



NSF's Power and Energy Thrust

OVERVIEW

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Division of Electrical, Communications and Cyber Systems (ECCS)

National Science Foundation (NSF)

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NSF Mission and Vision

The National Science Foundation Act of 1950 (Public Law 81-507) set forth

NSF's mission and purpose:

To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense....

The Act authorized and directed NSF to initiate and support:

- basic scientific research and research fundamental to the engineering process,
- programs to strengthen scientific and engineering research potential,
- science and engineering education programs at all levels and in all the various fields of science and engineering,
- programs that provide a source of information for policy formulation,
- and other activities to promote these ends.

NSF Vision

The National Science Foundation is a catalyst for progress through investment in science, mathematics, and engineering.

Guided by its longstanding commitment to the highest standards of excellence in the support of discovery and learning, NSF pledges to provide the stewardship necessary to sustain and strengthen the Nation's science, mathematics, and engineering capabilities and to promote the use of those capabilities in service to society.

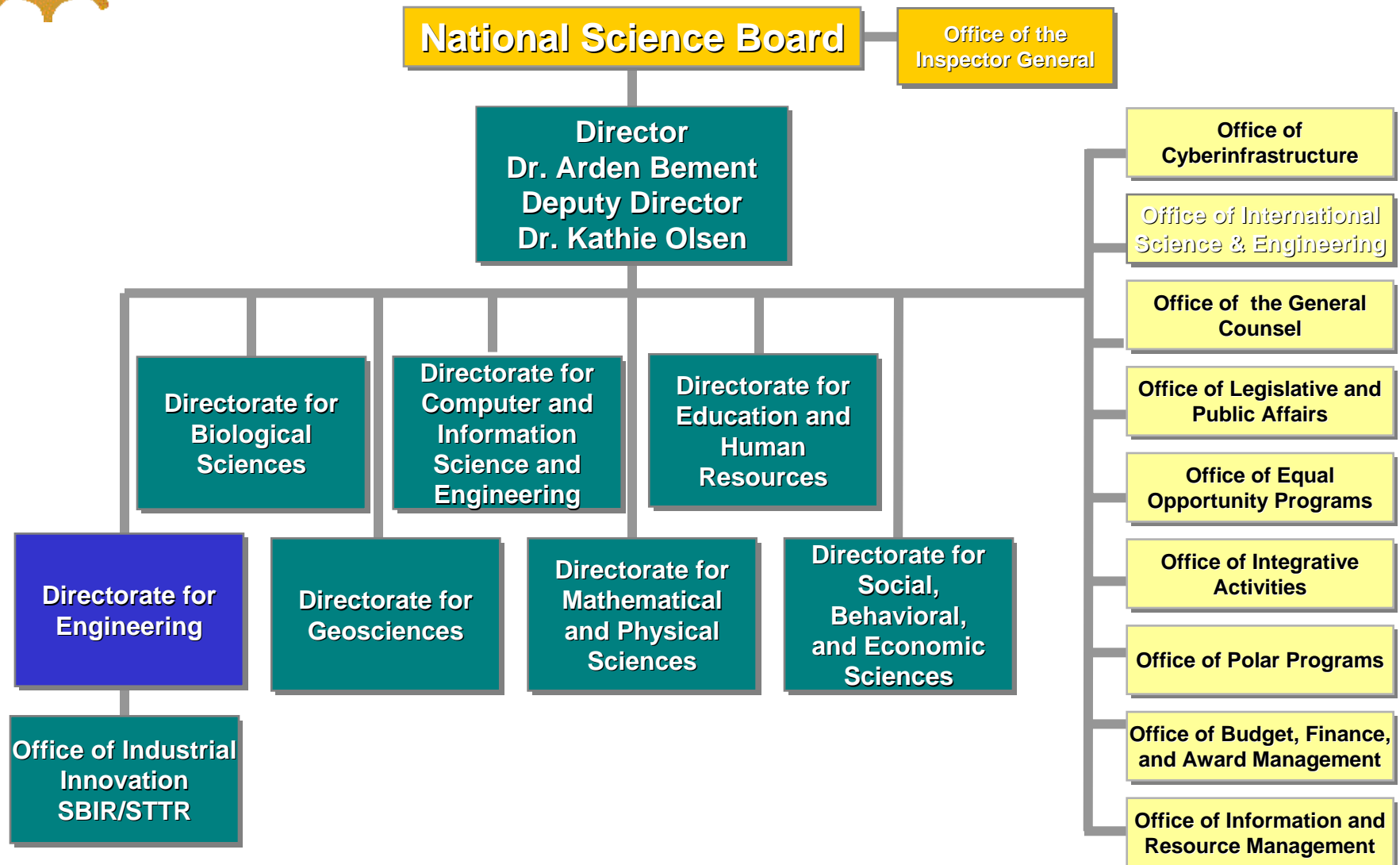


NSF in a Nutshell

- **Independent USG Agency**
- **Funds basic research & education**
- **Uses peer-review in selecting proposals to fund**
- **Low overhead; highly automated grant management processes**
- **Discipline-based structure complemented by cross-disciplinary mechanisms**
- **Bottom-up proposal driven**
- **Use of Rotators/IPAs**
- **Overseen by National Science Board**

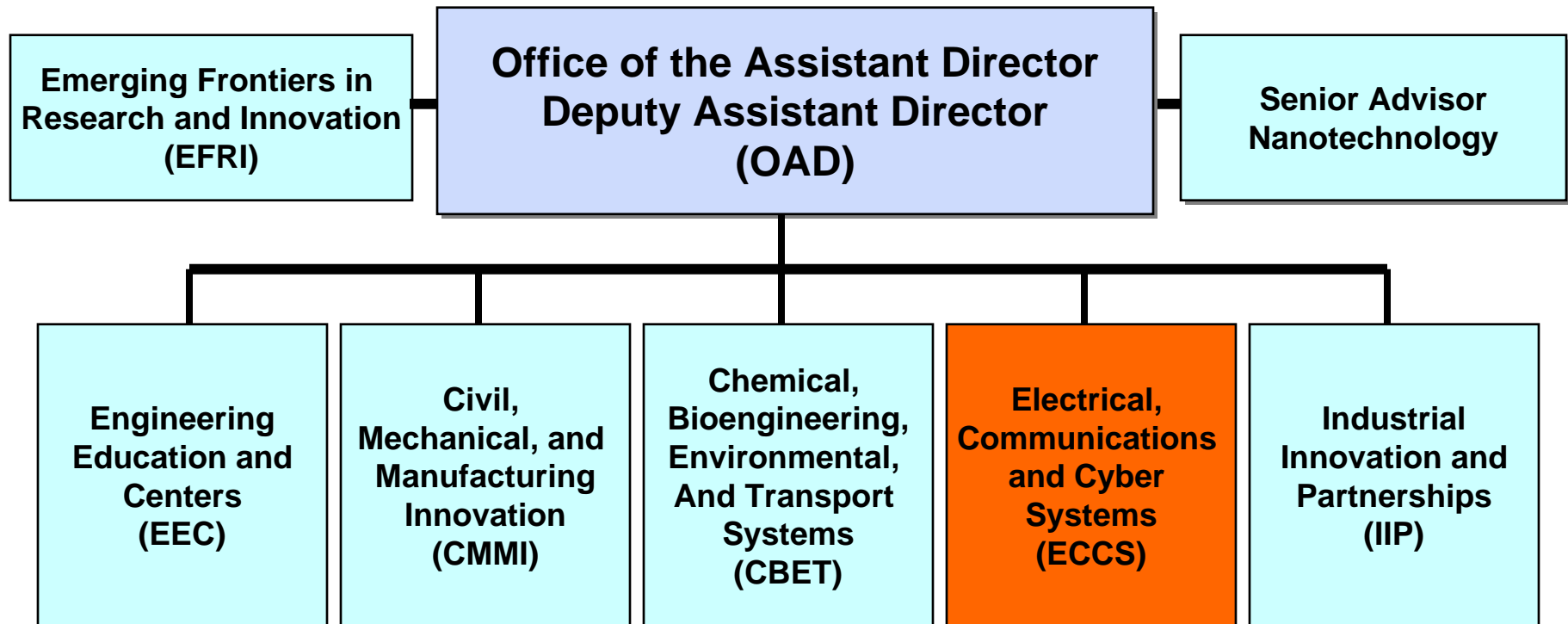


NSF Organizational Structure





Directorate for Engineering FY'07





ECCS Program

Usha Varshney
Division Director

Lawrence Goldberg
Senior Engineering Advisor
NNIN; ENG-MRI; STC

**Electronics, Photonics and
Device Technologies**

Rongqing Hui

Optoelectronics; Nanophotonics;
Ultrafast and Extreme Ultra-Violet

Rajinder Khosla

Micro/Nanoelectronics;
Bioelectronics; NEMS/MEMS;
Sensors

Olufemi Olowolafe

Micro/Nanoelectronics; Molecular
Electronics; Spin Electronics;
Organic Electronics;
Micromagnetics; Power Electronics

**Power, