first time in government)

The continuing challenges ahead

- Sustaining support for S&T under budget cuts

  Particularly difficult will be sustaining support for…

  – NSF (basic research, social science)
  – NASA (advanced technology, Earth observation)
  – NOAA (polar-orbiting satellites, climate research)
  – DOE (big science projects, CO_2 capture, fusion)
  – USDA (peer-reviewed agricultural science)
  – EPA & FDA (regulatory science)
  – USGCRP (climate science, sustainability science)
  – international cooperation in S&T

  NIH funding is less contentious politically but still hard to increase in percentage terms because it's already so large.

Continuing challenges (continued)

- Implementing the President's climate policy
  - in the face of Congressional challenges to executive actions and unwillingness to provide legislated alternatives
- Addressing systemic weaknesses in STEM-ed
  - weak teacher competence in K-12, inertia w respect to adopting more effective methods at college level
- Getting key messages across to the public
  - why science & engineering matter (to economy, health, environment, security), how science works, why climate change & evolution are not "matters of opinion"

The Role of the Academic Community in U.S STP

The role of academia

TEACHING

- Deploy evidence-based improvements in how STEM courses are taught at the undergraduate level.
- Get undergraduates into research labs.
- Strengthen the preparation of K-12 STEM teachers through collaboration of ed schools with STEM departments.
- Expose STEM students & postdocs to STP issues and to the option of K-12 STEM-teaching careers.
- Engage in public-private-academic-philanthropic partnerships to inspire, engage, recruit, & support more kids in STEM, including girls and minorities historically under-represented in STEM.

The role of academia (continued)

RESEARCH

- Continue to recruit and support the people, provide the facilities, and sustain the policies that have made universities the mainstay of U.S. basic and early-stage applied research.
- Make room for interdisciplinary and policy-relevant research as additions to the university's portfolio.
- Provide STEM PhD students & postdocs with an introduction to translating discovery into application in society.
- Partner with business where appropriate to leverage resources and exploit S&T advances for societal gain.

The role of academia (continued)

PUBLIC SERVICE

- Encourage & support faculty forays into STP positions in government via sabbaticals, IPAs, fellowships; and exploit the experiences of the returnees. in classes, seminars, symposia to interest others in STP.
- Create workshops and seminars for your Congressional delegation to acquaint them with the relevance of S&T (including *your* S&T) to society's interests.
- Conduct adult-education and public-outreach activities aimed at improving S&T literacy of decision-makers & the public, as a basis for more informed engagement with STP issues.
- Advocate for S&T and sensible S&T policies.

University of Michigan

Leadership in this Domain

U of Michigan leadership

- The Undergraduate Research Opportunity Program (UROP) has been engaging 1st & 2nd year students in research for over 20 years. UROP's Changing Gears Program connects community-college transfers with hands-on experiences in U-M research projects.
- The University's Women in Science and Engineering Program includes programs for grades 6-12 and for undergraduate & graduate women, aiming to increase numbers and success of women in STEM.
- The U-M Business Engagement Center builds relationships between industry and U-M faculty and students.

U-M leadership (continued)

- The Office of Technology Transfer facilitates commercial-ization of discoveries in U-M labs.
- The Lurie Nanofabrication Facility provides access to advanced nanofabrication equipment to students & researchers at U-M, other academic institutions, national labs, and industry.
- U-M is one of the founding partners of the American Lightweight Materials Manufacturing Institute, a Detroit-based part of the Obama-launched National Network for Manufacturing Innovation.
- The U-M Mobility Transformation Center is a public & private R&D partnership on mobility of people & freight.

U-M Leadership (continued)

U-M Faculty Currently Serving in the Administration

Betsey Ayer Stevenson
Associate Professor of Public Policy at the Ford School, has an appointment to the Council of Economic Advisors

Steven Croley
Harry Burns Hutchins Collegiate Professor of Law at the Law School, serves as the General Counsel at the Dept. of Energy

U-M Leadership (continued)

U-M Faculty Currently Serving in the Administration

Rosina M Bierbaum
Professor and Dean, SNRE, Member of President Obama's Council of Advisors on Science and Technology, Former OSTP Associate Director for Environment, Former Acting Director of OSTP

Francine Lafontaine
Davidson Professor of Business Economics and Public Policy at the Ross School, serves as the Director of the Bureau of Economics at the Federal Trade Commission

Thanks, Wolverines!

http://www.ostp.gov