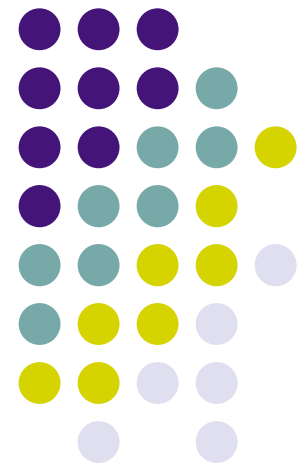
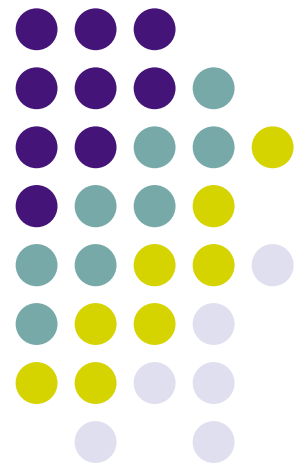
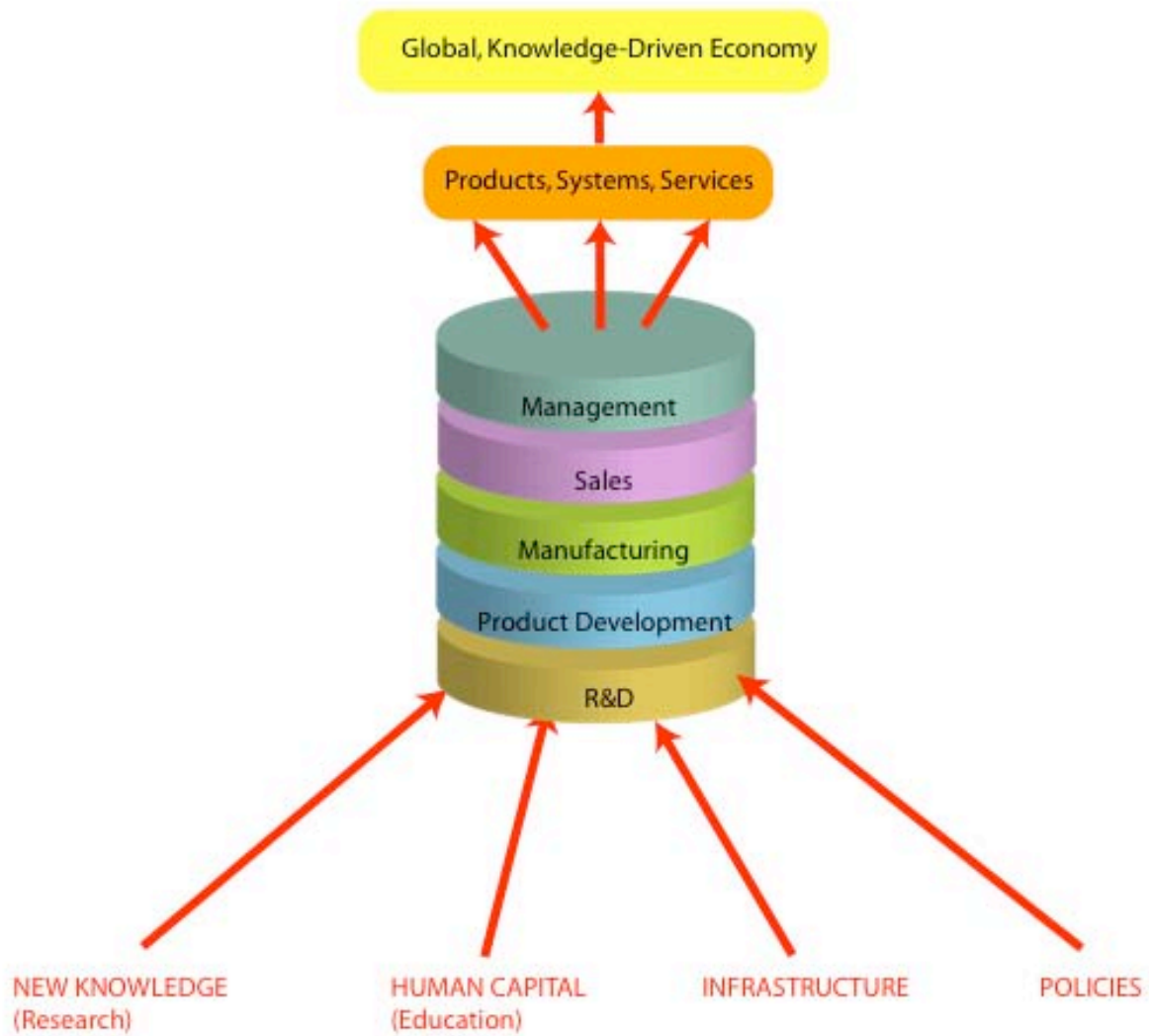


