

## Science and Engineering for the Public Good: Priorities, Policies, and Partnerships in the Obama Administration

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Director, White House Office of Science and Technology Policy



**The Herbert York Memorial Lecture**  
University of California, San Diego  
La Jolla • February 29, 2016

### Coverage of these remarks

- Celebrating Herb York & other giants in the field of science & engineering for the public good (SEPG)
- An introduction to SEPG policy in the Obama Administration: people, process, and priorities
- Some Obama SEPG initiatives for
  - the economy
  - public health
  - the environment
  - national & homeland security; international relations
  - STEM education
- The President's Climate Action Plan: A case study
- Challenges and opportunities on the path ahead



**Herbert F. York, 1921-2009**

- ❖ Founding Director of the Livermore Lab (at age 30!)
- ❖ 1<sup>st</sup> Director of DoD Defense Research & Engineering (at 36!)
  - ❖ Founding Chancellor of UC San Diego (at 39!)
- ❖ President Carter's Ambassador to the CTBT Negotiations
  - ❖ Mentor in Armc Cto Many (including me)

I had the good fortune to work with and learn from a number of other late great figures in the domain of SEPG.



**Harrison Brown**



**George Kistiakowsky**



**Roger Revelle**



**Jerry Wiesner**



**Pief Panofsky**



**Paul Doty**



**Chuck Vest**



**Jack Gibbons**

A number of other giants in this domain from whom I've learned much remain friends & advisors.



Dick Garwin



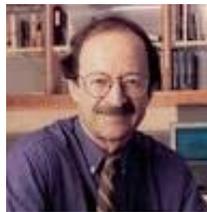
Neal Lane



Paul Ehrlich



Norm Augustine



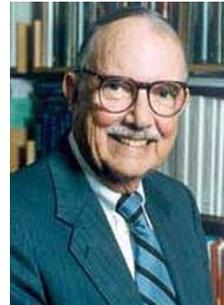
Harold Varmus



Jose Goldemberg



Evgeny Velikhov



Lew Branscomb

Following those rogues' galleries, I hasten to add I've worked with many great women in this field!



Marcia McNutt



Shirley Malcom



Kathy Sullivan



Shirley Ann Jackson



Sally Jewell



Gina McCarthy



Jo Handelsman



Megan Smith



Jane Lubchenco



Peggy Hamburg



Amy Gutmann



France Cordova

## SEPG in the Obama Administration

**“We will restore science to its rightful place...”**

Barack Obama, January 20, 2009



### What he's done to keep the pledge

#### Presidential appointments

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

#### Highlighting SEPG 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.

#### Using the White House venue to celebrate SEPG

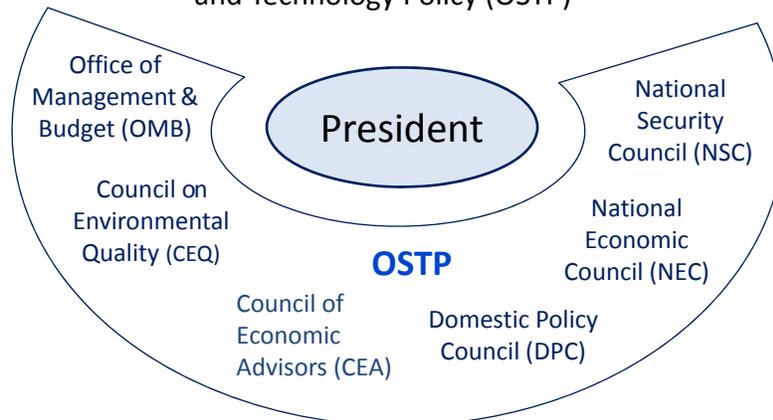
- 5 White House Science Fairs + 2 WH Astronomy Nights for Kids
- Annual ceremonies for winners of Nat'l Medals of Science and of Technology & Innovation, plus for US Nobelists & Kavli winners
- Meet-and-greets for Intel finalists, astronauts, winners of Presidential awards for STEM teaching, STEM mentoring, early-career achievement in science and engineering.

## What he's done... (continued)

- Rebuilt White House S&T leadership
  - Restoring the dual-hat of the OSTP Director as Assistant to the President for S&T
  - Restoring Environment and National Security & International Affairs as two of OSTP's four division, headed by Senate-confirmed Associate Directors
  - Tripling OSTP staff from the previous Administration
- Revitalized NSTC and PCAST
- Protected S&T budgets despite tight constraints
- Launched an unprecedented number of imaginative SEPG initiatives

## The place of science in the White House...

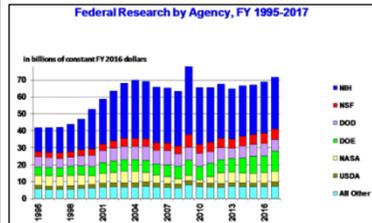
...is centered in the Office of Science and Technology Policy (OSTP)



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's two sets of responsibilities

### 1. Policy for science and technology



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



### 2. Science and technology for policy

Independent advice for the President and his other senior advisors about S&T germane to all policy issues on their plates

## OSTP's specific responsibilities also include...

- providing White House oversight for NSF and NASA
- chairing and managing...
  - the National Science & Technology Council (NSTC)
  - the Arctic Executive Steering Committee (AESC)
- co-chairing and helping manage..
  - the President's Council of Advisors on S&T (PCAST)
  - the National Ocean Council
  - the Council on Climate Resilience
- supporting National Security and Emergency Preparedness Communications
- coordinating & overseeing US cooperation in S&T with other countries

### **The National Science & Technology Council (NSTC)**

- Chaired by OSTP, includes Deputy secretaries & under-secretaries of cabinet depts w S&T missions & heads of NSF, NIH, NASA, NOAA, NIST, EPA, USGS, CDC
- Five standing committees: Science; Technology; Environment, Natural Resources, and Sustainability; National and Homeland Security; and STEM education
- Coordinates S&T activities that cross agency boundaries, incl US Global Change Research Program, National Climate Assessment, National Nanotechnology Initiative, and Networking and Information Technology R&D Program
- Obama's NSTC has produced 75+ reports for him and for the Congress.

### **President's Council of Advisors on S&T (PCAST)**

- A PCAST or its equivalent has existed under every U.S. President since Eisenhower.
- Currently 19 members: the Ass't to the President for S&T plus 18 part-time, uncompensated Special Government Employees appointed by the President.
- PCAST's function is to provide an additional high-caliber source of S&T advice for the President and to help link OSTP to the outside S&T community.
- Administrative support for PCAST is provided by an Executive Director and two deputies housed in OSTP.
- Obama's PCAST has produced 30 reports for him.

## The members of the 2<sup>nd</sup>-term Obama PCAST



President Obama has embraced a large fraction of PCAST's recommendations.

## **The place of S&T on the national agenda**

S&T are central to meeting challenges of

- economic recovery & sustainable growth
- biomedicine & health-care delivery
- clean, safe, reliable, & affordable energy
- climate-change mitigation & adaptation
- managing the Nation's land, water, and biota
- maintaining the health of the oceans
- ensuring national & homeland security
- improving the transparency, efficiency, and user-friendliness of government

## **Obama's strategy for getting it all done**

- Strengthen STEM education & worker training
  - pre-school to grad school to lifelong
  - inspiring, supporting, & mentoring more minorities, girls, & young women for success in STEM fields
- Invest in basic research and the institutions that do it...
  - because basic research is the "seed corn" on which future applied advances depend.
- Invest in the infrastructure that supports ST&I
  - broadband, wireless, high-capacity computing, space platforms, telescopes, accelerators...

