Big Deals

– Economic Stimulus and S&T
– "Green New Deal"
and
– Science of Science Policy

Presentation
Gerald Hane, Ph.D.
Q-Paradigm
March 18. 2009

Outline

- Landscape of US Science, Technology, and Innovation Policies
- "Green New Deal“
  - Policy Makers and Policy Shifts
- Science of Science and Innovation Policy
  - Impact of SciSIP on Science and Policy

The American Recovery and Reinvestment Act of 2009 (ARRA)

- $787 billion total
- $21.5 billion in federal research and development (R&D) funding (AAAS estimate)
  - $18.0 billion for the conduct of R&D
  - $3.5 billion for R&D facilities and capital equipment

S&T in Economic Stimulus

American Recovery and Reinvestment Act (ARRA)

Agency	Supplemental Funding
DOD – R,D,T&E	$300 million
DOE – Energy Efficiency Science ARPA-e	$16.8 billion $1.6 billion $400 million
NASA – Science Aeronautics Exploration Cross-Agency	$400 million $150 million $400 million $50 million
NIH	$10 billion
NSF – Research Education Equipment	$2.5 billion $100 million $400 million
NIST	$600 million
USGS	$140 million

Need for Economic Stimulus is also an Opportunity to Accelerate the Priorities of the Obama Administration –

Addressing the Challenge of Climate Change and the Green New Deal

Key Figures in Energy and Climate

Carol Browner
Assistant to the President
for Energy and Climate Change
“Energy and Climate Czar”

Steven Chu
Secretary of Energy

John Holdren
Assistant to the President
for Science and Technology

Nancy Sutley
Chair
Council on Environmental Quality

Lisa Jackson
Administrator
Environmental
Protection Agency

Todd Stern
Special Envoy for
Climate Change

Congressional Leaders

Edward Markey
Chair, Select Committee on Energy Independence and Global Warming

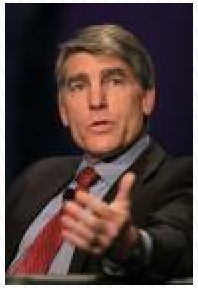
Henry Waxman
Chair, Committee on Energy and Commerce

Nancy Pelosi
Speaker of the House

Harry Reid
Senate Majority Leader

Senator
John Kerry

Senator
Olympia Snowe

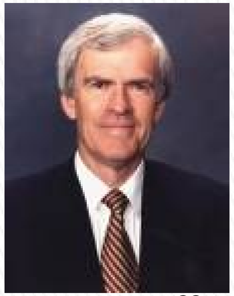


Mark Udall

Tom Petri

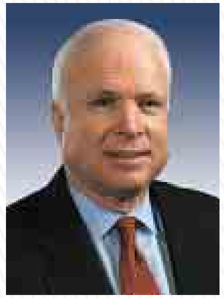
Senator
Barbara Boxer
Chair, Committee on Environment and Public Works

Senator
Bernie Sanders



Senator Jeff Bingaman
Chair, Committee on Energy And Natural Resources

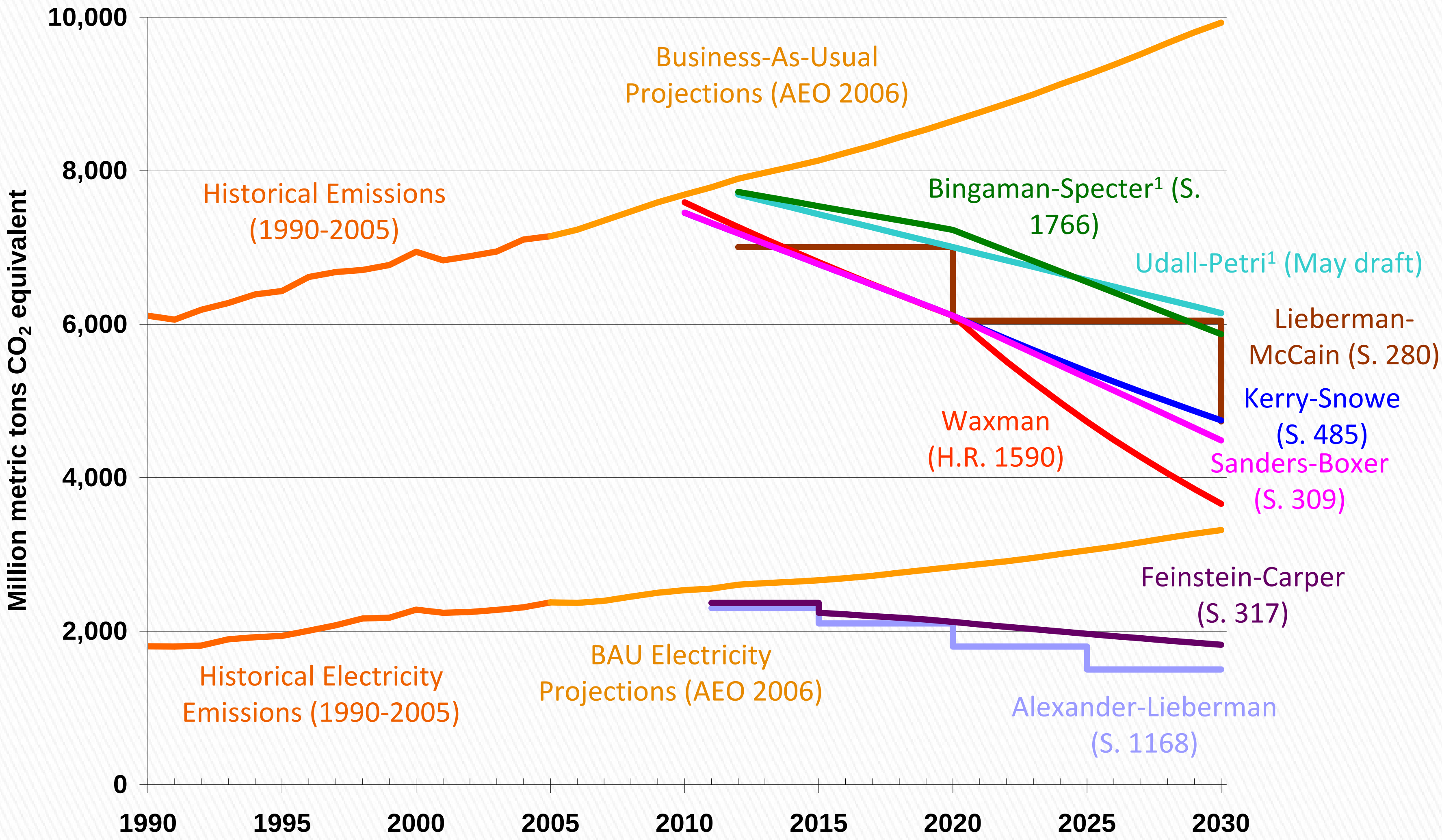
Senator
Arlen Specter



Senator
John
McCain

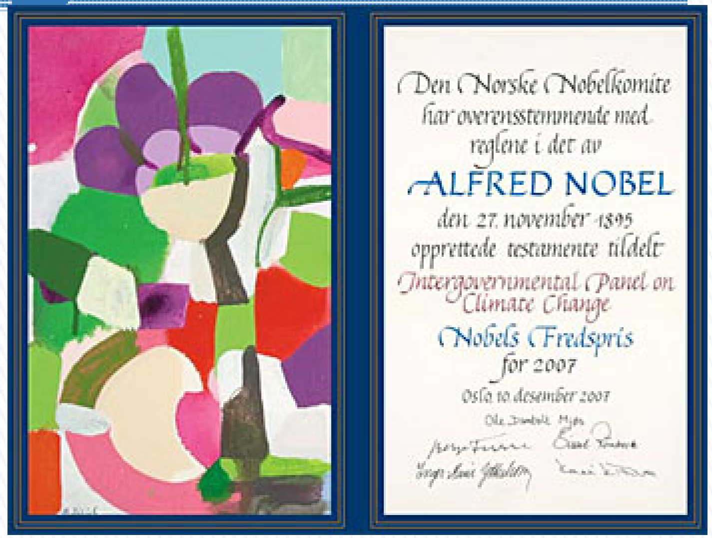
Senator
Joe
Lieberman

Emission Reduction Targets



(Ref. Ray Kopp, Resources for the Future, Oct 2007)

NGO/NPO Leaders



Jason Grumet
National Commission on
Energy Policy

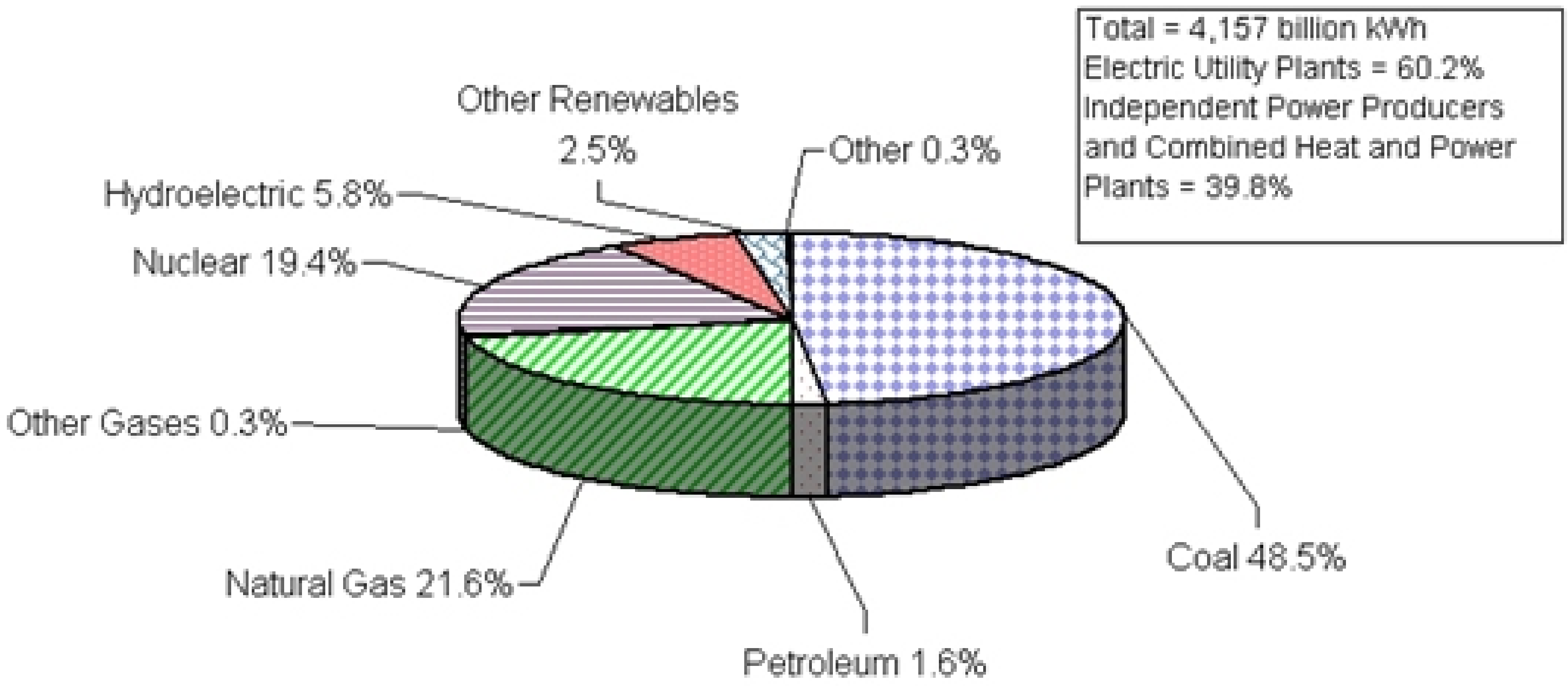
Major Innovation Systems Challenge

- Huge in scale
- Major market imperfections that must be addressed by policy
- Great need for new breakthroughs in science and technology
- Great need for process improvements and cost reduction

Obama-Biden Campaign

- Help create five million new jobs by strategically investing $150 billion over the next ten years to catalyze private efforts to build a clean energy future.
- Within 10 years save more oil than we currently import from the Middle East and Venezuela combined.
- Put 1 million Plug-In Hybrid cars -- cars that can get up to 150 miles per gallon -- on the road by 2015, cars that we will work to make sure are built here in America.
- Ensure 10 percent of our electricity comes from renewable sources by 2012, and 25 percent by 2025.
- Implement an economy-wide cap-and-trade program to reduce greenhouse gas emissions 80 percent by 2050.

