SAND2008-2328C

No Country is an Island: Collaboration in the 21st Century

Wendy R. Cieslak, Ph.D.
Sandia National Laboratories

AAAS-SWARM Presidential Address
10 April 2008

SWARM Southwestern and Rocky Mountain Division of AAAS EST. 1920

AAAS ADVANCING SCIENCE, SERVING SOCIETY

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Is America Falling off the Flat Earth? - Norman R. Augustine

"Distance is Dead"

- Consumers do comparison shopping on the Internet rather than visiting a few local stores
- Service departments are in Bangalore, Jamaica, elsewhere
- Washington D.C. receptionist on flat-panel display from Pakistan
- Software produced by international teams working round the clock
- Nearly 1 in 20 Americans works for a foreign-owned company
- ~50,000,000 jobs (1/3) are potentially capable of being exported

"What is clear is that attempting to build "walls," in the form of economic barriers, around the United States will simply ensure that we are left in isolation and become increasingly irrelevant as the rest of the world moves forward rapidly."

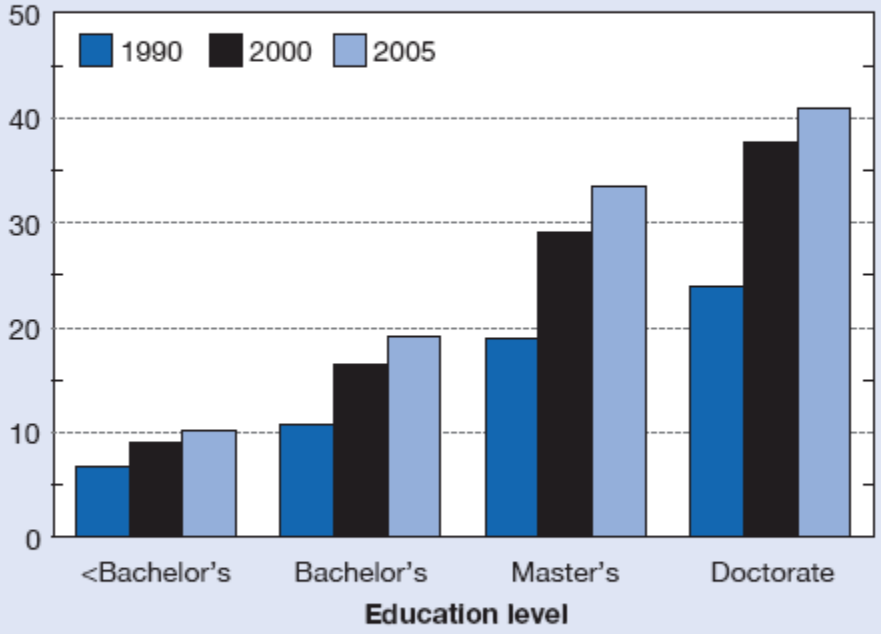
Powell Lecture
Friday at 7 PM

Most Americans have no idea what technology does for us!

Why do we need meteorologic satellites when we have the Weather Channel?

The importance of foreign-born scientists & engineers in the U.S. continues to grow

Figure O-52
Foreign-born individuals in U.S. S&E workforce, by degree level: 1990, 2000, and 2005



SOURCES: Census Bureau, decennial census, various years; and American Community Survey (2005).

Science and Engineering Indicators 2008

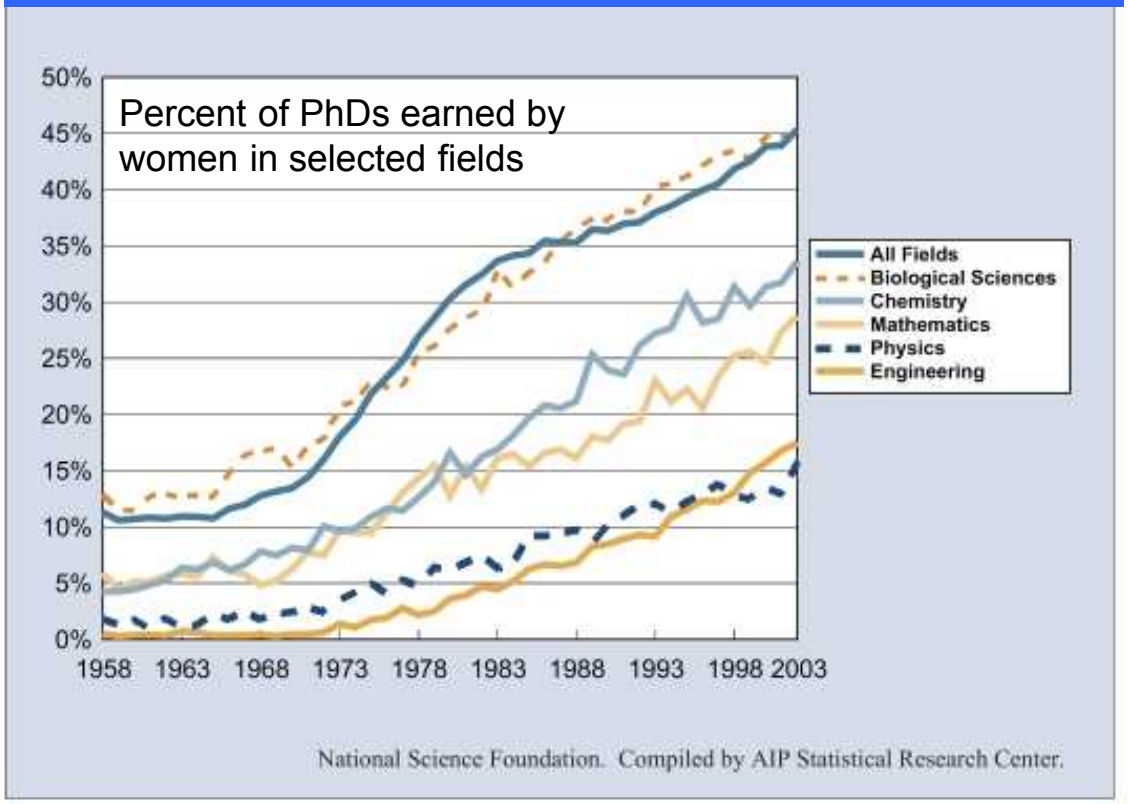
- S&E employment has grown faster (average annual rate 4.2%) than new degree production (1.5%)
- S&E proportion of total jobs increased from 2.6% in 1983 to 4.2% in 2006
- Over 40% of PhD S&E workers in the U.S. are foreign-born
- Although no one source country dominates, for doctorate level, 22% came from China and 14% from India (2003)
- The longer workers stay, the more likely they are to become U.S. citizens
- ~90% of those from China and India stay in the U.S. >5 years, and only 30-60% of those from other countries.

Lawrence Summers sparked discussion of gender issues in January 2005

L.H. Summers' Hypotheses
Harvard University President
14 January 2005

1. **"The high-powered job hypothesis"**
2. **"The different availability of aptitude at the high end"**
3. **"Different socialization and patterns of discrimination"**

Women are nearing parity in earning Ph.Ds in biology, and in all fields. Rates are slower in engineering and physics, but have risen steadily.



He did not mention implicit bias, as demonstrated in the Goldberg-paradigm (Goldberg, 1968: an experimental test of judgment difference about persons of different gender who are represented with identical stimulus material).

Social customs make it increasingly difficult for women to climb the ladder

Talking from 9 to 5: Men and Women at Work
by Deborah Tannen, Professor of Linguistics, Georgetown U.

- When is the wage gap a communication gap?
- Why don't you say what you mean?
- Marked: women in the workplace
- She's the boss: women and authority
- The Glass Ceiling as a wall of words
- Who gets heard: talking at meetings

"Life is a matter of dealing with other people, in little matters and cataclysmic ones, and that means a series of conversations."
- Deborah Tannen

Science and engineering research is an increasingly collaborative activity

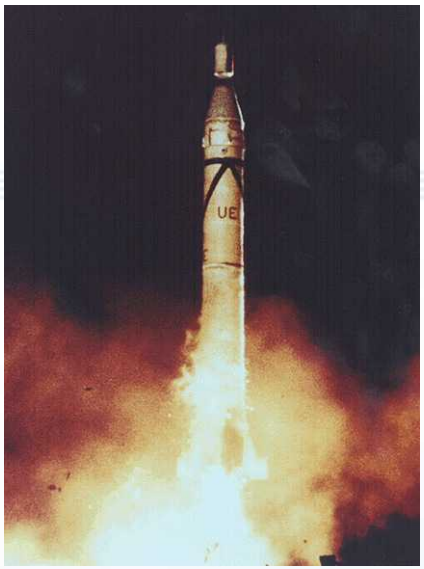
- Between 1988 and 2005, the share of publications with authors from multiple institutions grew from 40% to 60%
  - Coauthored articles with only domestic institutions grew from 32% to 41% of all articles
  - Articles with institutions from multiple countries grew from 8% to 20%
- The U.S. has the largest share of all internationally authored articles, and U.S. researchers collaborate most with Germany, U.K. and Canada
- Based on co-authorship, integration of R&D activities is occurring across the full range of R&D-performing institutions in the U.S.
- Although the U.S. share of publications and citations has declined, the influence has increased: In 2006, U.S. institutions had 83% more articles in the top 1% cited articles than would be expected based on total publications count.

What is today's threat and how can it mobilize us like the past did?

USSR Sputnik 1, October 4, 1957

"Until 1957…there was no demand from the political side for science to maintain a vigorous, continuing presence in Washington…But, of perhaps greater significance, there was virtually no initiative on the part of scientific leadership to establish a clearly identified place for science in the policy-making councils…In October 1957, the Soviets orbited *Sputnik*, and honeymoon fervor immediately returned to the romance between science and government."

- Daniel Greenberg, 1968



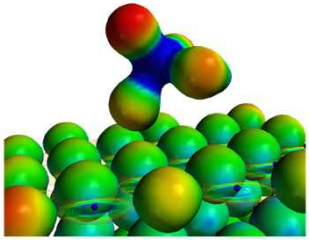
USA Explorer 1, January 31, 1958

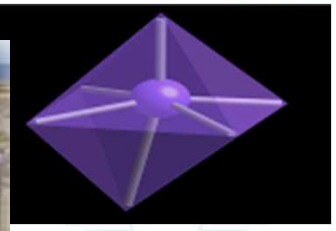
"You know, Jim, this bunch of scientists was one of the few groups I encountered in Washington who seemed to be there to help the country and not to help themselves."

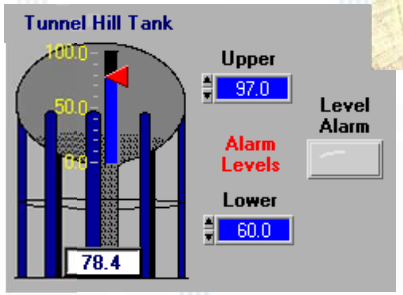
- Dwight D. Eisenhower to Jim Killian at Walter Reed Hospital months before his death in March 28,1969.

The threat is energy, water and climate change

Create Water through Desalination

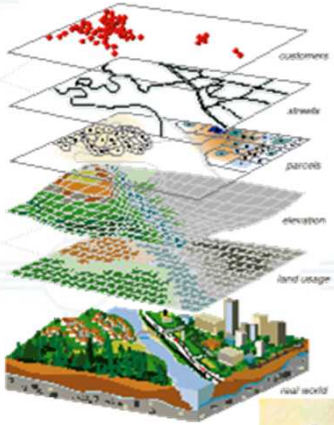






Water Security Systems

Water System Modeling/Management

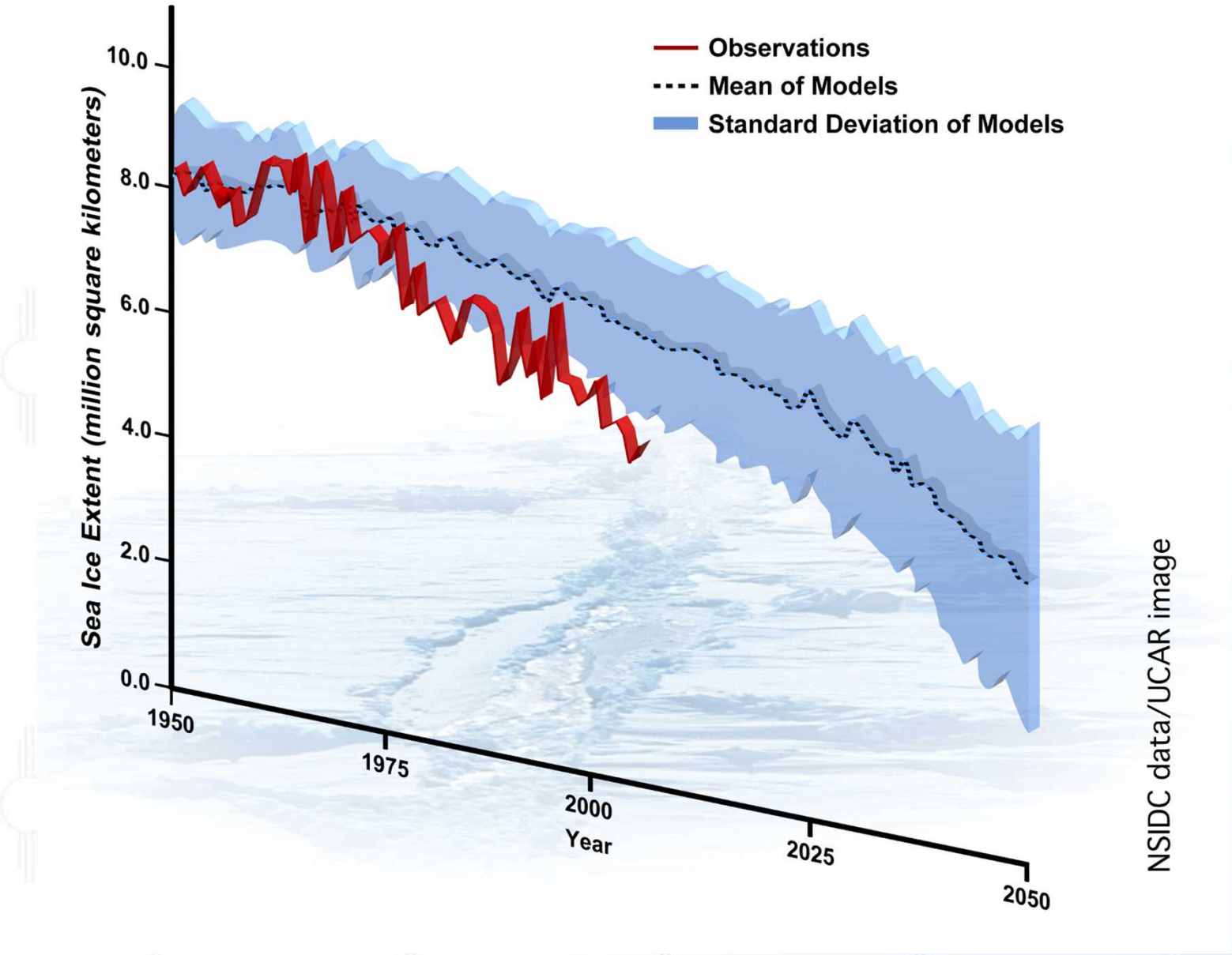


Energy and Water Interdependencies

Energy, Resources & Nonproliferation Program

Sandia National Laboratories

Models have underestimated the recent loss of Arctic sea ice

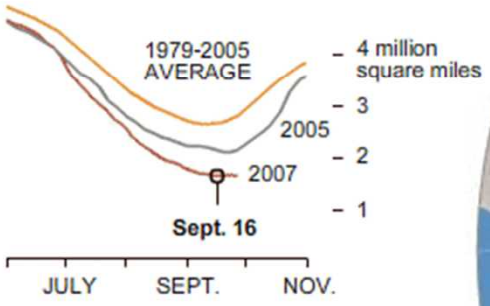


NSIDC data/UCAR image

Timelapse view of Artic sea ice illustrates the issue dramatically

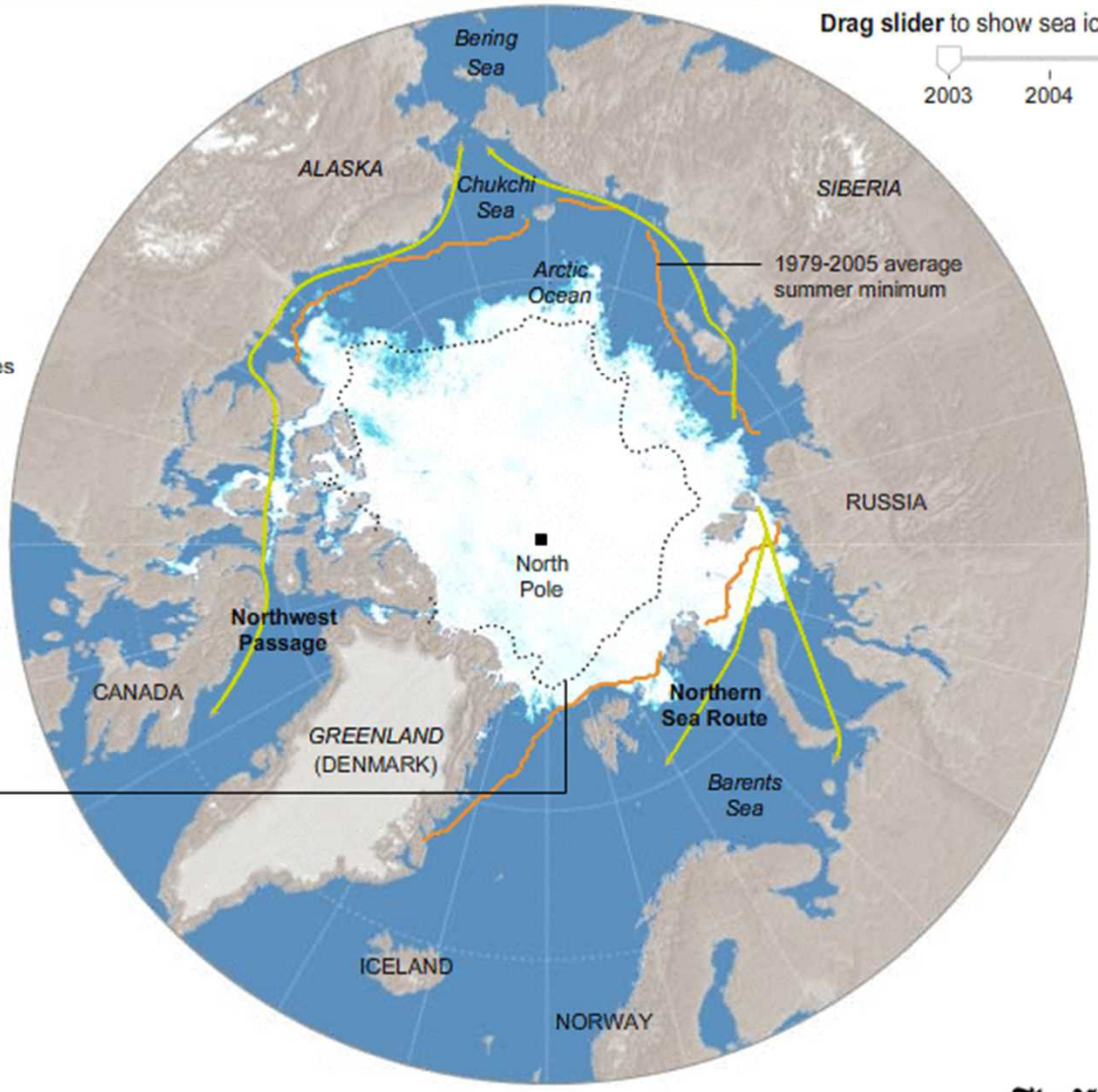
SUMMER SEA ICE
This summer saw a record-breaking loss of Arctic sea ice. Experts attribute the changes to the interaction of wind, weather, ice drift, ocean currents and greenhouse gases.

SUMMER SEA ICE EXTENT*



Sea ice extent is the area of ocean covered by at least 15 percent ice.

PERENNIAL SEA ICE
Ocean within this boundary had been covered with ice year-round since satellite records began in 1979. This summer was the first time that part of the perennial sea ice was open water.



The New York Times

Source: Erin Aigner, Jonathan Corum, Vu Nguyen/The New York Times
http://www.nytimes.com/interactive/2007/10/01/science/20071002_ARCTIC_GRAPHIC.html

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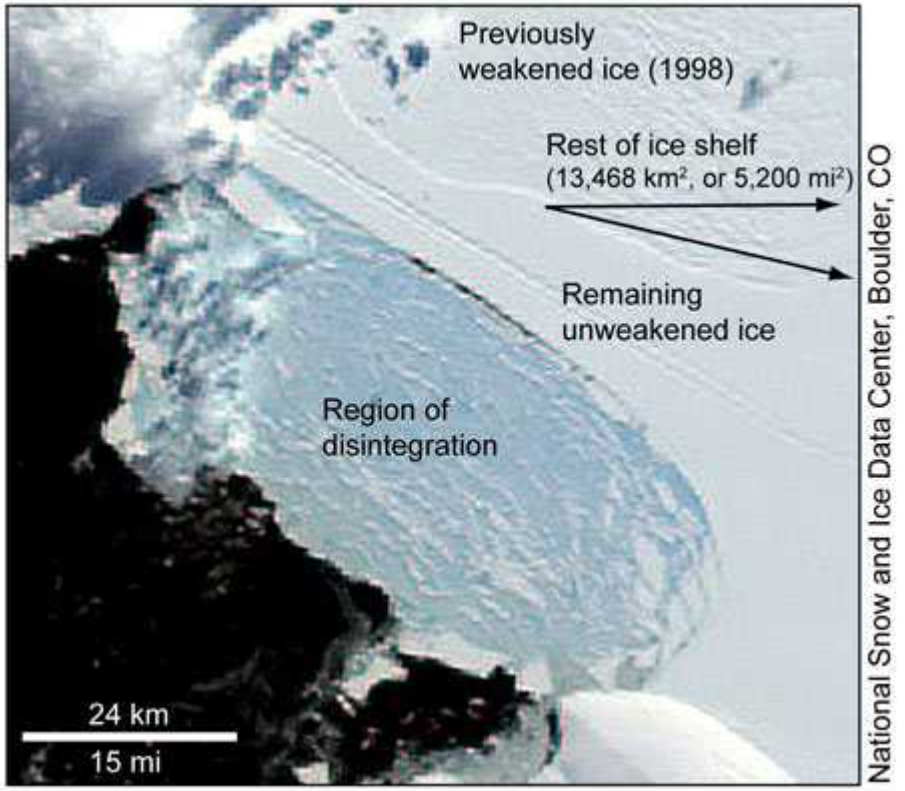
Headline: Huge Swath of Antarctica Ice Collapses

NATIONAL GEOGRAPHIC



Such occurrences are "more indicative of a tipping point or trigger in the climate system," said Sarah Das, a scientist at the Woods Hole Oceanographic Institution in Massachusetts.

Geopolitical impacts of climate change are likely to be severe

- Climate change will not be uniformly distributed; there will be winners and losers.
- Global economic power balances may shift.
- Mass migrations of populations from the most impacted areas (e.g. Bangladesh) will create international tensions.
- Extended growing seasons and new shipping lanes will benefit some nations.
- Chronic drought, sea-level rise, extreme weather events, and ecological deterioration will create economic hardship for other nations.
- Major powers will suffer from climate impacts occurring elsewhere.
- Perceived beneficiaries and principal contributors will suffer international scorn.
- International alliances will shift.

"Climate change is and will be a significant threat to our national security and in a larger sense to life on Earth as we know it to be."

