The Future of Science and Engineering in New Mexico and the Nation

The times … they are a changin'

New Mexico Faculty Leadership Program – 2010

January 5-7, 2010

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Science Advisor to Governor Richardson

Science Policy

Science The Endless Frontier

A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development, July 1945

(United States Government Printing Office, Washington: 1945)

Five Fundamentals - Vannevar Bush

1) Stability of funds over a period of years

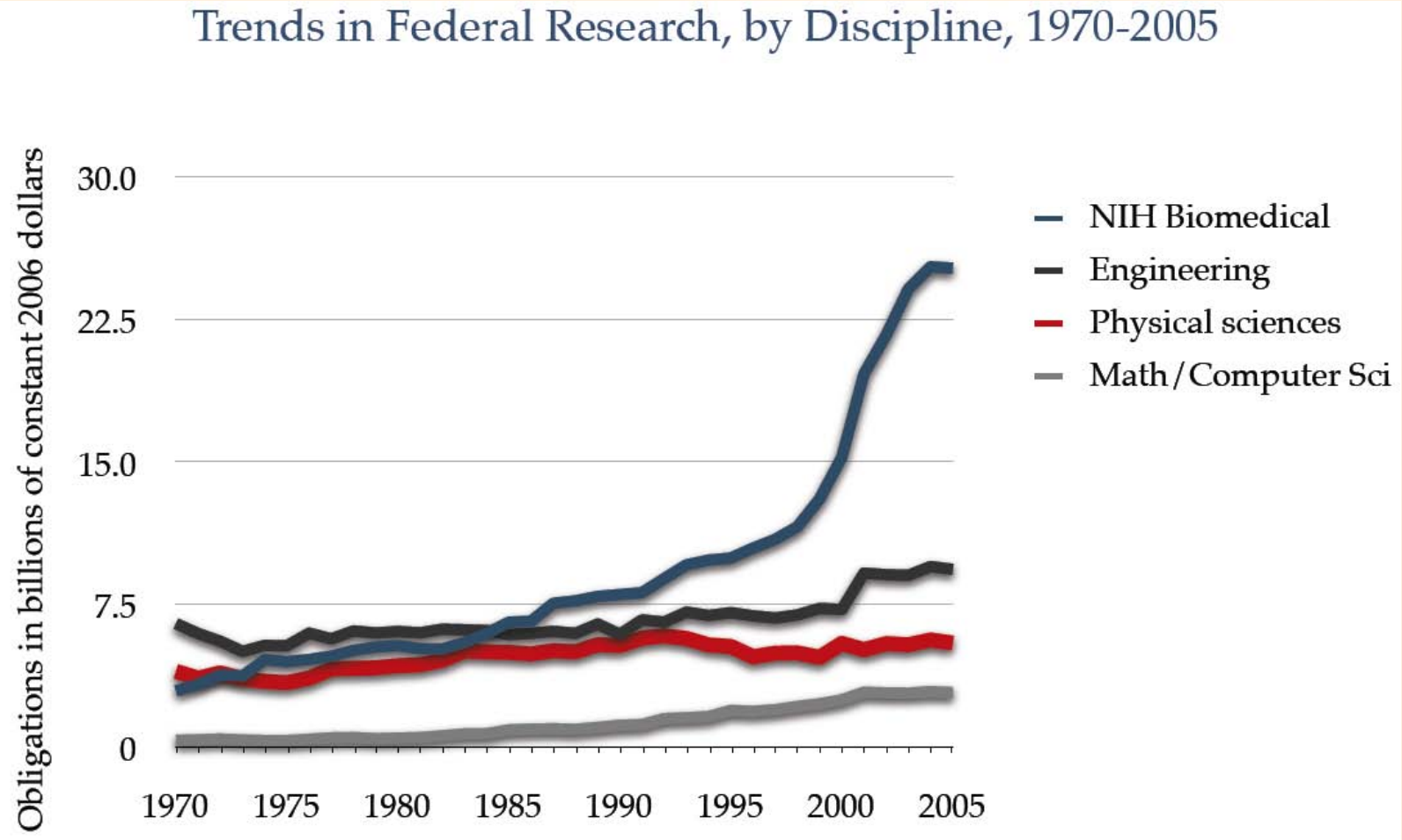
2) Funding agency composed of citizens with a broad understanding of science research selected based on interest in and capacity to promote the work of the agency

3) Agency should promote research at organizations outside the Federal Government. It should not operate any laboratories of its own.

4) Support of basic research must leave the control of the research to the institutions themselves. This is of the utmost importance.

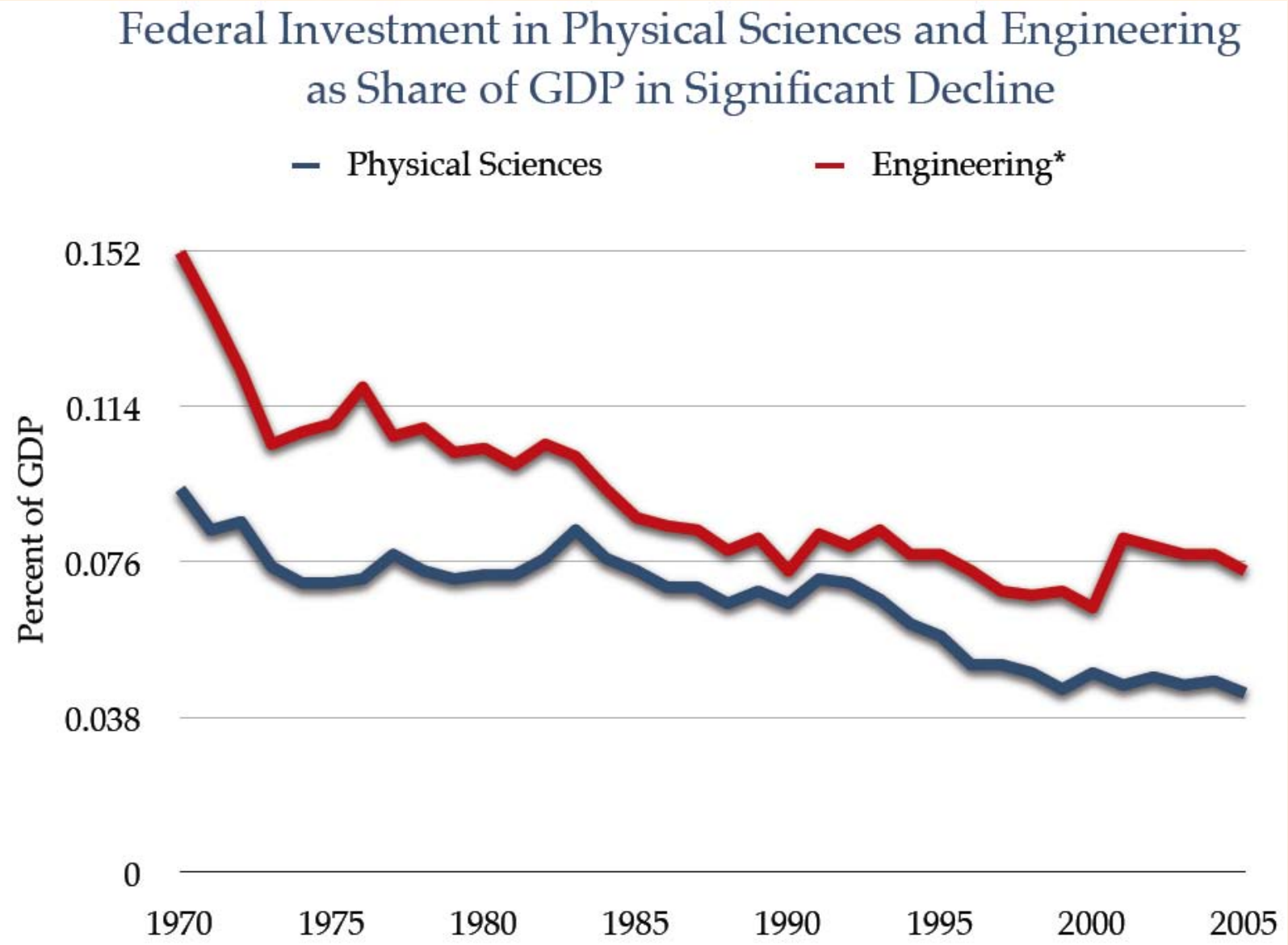
5) While assuring complete independence of the research and discretion in the allocation of funds, the Foundation must be responsible to the President and the Congress.

