



# The Politics of Innovation and Competitiveness



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Charles W. Wessner, Ph.D.  
Director, Technology, Innovation, and Entrepreneurship  
The National Academies



# The National Academies



- National Academy of Sciences
  - Chartered by Congress in 1863
  - A self-perpetuating Honorary Society
- National Research Council (1916)
  - The Operating Arm of the National Academies
- National Academy of Engineering (1964)
- Institute of Medicine (1970)

Today's Presentation Reflects my Personal Views



# Today's Presentation

- The Innovation Imperative
  - The Accelerating Pace of Competition
  - U.S. Innovation Strengths & Challenges
- U.S. Innovation Policies
  - Trends in U.S. R&D Spending
  - Growing Concerns and New Initiatives
  - Common Policy Myths and Their Impact on Innovation Programs
- The New Administration's Agenda



## Recent View of Some in the United States, e.g., the Congress

- “Life is good, so why worry about the future?”
- The answer:  
“A good life today may not be a good life tomorrow”

“Things change, & change rapidly”

- Dr. Wladawsky-Berger, IBM





# Today, There is a Shift from Complacency to Panic



- A risk that long-term needs and investments (e.g., research, education) can be lost in the scramble to 'save the economy.'



# The Rest of the World is Changing

## Global Competition is Increasing in Scale and Effectiveness

- **China** brings scale advantages, national focus and resources
  - National Goal to become a Global Manufacturing & Leading Edge R&D Center
  - Intense Focus on Innovation & Institutional Change
- **India's** Policy Liberalization now unleashing growth
  - Emerging as a center for high-end R&D
- **Japan** is Restructuring its Innovation System
  - High level policy focus and major investments
- **The UK, France, Netherlands, and Germany** are renewing & funding tech programs

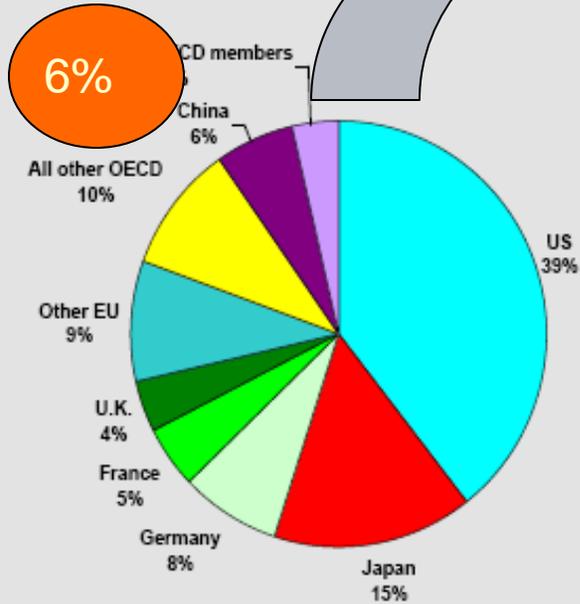
The Pace of Competition is Accelerating



# China's Remarkable R&D Growth

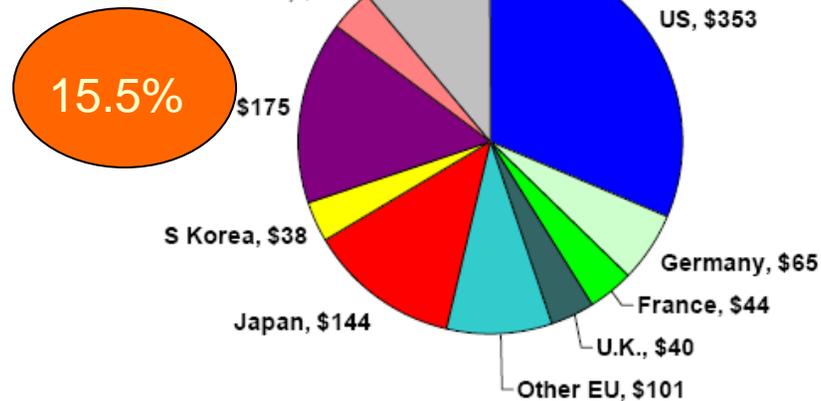
### Shares of Total World\* R&D, 1999

1999



### Shares of Total World R&D, 2007

2007



Total World R&D = U.S. \$1,124 billion\*\*

Source: Battelle, Global R&D Report, 2007, from Battelle, OECD, and R&D Magazine data. Projections for 2007, by performer nation. \*\* - calculated using purchasing power parities, in millions of dollars. DECEMBER '07 © 2007 AAAS





## Result: Growing Locational Competition

- Nations and regions spurring economic activity to create local jobs and improve living standards
- **What are they doing?**
  - Imitating 'successful' U.S. programs
    - Bayh-Dole incentives and/or SBIR type programs now found in Japan, India, UK, Russia, Finland, and other countries
  - Funding Research Universities
    - Finland's new Aalto University, Singapore's National University
  - Funding for innovative research and development
    - Tekes in Finland, VINNOVA in Sweden, OSEO in France
  - Building large scale science (and industrial) parks with support for facilities, staff, and joint research
    - Biopolis in Singapore, Competiveness Poles in France
- **The impact of these policies is of growing importance**



# The Innovation Imperative

- 3 Key Points
  - Innovation is Key to Maintaining a Country's Competitive Position in the Global Economy
  - Small Businesses and Universities Play a Key Role in the Innovation Process
  - Institutional Change is Necessary to Compete Successfully and New Incentives are Required for Change



# What is the United States Strategy to Address the Innovation Imperative?

(Well, there is no Strategy)  
What are the Strengths and  
Challenges?



## U.S. Advantages in Innovation

- A large and integrated domestic market
- An economic and institutional infrastructure that quickly re-deploys resources to their most efficient use
  - Strong and diverse higher educational infrastructure
  - Deep and **flexible** capital and labor markets
  - Strong S&T institutions
  - Entrepreneurial Culture
- The result: An ability to create new companies & grow new Large Firms



# A Major U.S. Advantage: Vibrant & Innovative Small Businesses

- **Jobs:** Generate 60 to 80 percent of net new jobs annually over the last decade
  - Employ 39 percent of high tech workers, such as scientists, engineers, and computer workers
- **Patents:** SMEs Produce 13 to 14 times more patents per employee than large patenting firms
  - Patents are of High Quality
  - Twice as likely as large firm patents to be among the one percent most cited
- **Small Companies are a Key source of Innovation by themselves and for Large Companies**

Sources: SBA Office of Advocacy (2005) data drawn from U.S. Bureau of the Census; Advocacy-funded research by Joel Popkin and Company (Research Summary #211); Federal Procurement Data System; Advocacy-funded research by CHI Research, nc. (Research Summary #225); Bureau of Labor Statistics, Current Population Survey; U.S. Department of Commerce, International Trade Administration



# A Positive Framework for Innovation

- **Positive Social Norms**
  - Individual initiative is encouraged and valued
  - High Social Value on Commercial Success
  - Forgiving Social Norms allow entrepreneurs more than one try: Entrepreneurs learn by doing
- **Entrepreneur-friendly Policies**
  - Markets Open to Competition
  - Reliable Contract Enforcement
  - Gentle Bankruptcy Laws permit rapid recovery
  - Tax laws give Prospect of Substantial Rewards
- **Strong Intellectual Property Protection**
  - Provides Personal Incentive for Invention
  - Encourages Research & Diffusion



# America's Secret Weapon: We Invest in R&D

- The U.S. Government supports R&D that serves important National Needs
  - In areas such as national defense, health, energy, the environment, natural resources, and agriculture.
- The U.S. government supports most of the nation's basic or Fundamental Research
  - Focused on gaining knowledge or understanding phenomena irrespective of any specific application
- U.S. Research also has Strong Problem-solving Orientation
  - Mission needs often drive research: Strong applied focus



# Another “Secret Weapon”

## Support for Excellence

### Funding for Research Universities

- A limited number of U.S. research universities receive a substantial portion of federal research funding: Centers of Excellence
- Universities are entrepreneurial
  - Faculty compete for federal grants
  - Presidents compete for donations and earmarks
  - States provide limited support
- U.S. research universities produce top quality science and commercialize the results
  - Research is both basic and applied
- This results in both good research and socially useful applications



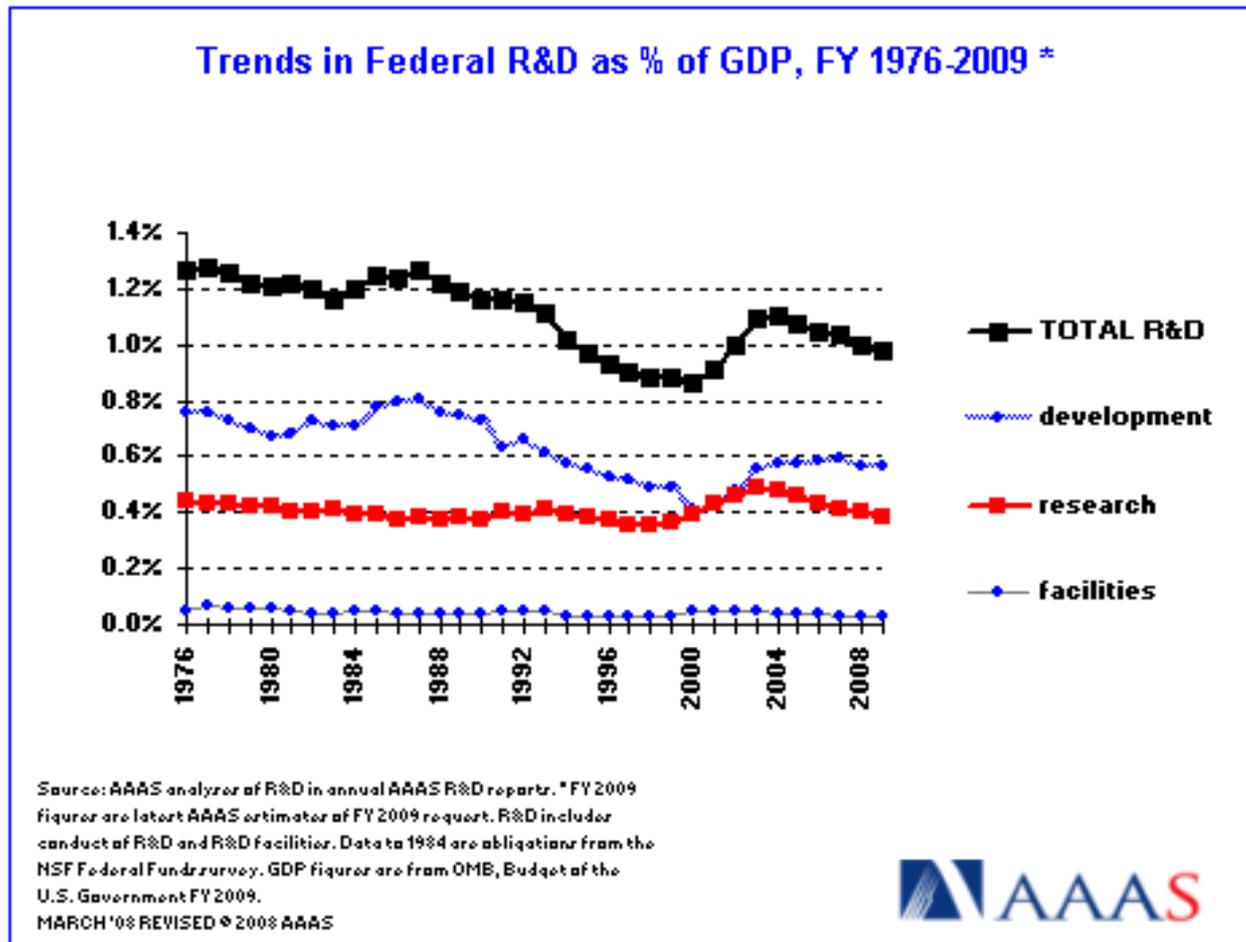
# However, the United States Faces Major Challenges to Sustaining its R&D Leadership over the Longer-Term

AAAS has highlighted that  
Federal R&D Levels are Stagnant

Key Policymakers remain Complacent

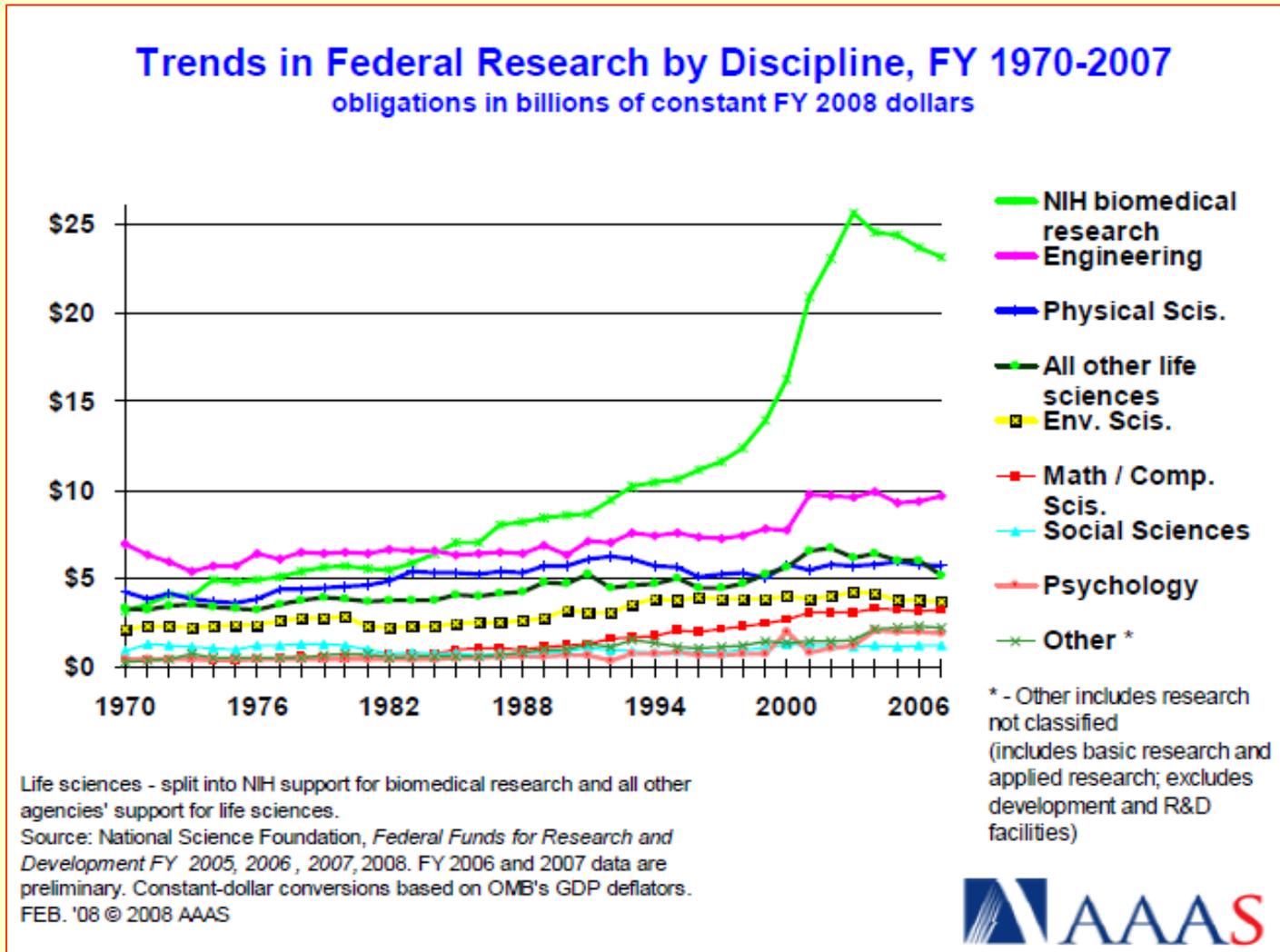


# Federal Funding for R&D has been declining as a percentage of GDP





# Significant Drop-off in NIH Funding



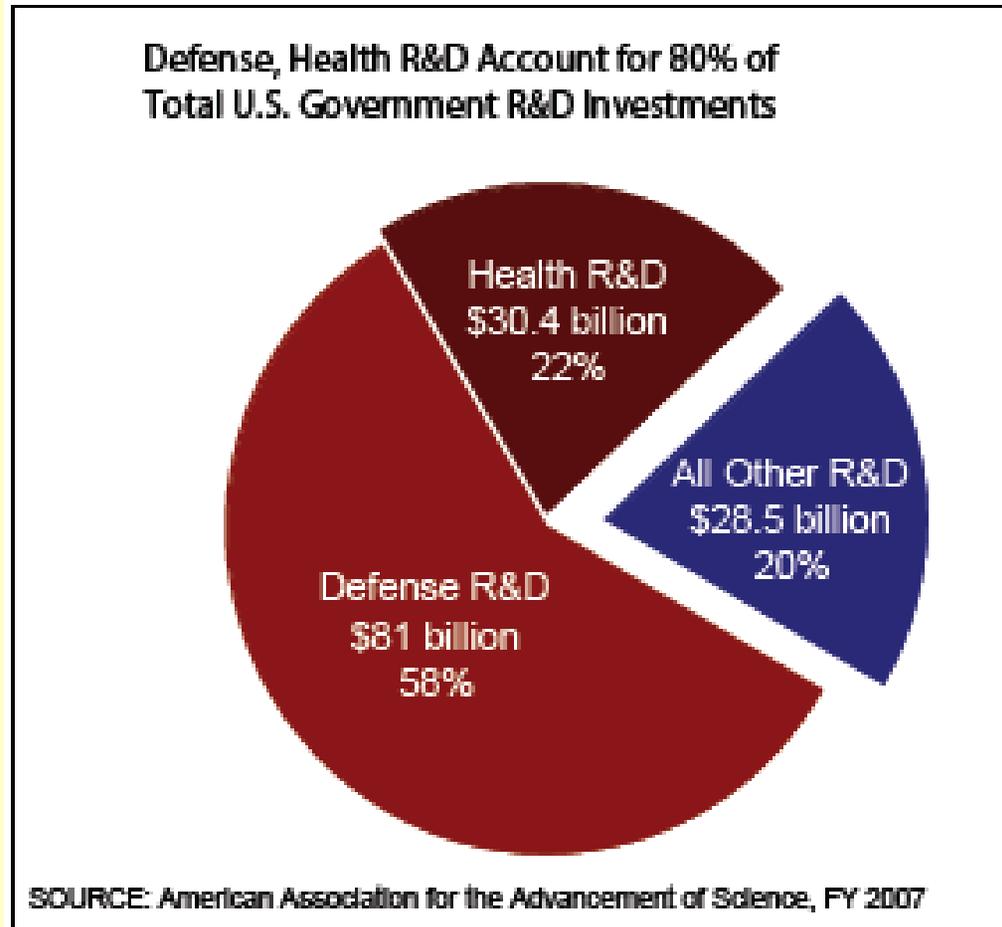


# Impact of Declining Health R&D Budgets

- Missed opportunities to pursue promising research and technologies
- Cohorts of new Post-Docs with limited opportunities for new RO1 grants
  - Excludes the young and the women
- A growing budget should let NIH
  - Keep up with medical inflation
  - Invest in new grants for new researchers
  - Encourage more cooperation across institutions and with industry



# Concerns about Allocation: 58% of U.S. Federal R&D is for Defense





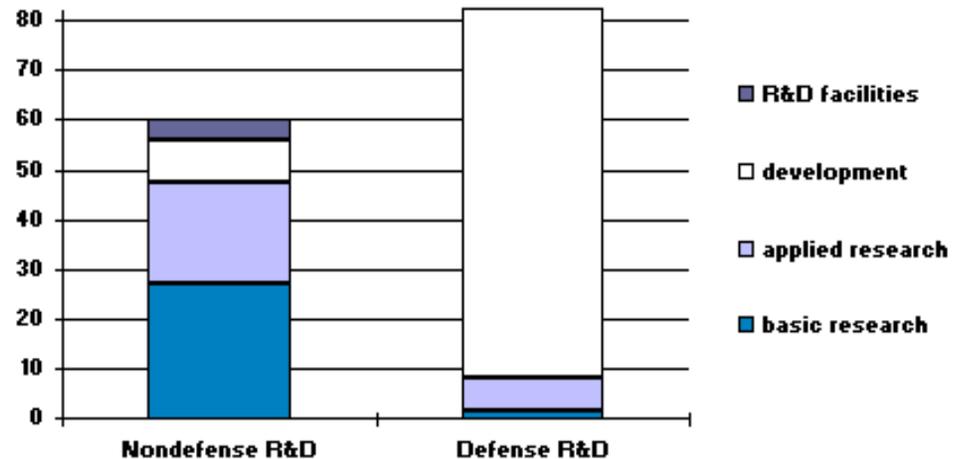
# ...But DoD Focus is on Development

## Is U.S. R&D Leadership Therefore a Myth?

The focus on weapons development and testing overstates the R&D element of the budget.

It is often not basic or even applied research but rather testing and certification.

Character of Defense and Nondefense R&D  
FY 2008 Budget, Budget Authority in Billions



Source: AAAS, based on OMB R&D budget data for FY 2008 and agency budget justifications. Defense R&D = DOD + DOE defense + DHS defense programs.  
MARCH 07 REVISED © 2007 AAAS





# Growing Chorus of Concern on US Innovation Policy

- National Innovation Initiative (2004)
  - Led by IBM and leading Universities
  - Ignored by the White House, but not by the Congress
- President's Council of Advisors on Science and Technology's Reports (2004)
  - Called for renewed investments in US Science & Engineering Capabilities
  - Called Attention to Growing Global Challenge in IT Manufacturing & Competitiveness
- Rising Above the Gathering Storm (2006)
  - A major National Academies assessment requested by the US Congress
  - **Warns of an "abrupt" loss of US leadership unless timely and adequate investments are made to support R&D**



# Concerns about U.S. Competitiveness led to the America Competes Act

- Signed into Law on August 6, 2007
- Authorized (but did not allocate) \$43.3 billion in federal spending in FY 2008-2010 in Science, Engineering, Mathematics, & Technology research
- “America Competes” Promised to
  - Double budgets of NSF, DOE’s Office of Science, NIST, MEP
  - Increase funding for new researchers
- The new law reflects recognition that the U.S. needs to change policy to meet the global innovation challenge
- **Only one problem, the funding was not provided!**
  - Funding America Competes in the current fiscal environment is a challenge



# U.S. Faces Severe Fiscal Challenges

- Iraq: A \$13 billion a month war
  - Center for Arms Control Estimate (FT 2008)
- Afghanistan: \$3 billion a month war
  - Center for Arms Control Estimate (FY 2008)
  - Afghan War to be escalated-spending will go up!
- Financial Rescue Package: \$700 billion & climbing
  - Bailout for Mortgage Funders, Insurance Firms (AIG), and Wall Street Financial Institutions
  - Detroit Automakers may be next: \$25 billion: Proposed
- Short-term fiscal stimulus to address expected economic recession
  - Investments in S&T are long-term; not tailored for short term stimulus spending (Lawrence Summers)



# Popular Myths about Innovation Continue to Obscure Need for Policy Action



## Why do Myths Matter?

- Policy Myths are often derived from elementary Economics models
  - Assume perfect information and costless transactions
  - Argue about what “Ought to be done” instead of what nations actually do
- **Impact: Sometimes, these myths distort U.S. policymaking**
  - U.S. suffers from “market oversell”
  - Too little appreciation of government contributions to industrial development
- What are some common myths?

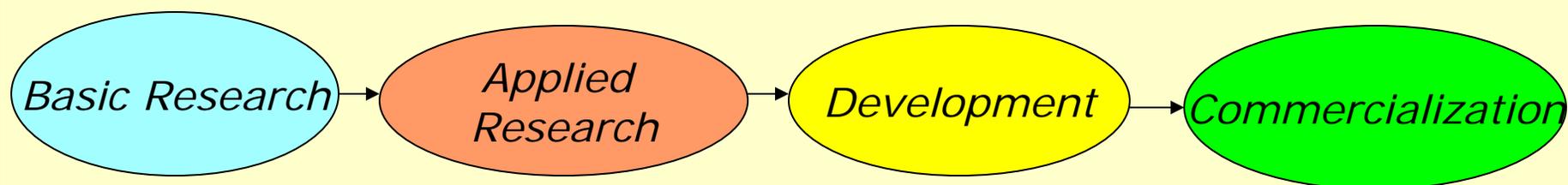


# The Myth of American Exceptionalism

- US Myth: American entrepreneurship and innovation is based on extraordinary qualities of Americans
- Reality: Incentives found in the US motivate individuals from all over the world to innovate by combining ideas with capital, know-how, and talent
  - Gentle Bankruptcy Laws permit rapid recovery
  - Forgiving Social Norms allow more than one try
  - High Social Value on Commercial Success
- Strong Clusters with Specialized Services, Markets Open to Competition, and the Prospect of Substantial Rewards all encourage Innovation



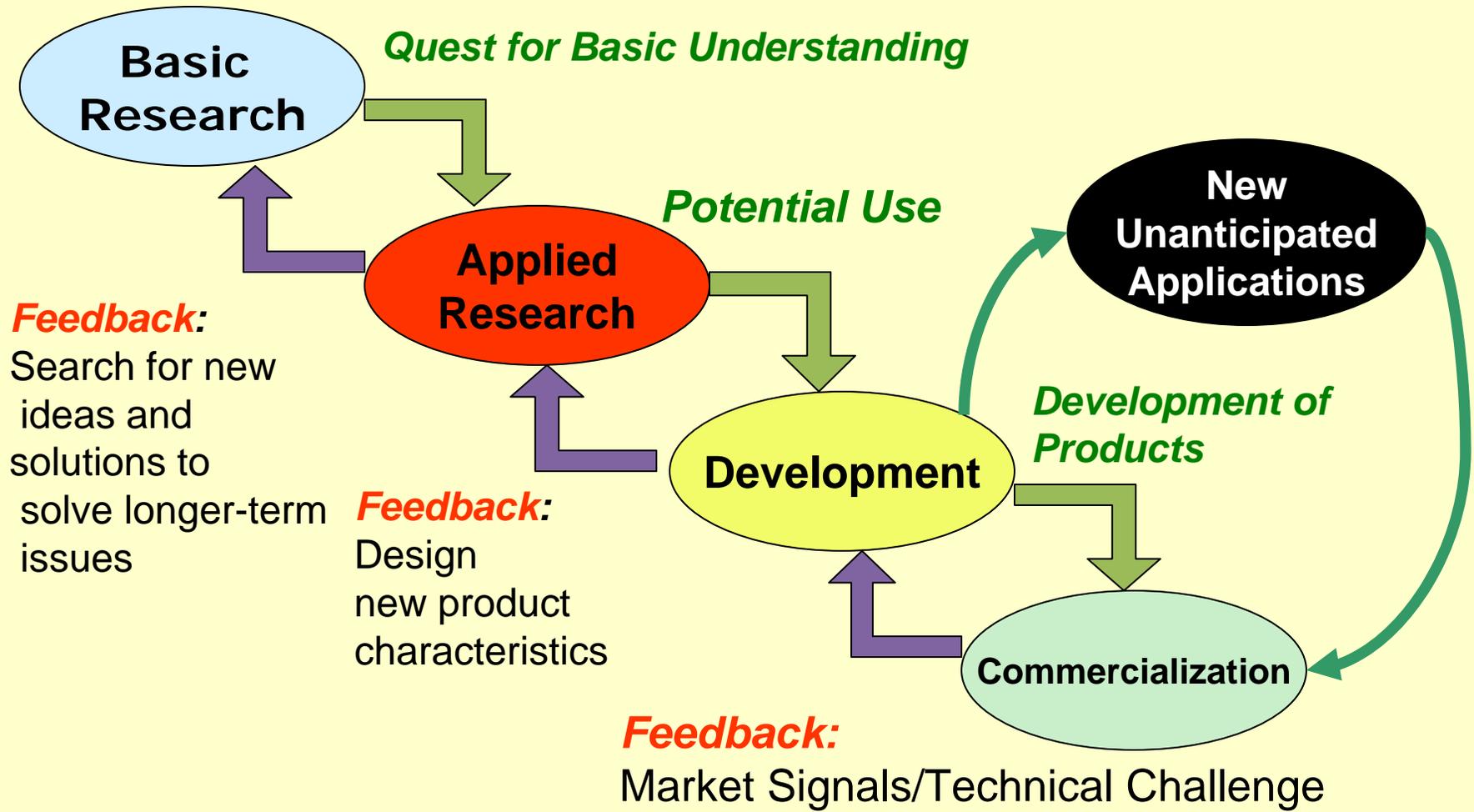
# The Myth of the Linear Model of Innovation



- **Reality: Innovation is a Complex Process**
  - Major overlap between Basic and Applied Research, as well as between Development and Commercialization
  - Principal Investigators and/or Patents and Processes are Mobile, i.e., not firm-dependent
  - Many Unexpected Outcomes
  - Technological breakthroughs may precede, as well as stem from, basic research
- **Many of our policies and institutions remain based on this linear model**



# Non-Linear Model of Innovation





# The U.S. Myth of Perfect Markets

- Strong U.S. Myth: “If it is a good idea, the market will fund it.”
- Reality: Potential Investors have less than perfect knowledge, especially about innovative new ideas
  - “Asymmetric Information” leads to suboptimal investments
    - This means that it is hard for small firms to obtain funding for new ideas
    - George Akerlof, Michael Spence and Joseph Stiglitz received the Nobel Prize in 2001, “for their analyses of markets with asymmetric information”



# The Myth of U.S. Venture Capital Markets

- Myth: “U.S. VC Markets are broad & deep, thus there is no role for government awards”
  - “If you have a good idea, a good team, and you sell it well, you will be funded”
    - George Scalise, President SIA, 29 April, 2008
- Reality: Venture Capitalists have
  - Limited information on new firms
  - Prone to herding tendencies
  - Focus on later stages of technology development
  - Most VC investors seek early exit



# Large U.S. Venture Capital Market is Not Focused on Early-Stage Firms

- Information on potential product is limited: Risk is too high
  - Proof of concept/prototype often absent or not yet achieved
  - Even Angel investors need more information
- Fund Operations: Small Investments have High Overhead Costs
  - Most Early Stage firms need investments in the \$100K to \$700K range
  - Average VC investment is \$8.3 million
  - Most VC firms do not want to manage numerous small investments
- See the current Funding break out

