# *Enhancing Competitiveness and Speeding Innovation: Design and initial results of the NIST Rapid Innovation and Competitiveness Initiative*
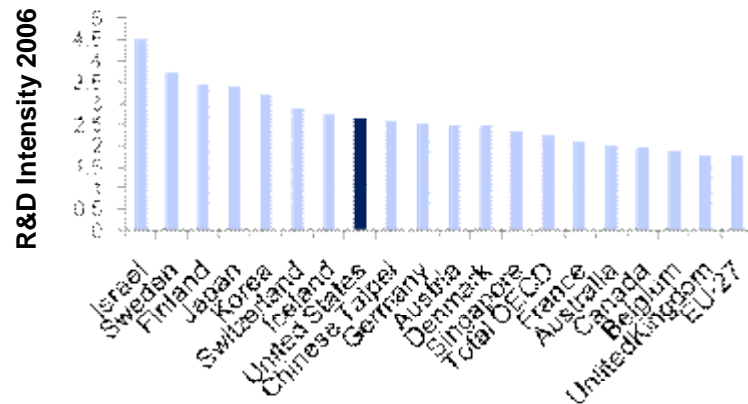
Marc G. Stanley

National Institute of Standards and Technology

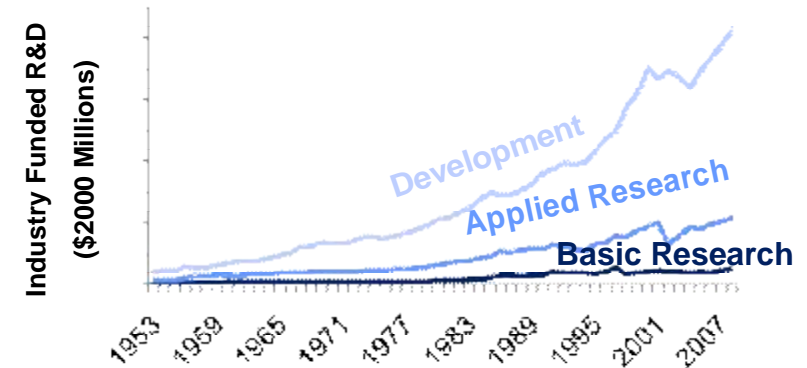# Problem: There are disturbing trends in R&D Investment
## R&D intensity is lagging while R&D Composition is changing

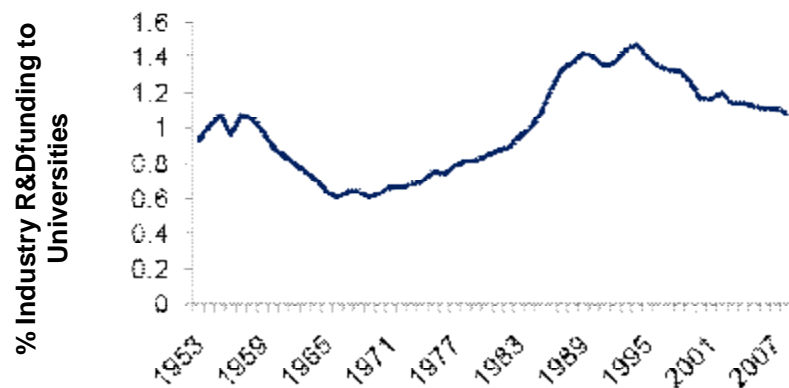**Need: Restore international innovation leadership**



Source: OECD, Main Science and Technology Indicators

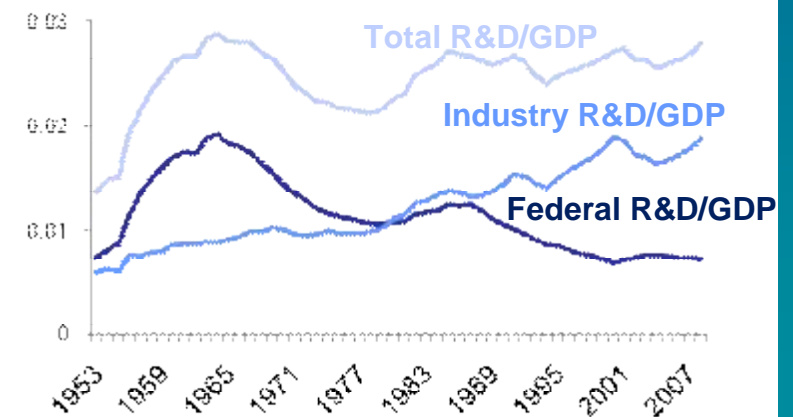**Need: Increase _industry_ focus on breakthrough research**