U.S. Investments in S&E by Discipline

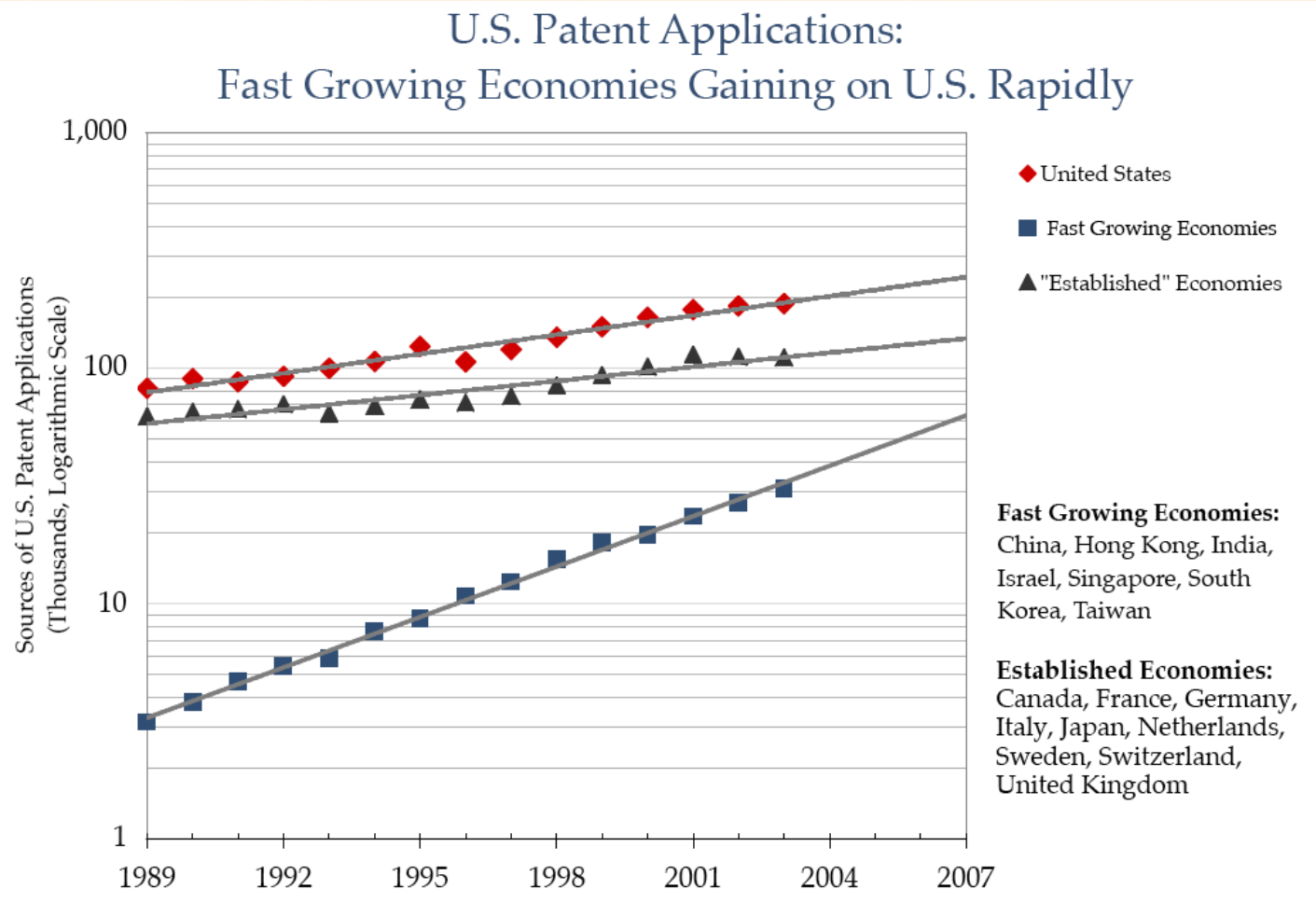


U.S. investing in health and making ourselves feel better
Other countries investing in physical sciences

