Science, the Endless Frontier Revisited...
During the years following the Great Depression and World War II, the United States launched a massive effort to invest heavily in both education and research.

- The G.I. Bill (Serviceman’s Readjustment Act)
- Truman Commission
- California Master Plan
- Vannevar Bush: Science, the Endless Frontier
“New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life.”

– Letter from President Franklin D. Roosevelt to Vannevar Bush, November 17, 1944, prompting Vannevar Bush to write the historic report *Science, the Endless Frontier*
Vannevar Bush: Science—The Endless Frontier

National Science Foundation
40th Anniversary
1950-1990
Key Elements of Science the Endless Frontier

- The importance of government support of research
- The government-university-industry partnership
- The practice of federal support of competitive, peer-reviewed grants, and a framework for contractual relationships between universities and government sponsors.
- The support of investigators to engage in research of their own choosing in the hope that significant benefits would accrue to American society in the forms of military security, public health, and economic prosperity.
Research Partnership
July, 1945

**States**
- RU Flagships
- Investment

**Feds**
- $$$ Basic research
- $$$ Grad Ed

**Research Universities**
- (Public, Private)
- Basic research
- Applied research
- Grad education
- Post docs
- Health care
- Intellectual property
- Entrepreneurs
- Spinoffs
- Tech transfer

**Industry**
- Employers
- OEMs

**Research grants, contracts**
- Centers and institutes
- Medical centers
- Manage National Labs
- Professional Schools
- University systems

**Win Cold War**
- National Security
- Public Health
- Leading economy
- Most educated nation
- High tech (computers, Internet, GPS, etc.)
- Space program
- Science leaders
Science, the Endless Frontier

1945: *Science, the Endless Frontier*, Vannevar Bush

1950: National Science Foundation Act
   The National Science Foundation
   The National Science Board

1950s -->
   The government-university-industry partnership
   The evolution of the “research university”
   Growth in the R&D budgets of mission agencies
Examples of Early Impact of U.S. Science Policy
Human Genome Project

Resources for the Biology Century
A New Century Has Brought New Worries
The Context

- Demographics, globalization, technological change
- Global, knowledge-driven economy
- Out-sourcing, off-shoring, inadequate diversity
- Importance of technological innovation to economic competitiveness and national security
obligations in billions of constant FY 2002 dollars

Another concern...
R&D as a Share of GDP by Funder

Source: National Science Foundation, National Patterns of R&D Resources series. © 2015 AAAS
The Media: A Gathering Storm

- William Broad: “The US has started to lose its worldwide dominance in critical areas of science and innovation. Europe and Asia are making large investments in physical science and engineering research, while the US has been obsessed with biomedical research to the neglect of other areas.”

- Tom Friedman: “The US is not graduating the volume of scientists and engineers, we do not have a lock on the new ideas, and we are either flat-lining or cutting back our investments in physical science and engineering. We are losing our competitive edge vis-à-vis China, India, and other Asian tigers.”
NAE Committee

Assessing the Capacity of the U.S. Engineering Research Enterprise
ENGINEERING RESEARCH AND AMERICA'S FUTURE

MEETING THE CHALLENGES OF A GLOBAL ECONOMY

NATIONAL ACADEMY OF ENGINEERING
OF THE NATIONAL ACADEMIES
Charge

To conduct a "fast-track" evaluation of

1) the past and potential impact of the U.S. engineering research enterprise on the nation's economy, quality of life, security, and global leadership; and

2) the adequacy of public and private investment to sustain U.S. preeminence in basic engineering research.
NAE Committee

- James J. Duderstadt
- Erich Bloch
- Ray M. Bowen
- Barry Horowitz
- Lee L. Huntsman
- James Johnson
- Kristina M. Johnson
- Linda Katehi

- David C. Mowery
- Cherry A. Murray
- Malcolm R. O'Neill
- George Scalise
- Ernie Smerdon
- Robert F. Sproull
- David Wormley
- Proctor P. Reid
Recommendations

- Balancing Federal R&D Portfolio
- Re-establishing Basic Engineering Research As A Priority of Industry
- Strengthening Linkages Between Industry and Research Universities
- Human Capital
- Discovery-Innovation Institutes
U.S. Leadership in Innovation will Require Changes