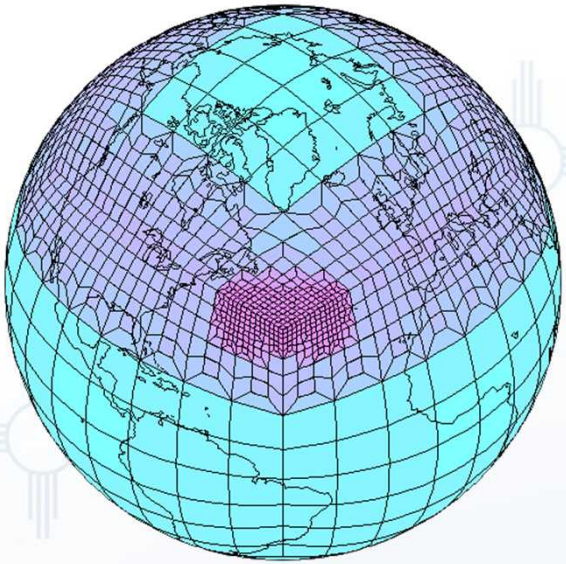
– General Gordon R. Sullivan (Ret), former U.S. Army chief of staff, to a Congressional Panel, 2007.

Climate change analyses provided courtesy of Mark Boslough, Sandia National Laboratories

Multi-disciplinary and multi-institutional collaboration will make the difference

For example:

- As computing power increases, scalable atmospheric models will be able to resolve regional climate effects which will be critical for agricultural, economic, and national security planners.
- DOE Multilab SciDAC project is creating a first generation Earth System Model to help policy makers determine safe levels of greenhouse gas concentrations in the atmosphere.
- Recently, team members achieved a breakthrough by using a cubed-sphere grid and showing excellent performance on 96,000 processors.
- Collaborators include
  - National Center for Atmospheric Research (NCAR, Boulder)
  - University of Alaska and its Supercomputing Center
  - University of NM and NMCAC
  - Oak Ridge, Los Alamos, Lawrence Livermore, Sandia, Argonne,and Pacific Northwest National Laboratories



NCAR

ALASKA CLIMATE RESEARCH CENTER

Mark Taylor, Sandia National Laboratories

Sandia National Laboratories

The Department of Energy is encouraging cooperation with China

"…energy security of both countries will be advanced through international cooperation."

K. Fredriksen, DOE-PI
August 6, 2006

12/12/2007 U.S. and China Increase Biofuels Cooperation Ahead of the Third U.S. – China Strategic Economic Dialogue http://www.energy.gov/news/5770.htm

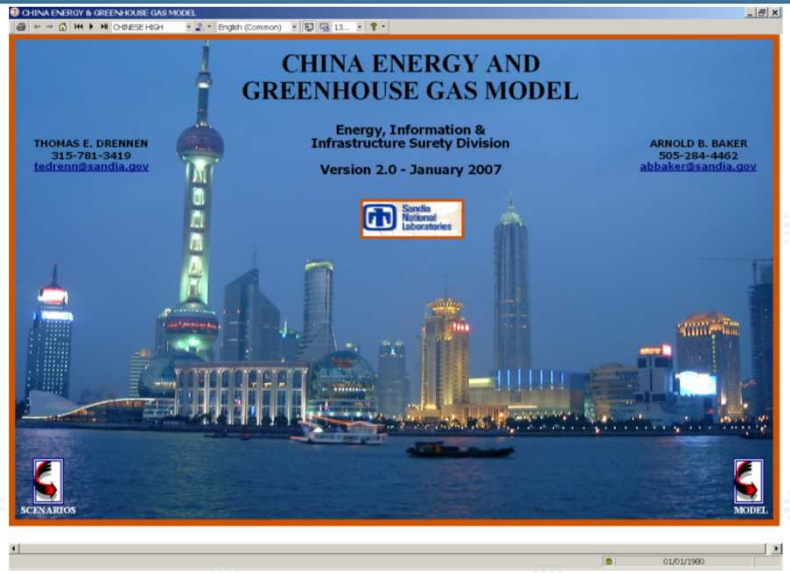
9/20/2007 U.S. and China Continue to Increase Cooperation on Vehicle Efficiency http://www.doe.gov/news/5518.htm

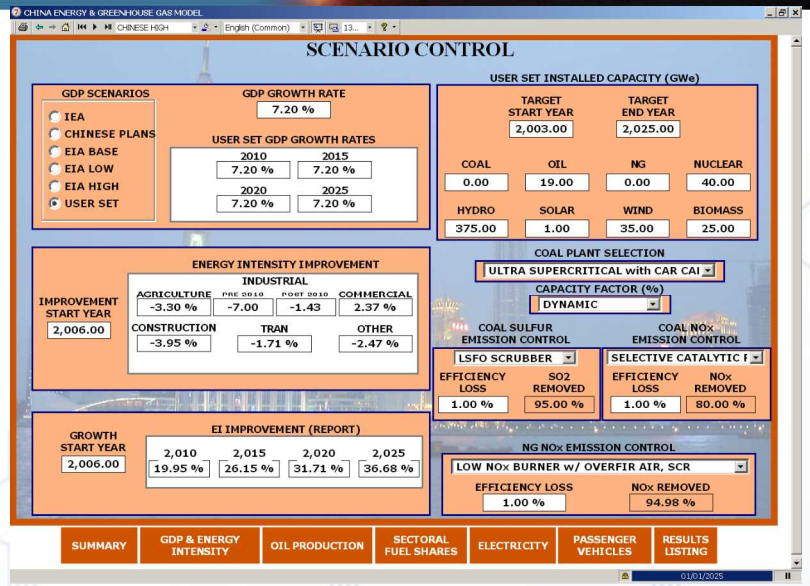
9/14/2007 U.S. and China Sign Agreement to Increase Industrial Energy Efficiency http://www.doe.gov/news/5495.htm

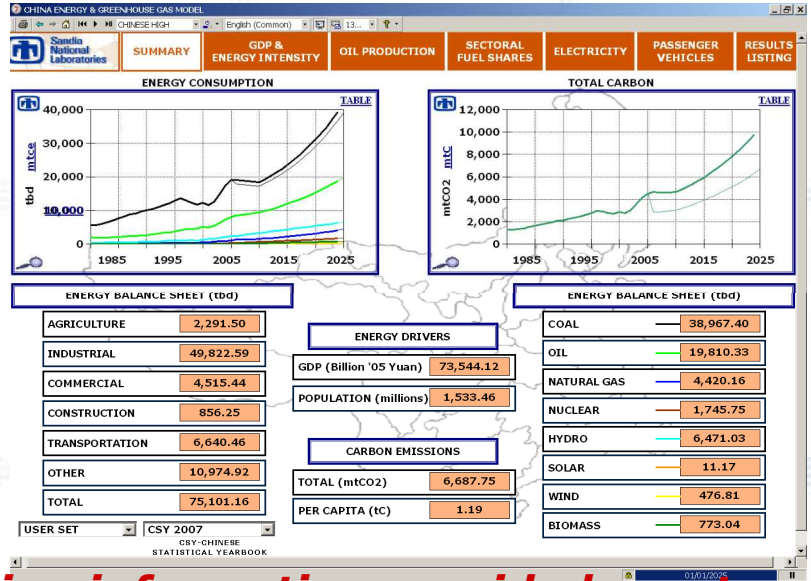
5/22/2007 U.S. – China Energy Cooperation http://www.doe.gov/news/5080.htm

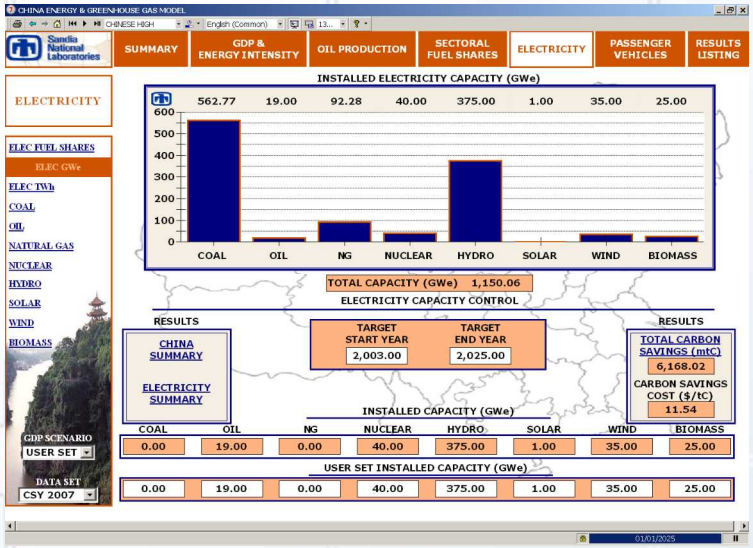
12/15/2006 U.S. and China Announce Cooperation on FutureGen and Sign Energy Efficiency Protocol at U.S.-China Strategic Economic Dialogue http://www.energy.gov/news/4535.htm

Systems analysis can help China to address the energy effect on greenhouse gas









China information provided courtesy of Amy Sun, Tom Drennan & Arnie Baker, Sandia National Laboratories

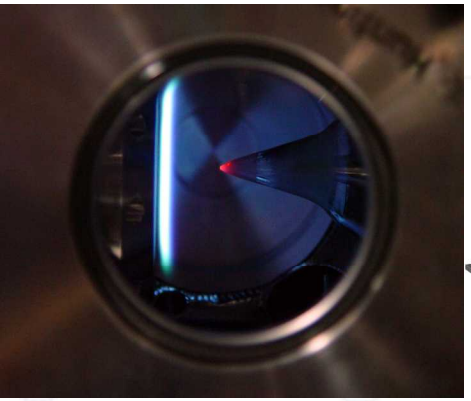
Sandia National Laboratories

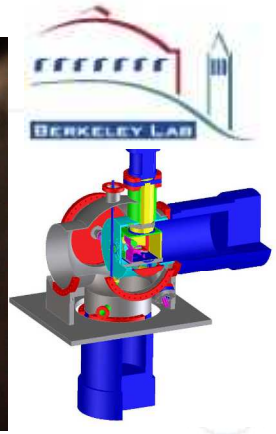
Sandia is working with U. Texas to provide national solutions to the healthcare crisis

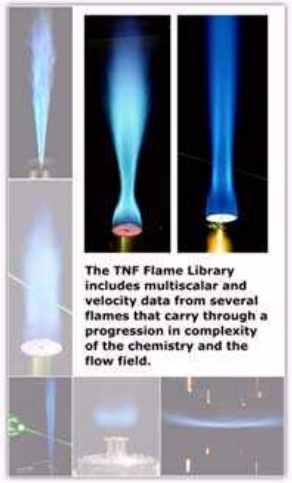
- Healthcare is approaching 20% of GDP
- We have no tools to evaluate consequences of policy proposals
- SNL/UT joint development of a national scope predictive simulation model
  - Open source
  - Freely licensed
  - Scalable
  - Extensible

David Strip, Sandia National Laboratories

Sandia's Combustion Research Facility: Collaborating for Energy Solutions





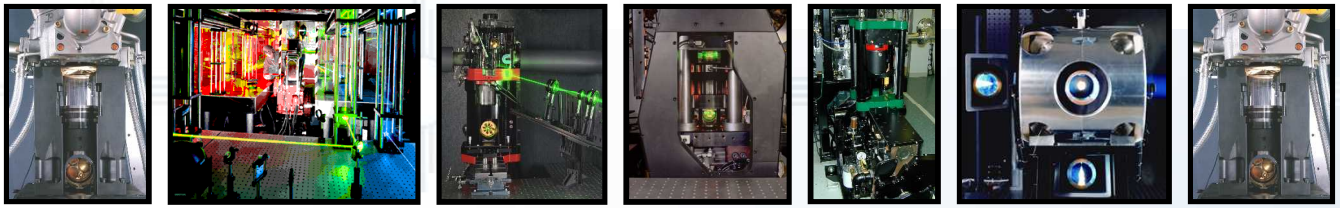


Expanding Frontiers of Science Through Leadership and Collaboration:

- Advancing Combustion Chemistry
  - LBNL/ALS collaboration
- Leading Turbulent Flame Research
  - TNF Workshop coordinates modeling and experiment

Applied Science Supporting Industry:

- Leading USCAR combustion work
  - MOU coordinates efforts of labs, universities, all major engine and energy companies



CRF

Andy McIlroy, Sandia National Laboratories

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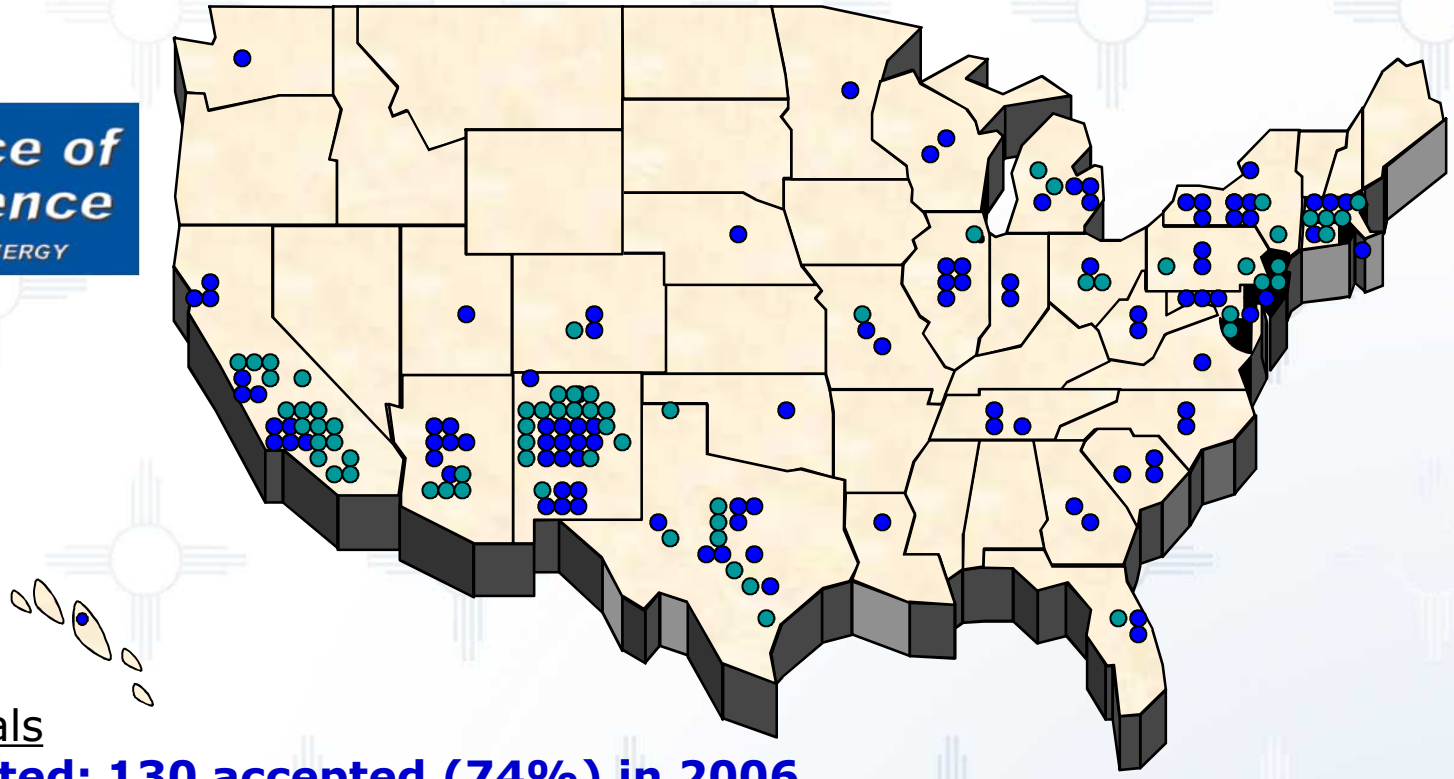
CINT User calls have attracted widespread interest

The Center for Integrated Nanotechnologies is a user facility devoted to establishing the scientific principles that govern the design, performance and integration of nanoscale materials.



User Proposals

175 submitted; 130 accepted (74%) in 2006

101 submitted; 79 accepted (78%) in 2007

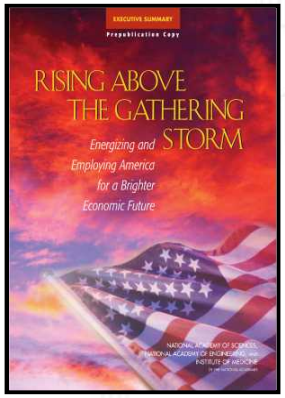
32 States & 10 Foreign Countries represented

207 researchers involved in current projects

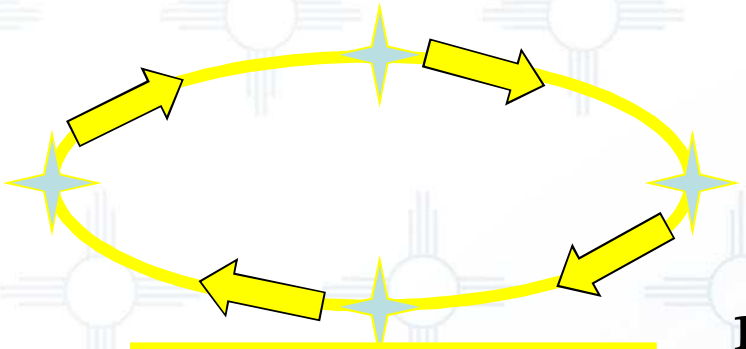
Neal Shinn, Sandia National Laboratories

The U.S. is developing an aggressive plan for global competitiveness

America COMPETES Act President Signs 8/9/07



Rising Above the Gathering Storm December 2005



Next Generation Of Innovators

Discovery Science and Engineering Innovation Institutes

Bring together …

'Innovation is the only competitive advantage in the global economy'

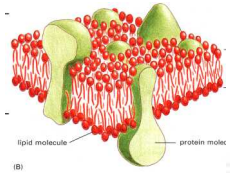
A vision for the next decade: Partnering for education & innovation

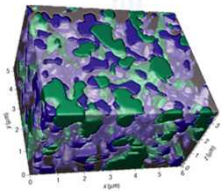
Discovery Science & Engineering Innovation Institutes

Young, diverse talent

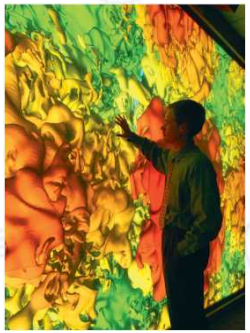
Transformed education

Broad collaborations





Compelling national research



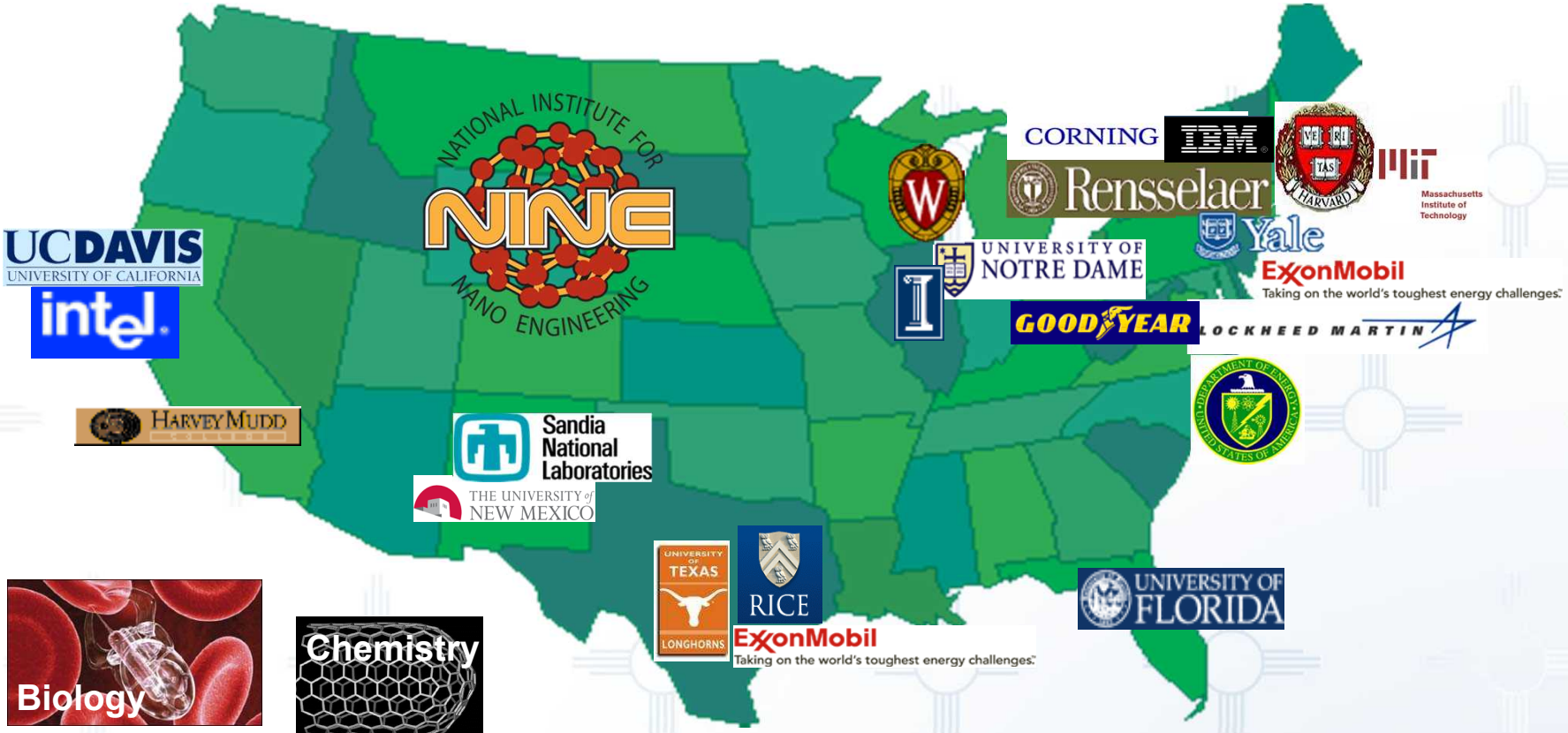
Lab & industry mentoring

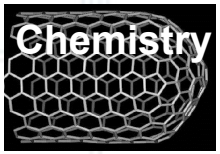
State-of-the-art facilities

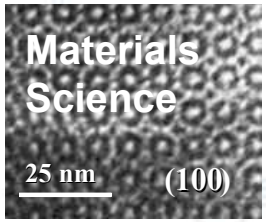
OUTCOMES

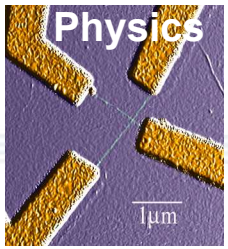
- **Future science & engineering leaders**
- **New breakthroughs**
- **Outreach & expanded partnerships**
- **Enhanced lab vitality**

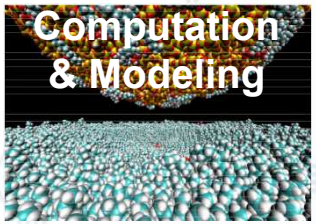
Prototyping the Innovation Institute Concept: *National Institute for Nano-Engineering*











- Next generation electronics
- Sensors
- Catalysts
- Energy conversion materials
- Optics
-

DSEII information courtesy of Duane Dimos, Justine Johannes and Regan Stinnet, Sandia National Laboratories

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Closing thoughts…

***No man is an island**, entire of itself; every man is a piece of the continent, a part of the main; if a clod be washed away by the sea, Europe is the less... any man's death diminishes me, because I am involved in mankind...*

Thus, with the recurring imagery of the island and the mainland, John Donne affirms that no one man can exist on his own, cut off from all the rest of society; there are no human islands.

Renaissance poet John Donne (1572-1631)