## Middle-school “mathletes” in the Oval Office



### Obama's strategy (continued)

- Create an innovation-friendly policy environment
  - tax incentives, access to capital, open markets, intellectual property rights, immigration policy
- Prioritize within goals, not among them
  - e.g., don't prioritize economy over environment, or vice versa; instead focus on the highest-leverage opportunities within each and look for "win-wins" that serve multiple goals
- Exploit the potential of partnerships
  - across branches & levels of government; across the public, private, academic, and civil-society sectors; and across nations.

## The President on Partnerships



“The challenges we face today – from saving our planet to ending poverty – are simply too big for government to solve alone. We need **all hands on deck.**”

### Obama's SEPG Initiatives

#### **S&E for economic prosperity**

- The Recovery Act (2009) helped start & grow clean-energy businesses across the country.
- The American Innovation Strategy (2009, 2011, 2015)
  - invest in the foundations of strength in S&E
  - promote market-based innovation
  - catalyze breakthroughs for national priorities (e.g., clean energy, advanced manufacturing, biotech)
  - increase support for: early career scientists & engineers; multidisciplinary & high-risk research; commercializing university research; and attracting more women/girls & under-represented minorities to STEM careers

## Obama's SEPG Initiatives

**S&E for economic prosperity** (continued)

- Data.gov (2009) has made 175,000+ gov't datasets available for innovation and entrepreneurship
- The Small Business Lending Act (2010) increased loans & cuts taxes for entrepreneurs.
- NSF's Innovation Corps (2011) trains S&E doctoral students & postdocs in entrepreneurship (replicated at NIH in 2015)
- The America Competes Reauthorization Act (2011) boosted gov'ts innovation capacity in many ways, incl giving innovation-prize authority to all agencies.

**Challenge.gov** 300+ Prize Competitions, 50+ Agencies  
Government Challenges, Your Solutions

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Scientific/Engineering All Agencies Search

**NIH** Design by Undergraduate Biomedical Teams (DEBUT) 2014 Challenge  
National Institute of Biomedical Imaging and Bioengineering  
FEATURED Posted by NIH  
NIH is challenging undergraduate student teams to develop technologies to address unmet needs in healthcare. Show more  
\$45,000 IN PRIZES  
OPENS ON JAN 27, 2014

**Sample Return Robot Challenge - 2014**  
NASA Centennial Challenge for an autonomous exploration robot  
FEATURED Posted by NASA  
\$1,495,000 IN PRIZES  
OPEN UNTIL JAN 07, 2014

**Winner of the Harvard Ash Center  
"Innovations in American Government" Award**

## Obama's SEPG Initiatives

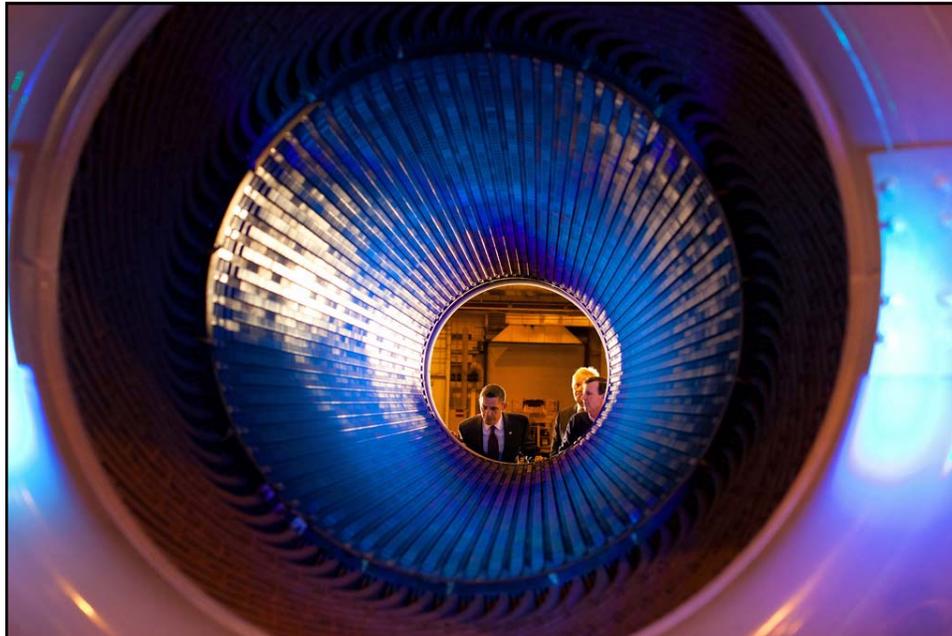
**S&E for economic prosperity** (continued)

- Startup America Initiative (2011) bolsters high-tech entrepreneurship by
  - accelerating transfer of new ideas from labs to market
  - creating new opportunities for small-business financing
  - improving regulatory environment for new businesses
- Jumpstart Our Business Startups (JOBS) Act (2012) allows crowdfunding, expands mini-public offerings, creates “IPO on-ramp”
- Big Data Initiative (2012) focuses on uses of large datasets for new insights and applications

## Obama's SEPG Initiatives

**S&E partnerships for prosperity**

- DOE’s energy-innovation hubs have linked national labs, universities, & industry to advance clean energy
- The government-industry Startup America Partnership has raised >\$1B in private funds to help startups
- The Advanced Manufacturing Partnership, linking research universities, high-tech companies, and the Federal government, is investing in emerging technologies to create high-quality manufacturing jobs.
- The National Robotics Initiative and Materials Genome Initiative are additional partnerships supporting the advanced-manufacturing effort.



President visiting GE Schenectady, 21 January 2011

#### Obama's SEPG Initiatives

### S&E for public health

- Neuroscience Initiative / BRAIN Initiative
  - Integrated neuroscience work at NIH, NSF, DARPA funded at >\$6 billion/yr. BRAIN (Brain Research through Advancing Innovative Neurotechnologies) component focuses on mapping brain function, has >\$400M in FY16.
- Combating Antibiotic-Resistant Bacteria (CARB)
  - PCAST Report, Executive Order, & Strategic Plan (2014)
  - National Action Plan (2015) to: slow emergence and spread of resistant bacteria; strengthen surveillance; accelerate development and implementation of new antibiotics, therapeutics, & vaccines; and improve international collaboration & capacity.
  - FY16 budget for CARB is \$1.0B, up from \$600M in FY15.

## Obama's SEPG Initiatives

**S&E for public health** (continued)

- Precision Medicine Initiative (PMI, 2015)
  - an approach to medical care combining genomics, EHR, and big data analytics to account for individuals' characteristics in prevention & treatment
  - ingredients include...
    - [cancer genomics](#) (basic science, diagnostics, & treatment; \$70M in FY16 budget);
    - [national cohort](#) (>1 million volunteers whose genomes, microbiome profiles, & health records will be mined to better prevent & treat disease; \$130M in FY16)
    - [reimbursement redesign](#) to prioritize value over volume (\$5M in FY16)

## Obama's SEPG Initiatives

**S&E for environment & energy**

- \$90 billion for clean & efficient energy in Recovery Act
- ARPA-E, initially funded in Recovery Act at \$200M/yr for FY09-10, has received a total of >\$1.5B through FY16.
- 1st-ever fuel-economy/CO<sub>2</sub> tailpipe standards for light-duty vehicles, plus fuel-economy standards for trucks & new appliance standards for residences and businesses
- 1<sup>st</sup>-ever DOE Quadrennial Energy-Technology reviews completed 2011 and 2015; 1<sup>st</sup>-ever interagency Quadrennial Energy Review first tranche in 2015
- first-ever National Oceans Policy (2010), implemented through interagency National Oceans Council in partnership w states, private sector, civil-society

## President Obama signing the National Oceans Policy Executive Order (19 July 2010)



### Obama's SEPG Initiatives

## The Sustainable Cities Initiative

### Creating a sustainable city

San Diego Supercomputing Center, Clean Tech San Diego, OSIssoft, and San Diego Gas & Electric



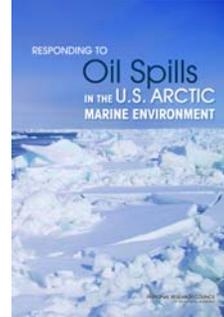
- Deploy a data infrastructure that connects physical systems (those managing **electricity, gas, water, waste, buildings, transportation and traffic**) in **San Diego**
- Aims to drive city-scale applications **that decrease electricity consumption and cost, discover and anticipate grid instabilities**, and educate the public
- Results will be published to **lead other communities on path to sustainability**



## Obama's SEPG Initiatives

**The Arctic Executive Steering Committee**

- **Helps shape & reconcile priorities**
- **Promotes coordinated implementation & evaluation**
- **Improves coherence of engagement with the State of Alaska and Alaska Native communities**
- **Support U.S. Chairmanship of the Arctic Council**



## Obama's SEPG Initiatives

**S&E for national & homeland security**

- Near-Earth Objects Strategy (2011-15): OSTP-led, multi-pronged upgrade of national efforts on detection, characterization, & deflection of NEOs on potential collision courses with Earth (links to NASA's Asteroid Redirect Mission)
- Space-Weather Initiative (2012-15): OSTP-led inter-agency program to upgrade understanding of and resilience against solar storms.
- Bio-defense Strategy (2010): OSTP co-leads with NSC Staff the components on biosurveillance and countermeasures.

## Obama's SEPG Initiatives

**S&E for natl & homeland security** (continued)

- Cybersecurity Initiative (2013-15): NSC-led, OSTP-supported comprehensive approach to upgrading cybersecurity (largely based on classified & unclassified PCAST reports). OSTP leads the R&D piece.
- National Strategic Computing Initiative (NSCI, 2015) >\$200M/yr gov't funds in OSTP-led public-private partnership to accelerate progress in high-capacity computing for science, economic competitiveness, and national security/intelligence.
- Strategic Plan for S&T for National Security (2016, currently in final review): OSTP-led strategy for attracting & retaining top talent, bolstering infrastructure, accelerating innovation

## Obama's SEPG Initiatives

**S&E for international relations**

- Reviving & strengthening the ministerial-level Joint Commissions on S&T cooperation with China, India, Brazil, Japan, S Korea, Russia
- Nurturing the strong S&T cooperation that has long existed with the EU, Canada, Australia, & NZ
- Streamlining the visa procedures for S&E visitors
- S&T as a new centerpiece of USAID strategy; White House / State Dep't Science Envoys
- Convening the Multilateral Economic Forum, US-China and US-India S&EDs, US China Dialogue on Innovation Policy, all with strong S&T focus

## Science Envoys: the 1<sup>st</sup> two cohorts

2009-10

**Bruce Alberts**  
Indonesia



**Elias Zerhouni**  
Morocco, Libya,  
Algeria, Tunisia,  
Qatar, Kuwait,  
Saudi Arabia



**Ahmed Zewail**  
Egypt, Turkey,  
Lebanon,  
Jordan



2011-12

**Rita Colwell**  
Bangladesh,  
Malaysia,  
Vietnam



**Gebisa Ejeta**  
South Africa,  
Tanzania,  
Kenya



**Alice Gast**  
Azerbaijan,  
Kazakhstan,  
Uzbekistan



[http://www.america.gov/science\\_envoys.html](http://www.america.gov/science_envoys.html)



#### Obama's SEPG Initiatives

### STEM education

- Educate to Innovate (2009): >\$750M in corporate & philanthropic resources to improve classroom experiences in K-12 STEM-ed
- Change the Equation (2010): >100 CEOs & full-time staff engaging to improve K-12 math-ed
- 100Kin10 (2011): >150 organizations & \$50M raised in pursuit of training 100,000 excellent new STEM teachers by 2021
- STEM Master Teacher Corps (2012): engages outstanding STEM teachers in training & mentoring colleagues (w \$20k/yr stipend for their trouble)

### Honoring outstanding STEM teachers



President Obama honoring educators who have shown excellence in teaching and mentoring students in mathematics and science at an awards ceremony at the White House, January 6, 2010.

Obama's SEPG Initiatives

### **STEM education** (continued)

- Undergraduate STEM-ed Initiative (2012): transform 1<sup>st</sup> two yrs of undergraduate STEM teaching to increase engagement & hands-on learning, aiming at 1,000,000 more STEM graduates over a decade.
- NSTC STEM-Ed Strategic Plan (2013-14): Coordination & focusing of 100+ Federal agency STEM-ed programs
- STEM Inclusion Initiative (2014): multiple partnerships to engage and support girls & minorities
- ConnectED (2015): \$2B from FCC, \$1B+ from private sector to provide broadband access & computers for classrooms

**Case study:  
How S&E shaped  
the President's  
Climate Action Plan**

## S&E underpinnings of the CAP

We know beyond reasonable doubt that:

- Earth's climate is changing at a pace and in a pattern not explainable by natural influences.
- The dominant cause of the changes is an increase in atmospheric concentrations of CO<sub>2</sub> and other heat-trapping gases caused primarily by fossil-fuel burning and land-use change.
- These changes are already causing harm to life, health, property, economies, and ecosystems.
- The harm will continue to grow for decades, because of momentum in the climate system and inertia in society's energy system.

## S&E underpinnings of the CAP (continued)

And we know that:

- The projected harm will be much smaller if we take prompt, strong evasive action than if we don't.
- Technologies already in the marketplace or within reach with modest increases in RD&D investments can drastically reduce the offending emissions at costs small compared to the damages from inaction.

## S&E underpinnings of the CAP (continued)

The key understandings from S&E provided:

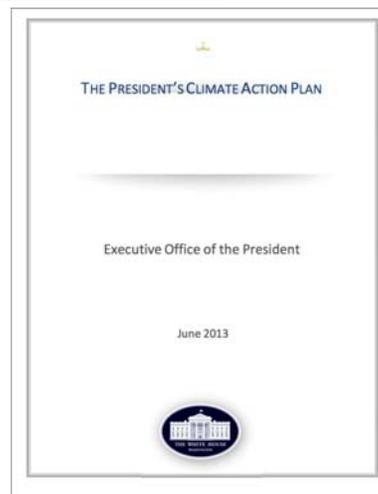
- the motivation for seeking to develop a cost-effective plan to reduce those impacts;
- the sense of urgency for doing so now rather than waiting;
- the awareness that such a plan must include both mitigation and adaptation;
- the knowledge of the sources of the offending emissions and the character of society's vulnerabilities to provide appropriate specificity in designing a plan; and
- the recognition that any U.S. plan must include a component designed to bring other countries along.

## Choosing action: President Obama's Plan



Georgetown University, June 2013

- Cutting carbon pollution in America (mitigation)
- Preparing the United States for the impacts of climate change (adaptation)
- Leading international efforts to address climate change



<http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>

### Principal ingredients of the CAP: Mitigation

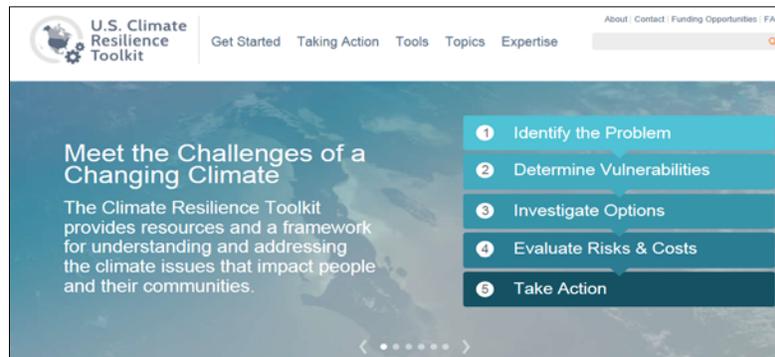
- Reducing carbon pollution from power plants
  - standards for cutting CO<sub>2</sub> from new power plants (Sept 2013) and from existing power plants (June 2014)
  - Clean Power Plan provides direction & flexibility for states to reduce emissions from power sector more than 30% by 2030
- Reducing other greenhouse gases
  - interagency strategy to reduce methane emissions (March 2014)
  - EPA proposal on hydrofluorocarbons (July 2014)
  - 2025 target to reduce methane emissions from the oil and gas sector by 40-45% from 2012 levels (January 2015)
- Accelerating U.S. leadership on clean energy
- Doubling down on energy end-use efficiency
- Building a 21<sup>st</sup>-century energy infrastructure

### Principal ingredients of the CAP: Adaptation

- Directing agencies to support climate preparedness/resilience
  - All agencies to develop & implement plans for integrating climate preparedness/resilience into their missions, policies, programs, investments, and grants. (Plans released 10-14.)
- Establishing internal & external task forces on resilience
  - Interagency Council on Climate-Change Preparedness & Resilience (~30 Federal agencies); established (11-13)
  - State, Local, & Tribal Leaders Task Force on Climate Preparedness & Resilience (26 elected officials from across the country; delivered recommendations to the Administration 11-14.)
- Managing flood, drought, and wildfire risks
  - Drought Resilience Partnership (11-13); USDA Agriculture Hubs (2-14); USDA/DOI Wildland Fire Strategy (4-14); HUD Urban Resilience Competition (6-14); Flood Risk Standard (1-15).

## Ingredients of the CAP: Adaptation (continued)

- Mobilizing science and data for climate resilience
  - Climate Data Initiative (03-14)
  - 3rd U.S. National Climate Assessment (05-14)
  - U.S. Climate Resilience Toolkit (11-14)



toolkit.climate.gov

## Ingredients of the CAP: International

- Enhancing bilateral engagement
  - U.S-China Joint Announcement in Nov. 2014 (with national targets, new joint research & demonstration projects)
  - Engagement with Mexico, Brazil, India, Indonesia to encourage their INDCs.
- Enhancing multilateral engagement
  - **G-20**: Agreement to phase out fossil-fuel subsidies and develop a methodology for a voluntary peer-review process (09-13).
  - **UN**: Successful pursuit of comprehensive agreement at COP21 in Paris in December 2015, with commitments from 195 nations, comprehensive reporting, and assistance on both mitigation and adaptation to countries in need
- Mobilizing clean-energy and preparedness finance
  - \$3B US contribution to Green Climate Fund; US-German Global Innovation Lab for Climate Finance

## **The path forward in the United States**

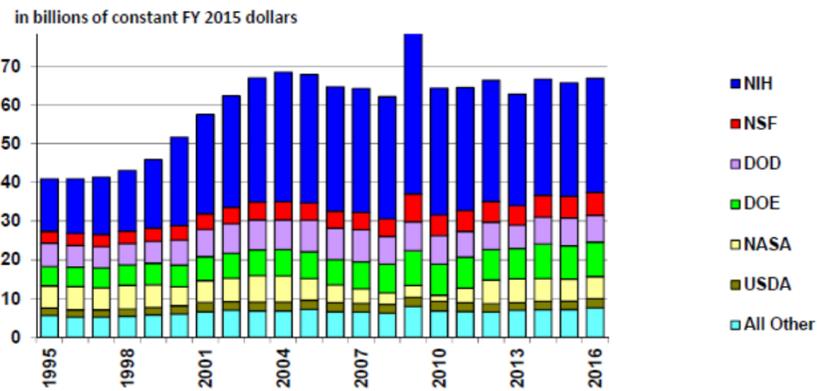
- Defend the requests for clean-energy RD<sup>3</sup> and for Earth observation in the President's FY17 Budget.
- Finalize EPA's Power Plant Rules.
- Improve the coverage, usability, and user base of the Climate Data Initiative and Climate Resilience Toolkit
- Strengthen partnerships across Federal-state-local governments, private sector, civil society
- Implement the President's Climate Education and Literacy Initiative to ensure continuing public support for all of the above.
- Elect a President in 2016 who will continue and build on President Obama's climate-change program.

## **The path forward internationally**

- Build the public-private-global partnership for boosting resilience in developing countries announced at the 09-14 UN Climate Summit.
- Continue to push toward a comprehensive, equitable, forward-leaning climate agreement in Paris.
- Begin to plan for the challenges of the steep declines in global emissions that will be needed after 2030.
- To that end, substantially ramp up global research, development & demonstration of the improved and new clean-energy technologies that such cuts will require.

## Some Other Challenges and Opportunities Going Forward

### The budget challenge: We haven't done what we wanted for Federal research



FY 2009 figures include Recovery Act appropriations.  
Research includes basic research and applied research.  
February 2015 OSTP

## Budgets (continued)

Sustaining Federal S&E budgets going forward will remain difficult, especially for certain items:

- NASA (JWST, advanced technology)
- NOAA (polar-orbiting satellites, climate service),
- DOE (CO<sub>2</sub> capture, fusion)
- NSF (basic research, social science)
- USDA (peer-reviewed agricultural science)
- EPA & FDA (regulatory science)
- USGCRP (climate science, sustainability science)
- international cooperation in S&T

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

## R&D from FY15 to the President's FY17 Budget

Budget authority in billions of current dollars	FY15 actual	FY16 enacted	FY17 POTUS	Change FY16-17
Total R&D	138.3	146.1	152.3	4.2%
<i>defense</i>	<i>71.7</i>	<i>76.6</i>	<i>80.0</i>	<i>4.4%</i>
<i>nondefense</i>	<i>66.5</i>	<i>69.5</i>	<i>72.4</i>	<i>4.1%</i>
Research	66.0	68.9	72.8	5.7%
<i>defense</i>	<i>10.9</i>	<i>10.9</i>	<i>11.8</i>	<i>7.9%</i>
<i>nondefense</i>	<i>55.2</i>	<i>58.0</i>	<i>61.0</i>	<i>5.2%</i>
Development	69.7	74.5	76.7	3.0%
<i>defense</i>	<i>60.5</i>	<i>65.3</i>	<i>67.6</i>	<i>3.5%</i>
<i>nondefense</i>	<i>9.2</i>	<i>9.1</i>	<i>9.1</i>	<i>-0.8%</i>

## Some other challenges

- Accelerating translation of S&E advances into economic and social benefits  
through closer public-private-academic partnerships
- Addressing systemic weaknesses in STEM-ed  
weak teacher competence in K-12, inertia w respect to adopting more effective methods at college level
- Avoiding a new nuclear arms race with Russia  
since falling into this trap would be even more foolish than it was the first time (see "Race to Oblivion")
- Getting key messages across  
why science & engineering matter (to economy, health, environment, security), how science works

## Some big opportunities

- Harnessing the full potential of partnerships (local/state/federal, public/private/academic/civil-society, international) to address all of the foregoing challenges.
- Building on the momentum of COP21 and the recent rapid growth of renewable energy deployments worldwide to fashion a global revolution in clean energy.
- Exploiting recent advances in biomedical sciences & “big data” to drastically improve healthcare.
- Applying current infotech & digital tech to improve the effectiveness & accessibility of government.



<http://www.ostp.gov>