U.S. Investments in S&E

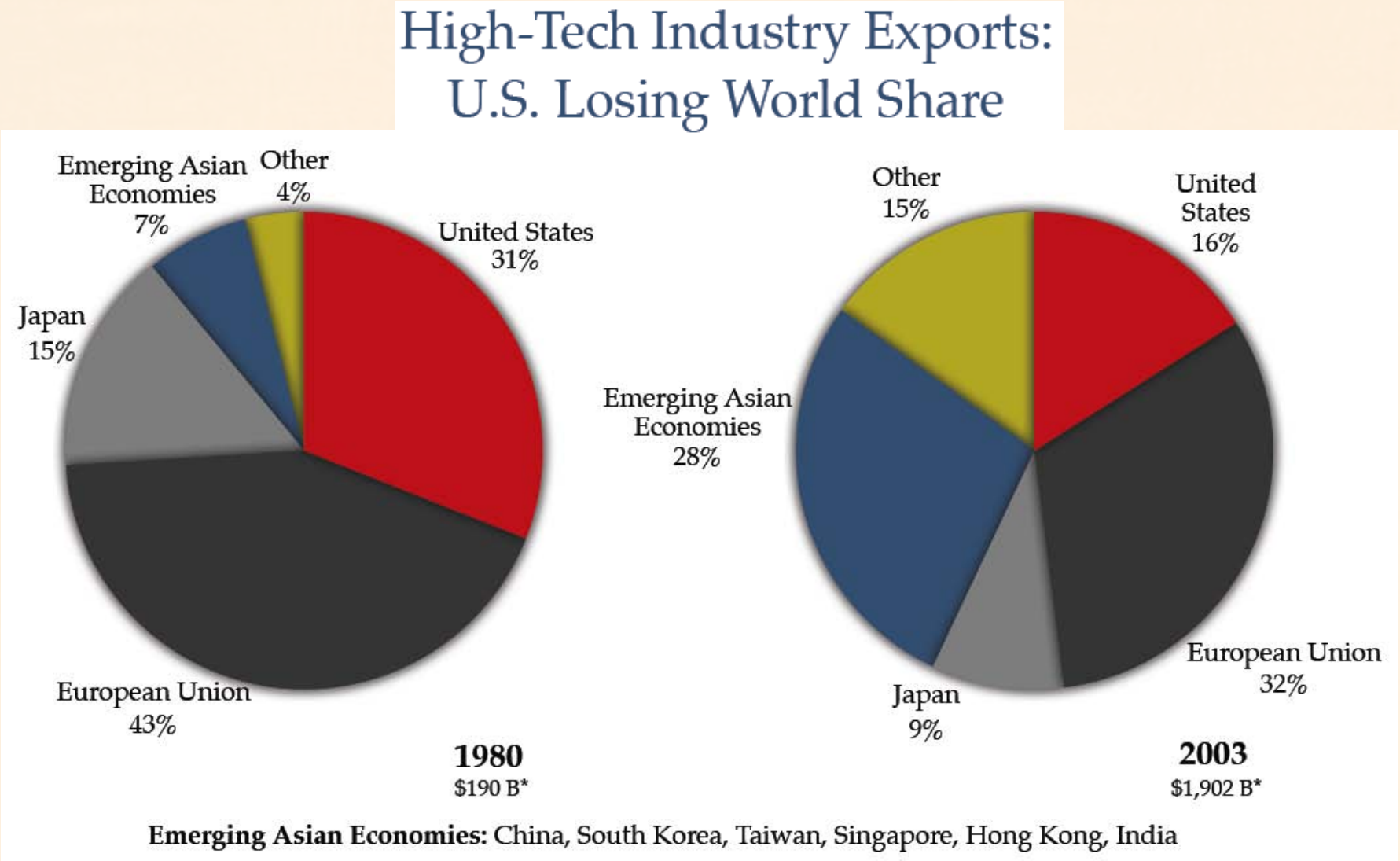


Innovation - U.S. Competitiveness

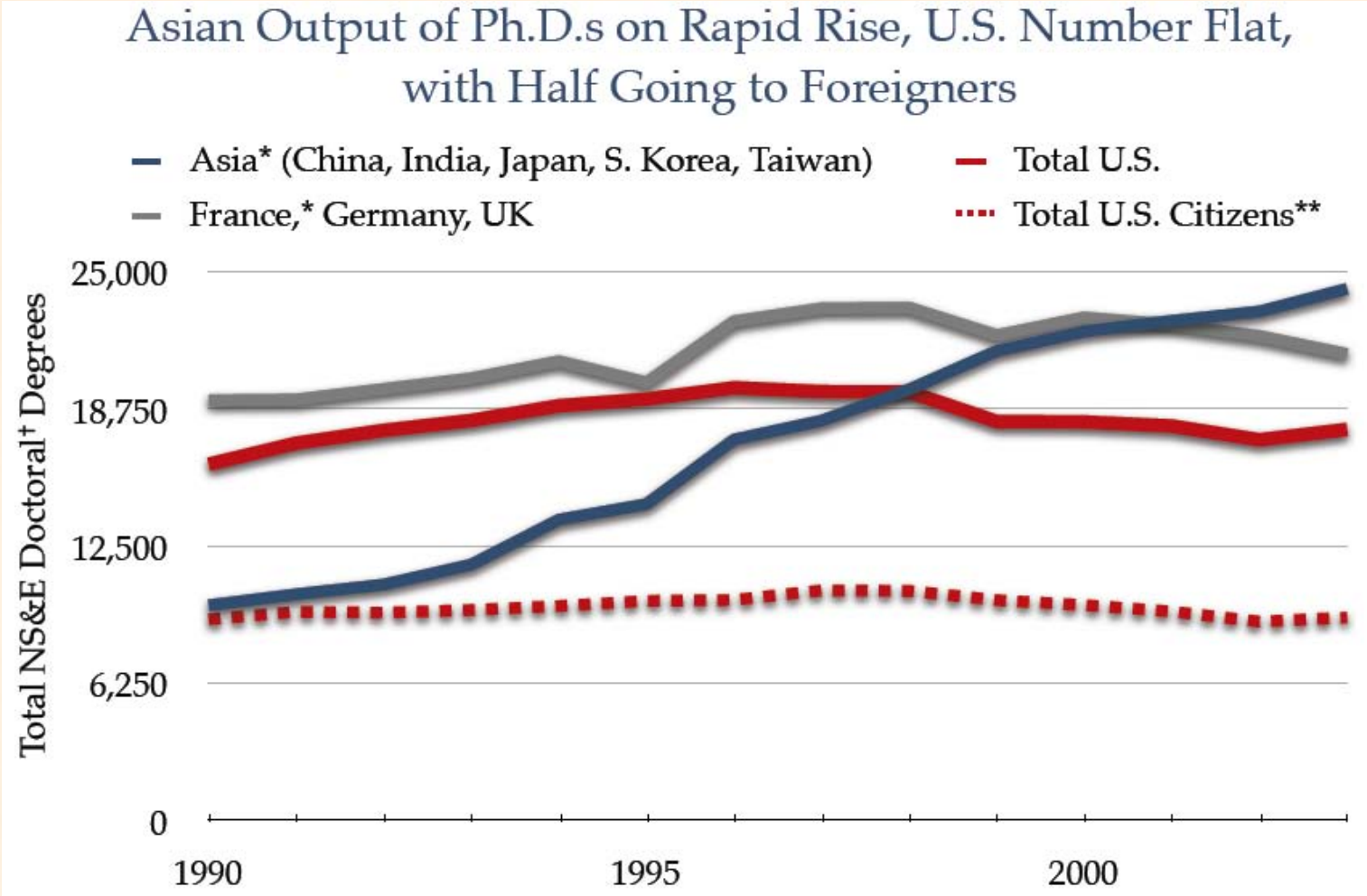


Science and Engineering publication rates show same trend
Western Europe eclipsed the U.S. in 1995

High-Tech Industry - Competitiveness

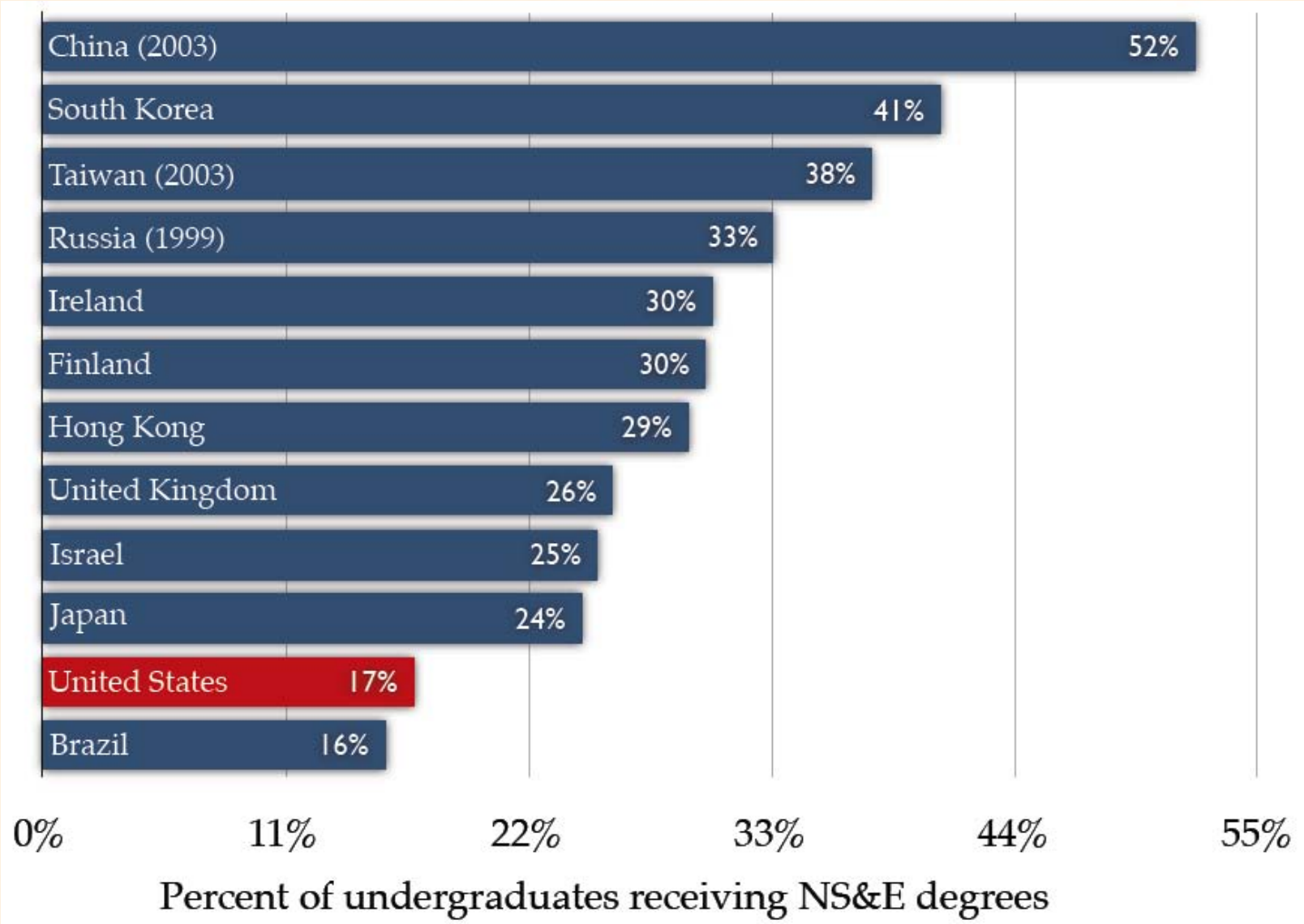


Educated Workforce - Competitiveness

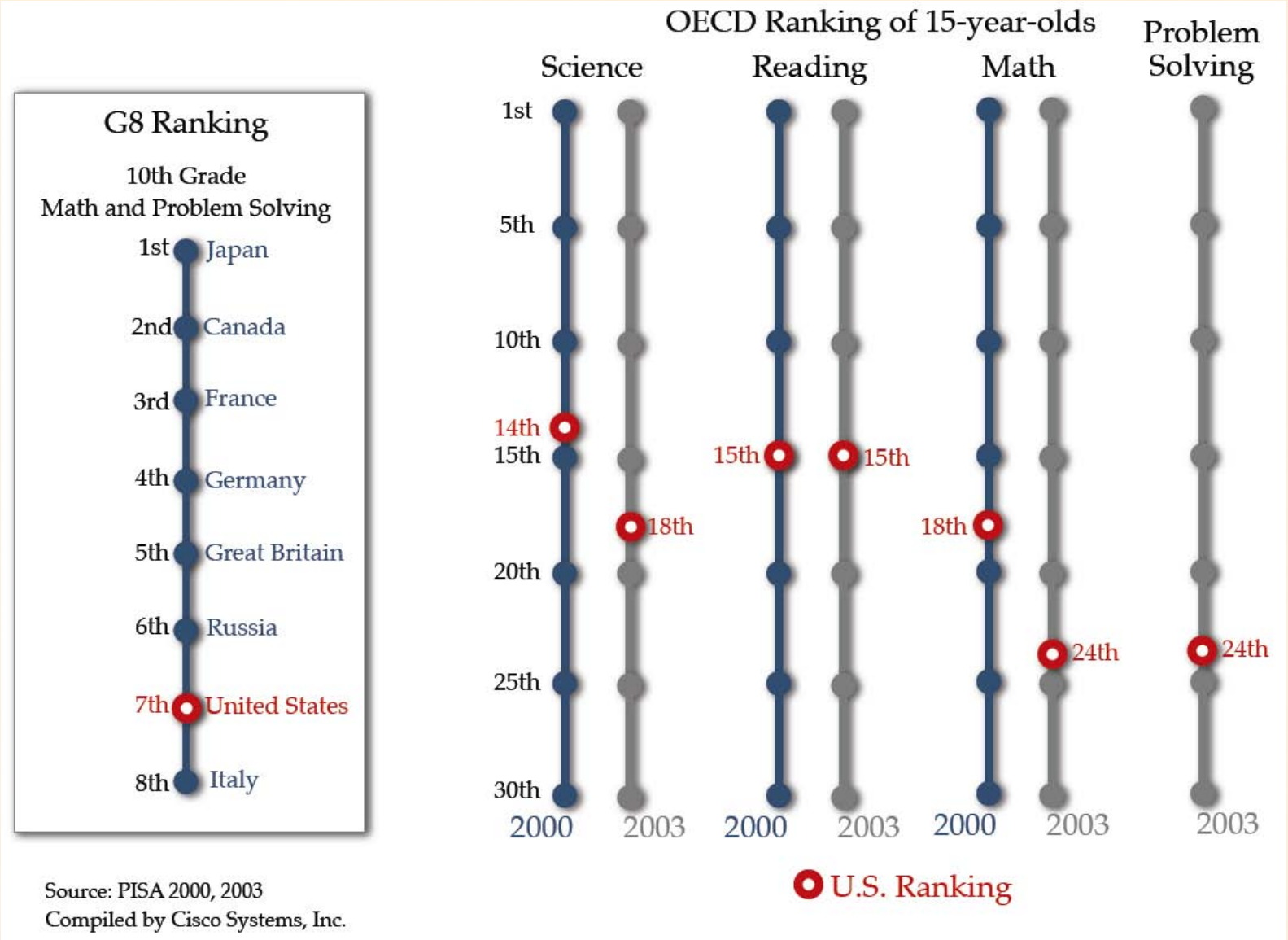


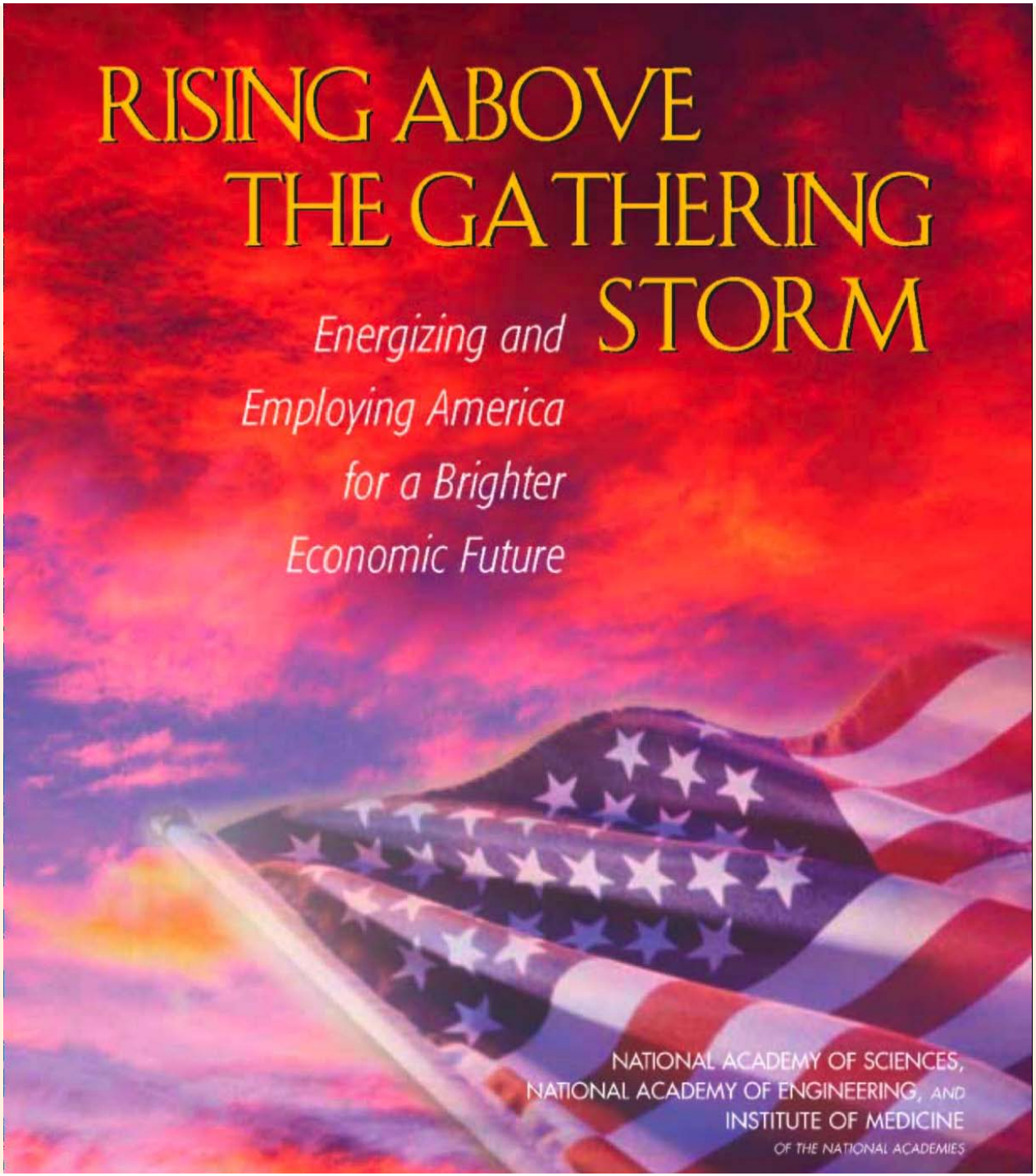
Same trend seen in undergraduate education

U.S. Ranking - S&E Degrees



Math and Science Education Rankings




RISING ABOVE
THE GATHERING
STORM
Energizing and
Employing America
for a Brighter
Economic Future
NATIONAL ACADEMY OF SCIENCES,
NATIONAL ACADEMY OF ENGINEERING, AND
INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

Gathering Storm Findings

"The committee is deeply concerned that the scientific and technical building blocks of our economic leadership are eroding at a time when many other nations are gathering strength."

"We are worried about the future prosperity of the United States. This nation must prepare with great urgency to preserve its strategic and economic security."

Key challenges coupled to science & engineering prowess :

Creating high-quality jobs for Americans

Responding to the nation's need for clean, affordable, and reliable energy.

Gathering Storm Recommendations

Increase America's talent pool by vastly improving K–12 science and mathematics education.

Sustain and strengthen the nation's traditional commitment to long-term transformational basic research

- Increase the federal investment in long-term basic research by 10% a year over the next 7 years.
- Allocate at least 8% of the budgets of federal research agencies to discretionary funding.

Make the United States the most attractive setting for the best and brightest students, scientists, and engineers from within the United States and throughout the world.

Ensure that the United States is the premier place in the world to innovate

Strategy for American Innovation:

Driving Towards Sustainable Growth and Quality Jobs

"History should be our guide. The United States led the world's economies in the 20th century because we led the world in innovation. Today, the competition is keener; the challenge is tougher; and that is why innovation is more important than ever. It is the key to good, new jobs for the 21st century. That's how we will ensure a high quality of life for this generation and future generations."

President Barack Obama, August 5, 2009

http://www.whitehouse.gov/administration/eop/nec/StrategyforAmericanInnovation/

Strategy for American Innovation

1. Invest in the Building Blocks of American Innovation.

- **Restore American leadership in fundamental research**
- **Educate the next generation with 21st century knowledge and skills while creating a world-class workforce**
- **Build a leading physical infrastructure.**
- **Develop an advanced information technology ecosystem**

2. Promote Competitive Markets that Spur Productive Entrepreneurship

- **Promote American exports**
- **Support open capital markets that allocate resources to the most promising ideas**
- **Encourage high-growth and innovation-based entrepreneurship**
- **Improve public sector innovation and support community innovation**

3. Catalyze Breakthroughs for National Priorities

- **Unleash a clean energy revolution**
- **Support advanced vehicle technologies**
- **Drive innovations in health care technology**
- **Harness science and technology to address the "grand challenges" of the 21st century**

New Mexico - Land of Enchantment

New Mexico is a land of contrasts:

Size: 121,356 sq miles (4th largest state)
Population: 1.93 M (2005)
Population Density= 15.0 persons / sq mi

Economy: Highest number of PhDs per capita of any state
Richest (per capita) county in US (Los Alamos)
Some of the poorest counties in US (Native American)

Diversity: 44% Hispanic, 44% White,
Native American 10%, Other 2%

Riches and natural resources:

Strong oil, gas, coal, uranium, solar, wind, biofuels resources
Export > 30% of energy produced

Relatively strong economy:

7.5% projected FY10 budget deficit
(~15th for smallest % deficit)

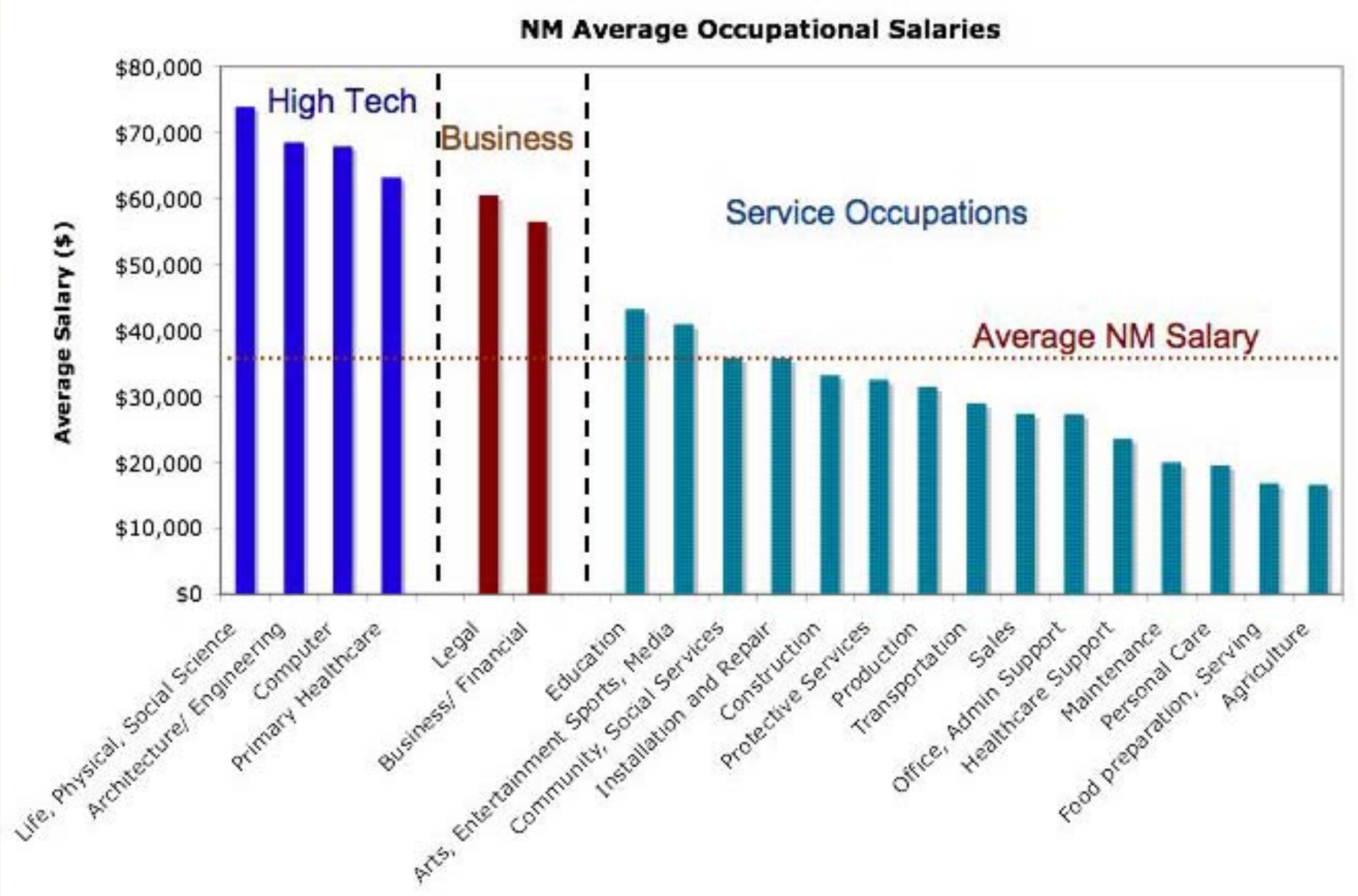
State Science and Technology Plan

Goal is to create high-paying jobs leveraging the $6B/yr Federal R&D in NM.

Primary recommendation:
Create and fund
The Research Applications Center

- *Created by Legislature in 2009 as a non-profit reporting to the Economic Development Department*
  - *Now being stood up*
- *Will coordinate development of new technologies, supercomputing, energy and water innovation.*

Primary Motivation



S&T Plan Goals

1) Develop model for making investments through a coordinated and sustained program.
   New Mexico has invested in:
   - Energy Innovation
   - Water Innovation
   - Supercomputing
   - Specific R&D projects

2) Determine priorities for state investments to translate Federal R&D investments into the commercial sector
   - *Prioritization provides significant challenges*
   - *Priorities determined primarily by market pull*

3) Goal is to develop sustained program of targeted investments in late-stage R&D to create new businesses and high-paying jobs

S&T Plan Factors for Success

Principles

- Stability and sustainability
- Flexibility
- Alignment of state, business, labs, universities, schools
- Market driven
- Return on investment

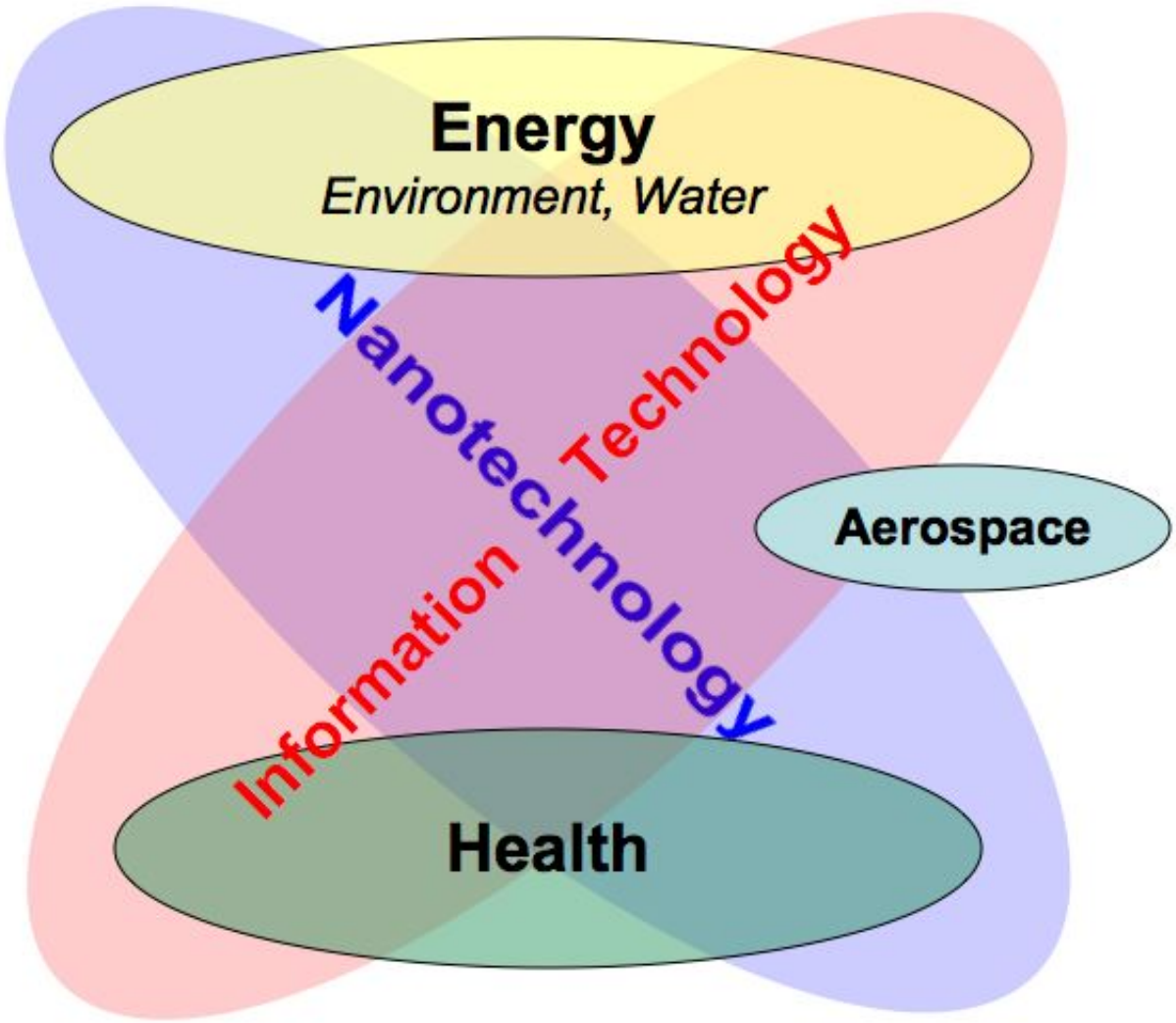
Resources Required

- Workforce
- Intellectual / natural
- Critical mass
- State and Federal investment
- VC / business investment

Operational

- Leadership
- Integration and coordination
- Priority setting

S&T Plan - Basis for Growth



Innovate-Educate (NM)

- Innovate-Educate is an alliance of 30 top 500 Fortune companies dedicated to reforming STEM education in the U.S.
    - *Funding support comes from member organizations*

- Looking at NM as the "incubator" state for Educate-Innovate
    - Catalyst to place 21st century skills at the center of P-20 education
        - *Partnerships of education, business, community and government*
    - Advance best practices and create mentoring and internship opportunities in STEM programs.
    - Recognize the importance of business clusters in economic development, working with NM business and bringing national partners to the State to advance a future knowledge workforce.
    - Collaborate with community and government leaders to advance economic development in all regions of the State.

Create a National Lab in NM for STEM education reform

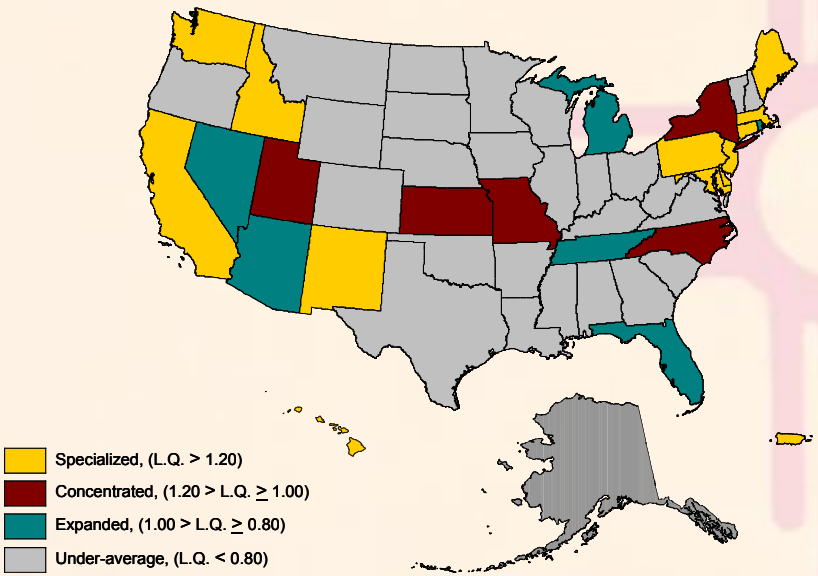
Spa

Projected Economic Impact:
2300 jobs w payroll of $300M in 2014

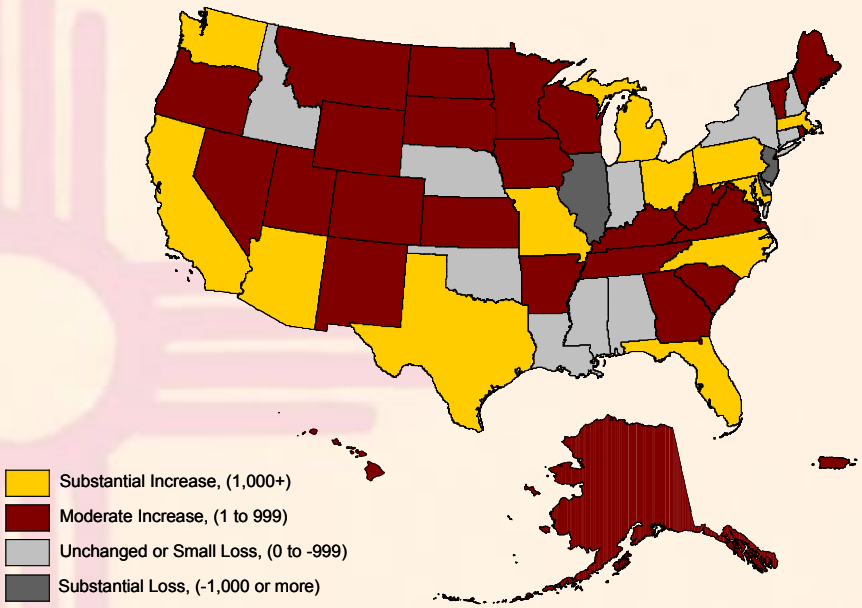
New Mexico Biotech

Research, Testing, & Medical Laboratories is the largest bioscience subsector, employing more than 413,000 U.S. workers

Research, Testing, & Medical Laboratories
Level of Employment Concentration relative to the U.S.



Research, Testing, & Medical Laboratories
Employment Gains and Losses, 2001-2004



The Research, Testing, & Medical Laboratories subsector had strong employment growth between 2001 and 2004, increasing by 8.2 percent

New Mexico has strengths in computational biology, genomics, HIV research, neuroscience, radioisotopes, cancer research, and diagnostics.

Nanotechnology in NM

NM is ranked 3d in nanotech intensity

Core Facility in Albuquerque

CINT Gateway to Sandia
Nanomaterials/Microfabrication

CINT Gateway to Los Alamos
Nanomaterials/Biosciences

Begin Operations	**April 2006**
Fully Operational	**May 2007**

Los Alamos

Sandia National Laboratories

New Mexico
Computing Applications Center

Founding Members

State of New Mexico
University of New Mexico
New Mexico State University
New Mexico Institute of Mining and Technology
Los Alamos National Laboratory
Sandia National Laboratories

Supercomputing underpins progress in all five New Mexico's innovation cluster areas

NMCAC Mission Statement

Create clean and green, well-paying jobs in New Mexico by driving the development of high-tech industries

Train and Equip Our Students to be More Competitive

We do this by bringing together the intellectual talent in New Mexico with a world-class compute system.

Focus development areas aligned with State Science and Technology Plan:

Biotechnology

Energy, Environment, and Water

Digital Media

NEW MEXICO COMPUTING APPLICATIONS CENTER

Statewide Focus: Gateways for New Mexico

Connect New Mexico together in a high-tech network that will:

Drive Economic Development
Provide new capabilities for HED
Support PED STEM Education
Support distance learning with increased bandwidth

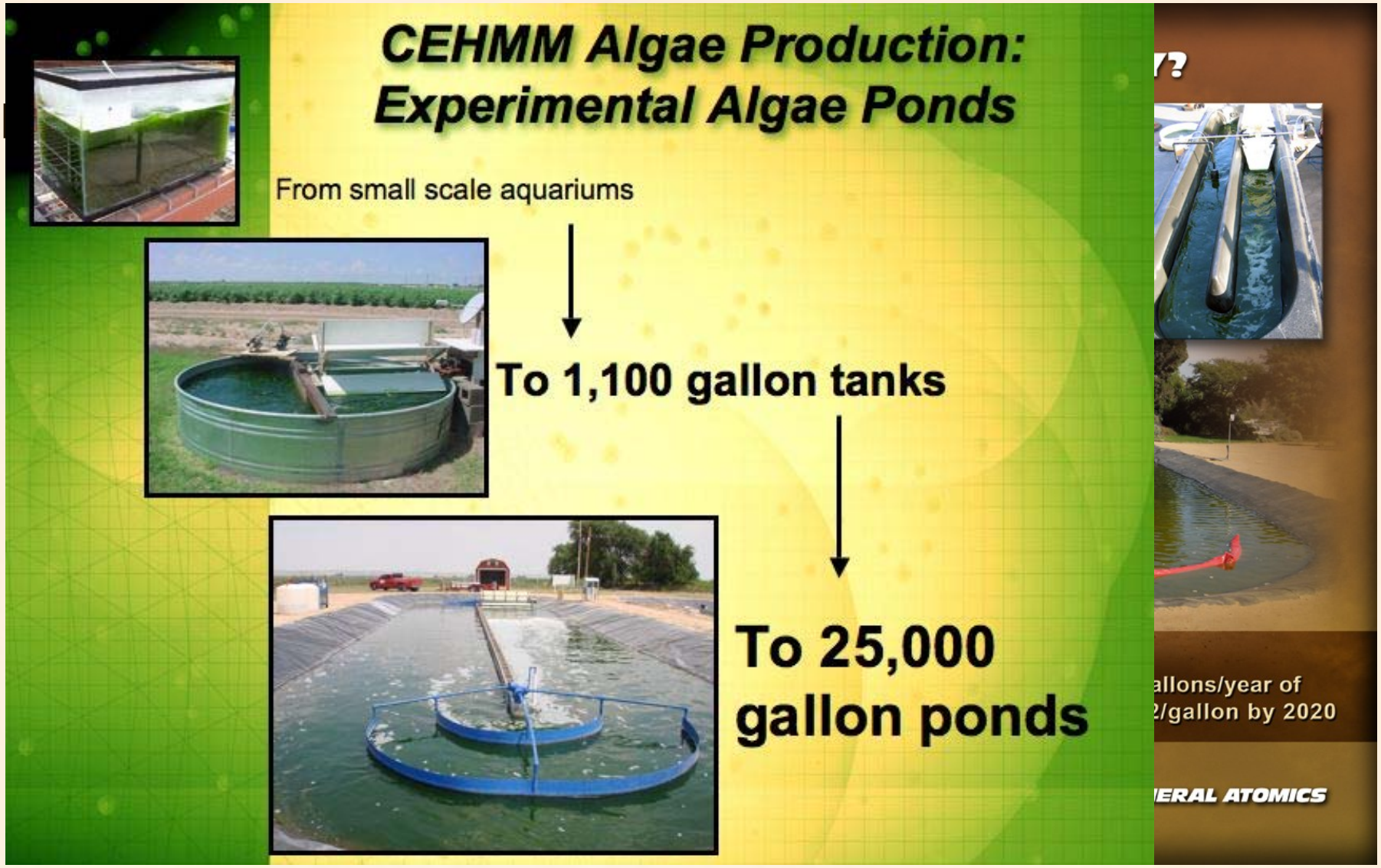
Conclusions

- The NMCAC is open for business
  - *Our goal is to support NM businesses and to attract new high-tech business to New Mexico*
  - *The combination of proactive management, world-class computing talent, and a powerful computing system provides a new paradigm for driving high-tech business development*
  - *As a nonprofit, we can be responsive to business needs.*

- The Center supports education and workforce development, essential components to sustaining high-tech development.

- The Center provides new capabilities for remote collaboration through the Gateways that are being installed at campuses of higher education across New Mexico.

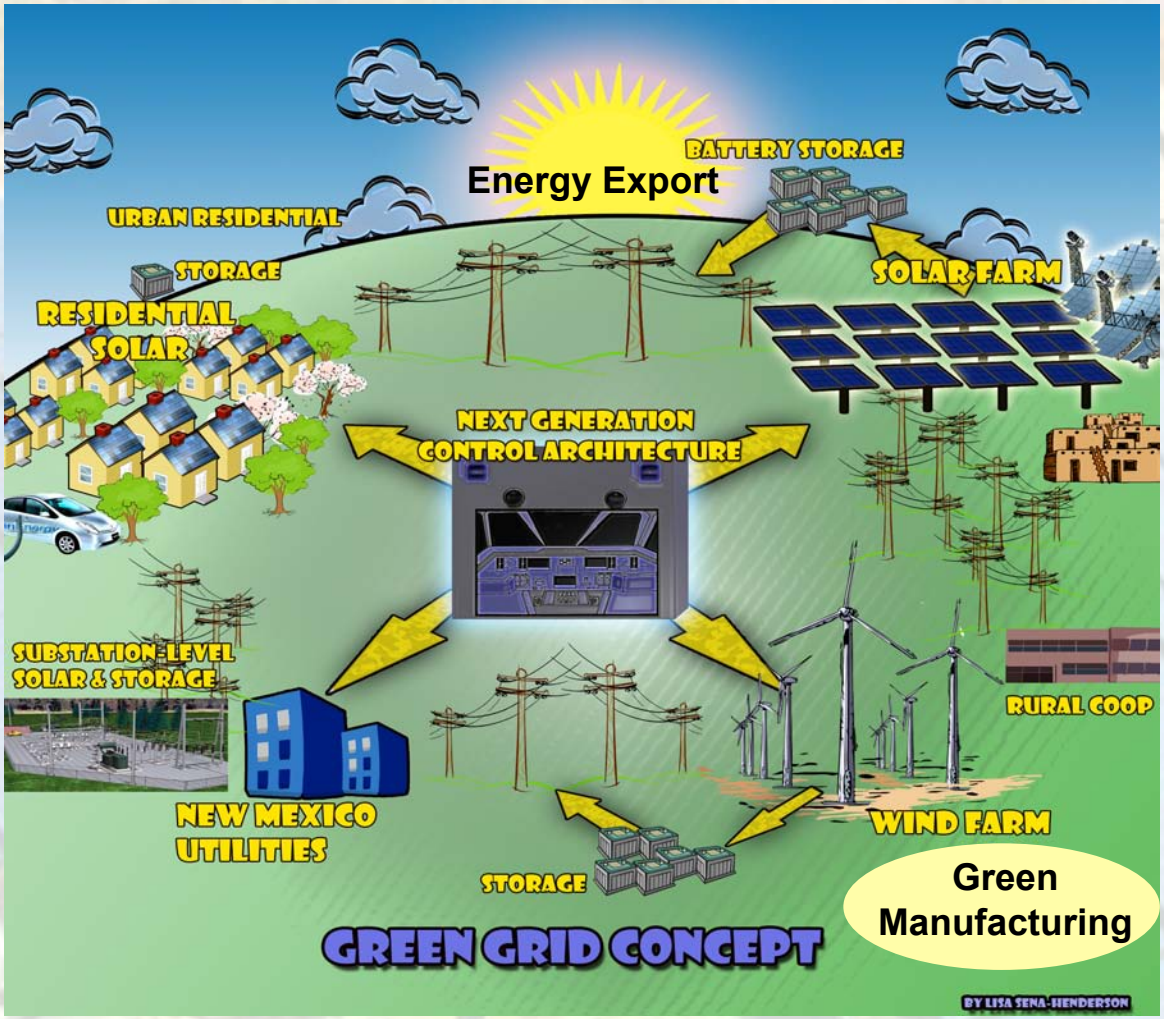
Clean Energy



New Mexico Green Grid Initiative

NM Green Grid:
100% smart grid with as much clean and renewable energy as current fossil energy

