Strategic Plan for 2009 and Beyond

Engineering Education and Centers

Spring 2008
ASEE-ERC
A.L. Soyster
National Science Foundation
FY 07 Budget Request ($6,020 million)

National Science Board

Office of the Inspector General

Staff Offices

Director

Integrative Activities (MRI, STC)
$131M

Directorate for Biological Sciences
$608M

Directorate for Computer and Information Science and Engineering
$527M

Directorate for Education and Human Resources
$816M

Directorate for Geosciences
$745M

Director of Mathematical and Physical Sciences
$1150M

Directorate for Social, Behavioral, and Economic Sciences
$214M

Directorate for Engineering
$520M + $109M (SBIR)

Directorate for Geosciences
$745M

Directorate for Mathematical and Physical Sciences
$1150M

Directorate for Social, Behavioral, and Economic Sciences
$214M

Summary
$4,666M R&RA
$240M MREFC
$816M EHR
$6020M Total
Directorate for Engineering
FY 2007

Emerging Frontiers in Research and Innovation (EFRI) $25M

Office of the Assistant Director Deputy Assistant Director (OAD) $629M*

Senior Advisor Nanotechnology

Engineering Education and Centers (EEC) $126M

Civil, Mechanical, and Manufacturing Innovation (CMMI) $152M

Chemical, Bioengineering, Environmental, And Transport Systems (CBET) $124M

Electrical, Communications and Cyber Systems (ECCS) $81M

Industrial Innovation and Partnerships (IIP) $120M

* FY 07 Request Amounts
EEC Mission

Support the development of diverse, creative, innovative and globally competitive engineers.
EEC Objectives for 2020

1. Enhance the K-12 Pipeline and its Diversity;
   * 10% of all matriculates study engineering.

2. Promote the Success of the Undergraduate Learning Experience;
   * 3 of 4 students complete BS in engineering.

3. Improve the Pathway to Graduate Engineering Programs for US and Permanent Residents;
   * 5000 PhDs granted to domestic students.

4. Build a Culture of Discovery and Innovation in Engineering through Multi-Disciplinary Centers;
   * 1000 Center-related students graduate annually
EEC Programs/Timelines

- Centers
  Next ERC Cycle—Tentative Fall ‘08 Announcement
  STCs—(Foundation-wide) May, June 2008 (info)

- Engineering Education
  Eng Ed -- April 30
  Ethics—April 3 (SBE)
  Nano-Ed—May 14
  Intl Res and Ed in Eng—(not in FY 2008)
  CCLI—May 20,21 (EHR)

- Human Resources
  RET—(Nov 28, 2008)
  REU—(Aug 18, 2008)
  CAREER —late July
  NSF Fellowships—(Nov 2007)
  GK12—(Summer 2008) (EHR)
  IGERT—April 24 (EHR)
Engineering Research Centers Program

Generation 3 ERCs

Partnerships in Transforming Research, Education and Technology
New Key Features of Gen 3 ERCs

- Build **partnerships** with at least one academic, state and local government, and other program designed to stimulate entrepreneurship, with start-up firms, and otherwise **speed the translation of academic knowledge into technological innovation**

- **Engage ERC students in all phases of the innovation process** so they understand what is required to translate fundamental knowledge discoveries into innovations

- Provide faculty and students with **cross-cultural, global research experiences through partnerships with foreign universities** or other means

- Build **long-term sustained partnerships with a few pre-college institutions** to increase the enrollment of domestic students in engineering and science degree programs
FY 2008 Due Dates & Funding

- February 02, 2007 - Letters of Intent - Required
- May 3, 2007 - Preliminary Proposals Due
- Sep 20, 2007 - Invitations
- Dec 10, 2007 - Invited Full Proposals Due
- March, April 2008 - Site Visits
- August 2008 - Awards

Five Awards Planned, funded under cooperative agreements with potential for 10 years of funding
Base funding starts at $3.25 M per year and increase to $4M in Year #4

No requirements for academic cost sharing or other third-party support, such as industrial support - New Feature (stay tuned)
ERC Strategic Framework
3 Plane Chart

Identify Societal/Market Needs, Define System & System Requirements

System Requirements

Technology Research and Testbeds

Develop Useful Insights from Fundamental Knowledge

Fundamental Research

Knowledge Base

Graduates & Technology

Technology Elements

Fundamental Insights
Engineering Education
### NSF Investment Timeline

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<td></td>
<td>• National Science Board Homer Neal Report</td>
<td>• Coalition</td>
<td>• NAE Center for Advancement of Scholarship in Engineering Education</td>
<td>• Rising Above the Gathering Storm</td>
<td>• NAE Competitiveness Initiative/ America Competes</td>
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<td>• Presidential Young Investigators</td>
<td>• ABET</td>
<td>• Science, Technology, Engineering &amp; Mathematics Talent Expansion Program</td>
<td>• NAE Engineer of 2020</td>
<td>• NAE Educating the Engineer of 2020</td>
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<td>• Engineering Research Centers</td>
<td>• Graduate Engineering Fellowships &amp; Traineeships</td>
<td>• Department Level Reform</td>
<td>• American Competitiveness Initiative/ America Competes</td>
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<td>• Calculus Reform</td>
<td>• Course &amp; Curriculum Development</td>
<td>• Research Experiences for Teachers</td>
<td>• Defense Level Reform</td>
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<td>• Instructional Labs</td>
<td>• Instrumentation &amp; Laboratory Improvement</td>
<td>• Centers for Teaching and Learning</td>
<td>• Model Institutions for Excellence</td>
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<td>• Research Experiences for Undergraduates</td>
<td>• UG Faculty Enhancement</td>
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<td>• ADVANCE</td>
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- **1980**: President eliminates education programs at NSF
- **1985**: Coalition
- **1990**: National Science Board Homer Neal Report
- **1995**: Graduate Engineering Fellowships & Traineeships
- **2000**: Course & Curriculum Development
- **2005**: Rising Above the Gathering Storm
Emerging Trends
Supply /Demand

(1) U. S. Population (20-24 year olds, NSB-2008)

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<th>2000</th>
<th>2050</th>
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<tr>
<td>White</td>
<td>11.8 mil</td>
<td>11.8 mil</td>
</tr>
<tr>
<td>African-American</td>
<td>2.8</td>
<td>4.1</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3.4</td>
<td>7.5</td>
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<tr>
<td></td>
<td>18.0 mil</td>
<td>23.4 mil</td>
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(2) U.S. Global Business

- Caterpillar (50% of sales)
- Pfizer – $30 billion foreign earnings
- G.E. - $200 billion (50% foreign)
- IBM—2/3 of all revenue
- INTEL—75% of all revenues
- Google---80% growth rate overseas
# Face the Brutal Facts

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<th>1985</th>
<th>1995</th>
<th>2005</th>
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<tr>
<td>BS Eng (Degrees)</td>
<td>70,000</td>
<td>64,000</td>
<td>66,000</td>
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<tr>
<td>U.S. Enrollment (all fields)</td>
<td>12.3 million</td>
<td>15.6 million</td>
<td>17.3 million</td>
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<tr>
<td>Eng Intention (freshmen)</td>
<td>11%</td>
<td>8.1%</td>
<td>8%</td>
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<tr>
<td>African American</td>
<td>9.6</td>
<td>8.6</td>
<td>7.2</td>
</tr>
<tr>
<td>Hispanic</td>
<td>12.6</td>
<td>11.2</td>
<td>6.4</td>
</tr>
<tr>
<td>Asian</td>
<td>23.9</td>
<td>13.3</td>
<td>15.0</td>
</tr>
<tr>
<td>Eng PhD</td>
<td>3200</td>
<td>6000</td>
<td>6400</td>
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<tr>
<td>U.S. Citizen</td>
<td>(40%)</td>
<td>(40%)</td>
<td>(31%)</td>
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Engineering Education Research

Who Does It? Who Gets It? Who Needs It?

Observations

• Supply-side Driven
• Where is Demand-side?
Modeling College Income

Total Income

Research Productivity

\[ y = b + mx \]
Eng College Revenues

6 Billion
Tuition

3 Billion
Fed Research
Student Pipeline

- K-12
- School Board Advisory
- University
- Industry Advisory Board
- Industry
Innovations in Engineering Education ($9 \text{ mil})

- Proposals due April 30, 2008
  Expansion(500k) and Exploratory(100-150k)

  (1) How People Learn (Expansion)
  (2) K-12 Partnerships (Exploratory)
  (3) Business of Engineering (Exploratory)
Rising Above the Gathering Storm

(1) Strengthen skills of 250,000 math /science teachers.

(2) Increase the number and preparation of U.S. citizens completing STEM degrees.

(3) Increase number of U.S. Citizens pursuing graduate degrees in “areas of national need”.
MOVING FORWARD
(November 2007, NSB)

- **Three Challenges**
  - Respond to Global Context of Engineering.
  - Perceptions of Engineering (Pathway)
  - Retention (60% after 6 years)

- **Recommendations**
  1. Expand REU (freshmen, sophomores, community colleges)
  2. Expand RET (Keep teachers connected)
  3. Engineering Education Research (Best practices, models for retention, ethics)
  4. Examine goals (what targets, when, visible?)
NSF STRATEGIC PLAN
(2006-2011)

(2) **Learning**
- Advance fundamental knowledge base
- Effectively bridge critical junctions in STEM education pathway
- Integrate research with education

(3) **Infrastructure**
- Strengthen collaboration with networks and innovative partnerships
Human Resources/Education
Current Activities

- **REU** (1400 students annually)
  PhD interest – 25% up to 48%

- **RET** (500 teachers annually)
  65% with advanced degree - 7% PhD

- **NANO UnderGrad ED**—37 active projects
Nanotechnology Undergraduate Education

Jackson State University NUE
(Nanotech & Civil Engineering)
Research Experiences for Teachers

Vanderbilt University RET

(Biomedical Engineering)
Research Experiences for Undergraduates

Oakland University REU

*(Helping the Blind to SEE)*
EEC in 2020

- Human Resources
  - Strong Pipeline
- Graduate Education
  - World Class PhD Programs
- Undergraduate Education
  - Improve Retention
- Centers
  - Innovative Graduates