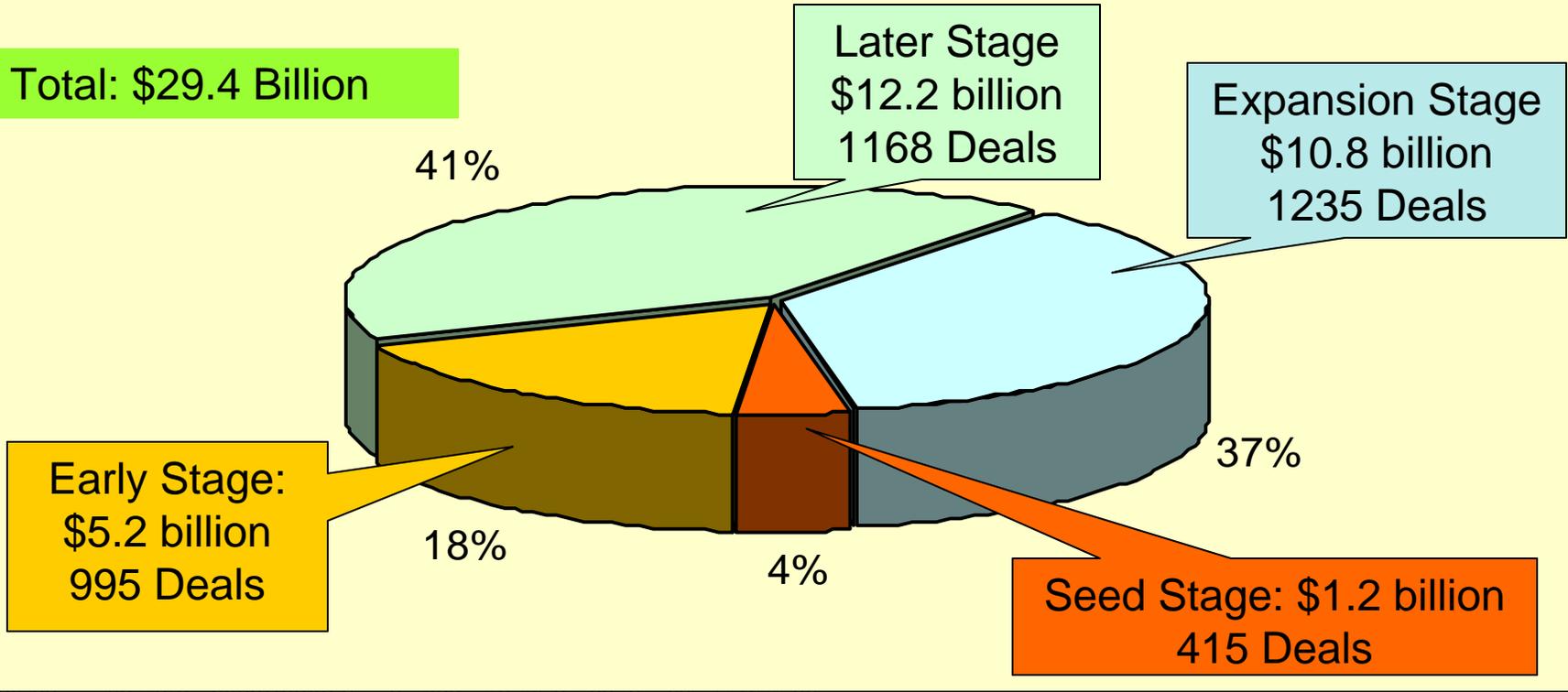


# The Venture Capital Constraint

Large U.S. Venture Capital Market is Not Focused on Seed/Early-Stage Firms

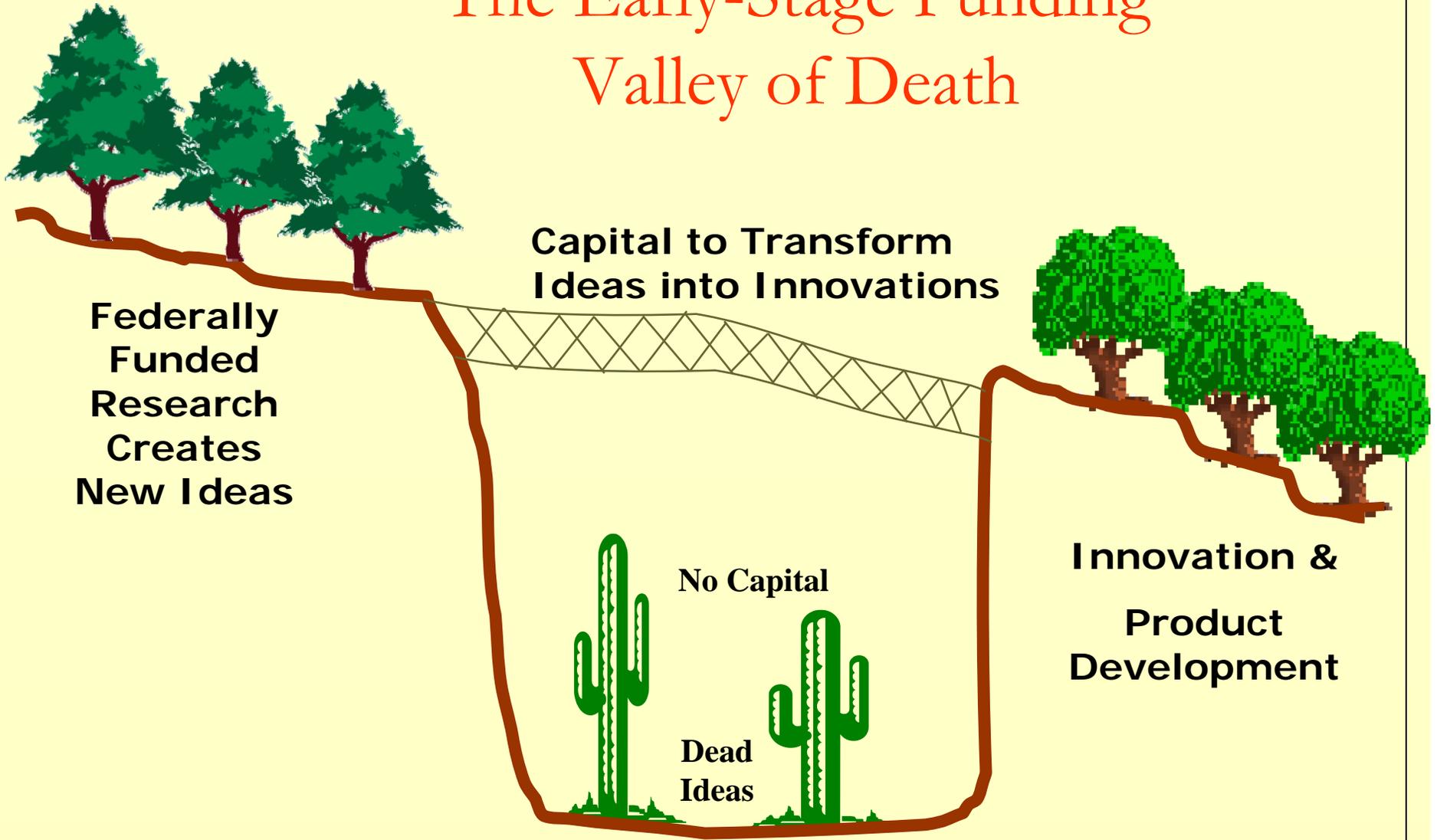
## U.S. Venture Capital by Stage of Investment 2007

Total: \$29.4 Billion





# The Early-Stage Funding Valley of Death





# How to Bridge the Valley of Death?

- The US “System” includes (incoherently)
  - Funding for Research and Development
    - University Research Supported by DoE, DoD, NSF & NIH
    - DARPA Funding for long-term goals & mission needs
  - **Public Private Partnerships**
    - Financing Proof of Principle & Prototype with SBIR
    - Joint Ventures with ATP/TIP
    - Industry-led Consortia Creates Standards & Joint Research
  - Tax Credits
    - Broad R&D and New Investment Tax Credits
  - An Entrepreneurial-friendly Policy Environment



## The Power of Myth

- “We should not pick winners & losers”
  - In Washington, this is considered profound
- They’re right of course. Pick winners, the losers will discover who they are.
- Winners in our system include banks and insurance companies, agriculture, e.g., corn and sugar producers, and, of course, oil companies.
- In fact, we have a long tradition of picking winners with government support.



# Public-Private Partnerships: A Long Tradition in the United States

- U.S. has long benefited from cooperation between government and private firms
  - “Government has played an important role in the technology development and transfer in almost every U.S. industry that has become competitive on a global scale”

Professor Vernon Ruttan



# Precedents for Public Role in Commercialization of Science in the U.S.

- **1798** - Grant to Eli Whitney to produce muskets with interchangeable parts, founds first machine tool industry
- **1842** - Samuel Morse receives award to demonstrate feasibility of telegraph
- **1903** – Wright Brothers fly, fulfilling the terms of an Army contract!
- **1915** – National Advisory Committee for Aeronautics instrumental in rapid advance in commercial and military aircraft technology



# Precedents for Public Role in Commercialization of Science in the U.S.

- **1919** – Radio manufacturing (RCA) founded on initiative (equity and Board Membership) of U.S. Navy with commercial and military rationale.
- **1940s, '50s, '60s** – Jet Aircraft, Semiconductors, Computers, Satellites, Nuclear Energy
  - Government-supported industries are “the Foundations of the Modern Economy,” Cohen & Noll
- **1969-1990s** - Government investment in forerunners of the Internet (Arpanet) and the Global Positioning System
- **Today:** Current investments in genomic and biomedical research, advanced computing and new materials, e.g., nanotechnology initiatives



# Government Role in Innovation

- Listening to some Americans critical of the government's role brings to mind the Jewish patriot criticism of the Romans in the Monty Python film "Life of Brian". "  
– The Economist, May 1, 2004



- But what, apart from the roads, the sewers, the medicine, the Forum, the theater, education, public order, irrigation, the fresh-water system and public baths...  
what have the Romans ever done for us?  
(and the wine, don't forget the wine...)



# Successful U.S. Partnerships are Threatened by the Politics of Innovation

The Advanced Technology Program was  
Eliminated

The SBIR Program is under Threat



# The Advanced Technology Program

- Designed to Build Cooperation between Large and Small Companies to develop Technologies with broad Applications
- Fairly Small at \$140 million per year but High Impact at the Cutting Edge of New Technologies
- Highly Competitive: Only 12.5% receive awards
- Globally recognized evaluation program
- Program Concept and Practice Validated by National Academies Assessment



## U.S. Ambivalence on Market Intervention: (Testimony – February, 14 2007)

- “The Bush Administration recognizes the benefits of the ATP Program. The issue isn’t the program’s effectiveness, **it is whether it is appropriate for the Federal Government to play that role.**”

Dr. William Jeffrey, NIST Director



- “My understanding is that **if it is not broken, then break it?** You’re saying that it is not the role of the government to be part of a program that is working well?”

Rep. Ben Chandler (D-Ky)





## Eulogy for ATP

- “The termination of ATP is a particularly egregious step in the wrong direction, in light of the past accomplishments of the program and the current global competition in technology that the United States faces.”
  - Senator Jeff Bingaman



# A New Innovation Program To Address these Political Challenges

- Technology Innovation Program (TIP)
  - Established in 2007 America Competes Act
  - Focused on Critical National Needs
  - Provides cost sharing grants through Merit Based Competition for high-risk, high-reward research to address national needs
  - Eliminates Joint Ventures with Large Companies
  - Seriously underfunded—i.e., around \$80 million



# The Small Business Innovation Research (SBIR) Program

Helping Small Businesses  
Cross the Valley of Death



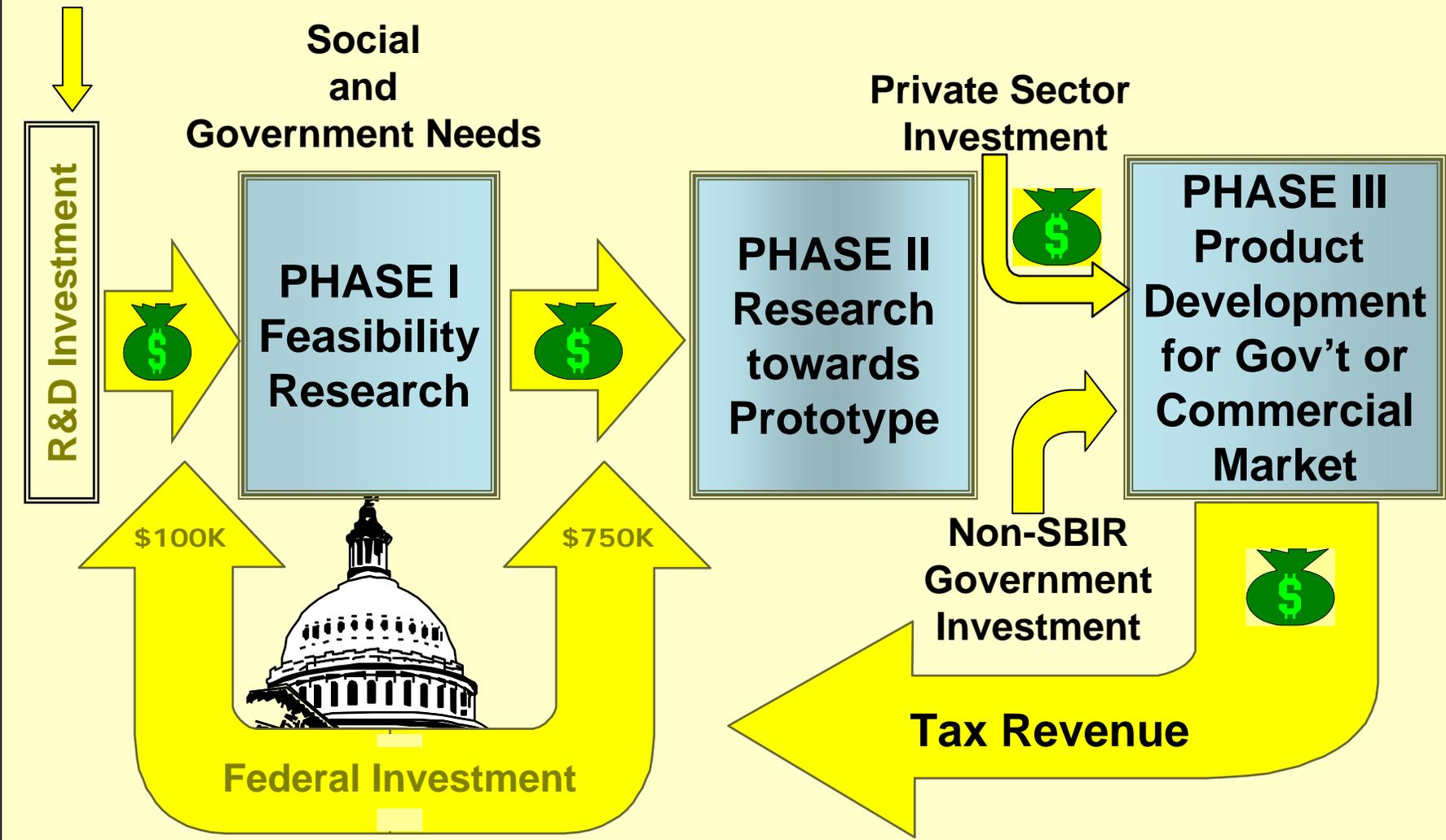
# SBIR Program—Key Features

- Long-lived:
  - In place for 25 years
  - Created by the Small Business Innovation Act of 1982 & renewed in 1992 & 2001
- Decentralized:
  - Each Agency uses its funds to support (or create) research by small companies
- Stable Budgets:
  - Agencies must allocate 2.5% of their R&D budgets for small business awards
- Large Scale:
  - Largest U.S. Innovation Partnership Program
  - Currently a \$2.3 billion per year
- Focus:
  - Funds Proof of Concept to help firms across the Valley of Death and attract private capital or public contracts



\$143 billion

# The SBIR “Open Innovation” Model





“The SBIR program is sound in concept and effective in practice.”

Key Finding of the National Academies' Recently Concluded Comprehensive Assessment of SBIR



# Common Innovation Myths Threaten SBIR Reauthorization

- Innovation is linear:
  - Widespread belief that government should only fund academic research, not small business research
- Market ideology
  - Government should not pick “winners and losers”—only markets should
- Supporting private sector R&D is pork
  - Some wrongly believe that SBIR represents a form of budget earmarks
- **The Result: Efforts to reauthorize SBIR in the 110th Congress have failed**
  - The SBIR program expires in March 2009
  - Congress has a narrow window to reauthorize SBIR



# What is President-Elect Obama's Innovation Agenda?

An ambitious list

Partnerships are a way to get this done,  
and quickly



# Obama's Proposed Support for Innovation

- **Encourage Science-based Policymaking**
  - Raise profile of the President's Science Advisor
  - Promote decision-making based on scientific evidence
- **Expand R&D Investments**
  - Fully fund the America Competes Act--Double federal funding for basic research over ten years
  - Back high-risk, high-return research
  - Encourage Multidisciplinary Research and Education
- **Grow the Science and Engineering Workforce**
  - Recruit best minds to teach K-12 math, science, and technology
  - \$500 million Technology Investment Fund to bring new technologies to schools
  - Partner with states to encourage and measure STEM learning
  - Triple the number of NSF Graduate Research Fellowships

Sources: [change.gov](http://change.gov); [barakobama.com](http://barakobama.com)



# Obama's Proposed Support for Innovation

- **Foster Innovation and Entrepreneurship**
  - Deploy Next-Generation Broadband
  - Reform the Patent System
  - Immigration reform to attract talent worldwide
  - Make the R&D tax credit permanent
  - Eliminate the capital gains tax on start-ups and small businesses
- **Address the “Grand Challenges” of the 21st Century**
  - Accelerate the transition to a low-carbon, oil-free economy
  - Encourage “green technologies” to sustain the planet and the environment while creating new industries
  - Use technology to improve the quality and lower the cost of healthcare



# Innovation Partnerships are a Proven Way to Advance this Agenda

- Encourage cooperation among university, government and industry to foster emerging technologies
  - Partnership call for Multi-disciplinary Research
- Augment and leverage the government's significant investments in R&D
  - Address Critical National Needs in Infrastructure
  - Address Grand Challenges in Energy, Health, and Environment
- We need to Support the Partnership Programs that Encourage Innovation
  - Renew and expand SBIR
  - Adequately fund the new Technology Innovation Program
  - Create new programs on proven principles.



# Our Common Challenge

- Adjusting to the new Globalization Dynamic and global warming are the key Challenges of the 21<sup>st</sup> Century
- This involves National Initiatives to encourage change through competitive incentives:
  - Incentives for entrepreneurial activity for Small Firms, Large Firms, and Universities
  - Incentives (not mandates) for cooperation among all actors
  - Public-private partnerships like SBIR can play an important role
- Mutual Learning and Cooperation are Essential for our Common Future



# Thank You



Charles W. Wessner, Ph.D.

Director, Program on  
Technology, Innovation and Entrepreneurship  
The U.S. National Academies  
500 Fifth Street NW  
Washington, D.C. 20001  
[cwessner@nas.edu](mailto:cwessner@nas.edu)  
Tel: 202 334 3801

<http://www.nationalacademies.org/step>