Source: National Science Foundation

**Need: Long-range research targeting _industry_ needs**



Source: National Science Foundation

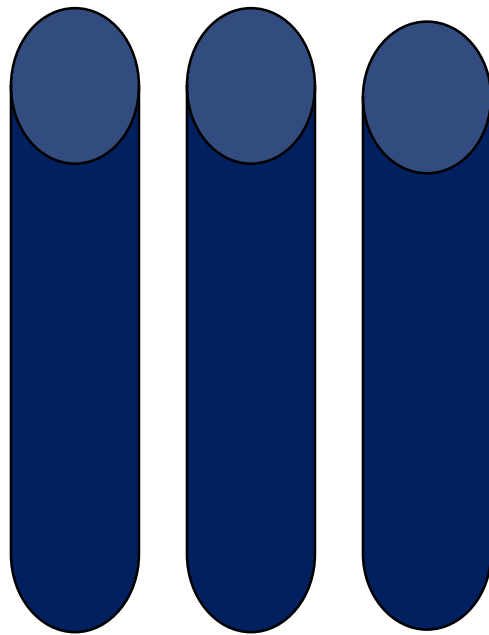**Need: Increase the intensity of federal R&D efforts**



Source: National Science Foundation

# Our Approach Must Change

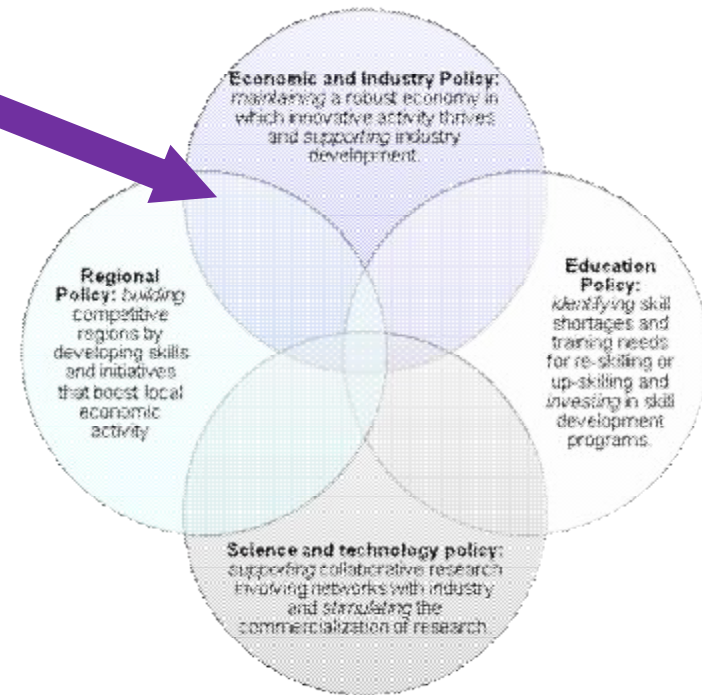Unprecedented challenges require innovative solutions for creating jobs and promoting regional prosperity.

From Silos …                                                    … to Collaboration.

Vital but limited
NIST/MEP role
in E-RIC



**Economic and Industry Policy:** maintaining a robust economy in which innovative activity thrives and supporting industry development.

**Regional Policy:** building competitive regions by developing skills and initiatives that boost local economic activity

**Education Policy:** identifying skill shortages and training needs for re-skilling or up-skilling and investing in skill development programs.

**Science and technology policy:** supporting collaborative research involving networks with industry and stimulating the commercialization of research

However, NIST has another pilot cluster initiative that builds upon the scientific base and leverages NIST assets in all 4 key areas ...

**3**

# The Rapid Innovation and Competitiveness (RIC) Initiative
## *A new public-private partnership for R&D investment*

**Goals:**

- Increase the Nation's return on its scientific investment
- Collapse the timescale of technological innovation
- Stimulate the economy and enhance competitiveness

**Approach:**

- Coordination and Advanced Planning
  - Partners from **industry**, **academia**, and **government** develop a shared vision of an industry sector's research needs via a technology roadmap
- Research and Knowledge Transfer
  - **Industry** and **government** fund goal oriented basic research, measurement science research, and standards development based on the needs and priorities of the roadmap
  - Periodically re-evaluate the impact and priority of that research
  - Sponsor postdoctoral fellowships and personnel exchanges to facilitate tacit knowledge transfer
- Transition scientific findings to commercial products
  - Provide a framework that facilitates **regional government** and **venture-capital** support, enabling a clear path to commercialization

# Pilot Program with Nanoelectronics Research Initiative (NRI) Initiated in 2007

- For pilot, NIST sought public-private partnerships to accelerate the support of research and innovation in nanoelectronics, an emerging area that exploits unique properties of nanometer-scale materials

- Competition announced in Federal Register May 4, 2007

- NIST/NRI partnership announced September 13, 2007
  - The NRI is a collaborative effort between industry, government, and academia to support world-class research in nanoelectronics.
  - NRI is part of the Semiconductor Research Corporation (SRC), which is part of the Semiconductor Industry Association (SIA)
  - NRI goal: Demonstrate novel yet practical computing devices capable of replacing conventional chip technology by 2020

- Cooperative agreement, renewable for up to five years

- NIST provides $2.76 million per year; six NRI partners match with at least 25% each

- Funds combined and competitively awarded for research at U.S. universities to meet industry's long term needs

- Starting FY2009 NIST has an additional $1.5 million for related in-house research

# NIST/NRI Funding

**Strategic Planning and Evaluation**
International Technology Roadmap for Semiconductors
*POST-CMOS: NRI Defined 13 Research Vectors of primary importance for finding the next switch*

$2.75M per year NIST

$5M per year Industry Partners

$15M per year States

>$200M / over 5 years States & Private

## University-Based Research

- **INDEX: Institute for Nanoelectronics Discovery and Exploration**

- **MIND: Midwest Institute for Nanoelectronics Discovery**

- **SWAN: South West Academy of Nanoelectronics**

- **WIN: Western Institute of Nanoelectronics**

**Research Results**

## Business Start-up, Development, and Commercialization

**Regional Government Contributions:**
- Grants
- Tax Incentives

**Industry Contributions**
- VC Funds
- Direct Investment

# 4 Centers, 35 Universities, 20 States

**MIND**
Nanoelectronics · Architectures
MIDWEST INSTITUTE FOR NANOELECTRONICS DISCOVERY

★ **Notre Dame**  Purdue
**Illinois-UC**  Penn State
**Michigan**  UT-Dallas

**INDEX**
INSTITUTE FOR NANOELECTRONICS DISCOVERY AND EXPLORATION

★ **SUNY-Albany** GIT  Harvard
Purdue  RPI  Columbia
Caltech  MIT  NCSU
Yale  UVA

**WIN**
Western Institute of Nanoelectronics

★ **UC Los Angeles**
UC Berkeley
UC Irvine
UC Santa Barbara
Stanford
U Denver
Portland State
U Iowa

**SWAN**
Southwest Academy of Nanoelectronics

★ **UT-Austin**  Rice  Texas A&M
**UT-Dallas**  ASU  Notre Dame
**U. Maryland**  NCSU  Illinois UC

**NSF**

Columbia
Harvard
Purdue
UVA
Yale
UC Santa Barbara
Stanford
U. Mass
U. Arkansas
U. Oklahoma
Notre Dame
U. Nebraska/Lincoln
U. Maryland
Cornell
UT Austin
Caltech

# RIC Initiative
## NIST/NRI Results

NIST/NRI Supports PI's from over 30 Universities to work at regional centers.

NIST/NRI interactions are currently supporting 128 graduate students and 24 post-docs through the four regional centers.

- WIN            38 PhD students, 6 post-docs
- INDEX        24 PhD students, 2 post-docs
- SWAN       26 PhD students, 11 post-docs
- MIND         40 PhD students, 5 post-docs

Number of Publications

From 10-1-2007 through 10-1-2009 the centers under the NRI/NIST partnership have generated 239 publications.

Number of patents

To date 13 patents applications have been filed based on the work of sponsored by the NRI.

# Industry Support of NIST's Involvement

- "NIST joining NRI not only enabled the recent expansion of the program, but also was **instrumental to convincing the NRI industry members to extend their commitments for funding the program beyond 2008**, so this partnership has already resulted in increased support for the program."

  -- Jeffrey Welser, Director of the Nanoelectronics Research Initiative:

- "There is tremendous interest in every part of the world to win the nanoelectronics race and reap the economic rewards that will go with it.  For America to win, it will take radical collaboration between government, higher education and industry.  The best example of this type of collaboration is the important work going on in the Nanoelectronics Research Initiative at more than 30 universities with funding and participation from NIST, IBM and other major semiconductor and research institutions."

  -- John E. Kelly III, IBM Senior Vice President and Director of Research

- "The research results from this new initiative will enable the semiconductor industry to extend Moore's Law -- the 40-year-old prediction that the industry can double the amount of transistors it places on a computer chip every couple of years -- far beyond the year 2020 when the potential limits of the current industry technology may be approached."

  -- Larry Sumney, President and CEO of the Semiconductor Research Corporation

- "The Nanoelectronics Research Initiative (NRI) and the regional research centers exemplify what can be done when industry, government and academia work together. This investment is likely to pay substantial dividends in the future. Leading-edge university research centers have proved to be powerful magnets for investment by technology companies and will help build the high-tech ecosystem for high-value jobs in the future."

  -- George Scalise, President of the Semiconductor Industry Association

- "NRI experiment is working; we learned more about graphene for device applications in the last 2 years than we would normally learn in 5 or 10 years in the business-as-usual research model."

  -- Industry member at INDEX review (9/08)

# NIST Toolkit: Impacts across the technology lifecycle

## *Science and Technology Policy*

**Need Driven Basic Research (RIC)**

| Economic Benefit, National Priority, public good | | Economic Benefit |

**Measurement Science and Standards Grants**

Economic Benefit, National Priority, public good

**Technology Proof of Concept**

TIP: National Priorities and Public Good

**Meas. Sci. & Stds. Technology Infrastructure (Labs)**

Economic Benefit, National Priority, public good

## *Education Policy*

**Industrial Technology Fellowship Program**

Economic Benefit, National Priority, public good

## *Regional Policy*

**Construction Grants Program**

Economic Benefit, National Priority, public good

## *Economic and Industry Policy*

**Extension Programs**

MEP: Economic Benefit

**Basic**          **Applied R&D**          **Commercialization**

□ NIST          ■ Industry          □ NIST, State and Private Sector Partnership