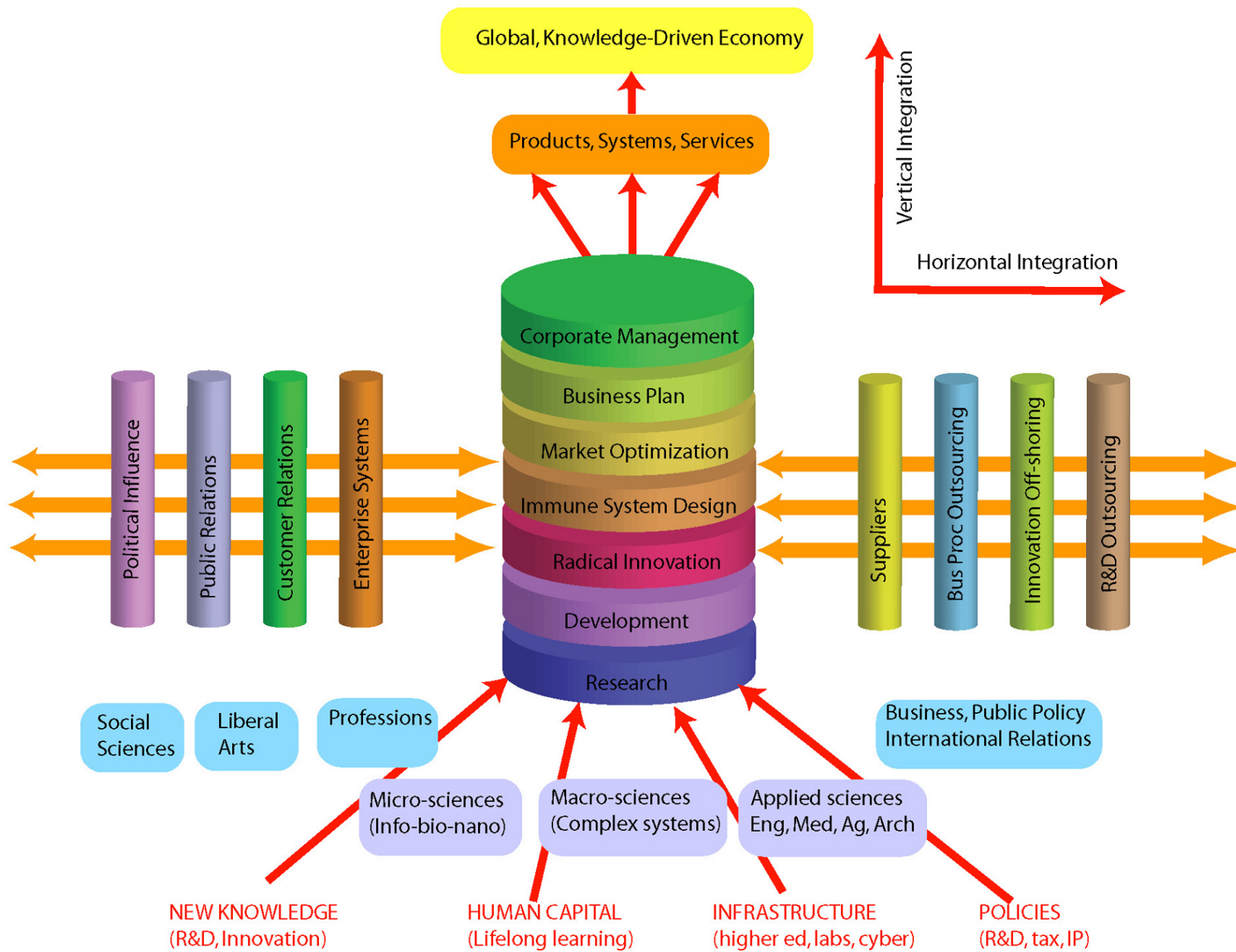
New Research Paradigms for Technological Innovation