The New Mexico Green Grid Initiative was formed in August 2008 to make New Mexico the first state with a Green Grid

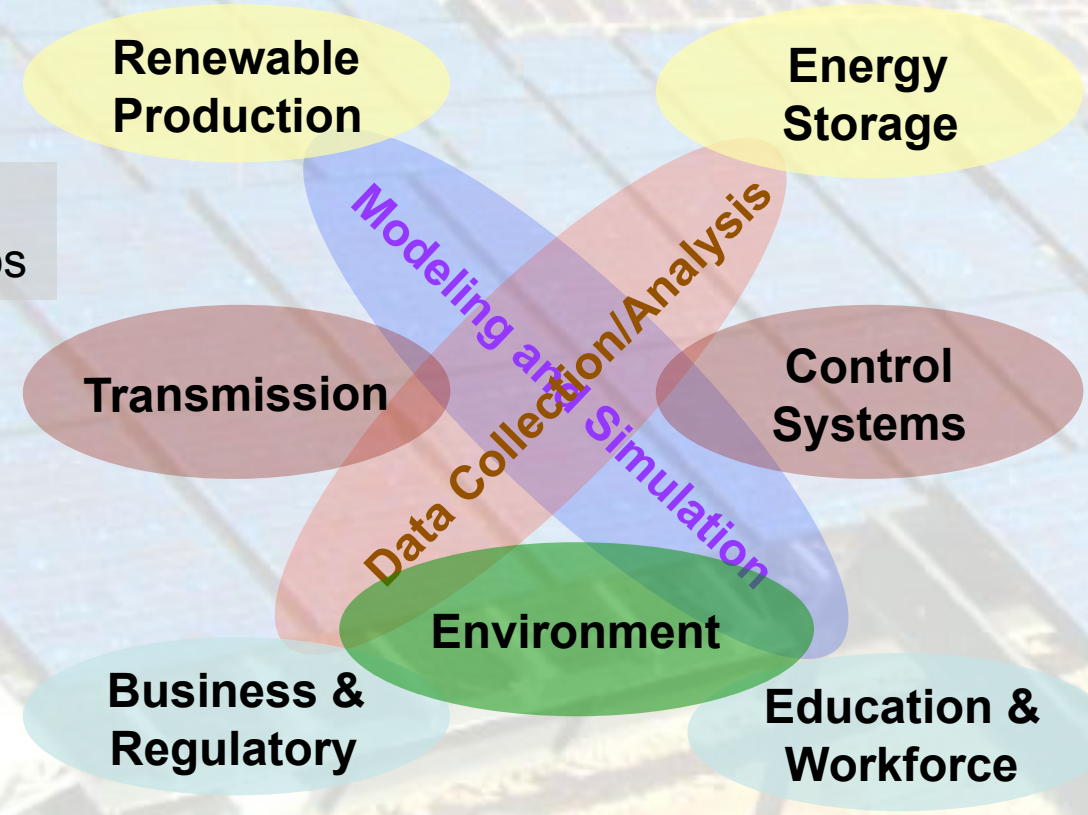


Goal: High penetration of renewables into the smart grid

Green Grid Goal

Demonstrate to business and venture capital firms that risks are understood and that it is possible (and profitable) to build out a statewide green grid

Formed nine working groups

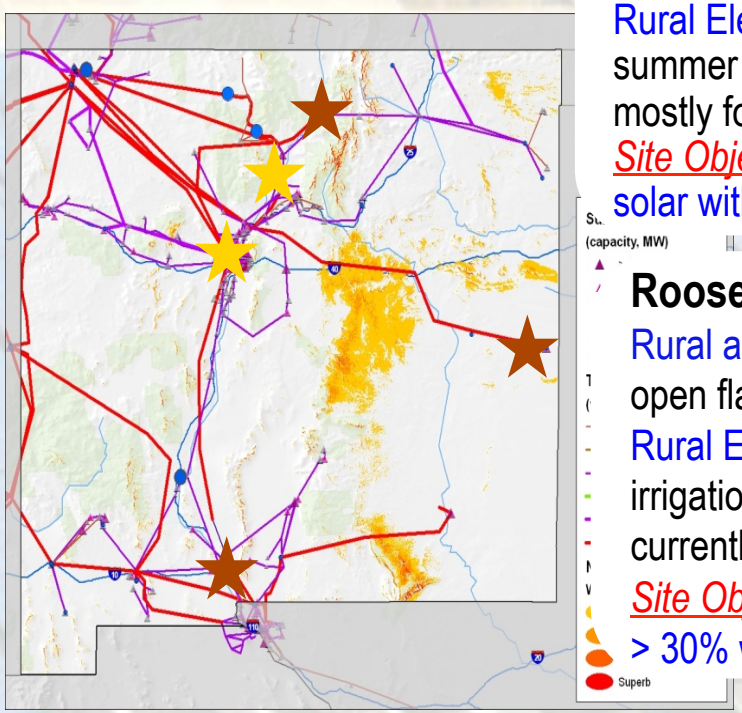


Providing a fully integrated approach

NM Green Grid Demonstration Sites

Los Alamos
Suburban w national lab;
hi elevation mountainous terrain;
Municipal Utility: residential use of fossil and hydro;
Smart grid with > 30% solar and storage; smart grid model home.

Mesa del Sol (Albuquerque)
Largest NM urban center;
hi elevation semi-arid desert;
State's largest IOU; average commercial demand; mostly fossil fuel generation;
Site Objectives: Energy efficient buildings, smart grid with 30-100% solar PV and storage.



Taos / Taos Pueblo
Rural county and Pueblo;
hi elevation mountainous terrain
Rural Electric Cooperative Utility;
summer cooling/winter heating;
mostly fossil generation;
Site Objectives: smart grid with > 30% solar with 10 MW PV and storage.

Roosevelt County
Rural agrarian community;
open flat plains;
Rural Electric Cooperative Utility;
irrigation water pumping demand;
currently mix of fossil and wind;
Site Objectives: smart grid with > 30% wind/pumped water storage.

NMSU / Las Cruces
University campus; semi-arid desert;
University-owned/operated utility with IOU provider;
summer cooling demand; currently nuclear and fossil;
Site Objectives: smart grid w advanced controls.

★ NEDO Sites

Green Grid Partners

PARTNERS

New Mexico Computing Applications Center
New Energy and Industrial Technology Development Organization (NEDO) of Japan
CH2MHill, Intel, New Mexico State University
Los Alamos National Laboratory, Sandia National Laboratories
Kit Carson Electric Cooperative
Los Alamos County Department of Public Utilities
Roosevelt County Electric Cooperative

PARTICIPANTS

NM Economic Development Dept
NM Research Applications Center
NM Energy, Minerals & Natural Resources Dept
NM Public Regulation Commission
NM Renewable Energy Transmission Authority
New Mexico Institute of Mining and Technology
University of New Mexico, Mesa del Sol
El Paso Electric Company, Public Service Company of New Mexico
Galvin Electricity Initiative, General Motors, Hunt Energy
Schweitzer Engineering Laboratories, Siemens
Viridity Energy, Whirlpool

Green Grid Return on Investment

- $110M project funding in hand
- Will help consumers with energy costs:
  - *Up to 50% penetration of renewables*
  - *Reduce peak energy generation by 25% by 2025*
  - *Reduce per capita energy usage by 6%*
  - *25% reduction in the state's carbon footprint*
- Drive high-tech economic development in New Mexico
  - *Provide clean, secure energy for New Mexico*
  - *Export of renewable energy to other states*
  - *Positions New Mexico to become regional hub for export of Green Grid equipment to other states*

Summary

- States must invest in innovation for a healthy future
  - While the Federal government funds basic R&D, states need to drive the transition from R&D to commercialization.
- The elements required for leadership have long been recognized
  - The U.S. has chosen to focus largely on the short term and has not been making the S&T investments needed to be competitive.
  - This trend is being reversed under the Obama administration
- Science policy can drive innovation at the state level
  - We have the resources and a plan but need the commitment to make the necessary investments.
- The scientific community must become more proactive in educating the public and legislators

States like New Mexico are working to turn the tide