US Electric Power Industry Net Generation, 2007

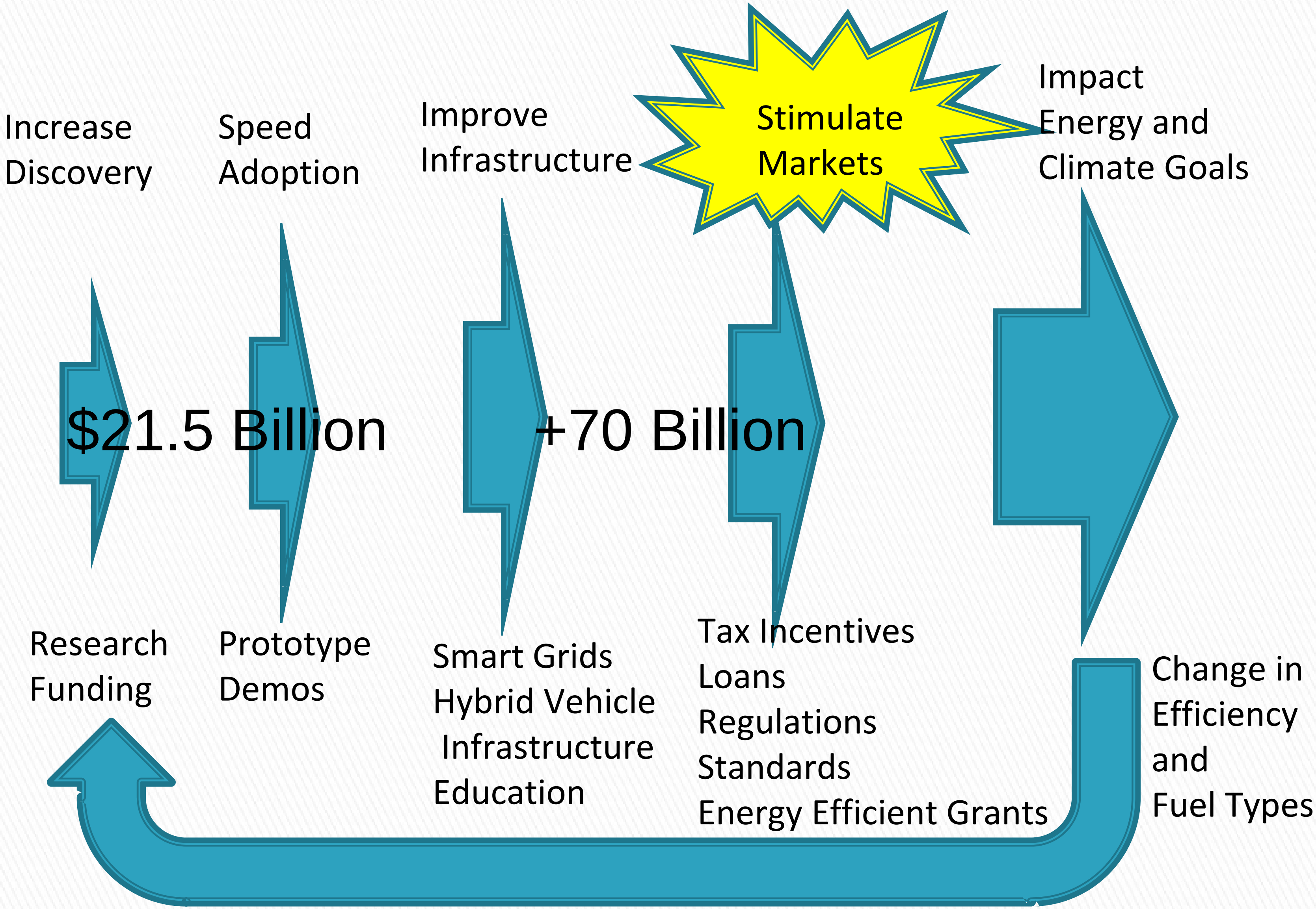


(ref. Energy Information Administration)

New Energy for America – Targets

- **Provide Short-term Relief to American Families**
  - Crack Down on Excessive Energy Speculation.
  - Swap Oil from the Strategic Petroleum Reserve to Cut Prices.
- **Eliminate Our Current Imports from the Middle East and Venezuela within 10 Years**
  - Increase Fuel Economy Standards.
  - Get 1 Million Plug-In Hybrid Cars on the Road by 2015.
  - Create a New $7,000 Tax Credit for Purchasing Advanced Vehicles.
  - Establish a National Low Carbon Fuel Standard.
  - A "Use it or Lose It" Approach to Existing Oil and Gas Leases.
  - Promote the Responsible Domestic Production of Oil and Natural Gas.
- **Create Millions of New Green Jobs**
  - Ensure 10 percent of Our Electricity Comes from Renewable Sources by 2012, and 25 percent by 2025.
  - Deploy the Cheapest, Cleanest, Fastest Energy Source – Energy Efficiency.
  - Weatherize One Million Homes Annually.
  - Develop and Deploy Clean Coal Technology.
  - Prioritize the Construction of the Alaska Natural Gas Pipeline.
- **Reduce our Greenhouse Gas Emissions 80 Percent by 2050**
  - Implement an economy-wide cap-and-trade program to reduce greenhouse gas emissions 80 percent by 2050.
  - Make the U.S. a Leader on Climate Change.

Innovation Systems Approach



Energy Mission

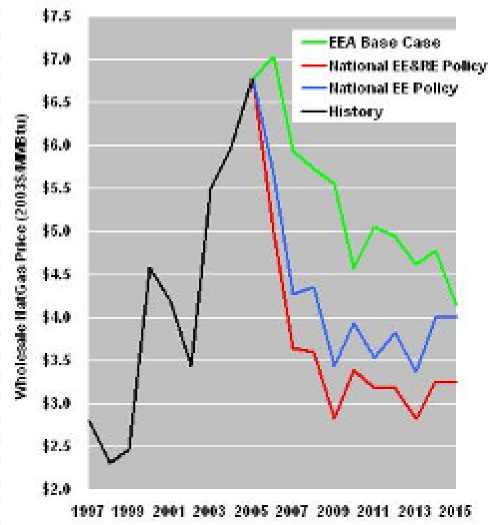
Steven Chu, March 5, 2009, testimony to the Senate Committee on Energy and Natural Resources.

"If we, our children, and our grandchildren are to prosper in the 21st century, we must decrease our dependence on oil, use energy in the most efficient ways possible, and decrease our carbon emissions. Meeting these challenges will require both a sustained commitment for the long-term and swift action in the near-term."

That is ...

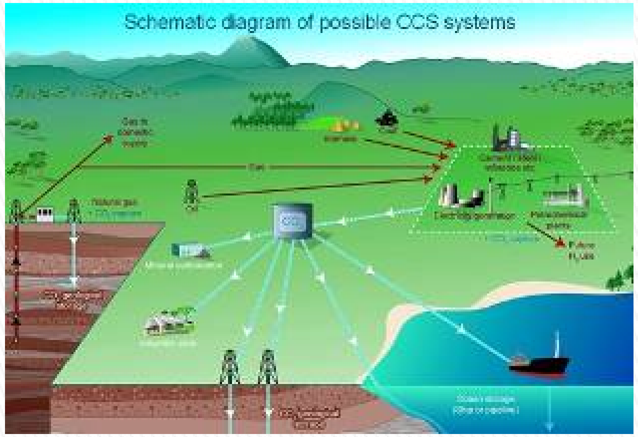
Renewables

(image ref. GENI)



Efficiency

(image ref. National Council
For An Energy-Efficient Economy)



Carbon Reduction

(image ref. IPCC)

Steven Chu (Congressional Testimony) – More Like Bell Labs

- *"DOE must strive to be the modern version of the old Bell Labs in energy research. Because the payoffs from research in transformational technologies are both higher risk and longer term, government investment is critical and appropriate. "*

Steven Chu, Congressional Testimony – Energy Technology Challenges

"We need to do more transformational research at DOE to bring a range of clean energy technologies to the point where the private sector can pick them up, including:

- *Gasoline and diesel-like biofuels generated from lumber waste, crop wastes, solid waste, and non-food crops;*
- *Automobile batteries with two to three times the energy density that can survive 15 years of deep discharges;*
- *Photovoltaic solar power that is five times cheaper than today's technology;*
- *Computer design tools for commercial and residential buildings that enable reductions in energy consumption of up to 80 percent with investments that will pay for themselves in less than 10 years; and*
- *Large scale energy storage systems so that variable renewable energy sources such as wind or solar power can become base-load power generators."*

Feedstock grasses (*Miscanthus)* is a largely unimproved crop.

Non-fertilized, non-irrigated test field at U. Illinois yielded

15x more ethanol / acre than corn.

50 M acres of energy crops plus agricultural wastes (wheat straw, corn stover, wood residues, urban waste, animal manure, etc.) can produce ***half*** to ***all*** of current US consumption of gasoline.

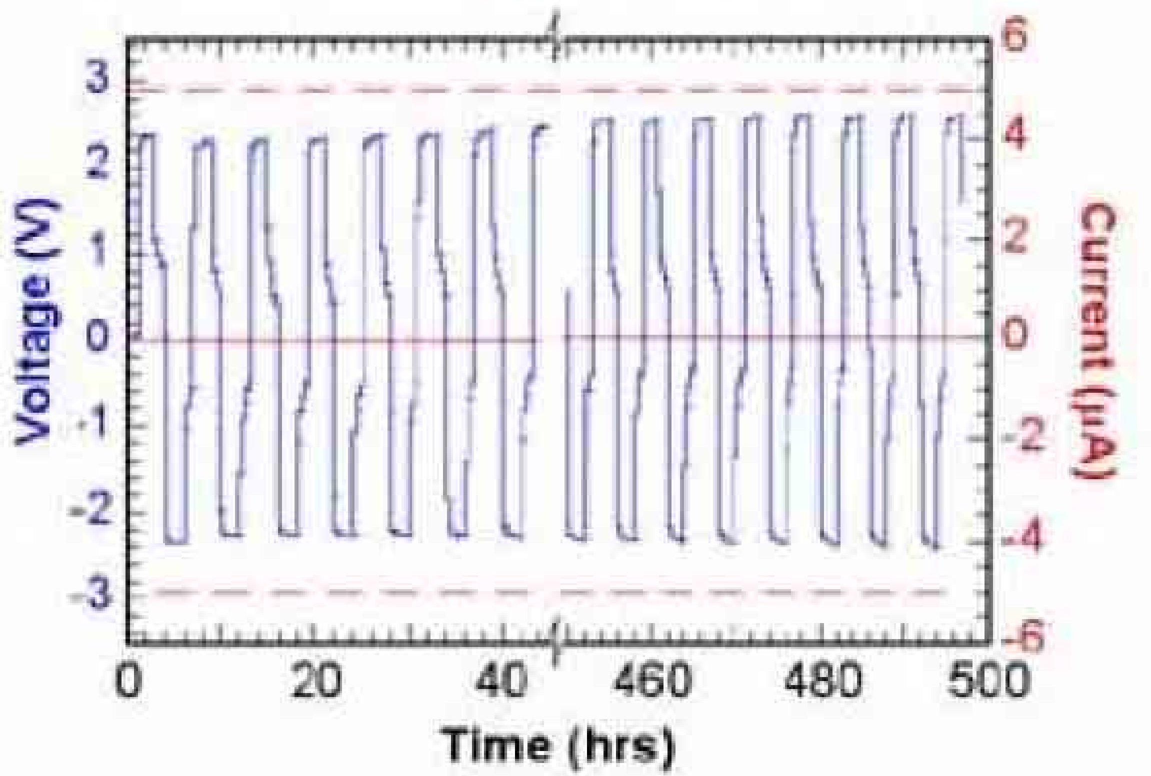
Source: Steven Chu Presentation to CARB, Feb 2008)

Berkeley Lab

Office of Science
U.S. DEPARTMENT OF ENERGY

A lithium – metal battery material with a dry, block copolymer separator shows promise. (Nitash Balsara)

Latest results of prototype ~ 1000 deep discharge cycles and ***no*** sign of degradation. Energy density initial target: 2x Li-ion



Source: Steven Chu Presentation to CARB, Feb 2008)

Reel-to-reel mass production of solar cells using nano-technology?

(Source: Steven Chu Presentation to CARB, Feb 2008)

Steven Chu (Congressional Testimony) – International Cooperation

- *“And we will seek partnerships with other nations. For example, increased international cooperation on carbon capture and storage technology could reduce both the cost and time of developing the range of pre- and post-combustion technologies needed to meet the climate challenge.”*

Addressing Demand-Side Issues for Energy as Part of the Innovation Ecosystem is Key to Success

Tax Incentives, Financing

- Expand tax incentives for renewable energy facilities. $14.0 billion
- Provide additional financing for Innovative Energy Loan Guarantee program - projects that "avoid, reduce, or sequester air pollutants or anthropogenic emissions of greenhouse gases," $6.0 billion
- Increase tax credits for residential energy efficiency improvements. $2.0 billion
- Incentive for alternative vehicle, increase the tax credit for purchasing plug-in hybrid vehicles to $7,500. $2.0 billion
- Incentive for advanced energy investment. Establish a new 30 percent investment tax credit for manufacturers of advanced energy property. $1.6 billion
- Support battery manufacturing. $2.0 billion
- Provide consumers rebates for energy-efficient appliances $300 million
- Expand tax incentives for residential renewable energy properties. Remove dollar caps on the 30 percent residential credit for solar thermal, geothermal and small wind property. $268 million
- Incentive for alternative fuel pumps. Increase tax credits for gas stations and other businesses that install non-hydrogen, alternative fuel pumps to 50 percent through 2010, for up to $50,000. $54 million

Interesting Renewable Tax Provision

- Tax Grant - allows businesses that invest in building renewable-energy facilities (such as wind and solar farms) to claim a government grant that covers 30 percent of the investment, <u>rather than</u> claiming a tax credit. Many companies cannot claim the tax credit because they have no tax liability. (The tax credits plus grants are expected to cost the government $14 billion.)

State and Local Funding

- Provide grants to cities, counties and states to increase energy efficiency $6.3 billion
- Authorize more state and local bonds for energy-related purposes. Authorize an additional $1.6 billion in renewable energy bonds and $2.4 billion in energy conservation bonds to finance state and local government projects. $1.4 billion
- Provide grants to states for energy-efficient vehicles and infrastructure. Includes $300 million to help state and local governments purchase hybrid vehicles and $100 million to start electrical infrastructure projects that encourage the use of electric vehicles. $400 million

Operation and Maintenance

- Increase financing for home weatherization program. $5.0 billion
- Increase energy efficiency in federal buildings $4.5 billion
- Repair and modernize public housing units $4.0 billion
- Replace older vehicles owned by the federal government with hybrid and electric cars $300 million
- Improve energy efficiency in government-subsidized apartment buildings $250 million
- Repair and modernize about 4,200 Native American housing units. $510 million

Energy STEM Related

- Modernize the electric grid. Make the electric grid "smarter." $11.0 billion. Of this amount, $4.5 billion for R&D, pilot projects and matching funds for the program.
- Invest in fossil energy - near-zero emissions power plants, clean coal technology and carbon capture. $3.4 billion. Of this amount,
  - Carbon Capture and Energy Efficiency Competitive Grants - $1.52 billion
  - Fossil Energy R&D - $1 billion
  - Clean Coal Power Initiative - $800 million;
- Renewable energy and energy efficiency research $2.5 billion
  - Biomass - $800 million
  - Geothermal activities and projects - $400 million
  - Industrial energy efficiency - $500 million
- Provide additional funding for science and research at the Department of Energy. Includes $400 million for ARPA-e. $2.0 billion
- Train workers for careers in energy efficiency and renewable energy fields $500 million

(Ref. New York Times, March 3, 2009, "The Stimulus Package – Energy")

How Large an Impact?

- To be determined ...

The Science of Science Policy – What's its Impact on Science and Science Policy?

What Could it Do? Examples of Overarching Challenges

- Development of portfolio models of investment in science and technology
- Creating real-time evaluative and decision-making tools for assessing public sector investments in fundamental science and technology on economic growth and social well-being
- Measuring spillover effects between scientific discovery and technological innovation, particularly among universities, firms and government labs

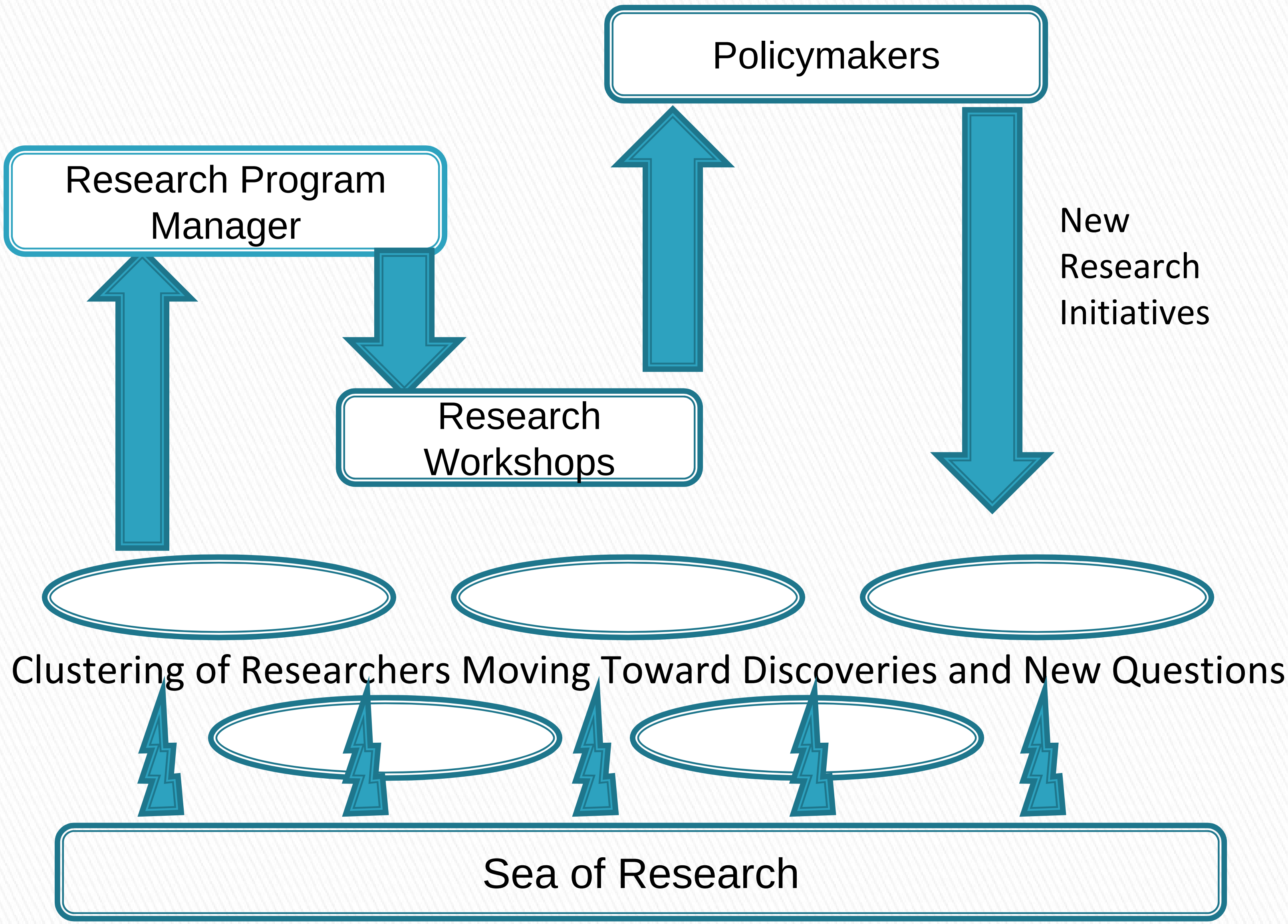
(Ref. Julia Lane, NSF)

Specific Science of Science Policy Questions

- What is the optimum portfolio of science agencies?
- How can science agencies track the impact of investment?
- What is the optimal size of the STEM workforce?
- What is the relative effectiveness of different policy instruments (funding, taxation, IP, transparency)?
- Is innovation always beneficial?
- Should all investment be high in tech?

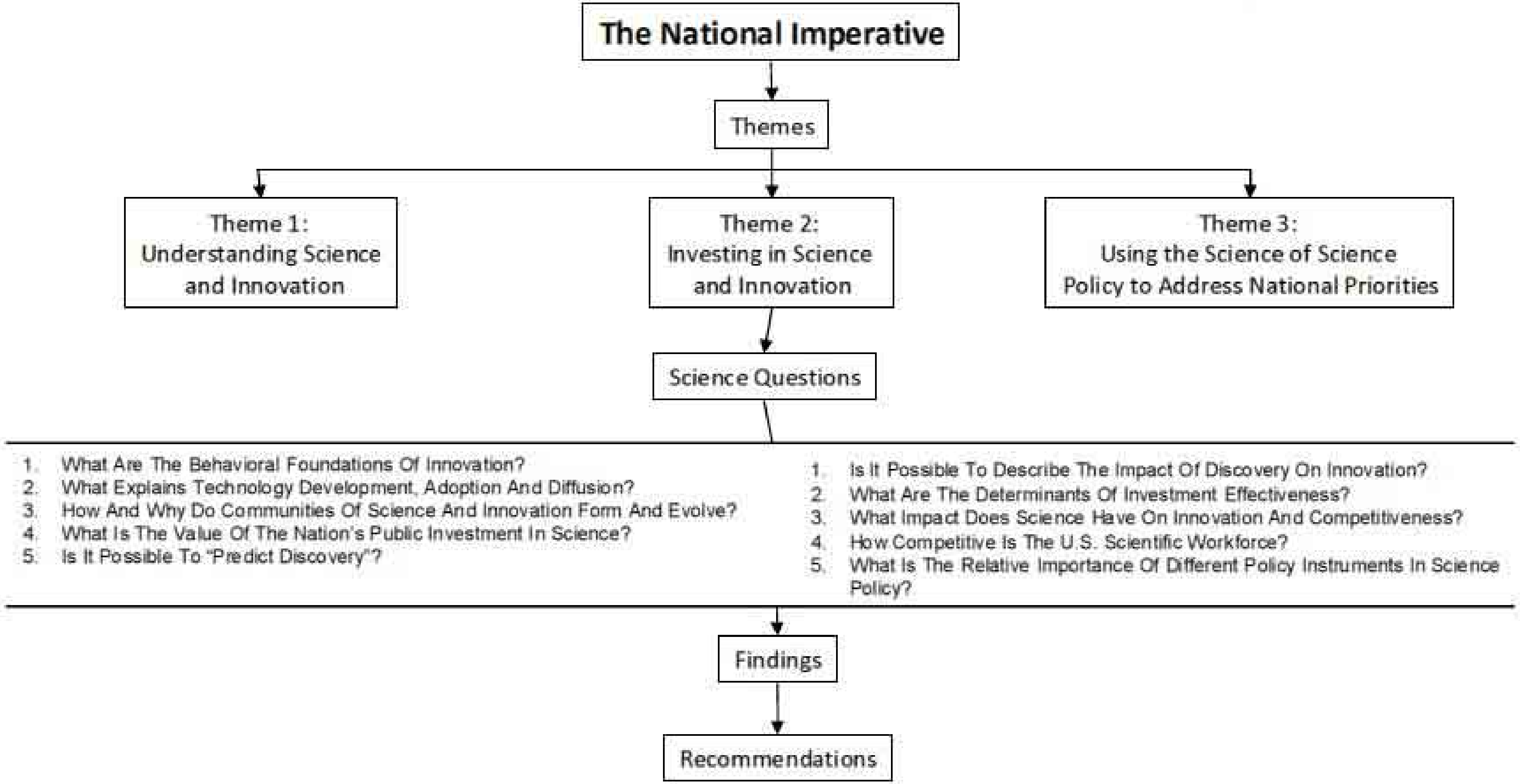
(Ref. Julia Lane, NSF)

Evolution of New Research Initiatives



(ref. G Hane background paper for IFTECH)

Structure of The Roadmap



3 Themes of SciSIP

Understanding Science and Innovation

1. What are the behavioral micro-foundations of innovation?
2. What explains technology adoption and diffusion?
3. How and why do communities of innovation form and evolve?

Investing in Science and Innovation

4. What is the value of publicly funded knowledge?
5. Is it possible to predict discovery?
6. Is it possible to describe the impact of discovery?
7. What are the determinants of investment effectiveness?

Using the Science of Science Policy Analysis to Address National Priorities

8. What impact does science have on innovation and competitiveness?
9. How competitive is the US scientific workforce?
10. What is the relative importance of policy instruments in science policy?

Recommendations

- Create an interagency research program to address the 10 scientific challenges
  - Invest in research data infrastructure
  - Invest in models, tools and metrics using ITG Evaluation Template
- Develop a National Innovation Framework
  - Explain benefits and effectiveness of S&T investments
  - Provide scenarios and options
- Create interagency entity to develop and sustain science policy analysis efforts
  - Synthesize and provide guide to current policy analysis practice
  - Nurture the nascent community of practice consisting of researchers and practitioners

Roadmap Workshop Summary Observations

- There is a well developed body of social science knowledge that could be readily applied to the study of science and innovation.
- Although many Federal agencies have their own communities of practice, the collect on and analysis of data about the science and scientific communities they support is heterogeneous and unsystematic.
- Agencies are using very different models, data and tools to understand their investments in science and technology.
- The data infrastructure is inadequate for decision-making.
- New tools and data sets could be developed and used to quantify the impact that the scientific enterprise has had on innovation and competitiveness.

Researching Impact of Stimulus

- Rapid Response Research (RAPID) to Study the Impact of the Economic Stimulus Package and to Advance the Scientific Understanding of Science Policy
  - What was the contribution of the science investment to the creation and retention of jobs?
  - What was the contribution of the science investment to science and technology industries?
  - What scientific or technological advances were achieved?
  - What was the impact on the scientific workforce?

Science and Technology Agents of Revolution (STAR) Database

Figure 1 – Major Features of the U.S. National Innovation System in the STAR Database: Policy, Innovation, Institutional Processes, and Economic Growth

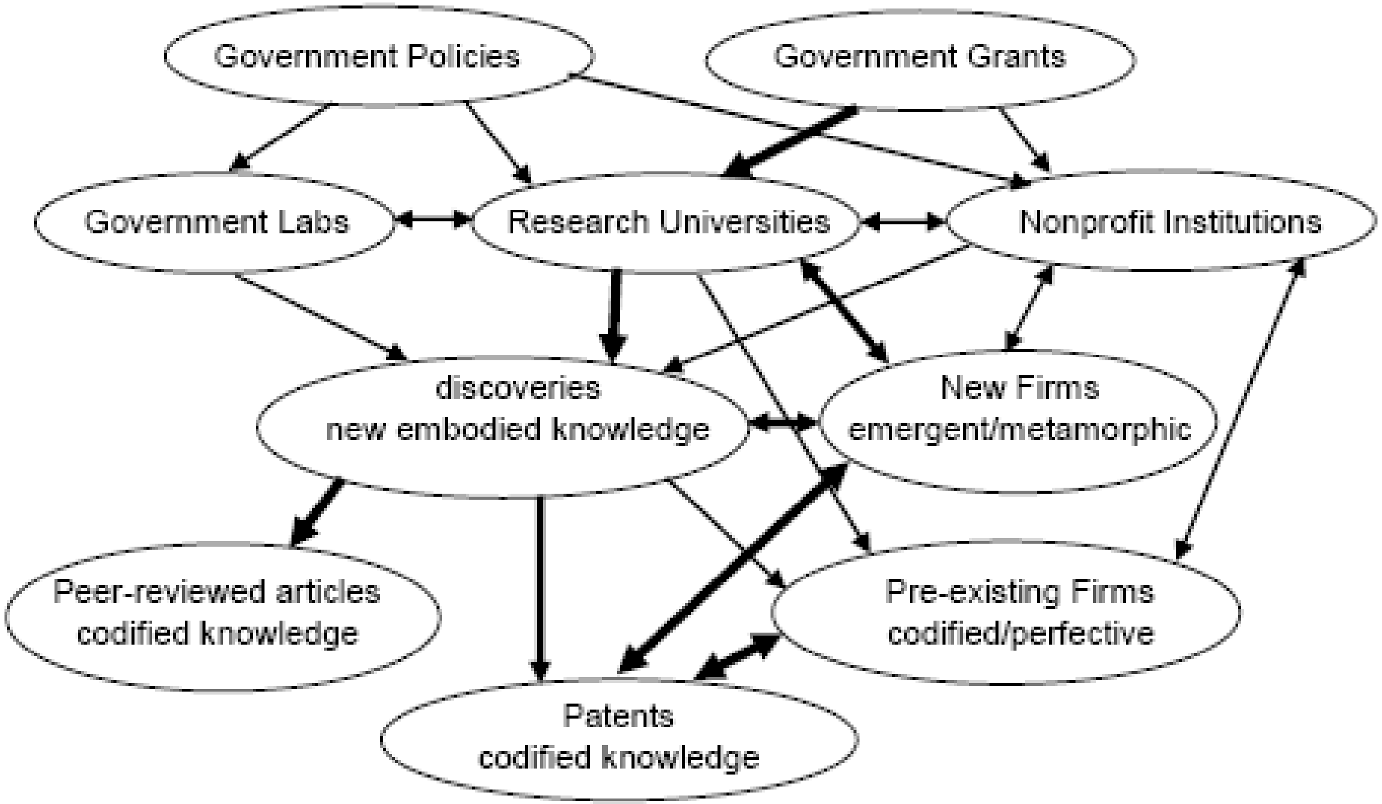
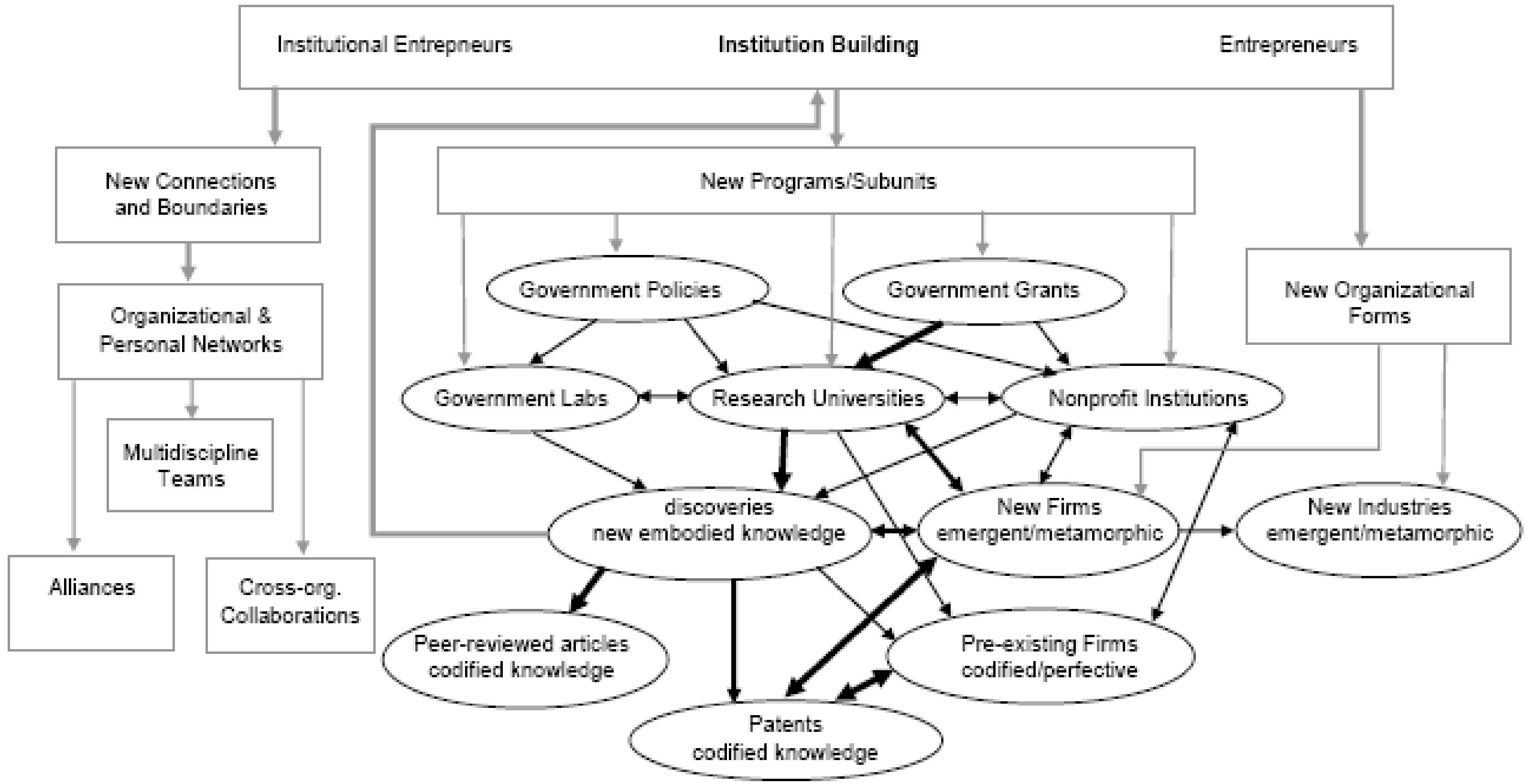


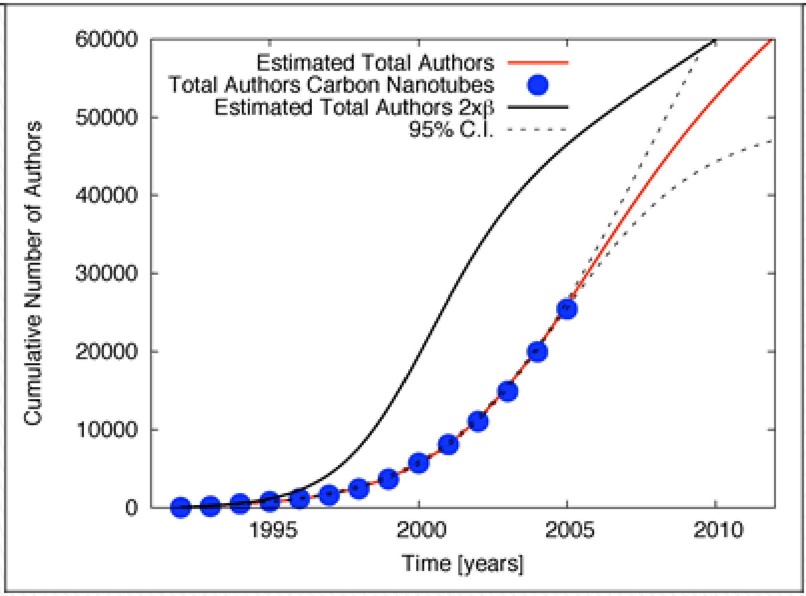
Figure 2 – Institutional Processes in Tandem with Knowledge Creation, Transmission and Use



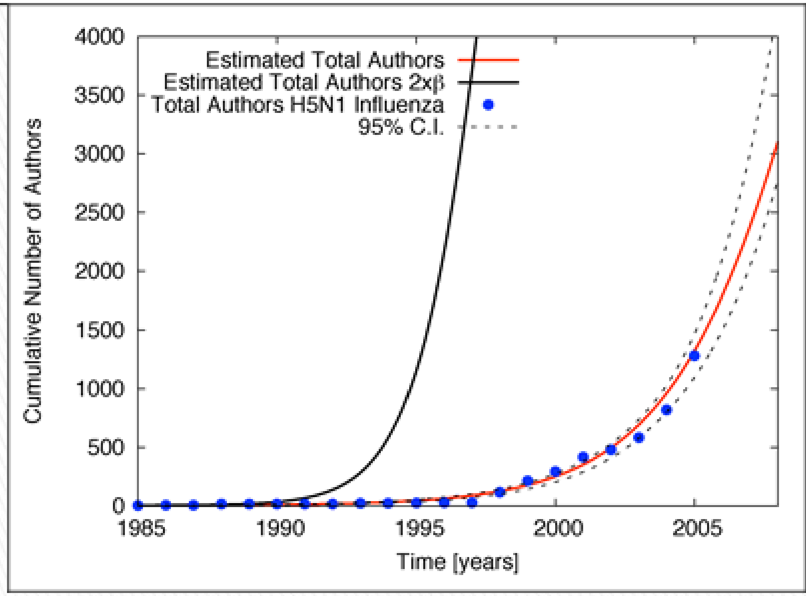
Note: grey boxes and arrows denote institutional processes

DOE Office of Scientific and Technical Information (OSTI)

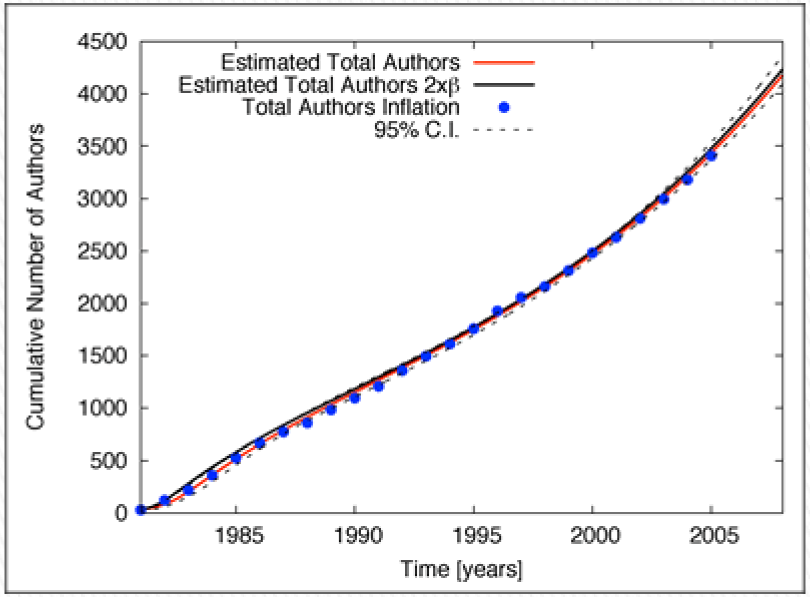
- OSTI is conducting applied research to explore ways to speed the diffusion of scientific knowledge and accelerate scientific progress. The intention is to save years and even decades in discovery time.
- Although “we don't know how large the economic or scientific impact might have been of turning the lights on for an additional generation, OSTI operates as if the benefits would have been significant.”



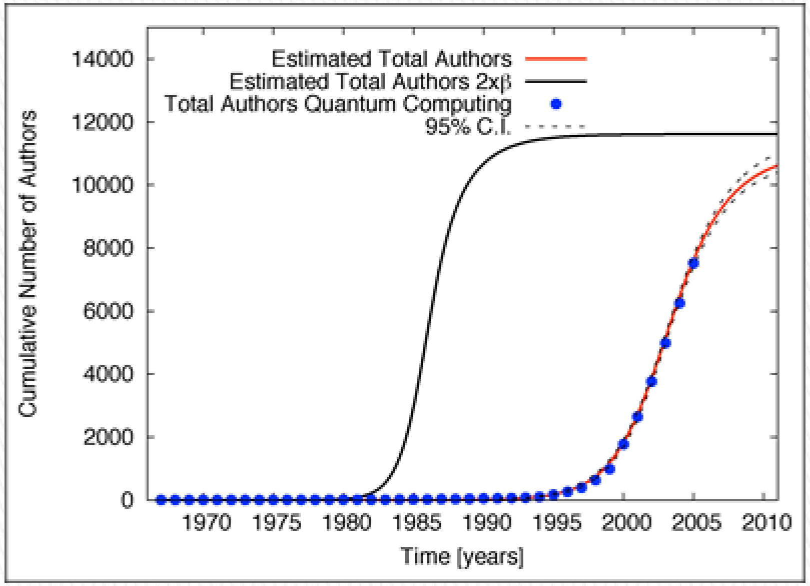
Carbon Nanotubes. Moderate sensitivity to the contact rate. Doubling the rate speeds up the science by about four years. This is a relatively large community with total authors estimated at tens of thousands.



Bird Flu. Doubling the contact rate between authors shows a discovery time savings of approximately one decade.



Cosmological Inflation Theory. Almost no sensitivity to the contact rate. Factors other than the contact rate limit the speed of discovery. This is a relatively small community with a few thousand authors.



Quantum Computing. A relatively extreme sensitivity to the contact rate. Doubling the rate speeds up the science by over fifteen years. This is a medium sized community with around ten thousand authors.

SRS Improvement/Expansion Activities and SciSIP

- Some activities accelerated or expanded to support SciSIP:
  - Redesigning the Industry R&D Survey
  - Working with the Bureau of Economic Analysis (BEA) to develop an R&D satellite account
  - Working to improve information about those in postdoctorate positions
  - Exploring approaches to gathering information on innovation
  - Redesigning the Academic Research and Development Survey
  - Adding a Field of Degree question to the American Community Survey
  - Exploring issues and approaches for surveys of the federal sector R&D
  - Exploring ways of collecting information about the interdisciplinary and collaborative nature of S&E jobs

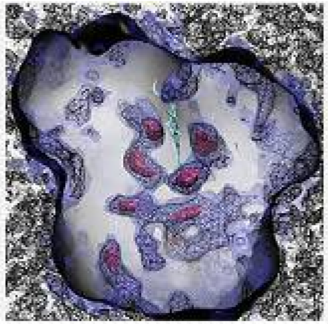
(Ref. Lynda Carlson , NSF, SRS)

SRS Improvement/Expansion Activities and SciSIP (cont'd)

- Establishing ongoing Experts Panels in major topical areas: Industry, Human Resources and Academic R&D
- Exploring the feasibility of linking SRS data with other data sets to increase the relevance of SRS data for SciSIP issues
- Exploring the feasibility of collecting SciSIP relevant information from non-profit institutions
- Improving the usability, coverage and data quality of the Survey of Graduate Students and Postdoctorates.
- Holding many workshops with data users on specific S&E issues related to SRS data

(Ref. Lynda Carlson , NSF, SRS)

NSF Cyber-Enabled Discovery and Innovation



- **Knowledge extraction.** Knowledge extraction encompasses a variety of techniques-such as data mining, visualization and using basic concepts from computation, geometry and topology
- **Interacting elements.** Analyzing the flow of electricity or information across the power grid or Internet, describing protein folding and unfolding, and finding principles for scaling from the quantum to the nano to the macro scales, require scientists and engineers to understand interacting systems.
- **Computational experimentation.** Computational experimentation allows insight into complex, real-world systems such as hurricanes, nerve synapse activity, or the Big Bang, by enabling the creation of a virtual description.
- **Virtual environments.** Virtual environments are important mechanisms to enhance discovery, learning and innovation. They permit collaboration among diverse populations spread across geographic distances and at different times.
- **Educating researchers and students in computational discovery.** The promise of these new technologies, as well as their diffusion into other segments of the economy, will not be realized without education.

How Large is the Impact of Science for Science Policy on Science Policy?

- To be determined ...

THANK YOU