- In the way research is prioritized, funded, and conducted.
- In the education of engineers and scientists.
- In policies and legal structures such as intellectual property.
- In strategies to maximize contributions from institutions (universities, CR&D, federal agencies, national laboratories)
Discovery Innovation Institutes

To address the challenge of maintaining the nation’s leadership in technological innovation, the committee is convinced that a bold, transformative initiative is required. To this end, we recommend the establishment of multidisciplinary Discovery-Innovation Institutes on university campuses designed to perform the engineering research that links fundamental scientific discovery with the technological innovation to create the products, processes, and services needed by society.
Discovery/Innovation Institutes

Linking scientific discovery with societal application
Produce innovators/entrepreneurs/engineers
Build infrastructure (labs, cyber, systems)
Analog to Agriculture Exp Stations or Academic Medical Centers

Support
- Core federal support (e.g., Hatch Act)
- State participation (facilities)
- Industry participation
- Entrepreneur participation
- University participation
- Co-Investment
- Policies (particularly IP policy)

National Priorities
- Economic Competitiveness
- National and Homeland Security
- Public health and social well-being

Global Challenges
- Global Sustainability
- Geopolitical Conflict

Opportunities
- Emerging Technologies
- Interdisciplinary Activities
- Complex, Large-scale Systems
Discovery-Innovation Institutes

- Like **corporate R&D laboratories**, they would link fundamental discoveries with the engineering research necessary to yield innovative products, services, and systems, but while also educating the next generation technical workforce.
- Like **academic medical centers** they would bring together research, education, and practice.
- Like **agricultural experiment stations and cooperative extension services** (the “Land Grant” paradigms), they would be responsive to societal priorities and closely coupled to the marketplace.
The DII concept is a contemporary adaptation of a successful research paradigm created over a century ago through the Morrill Land–Grant Act.
New wine from old bottles…

- The proposed network of regional energy discovery-innovation institutes is remarkably similarly to the “agricultural and mechanics” experiment stations established by the Hatch Act of 1887, both in spirit and in structure.
- These would involve a partnership among research universities, business and industry, entrepreneurs and investors, and federal, state, and local government.
- The energy discovery-innovation institutes would conduct the research, development, and commercialization of new energy technologies necessary to build a sustainable national energy infrastructure for the 21st century while stimulating strong regional economic growth and job creation.
In summary

- DIIIs would be engines of innovation that would transform institutions, policy, and culture and enable our nation to solve critical problems and maintain leadership in a global, knowledge-driven society.

- The DII proposal is designed to illustrate the bold character and significant funding level we believe are necessary to secure the nation's leadership in technological innovation.
The Brookings Next Energy Project
Secretary of Energy Advisory Board
Task Force on the Future of Science Programs
at the Department of Energy

Members

Dr. Charles M. Vest, Chairman
President
Massachusetts Institute of Technology
Cambridge, Massachusetts

Dr. John Baldeschweller
Johns Hopkins Professor & Professor Emeritus
Chemistry Department
California Institute of Technology
Pasadena, California

Mr. Alfred R. Berkley III
Former President and Vice Chairman
Nasdaq Stock Market Inc.
Washington, D.C.

Dr. Robert Birgeneau
President
University of Toronto
Toronto, Ontario
Canada

Dr. James Duderstadt
University of Michigan
Ann Arbor, Michigan

Dr. M.R.C. Greenwood
Chancellor
University of California, Santa Cruz
Santa Cruz, California

Ms. Deborah Wince-Smith
President
Council on Competitiveness
Washington, D.C.

Dr. Ray Irani
Chairman
Occidental Petroleum
Los Angeles, California

Dr. Steve Koonin
Provost
Professor of Theoretical Physics
California Institute of Technology
Pasadena, California

Dr. Leon Lederman
Resident Scholar
Illinois Math & Science Academy
Aurora, Illinois

Honorable William F. Martin
Chairman
Washington Policy and Analysis, Inc.

Honorable Peter McPherson
President
Michigan State University
East Lansing, Michigan

Dr. Modesto A. Maldique
President
Florida International University
Miami, Florida

Mr. Steven Papermaster
CEO, Powershift
Austin, Texas
DOE SEAB Study

- "America cannot retain its freedom, way of life, or standard of living in the 21st century without secure, sustainable, clean, and affordable sources of energy.
- America can meet its energy needs if and only if the nation commits to a strong and sustained investment in research, and if we translate advancing scientific knowledge into practice.
- The nation must embark on a major research initiative to address the grand challenge associated with the production, storage, distribution, and conservation of energy as an urgent national priority."
Existing R&D paradigms are not up to the task…

- DOE SAEB Study: "DOE has a historically poor reputation as badly managed, excessively fragmented, and politically unresponsive".

- "The organizational separation of DOE's basic and applied energy research programs makes the migration of basic research findings to applied research solutions difficult and undisciplined."

- DOE is characterized by stovepipe organizations that are all too frequently risk-adverse and parochial.

- DOE labs lack broader expertise in nontechnological issues (legal, business, public policy, social sciences, education)
So what have we done thus far?

- Over the past two decades, energy research has actually been sharply curtailed by the federal government (75% decrease), the electrical utility industry (50%), and the domestic automobile industry (50%).
- Today the federal government effort in energy R&D is less than 20% of its level during the 1980s.
- Despite the fact that a major increase in energy research was intended to be a major component of both the America Innovation Initiative and the America COMPETES Act, this has largely been ignored by the current administration.

U.S. DOE Energy RD&D Spending
FY1978-FY2009 Request

FY2008 level is just equal to FY1984 in real terms, with real GDP 2X higher.

Kelly Gallagher, Harvard U, 2-14-08
Declining energy R&D by economic sector (Kammen, 2005)
How much energy R&D?

- Federal R&D efforts
  - NASA: $12 B/y
  - NIH: $31 B/y
  - DOD: $84 B/y
  - DOE energy: $2 B/y

- Sector size
  - Health care: $2.3 trillion
  - Defense: $0.7 trillion
  - Energy: $1.4 trillion
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  - Energy: $1.4 trillion

- These comparisons suggest federal energy R&D should be in the range of $30 to $40 billion/year, at least an order of magnitude higher than current levels of federal investment!
The scale of the energy challenge

- Growing global energy demand will require over $16 trillion in capital investments over next two decades.
- To meet the projected growth in electricity demand, the world will need to bring online a new 1,000 Mwe powerplant every day.
- Clearly this requires a federal R&D effort comparable in scale to the Manhattan Project or the Apollo program.
The scale of the energy challenge

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- To meet the projected growth in electricity demand, the world will need to bring online a new 1,000 Mwe powerplant every day.
- Clearly this requires a federal R&D effort comparable in scale to the Manhattan Project or the Apollo program.
- But this is quite different from putting a man on the moon! Rather it involves building an entirely new economic sector focused on sustainable energy technologies.
New paradigms are required

- Appropriate to respond to the urgency, scale, and complexity of the energy challenge.
- Highly multidisciplinary, extending beyond technology
- Highly innovative commercialization approaches capable of rapid deployment into the marketplace
- Intimate partnerships among multiple players—federal agencies and labs, research universities, established industry, entrepreneurs, and the investment community.
- A new research culture based on nonlinear flow and activity among a scientific discovery, technological innovation, entrepreneurial business development, and legal, social and political imperatives.
Energy Discovery-Innovation Institutes: A Step toward America’s Energy Sustainability

James Duderstadt, Gary Woz, Robert McGrath, Mark Muro, Michael Corrado, Linda Kellie, and Rick Shargow

The need to renew America’s economy, foster its energy security, and respond to global climate change compel the transformation of U.S. energy policy. Innovation and its commercialization must move to the center of national reform. Not only must a broad range of carbon pricing and regulatory responses be adopted, but major increases in federal R&D are essential along with the deployment of bold new research agendas. To that end, the federal government should establish a national network of regionally based Energy Discovery-Innovation Institutes (e-DIs) to serve as the hubs of a distributed research network linking the nation’s best scientists, engineers, and facilities. Through such a network, the nation could once again leverage its current inadequate energy R&D effort and complement existing resources with a new research paradigm that would join the unique capabilities of America’s research universities to those of corporate R&D and federal laboratories.