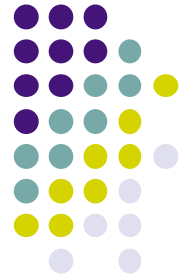
The Way the World Works Today







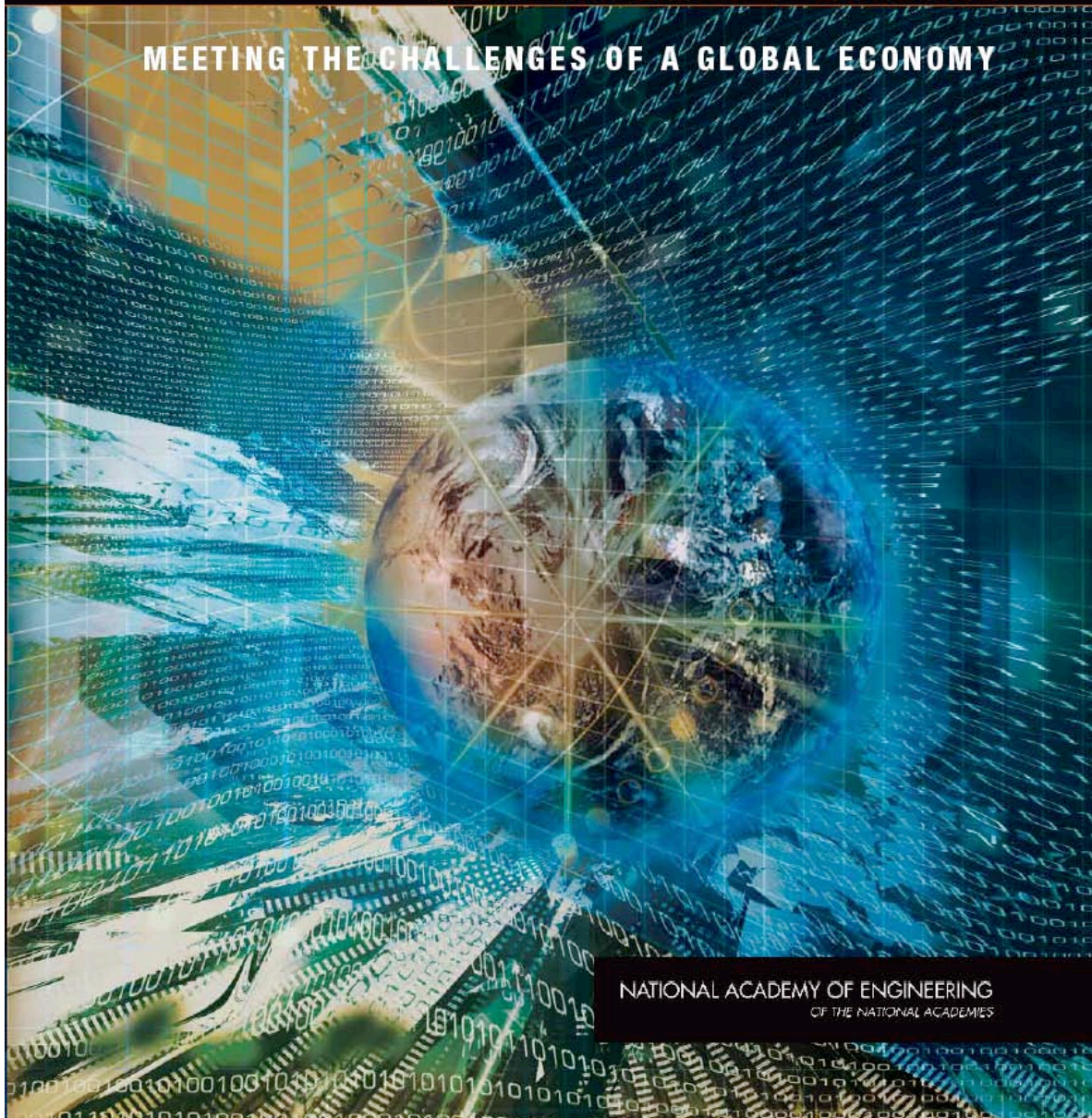
Leadership in Innovation will Require Changes



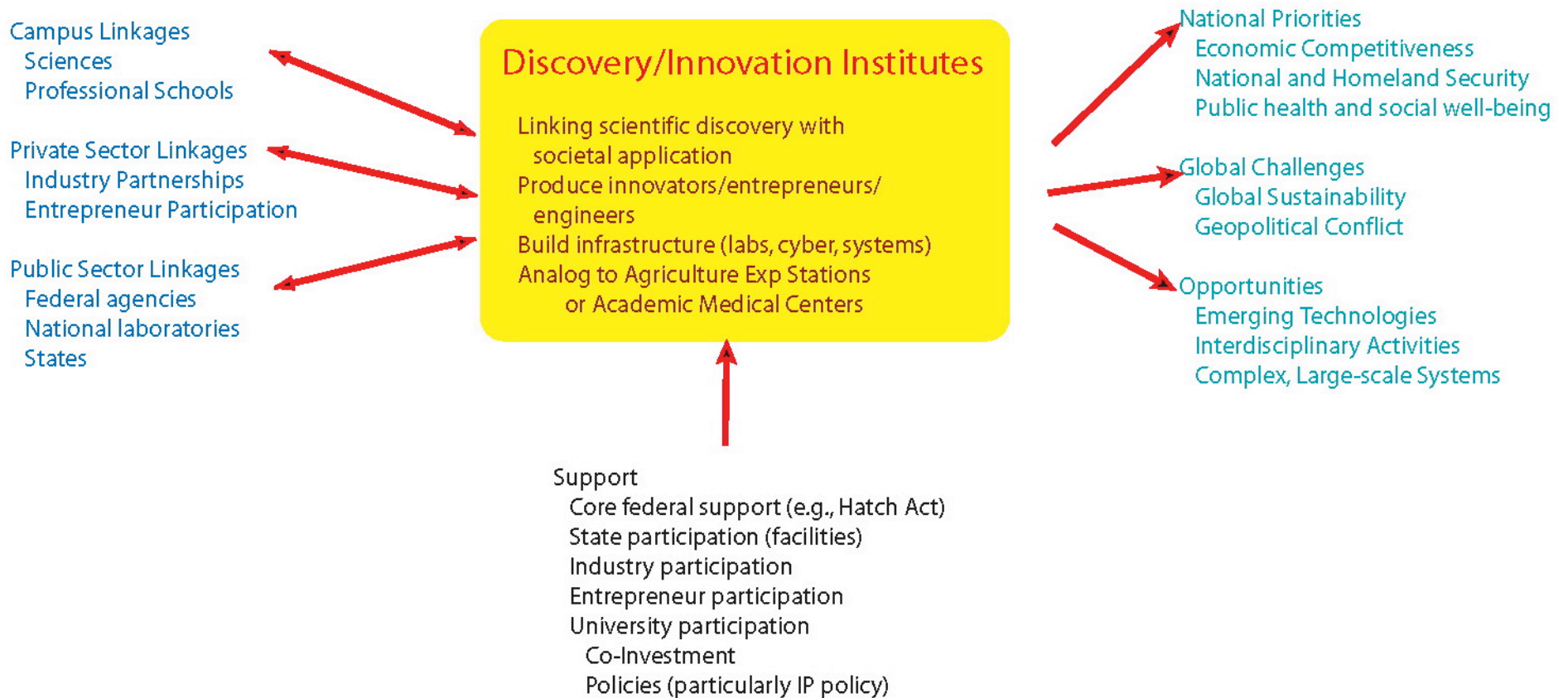
- In the way research and development is **prioritized, funded, and conducted**.
- In policies and legal structures such as **intellectual property**.
- In **partnering strategies** to maximize contributions from multiple institutions (universities, corporate R&D, state and federal agencies, national laboratories, entrepreneurs, investors)

ENGINEERING RESEARCH AND AMERICA'S FUTURE

MEETING THE CHALLENGES OF A GLOBAL ECONOMY



NATIONAL ACADEMY OF ENGINEERING
OF THE NATIONAL ACADEMIES





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.



Corporate R&D Laboratory (Pfizer)



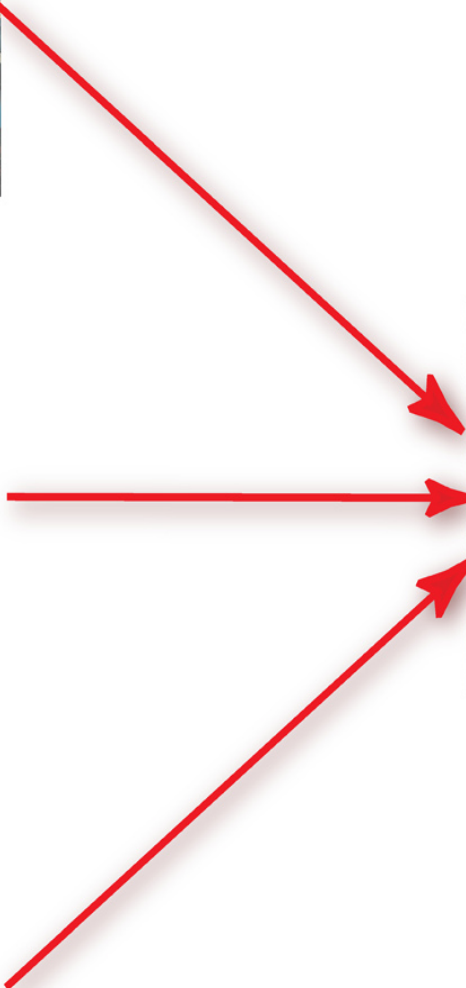
Agricultural Extension (Michigan State)



Academic Medical Center (Michigan)

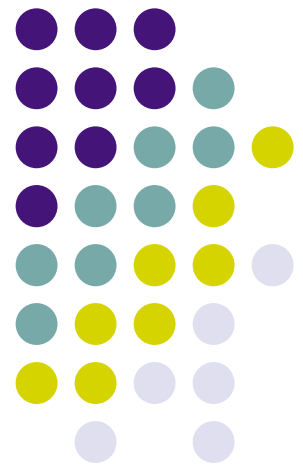


Discovery Innovation Institute???



An Application of Discovery-Innovation Institutes

Building a Sustainable
U.S. Energy Infrastructure





Today...

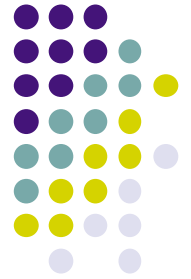
There are few contemporary challenges facing more threatening than the **unsustainable nature of our current energy infrastructure.**

Every aspect of contemporary society is dependent upon the availability of clean, affordable, flexible, and sustainable energy resources.



The Challenges

- Our current energy infrastructure, heavily dependent upon hydrocarbons, is unsustainable.
- **Global oil and gas production is expected to peak** within the next several decades.
- The burning of fossil fuels poses increasingly unacceptable risk to both humankind and the environment, particularly within the context of **global climate change**.
- The security of our nation is threatened by our **reliance on foreign energy imports** from politically unstable regions of the world.



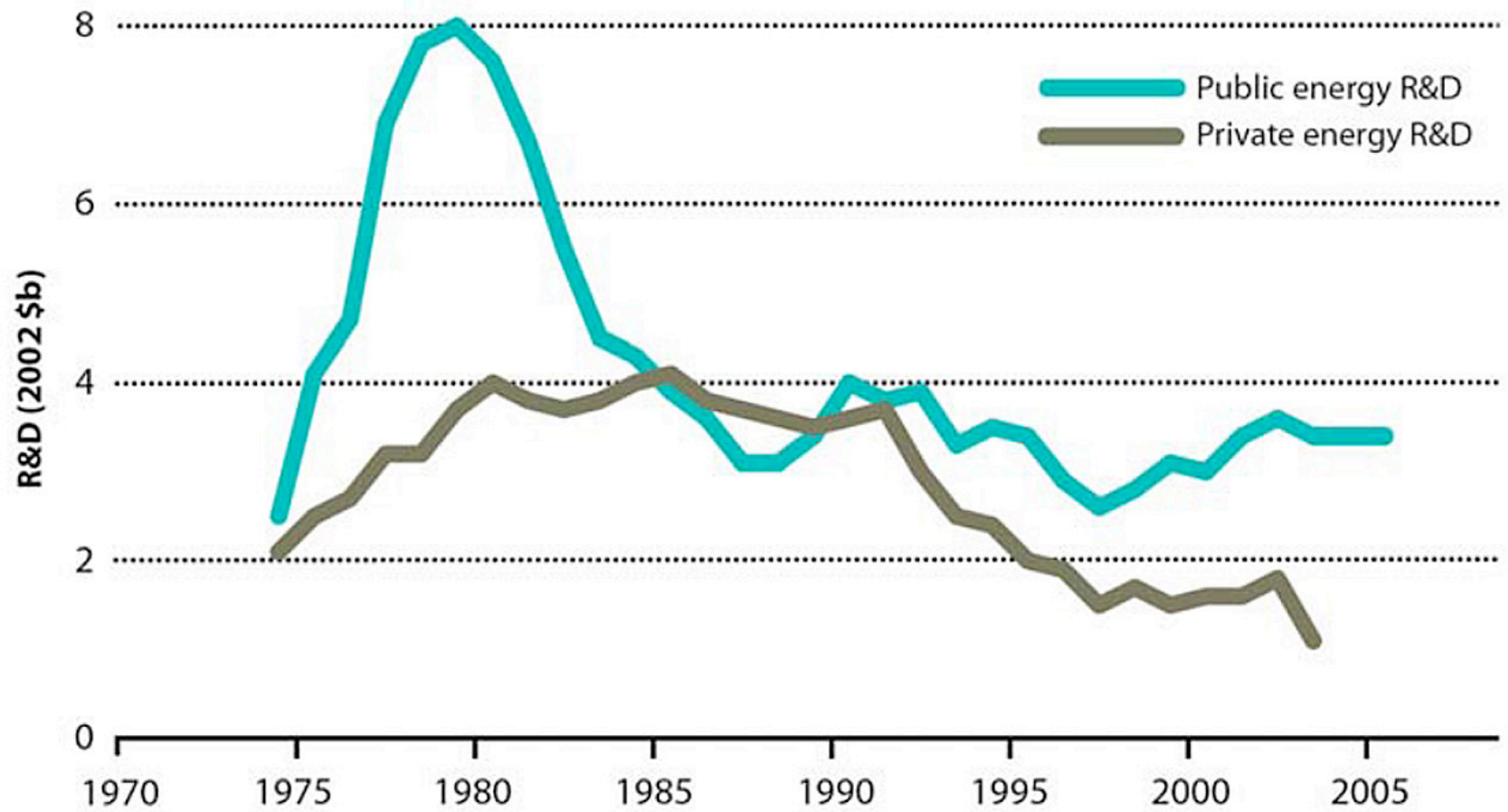
Complexity

- Large scale deployment of sustainable energy technologies will involve not only advanced scientific research and the **development of new technologies...**
- But careful attention to **complex social, economic, legal, political, behavioral, consumer, and market issues...**
- All characterized by **complex regional, national, and international relationships.**



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.



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
- 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!



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, 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.



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 works...
 - **Obama transition team**
- Rollout: National Press Club, February 9



The scale of the energy challenge

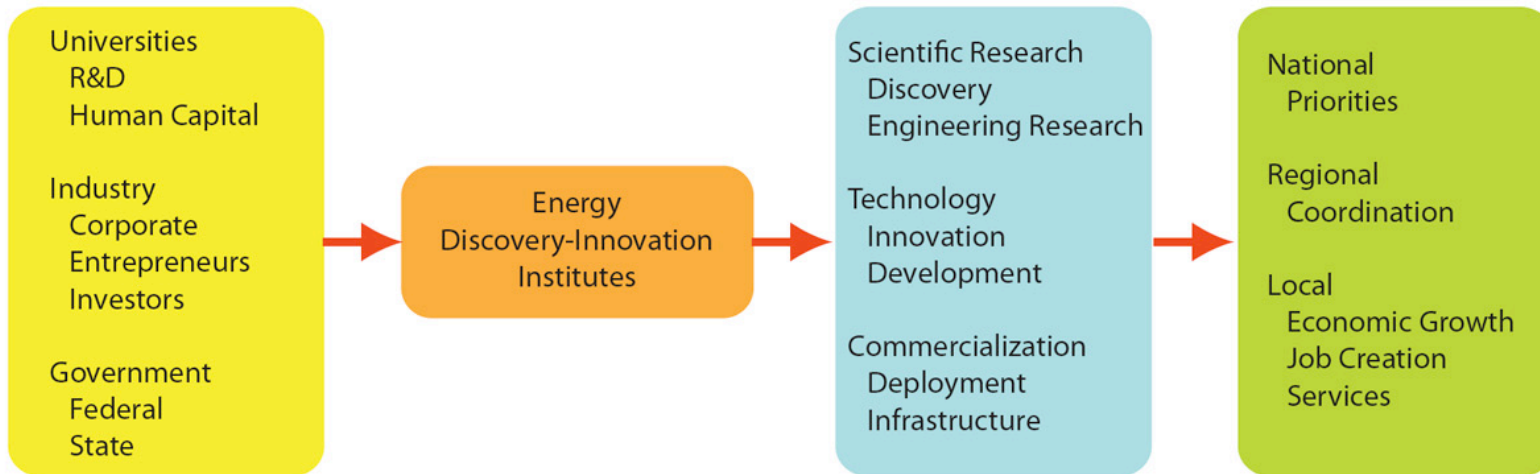
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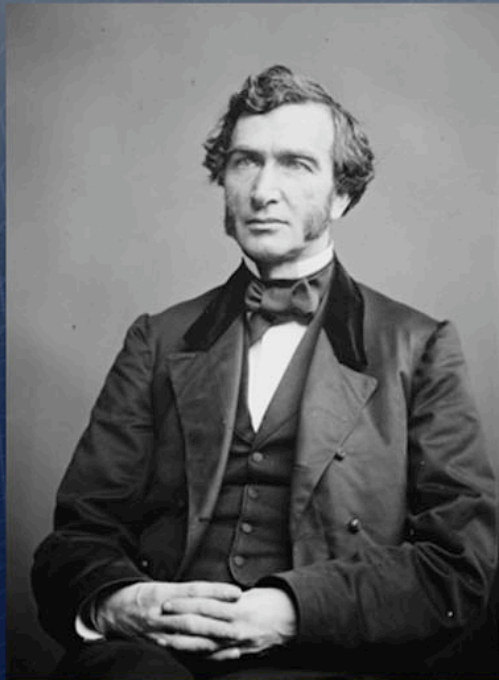
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- To meet the projected growth in electricity demand, the world will need to bring online a new 1,000 Mwe powerplant every day.
- Clearly this requires a federal R&D effort comparable in scale to the **Manhattan Project** or the **Apollo program**.
- 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**.

Energy Discovery- Innovation Institutes



The DII concept is a contemporary adaptation of a successful research paradigm created over a century ago through the Morrill Land-Grant Act



Justin Smith Morrill



The original Land-Grant colleges and universities (1862)

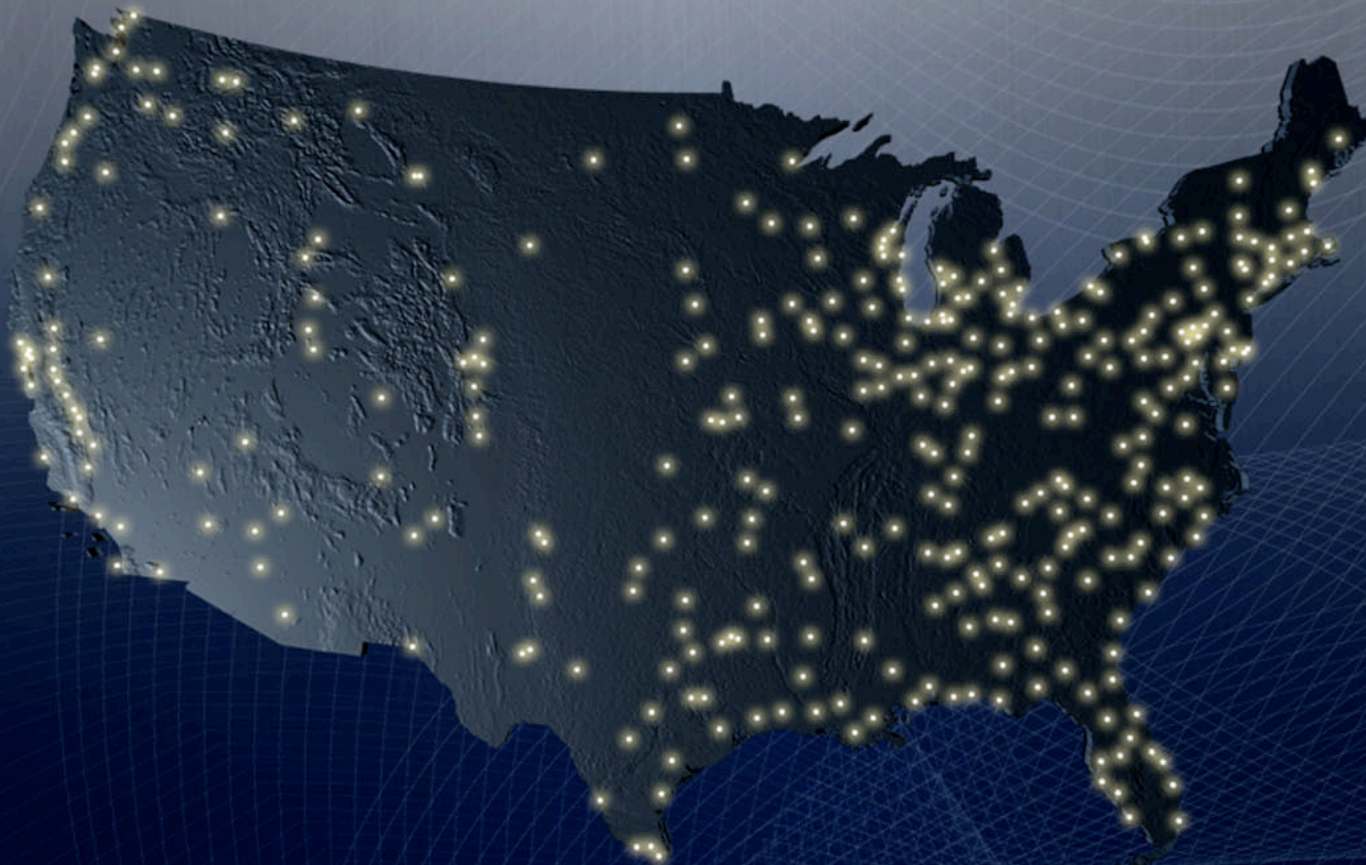


New wine from old bottles...

- The proposed network of regional energy discovery-innovation institutes is remarkably similar 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.

Blueprint for American Prosperity

Unleashing the Potential of a Metropolitan Nation

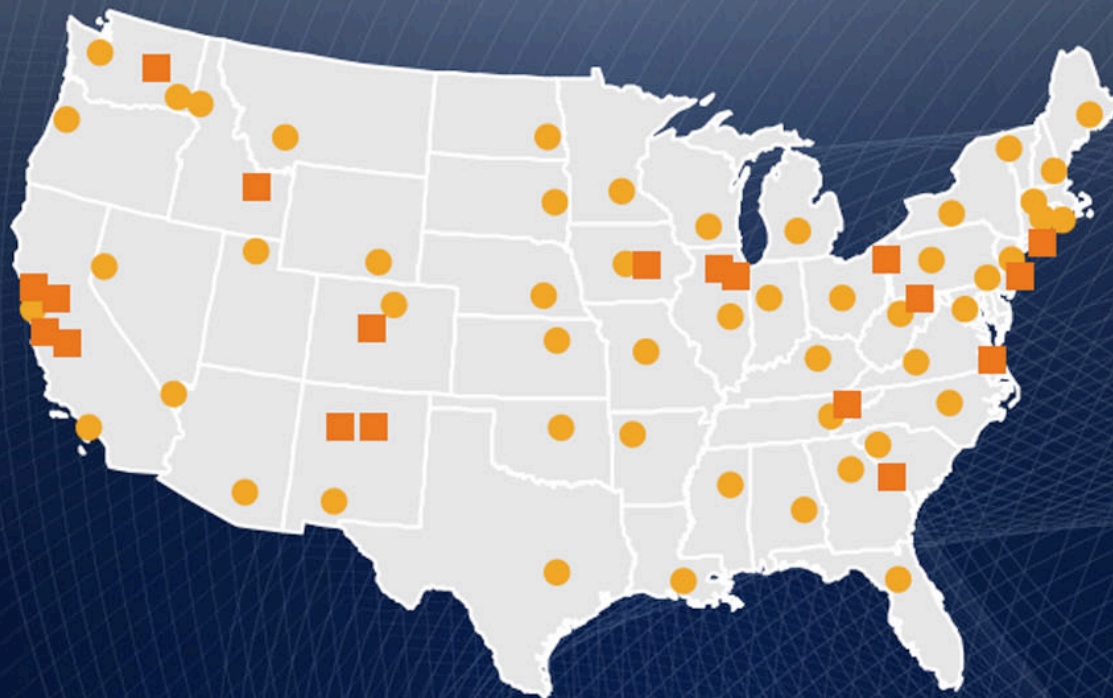


Metropolitan Policy Program
at BROOKINGS

February 9, 2009
Washington D.C.

Core federal support would range from \$10s of millions per year for small institutes to \$200 million per year for larger university or laboratory consortia and partnerships

Total federal commitments would approach \$6 billion per year—about 25 percent of the total recommended energy R&D funding goal of \$20 to \$30 billion annually



The energy DIIs should be distributed competitively among the nation's universities and federal laboratories

Several types of institutes would anchor the national network:

- University-based e-DIIs
- Federal lab-based e-DIIs
- Federal lab—university partnerships
- Satellite energy research centers

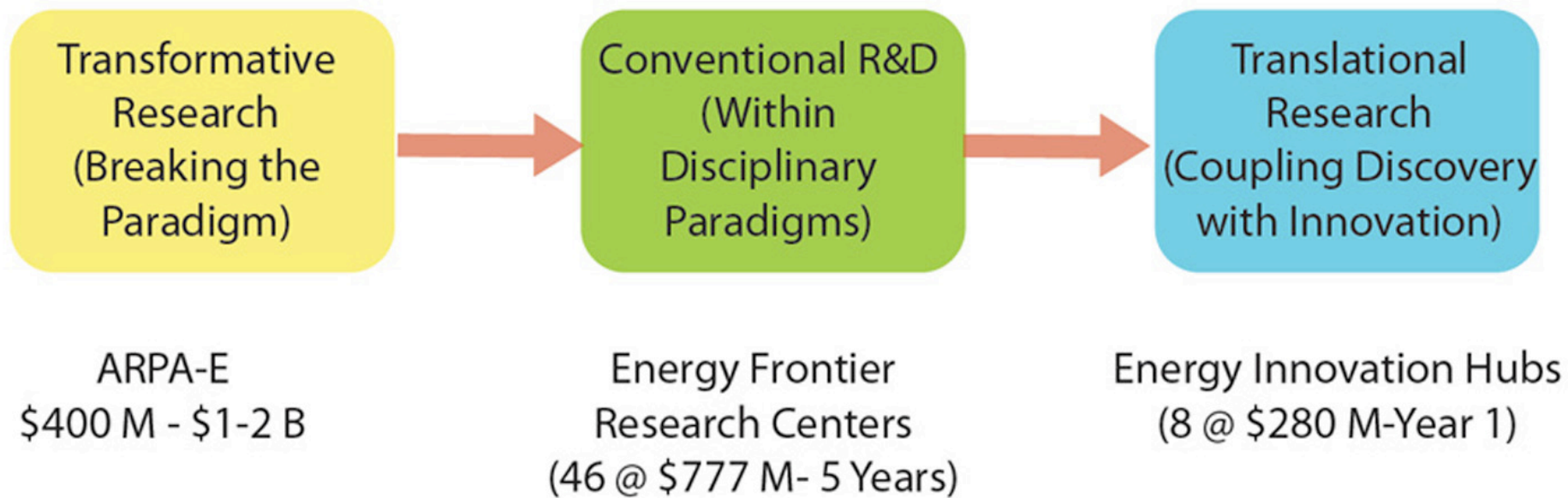


U.S. DEPARTMENT OF
ENERGY

**Department of Energy
FY 2010 Budget**

**Transforming the Energy Economy
through Science and Innovation**

May 7, 2009



**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:



