Overview of the College of Engineering Research Plans

"Implementing the Strategic Plan"

- Strategic plan objectives for research
- Review of the College's six strategic areas
- Research funding and graduate student trends
- Updates
  - ERC Proposal
  - Communication strategy (research)
  - MS/Phd. URM students
  - MENG Review
- Guided Questions

Strategic Plan Research Goals

- To be considered one of the nation's top five engineering colleges undergraduate and our graduate programs.
- To be the nation's premier research university in advanced materials, information sciences, and nanoscience and a world leader in bioengineering, complex systems, and energy and the environment.

Strategic Plan Research Objectives

- Increase the average research funding per faculty member by at least 10% per year, with a goal of doubling the funding within 10 years. .
- Double the number of Ph.D. Fellowships available, with an emphasis on fellowships for underrepresented minority and female students. Increase the flexibility given to departments and graduate fields in administering fellowships.
- Significantly grow the Ph.D. Program, particularly in the six areas of strategic focus: advanced materials, information science, nanoscience, bioengineering, complex systems, and energy and the environment. .
- Increase underrepresented minority graduate students from 4% to at least 7% and women graduate students from 21% to at least 30%. .

Advanced Materials

Materials with unprecedented properties are being tailored atom by atom at Cornell, which has been a pioneer in materials research. Fundamental advances in the characterization of materials are enabling new understanding of structure-property relationships. Some anticipated themes include further emphasis on computationally designed materials; ***increased functionality*** *by convergence and integration of biological, organic, electronic and structural materials; creation of self-assembly methods allowing materials to build themselves; and* ***tailoring of interfaces*** *to produce nanocomposites.*

Nano-materials, Nano-science, and Devices

Engineering at very small length scales *has the potential to produce important technologies utilizing materials with new and fundamentally different properties. It is now possible to fabricate structures on the molecular level using microelectronics techniques (top-down processes) or grow them using new molecular fabrication techniques (bottom-up processes). Research is active or forthcoming in microfluidics, microchemical systems, microelectromechanical systems, nanomaterials and actuation, and fabrication of materials at the molecular level*

Complex Systems and Networks

Such ***critical services as water, power, transportation, information, financial analysis, and emergency response are delivered by complex, automated systems*** *that integrate actuation, sensing, and digital communication and control into physical devices to meet complicated design requirements. Cornell has a broad-based foundation in the study of such complex systems, including expertise in communication, information technologies, electric power, transportation, manufacturing, intelligent systems, and systems biology.*

Communication, Computation and Information

Computer simulations can predict the behavior of exceedingly complex systems and have begun to play a role in engineering research equal to that of physical experiments. *While rapid and reliable simulations are common in many areas of engineering research, there is a need to continue developing novel methods and algorithms in other areas such as the modeling of multi-scale phenomena. Fatigue fracture, for example, can be simulated at the component, grain, and atomistic levels, but coupling these simulations effectively requires new insights.*

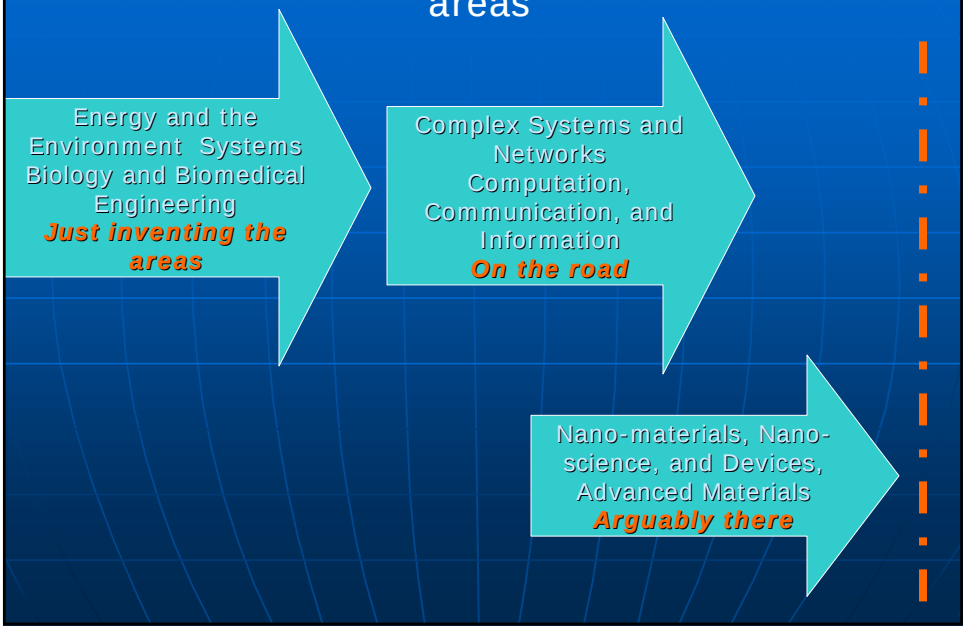
Systems Biology and Biomedical Engineering

With quantitative and predictive methods of engineering producing a greater understanding, design, and control of biological systems, ***Cornell is poised to make important contributions at the interface of engineering and life sciences*** *with novel technologies and analytical approaches relevant to medical application, nanobiotechnology, bioprocess development, drug delivery, genomics and proteomics , environmental remediation, instrumentation, metabolic engineering, and biomechanics.*

Energy and the Environment

Over the next 50 years the earth's population is expected to increase by two-thirds to 10 billion people with concurrent energy demand predicted to rise from 15 terawatts to 50 terawatts. *With such dependence on oil, national gas, and electricity generated by coal, this growth will no doubt affect the environment and require an enormous change in the way people live. Alternative energy sources may become viable with appropriate research and development. As in other areas, progress is often based on multidisciplinary efforts (in combustion, biomaterials, and bioremediation, for example) and will benefit from interactions with other initiatives and colleges at Cornell*

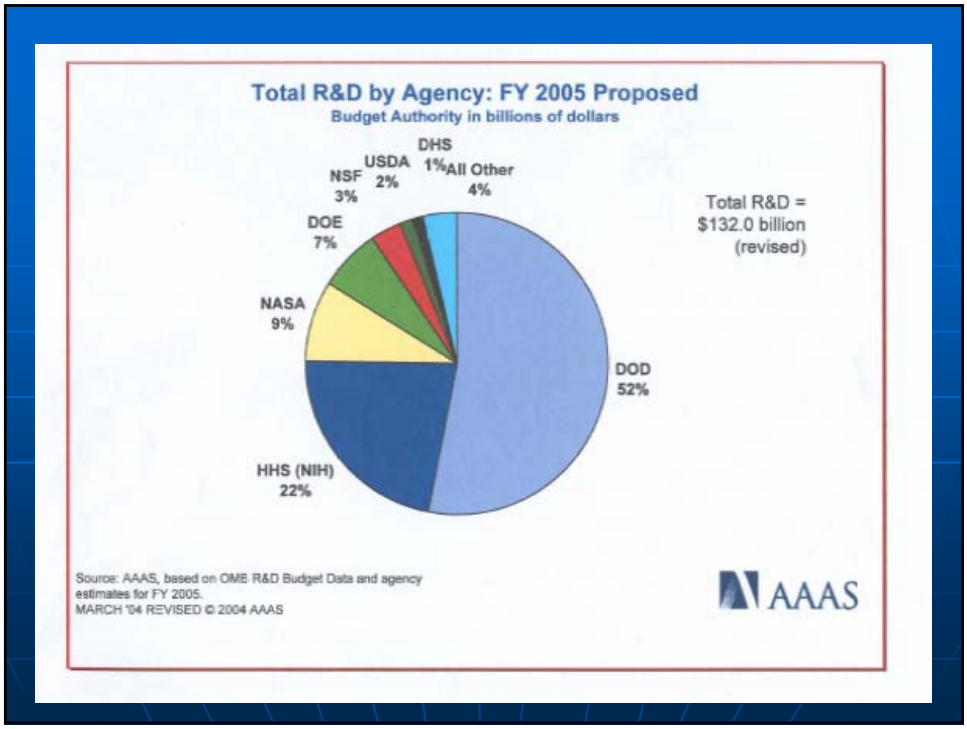
Progress toward our goals in the six strategic areas



Federal and Cornell (Engr.) Funding Trends

Federal Budget Highlights

- Record-breaking deficits, with no return to surpluses in sight. FY 05 budget essentially flat funding for university R&D
- The federal budget determines 60% of all university R&D. Total federal support of engineering research in 03 was $8.2 billion R&D investments track discretionary spending. The budget plans for cuts in discretionary spending over the next several years.
- Nanoscale science initiative still a top priority


Total R&D by Agency: FY 2005 Proposed
Budget Authority in billions of dollars
DHS 1%
All Other 4%
USDA 2%
NSF 3%
DOE 7%
NASA 9%
DOD 52%
HHS (NIH) 22%
Total R&D = $132.0 billion (revised)
Source: AAAS, based on OMB R&D Budget Data and agency estimates for FY 2005.
MARCH '04 REVISED © 2004 AAAS
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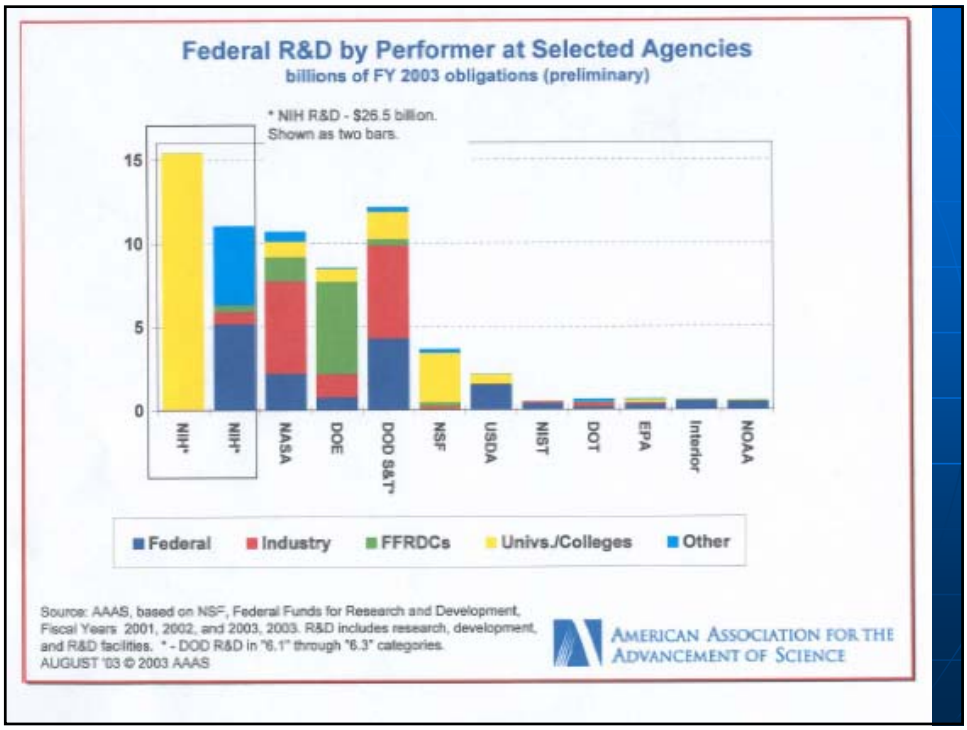
Federal R&D by Performer at Selected Agencies
billions of FY 2003 obligations (preliminary)
* NIH R&D - $26.5 billion. Shown as two bars.
15
10
5
0
NIH*
NIH*
NASA
DOE
DOD S&T*
NSF
USDA
NIST
DOT
EPA
Interior
NOAA
Federal
Industry
FFRDCs
Univs./Colleges
Other
Source: AAAS, based on NSF, Federal Funds for Research and Development, Fiscal Years 2001, 2002, and 2003, 2003. R&D includes research, development, and R&D facilities. * - DOD R&D in "6.1" through "6.3" categories.
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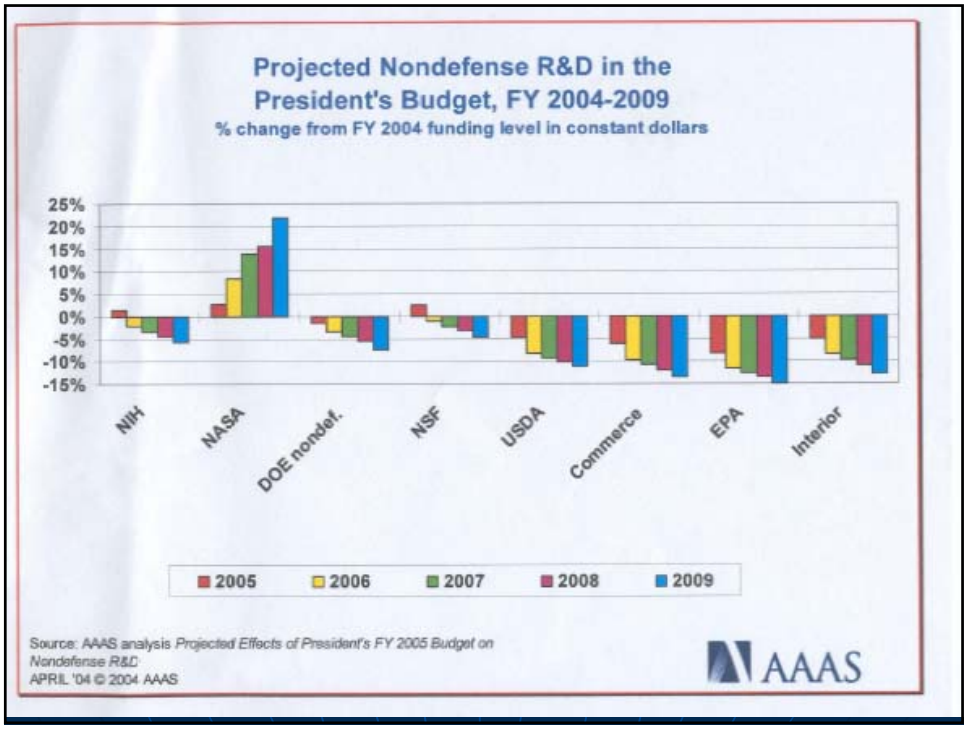
American Association for the Advancement of Science


Projected Nondefense R&D in the President's Budget, FY 2004-2009
% change from FY 2004 funding level in constant dollars
25%
20%
15%
10%
5%
0%
-5%
-10%
-15%
NIH
NASA
DOE nondef.
NSF
USDA
Commerce
EPA
Interior
2005
2006
2007
2008
2009
Source: AAAS analysis Projected Effects of President's FY 2005 Budget on Nondefense R&D
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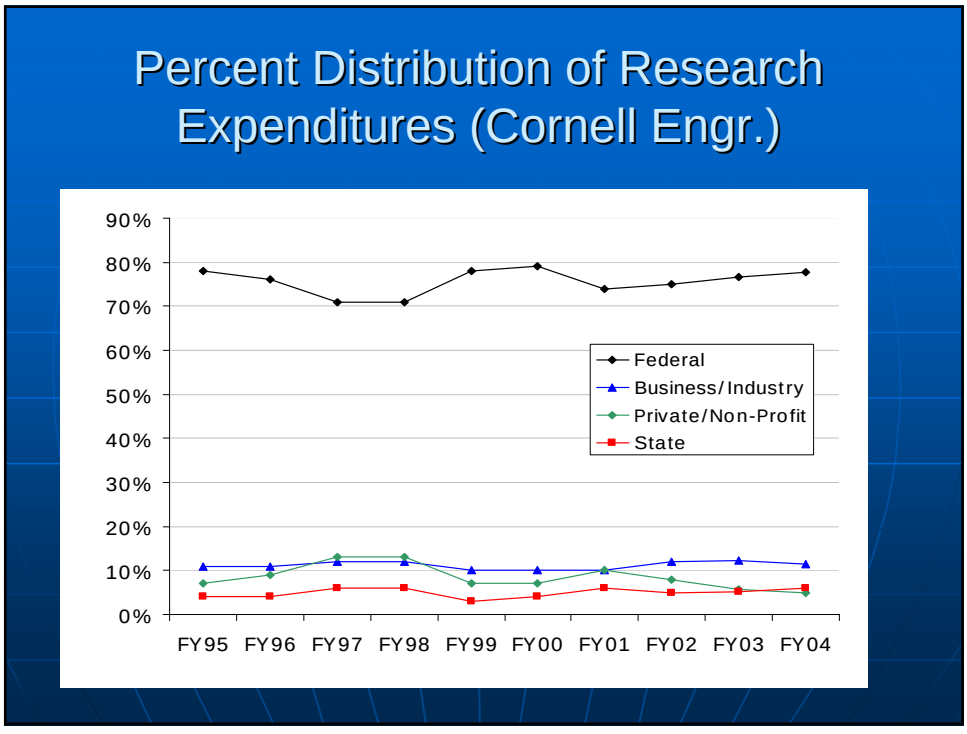
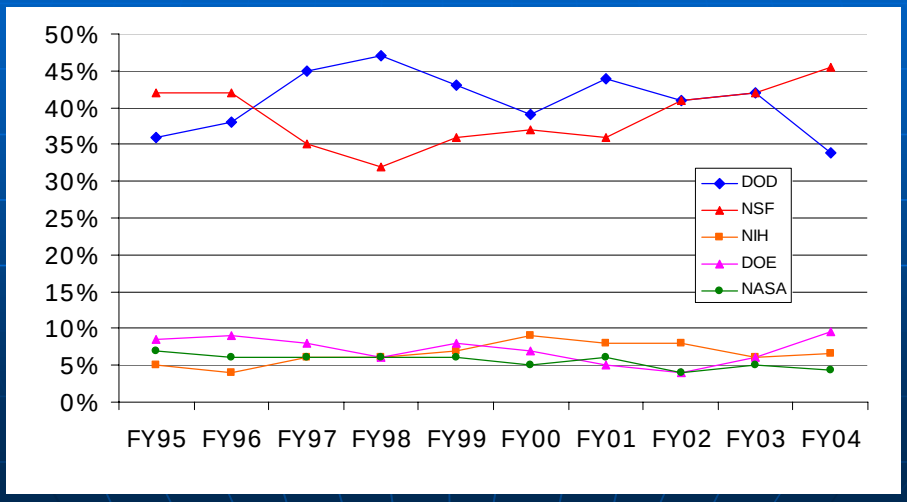
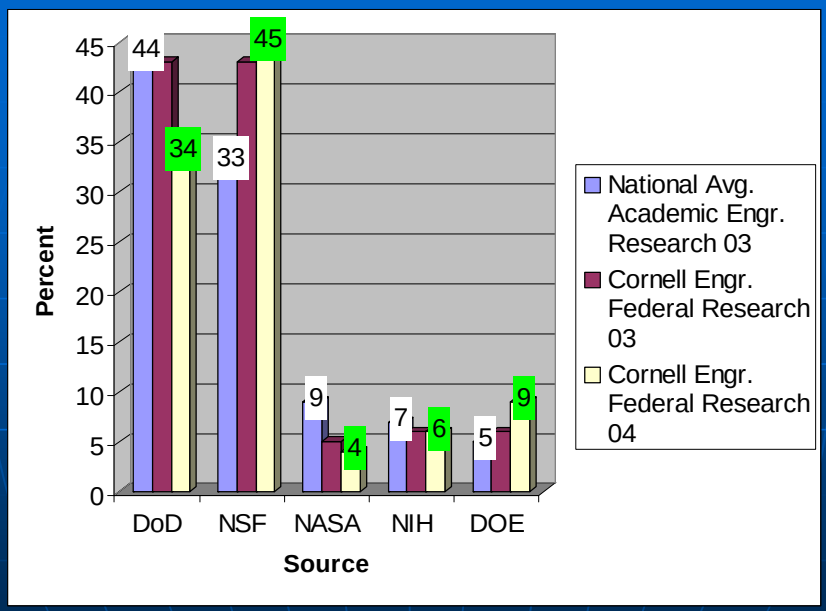
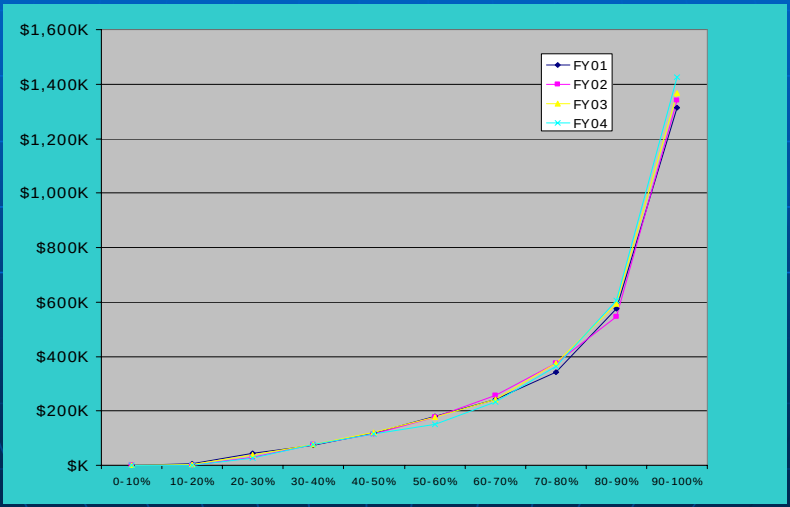

Percent Distribution of Research Expenditures (Cornell Engr.)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
FY95
FY96
FY97
FY98
FY99
FY00
FY01
FY02
FY03
FY04
Federal
Business/Industry
Private/Non-Profit
State

Research Expenditures – Distribution of Federal Funding (Cornell Engr.)



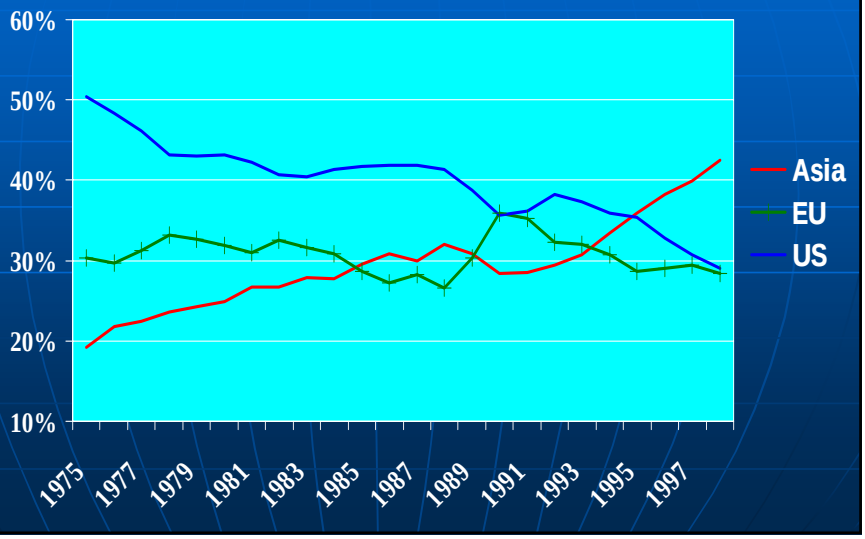


Average Faculty Research Expenditures by Decile ($K)



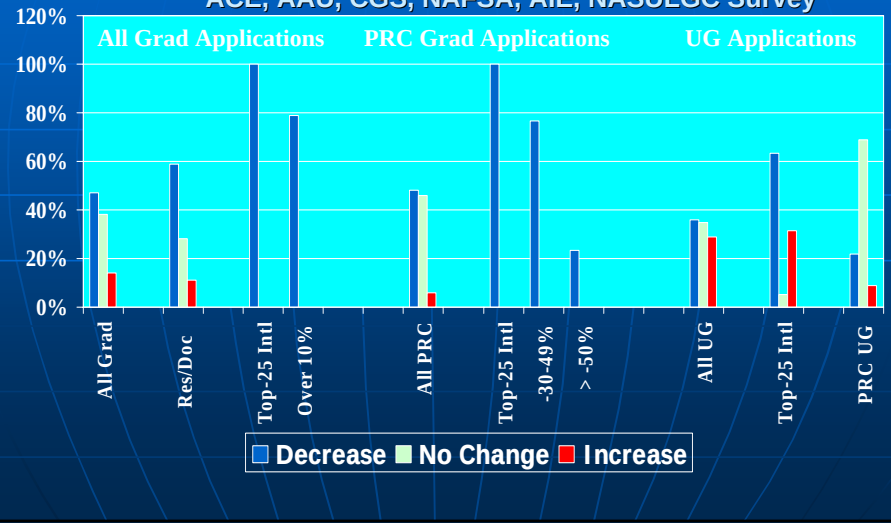
Graduate Student Trends

Engineering Doctorate Degrees



International Graduate Applications Fall 2003 - Fall 2004

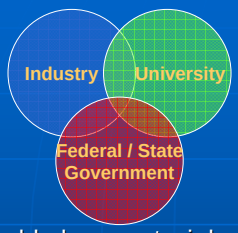
ACE, AAU, CGS, NAFSA, AIE, NASULGC Survey



Updates

Cornell Center for Ubiquitous Flexible Electronics

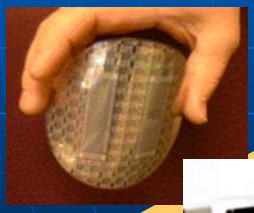
Director Chris Ober

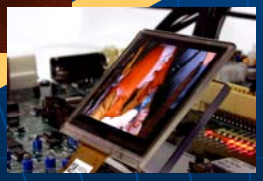


- World class materials fabrication and characterization facilities
- Culture of collaborative research
- Experience with interdisciplinary centers
- **Geographic proximity to major display related companies**
- **Complementary universities**

At the end of Moore's Law: where does the future take you?

Today's Technology:
- Display materials primarily glass-compatible
- Backplane electronics moving to plastic
- Barrier and encapsulation: Challenging
- Integration: Just beginning



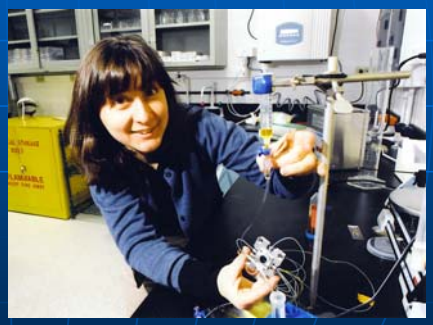


Future:
- Low cost manufacturing (roll-to-roll)
- Solid state lighting
- Wall-size displays

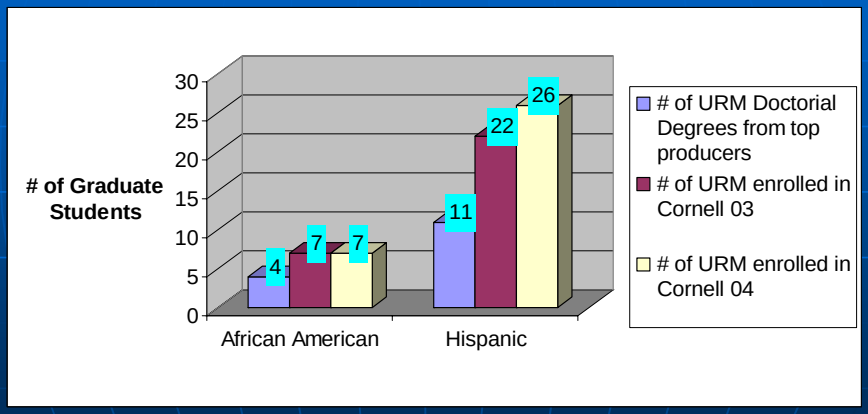
Tomorrow:
- New materials to meet backplane and encapsulation requirements.
- New integration and manufacturing techniques
- Fully integrated flexible displays as test vehicles

Strategic Plan for Research: Communications

- Strategic Plan
  - Bound copies
  - Online document
  - Marketing brochure
  - Launch event(s)
- Research Brochure
  - High-quality full color publication
  - Corporate Insert
  - Grad Insert
- General Interest Brochure
- New Engineering Web Site



Underrepresented Minorities



Meng. Program Description

The M.Eng. program is nationally unique in its creative scope and structure. The program serves students, industry, and the nation by providing students the opportunity to enhance their engineering knowledge and expertise in innovative areas of market demand. The program is one component of Cornell Engineering's commitment to Cornell's land grant mission. The program is also unique in the college because it provides a revenue stream that is directly dependent on enrollments. The M.Eng. program quality and size requires field-specific analysis and adjustment to ensure that the program achieves its mission and also helps enable the missions of the undergraduate program and the M.S./Ph.D. program.

Source College Strategic Plan July 04

Timetable of the review

- Feb 15th-MENG Self Study completed
- Mar 18th-Draft Presentations by Departments completed
- April 20th- ECC Review

Guided Questions

Guided Questions

1. Should the College of Engineering faculty be working on overarching *grand challenges*, e.g., world hunger? If so, what are they?
2. What trends and opportunities do you see in the next 5 years for research funding (federal, state, industry, industry) and how should the College respond?
3. Should the College engage in more applied research? Should we be engaged in classified (e.g., through the Department of Homeland Security), secret, or corporate confidential research?
4. What is your reaction to the presentations by Professors Leibovich, Shuler, Strogatz, and Wicker?

Guided Questions

5. How should we measure, evaluate, and enhance the quality, impact, and visibility of our research?
6. For faculty that are not as productive in their research as they could be, how can we help them renew/revitalize their research or help faculty transition to retirement?
7. Should Cornell have "research faculty" who exclusively focus on research (i.e., do very little teaching) in addition to our current tenure-track faculty?
5. Are their opportunities for research collaboration with European companies or other overseas corporations?

Guided Questions

9. How can we more effectively utilize Cornell's medical school in NYC?
10. Should faculty in engineering partner more in research with faculty in social sciences, humanities, architecture, law, or the hotel school? (These are the areas with less research collaboration.)
11. How can we develop strategic alliances with industry in our six broad areas of research?
12. Should we prioritize the six broad research areas to best increase the quality, impact, and visibility of our research? What criteria would you use?
13. How should we couple college wide resources (e.g., faculty hiring) with our research aspirations?