America’s Challenge
Massive sustainability and security challenges plague the nation’s energy production and delivery system. Transformational innovation and commercialization will be required to address these challenges. However, current innovation efforts remain inadequate to assure the development and deployment of clean energy technologies and processes. States and localities lack the wherewithal to make the needed investments. Additionally, numerous market, federal, and private firm from investing sufficiently in clean energy. Because firms cannot capture all the benefits of their innovative activity, they underinvest and focus on short-term, low-risk research and product development.

Limitations of Existing Federal Policy
Federal energy efforts, meanwhile, suffer from two key shortcomings. First, the federal government spends less than 1 percent of its R&D budget on energy—a level less than one-fifth of expenditures in the 1990s and 1980s—clearly insufficient in light of daunting challenges. Beyond that, federal energy efforts are also based on an obsolete research paradigm. Most federal energy research is conducted within “closed labs” that are too removed from the marketplace and too focused on their existing portfolios to support “transformational” or “user-inspired” research targeted at new energy technologies and processes.

A New Federal Approach
The federal government should create a national network of several dozen e-DIs. An interagency process should establish the network and competitively award core federal support of up to $200 million per year for each major e-DI operated by university or national laboratory consortia, along with funding for smaller e-DIs and distributed energy networks connected to the large e-DIs. Federal funding would be augmented with participation by industry, investors, universities, and state governments, for a total federal commitment growing to roughly $6 billion per year (or 28 percent of a recommended total federal energy R&D goal of $20 to $30 billion per year). The e-DIs would:

- Foster partnerships to pursue cutting-edge, applications-oriented research among multiple participants and disciplines
- Develop and rapidly transfer highly innovative technologies into the marketplace
- Build the knowledge base and human capital necessary to address the nation’s energy challenges
- Encourage regional economic development by spawning clusters of nearby startup firms, private research organizations, suppliers, and other complementary groups and businesses

To create a wealthy, clean, and energy-secure future, the federal government needs a broad-based, hands-on energy innovation strategy that leverages the nation’s scientific and technological capabilities.
The “Next Energy” Plan

- Brookings Institution ("Blueprint for American Prosperity")
- Big 10, Pac 10, (plus U. Colorado, U. New Mexico)
- Co-chairs: Gordon Gee (OSU); Michael Crow (ASU)
- VPRs: UM, OSU, UW, UI, ASU, CU, UCLA, UW
- Drafting Team (JJD chair):
  - Big 10: Energy faculty (UM, UW, UI, OSU, MSU,…)
  - Pac 10: VPs-Research (ASU, UW, UCLA, CU, UCSD)
  - Vetting by industry, DOE labs, federal policy wonks…
- Target Date for Brookings rollout: early December 2008!
The Proposal

- A National Energy Research Network:
- Create a highly coordinated national network of discovery-innovation institutes focused on energy research.
- Each located adjacent to a major research university.
- Organized into clusters addressing the particular challenges faced by various regions of the nation.
More specifically

- Each discovery-innovation institute would be created as a **Federal R&D Center** with core support from multiple federal agencies growing to $200 M/y.
- With **additional support** from state governments, industry, investment community, foundation, and university sources.
- **Organized into regional clusters** managed by a university consortium with strong participation from the private sector.
- And **highly integrated** using rapidly evolving cyberinfrastructure and virtual organizational structures (similar to the Blue Waters petascale effort).
Energy Discovery-Innovation Institutes

Universities
- R&D
- Human Capital

Industry
- Corporate
- Entrepreneurs
- Investors

Government
- Federal
- State

Energy Discovery-Innovation Institutes

Scientific Research
- Discovery
- Engineering Research

Technology
- Innovation
- Development

Commercialization
- Deployment
- Infrastructure

National Priorities

Regional Coordination

Local Economic Growth
- Job Creation
- Services
Regional characteristics

- Great Lakes: Energy-intensive economy (manufacturing, agriculture, transportation); large urban populations; few national laboratories; major research universities
- Mountain West: fragile ecosystems; highly dispersed populations; significant primary energy sources; strong potential for solar and wind energy; numerous national laboratories
- Northeast, Southeast, Midwest, …
NREN: A response to the energy challenges of the 21st Century.

- The proposed National Energy Research Network of regional energy discovery-innovation institutes is remarkably similarly to experiment stations established by the Hatch Act of 1887, both in spirit and in structure.
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  - Vetting by industry, DOE labs, federal policy wonks…
  - Obama transition team
- Rollout: National Press Club, February 9
Another Opportunity (2008)

- A New Administration
  - Obama Science Team
    - John Holdren, Kei Koizumi, Tom Kalil
    - Steve Chu, Kristina Johnson, Steve Koonin
    - Carol Browner
  - Meetings: Koizumi, Chu, Kalil, …
- Congress
  - Bart Gordon
  - Henry Waxman (replaced Dingell), Markey
Followup

- Administration
  - Obama Science Team
    - John Holdren, Kei Koizumi, Tom Kalil
    - Steve Chu, Kristina Johnson, Steve Koonin
    - Carol Browner
  - Meetings: Koizumi, Chu, Kalil, …

- Congress
  - Bart Gordon
  - Henry Waxman (replaced Dingell), Markey
Transformative Research (Breaking the Paradigm)

Conventional R&D (Within Disciplinary Paradigms)

Translational Research (Coupling Discovery with Innovation)

ARPA-E
$400 M - $1-2 B

Energy Frontier Research Centers
(46 @ $777 M - 5 Years)

Energy Innovation Hubs
(8 @ $280 M-Year 1)
New Energy for America’s Economy

FY 2010 budget funds breakthrough science

Eight Energy Innovation Hubs – $280 million

Encourage collaboration and team science

Connect research lab to industrial world

Builds on success of DOE’s Bioenergy Research Centers:

jbei
Joint BioEnergy Institute

GLBRC
Great Lakes Bioenergy Research Center

BESC
BioEnergy Science Center

DOE FY 2010 Budget
Advanced Modeling and Simulation

Consortium for Advanced Simulation of Light Water Reactors (CASL) Energy Innovation Hub

CASL brings together a team that will apply existing modeling and simulation capabilities and develop advanced capabilities to create a usable environment for predictive simulation of light water reactors (LWRs). This environment, designated the Virtual Reactor (VR), will:
The Joint Center for Artificial Photosynthesis (JCAP) is the nation's largest research program dedicated to the development of an artificial solar-fuel generation technology. Established in 2010 as a U.S. Department of Energy (DOE) Energy Innovation Hub, JCAP aims to find a cost-effective method to produce fuels using only sunlight, water, and carbon dioxide as inputs.

Color enhanced scanning electron microscope image of a silicon column and pit patterned by electron-beam lithography.

**JCAP NEWS**

**JUNE 4, 2014**
JCAP featured in Nature journal. [MORE](#)

**JANUARY 15, 2014**
JCAP's Adam Weber named a winner of the Presidential Early Career Award by President Obama. [MORE](#)

**SEPTEMBER 19, 2013**
JCAP researchers featured in New Yorker magazine. [MORE](#)

**AUGUST 28, 2013**
JCAP's Meenesh Singh receives 2013 American Institute of Chemical Engineers (AIChE) Process Development Division Student Paper Award.
CMI leaders on RETA tour to GE

About CMI

CMI created a table of more than 450 recent U.S. patents that address rare earth magnet compositions and processes.

CMI Highlights

CMI magnet researchers met with industry representatives at GE in August. For a list of CMI research projects on magnets, see the Developing Substitutes chart.

CMI in the News

- Oak Ridge National Laboratory: ORNL Thermomagnetic Processing Method Provides Path to New Materials
- American Physical Society: Next Steps for Energy Critical Elements
- U.S. Department of Energy: Silicon Shovels for Rare-Earth Solutions
- Casper, Wyoming, Star-Tribune: A Q&A with Alex King, director of the Critical Materials Institute
- U.S. Department of Energy: Ames Laboratory and Japanese R&D organization discuss rare earths
Digital Manufacturing and Design Innovation Institute (DMDII)

Date Launched: Feb. 25, 2014
Focus Area: Integrated digital design and manufacturing
Capsule Summary: The DMDII is the nation’s flagship research institute for applying cutting-edge digital technologies to reduce the time and cost of manufacturing, strengthen the capabilities of the U.S. supply chain and reduce acquisition costs for the U.S. Department of Defense (DoD). The DMDII develops and demonstrates digital manufacturing technologies, and deploys and commercializes these technologies across key manufacturing industries. The goal is to create product and manufacturing process definitions simultaneously. Design innovation is the ability to apply these technologies, tools and products to re-imagine the manufacturing process from end to end.

Team:

- Director: Dr. Dean Bartles
- Chief Technology Officer: Dr. Bill King
- Federal Program Officer: Greg Harris

Founding Organization: UI Labs
Federal Partner: Department of Defense
Funding: Federal $70 million, Matching $106 million

Address: Aon Center, 200 E. Randolph, Suite 200, Chicago, IL 60601
Email: manufacturing@uilabs.org
Web: http://dmdii.uilabs.org
Twitter: @DMDII_
America Makes

**Date Launched:** Aug. 16, 2012  
**Focus Area:** Additive manufacturing  
**Capsule Summary:** America Makes focuses on helping the United States grow capabilities and strength in 3D printing, also known as additive manufacturing. America Makes facilitates collaboration among leaders from business, academia, nonprofit organizations and government agencies, focusing on areas that include design, materials, technology and workforce and help our nation’s three-dimensional (3D) printing industry become more globally competitive.

**Team:**

- Director: Ed Morris
- Founding Director: Ralph Resnick
- Director of Operations: Rob Gorham
- Federal Program Officer: Jennifer Fielding

**Founding Organization:** National Center for Defense Manufacturing and Machining  
**Federal Partner:** Department of Defense  
**Funding:** Federal $50 million, Matching $39 million

**Address:** 236 W Boardman St., Youngstown, OH 44503  
**Phone:** 330-622-4299  
**Email:** info@americamakes.us  
**Web:** [http://americamakes.us/](http://americamakes.us/)  
**Twitter:** @AmericaMakes
The Institute of Advanced Composites Manufacturing Innovation (IACMI)

**Date Launched:** Jan. 19, 2015  
**Focus Area:** Advanced Fiber-Reinforced Polymer Composites  
**Capsule Summary:** Advanced composites are currently used for expensive applications like satellites and luxury cars. Researchers at IACMI will work to develop lower-cost, higher-speed, and more efficient manufacturing and recycling processes for them. Bringing these materials down the cost curve can enable their use for a broader range of products including lightweight vehicles with record-breaking fuel economy; lighter and longer wind turbine blades; high pressure tanks for natural gas-fueled cars; and lighter, more efficient industrial equipment. The Institute will focus on lowering the overall manufacturing costs of advanced composites by 50 percent, reducing the energy used to make composites by 75 percent and increasing the recyclability of composites to over 95 percent within the next decade.

**Team:**
- Director: Craig Blue

**Founding Organization:** University of Tennessee, Knoxville  
**Federal Partner:** Department of Energy  
**Funding:** Federal $70 million, Matching $180 million

**Location:** Knoxville, TN  
**Web:** [http://www.iacmi.org/](http://www.iacmi.org/)
LIFT: Lightweight Innovations For Tomorrow

**Date Launched:** Feb. 25, 2014

**Focus Area:** Lightweight Technology

**Capsule Summary:** LIFT is part of a national network of research institutions and industrial companies geared toward advancing America’s leadership in manufacturing technology. The center will speed development of new lightweight metal manufacturing processes from laboratories to factories for products using lightweight metal, including aluminum, magnesium, titanium and advanced high-strength steel alloys. An equally important mission is to facilitate the training of the workers who will use these new processes in factories and maintenance facilitates around the country.

**Team:**

- Executive Director: Larry Brown
- Chief Technology Officer: Alan Taub
- Federal Program Officer: Johnnie Deloach

**Founding Organization:** EWI

**Federal Partner:** Department of Defense

**Funding:** Federal $70 million, Matching $78 million

**Address:** 1400 Rosa Parks Boulevard, Detroit, MI 48216

**Phone:** 313-309-9003

**Email:** info@lift.technology

**Web:** http://lift.technology/

**Twitter:** @NewsfromLIFT

**YouTube:** https://www.youtube.com/channel/UCBA6sxzWZGLvEBn8uybKtwA
Date Launched: Jan. 15, 2015  
Focus Area: Wide Bandgap Semiconductors  
Capsule Summary: The mission of PowerAmerica is to develop advanced manufacturing processes that will enable large-scale production of wide bandgap (WBG) semiconductors, which allow electronic components to be smaller, faster and more efficient than semiconductors made from silicon. WBG semiconductor technology has the potential to reshape the American energy economy by increasing efficiency in everything that uses a semiconductor, from industrial motors and household appliances to military satellites.

Team:

- Executive Director: Nicholas G. Justice (U.S. Army retired major general)
- Deputy Director and Chief Technology Officer: John Muth
- Federal Program Officer: Anant Agarwal

Founding Organization: North Carolina State University  
Federal Partner: Department of Energy  
Funding: Federal $70 million, Matching $70 million

Address: NC State Springboard Innovation Hub @Poulton Innovation Center, 1021 Main Campus Drive, CB 7005, Raleigh, NC 27606  
Phone: 919-513-2982  
Email: muth@ncsu.edu  
Web: http://research.ncsu.edu/power/  
Twitter: @poweramer
The Worries Remain...
Federal R&D in the Budget and the Economy
Outlays as share of total, 1962 - 2016

Source: Budget of the United States Government, FY 2016. FY 2016 is the President's request. © 2015 AAAS
R&D as a Share of GDP by Funder

Source: National Science Foundation, *National Patterns of R&D Resources* series. © 2015 AAAS
Contentious markup expected today as House science panel takes up COMPETES bill
President’s science adviser attacks COMPETES bill in U.S. House, raises concern about NASA bill
ARE AMERICAN RESEARCH UNIVERSITIES RIDING ON THIN ICE?

JULY • 2010

STUDY ON RESEARCH UNIVERSITIES

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine
The danger signs

- Federal policies no longer place a priority on university research and graduate education.
- In the face of economic challenges and the priorities of aging populations, states no longer are either capable or willing to support their public research universities at world-class levels.
- Business and industry have largely ceded their basic research to research universities but with only minimal corporate support.
- Research universities themselves have failed to achieve the cost efficiency and productivity enhancement in teaching and research required of an increasingly competitive world.
The Key Themes

- **Revitalizing the partnership**: The first four actions will strengthen the partnership among federal and state governments, business and philanthropy, and universities.

- **Strengthen the institutions**: The next three actions will streamline and improve productivity of research.

- **Build talent**: The final three actions will strengthen educational opportunity at the K-12, undergraduate, and graduate level for the best students, both American and from around the world.
Early National Academy Progress

- Launch of National Commission to assess impact of unnecessary regulation on universities
- Release of new study on reforming graduate and postdoctoral education
- Alignment with other efforts (e.g., American Academy of Arts and Science studies)
- Building political support for achieving and sustaining goals of America COMPETES Act and NIH budget doubling
- Building state-based approach to stimulating federal matching grants programs for faculty and facilities
- Reform of U.S. immigration policies (Staple Act)???
Summary of Investment Goals
(Annual Growth Targets Achieved by 2022)

New Investments Requested in Report ($B/y)

Federal Support for Research Universities

- Full Funding of the American COMPETES Act (RU share) $6
- Full-cost funding of research grants (no net increase) 0
- Reduction of regulatory burdens 0
- Strategic Investment Fund (requiring matching grants)
  - Junior faculty chairs 2
  - Cyberinfrastructure / research infrastructure 5
- Graduate fellowships and traineeships 2
- STEM programs for women and minorities 1
- R&D Tax Credits for industry-university research partnerships 2
  - Total new federal support $18

State support
- Restoration of appropriations per student to 1990 levels $15

Private Sector
- Strategic Investment Fund Matching Grants 9
- Industry-University research partnerships (R&D Tax Credit) 6 $15

Research university productivity and cost reduction (20%) $15

- Total Investment Requested from All Sources $63 B/y
A Strengthened Research Partnership for America’s Future

Partnership

States
RU Autonomy, agility
RU Hybrids?

Feds
Supportive policies
Stable funding
National Labs

Research Universities
Efficient
Productive
Accountable

Industry
Peer-to-peer
Partners

University Activities
Knowledge
Innovation
Educated people
Entrepreneurial zeal
Paradigm breakers
Path finders

University Structures
Strategic
Responsive
Accountable
Collaborative
National, Global
Innovative

Impact

Prosperity
Health
Security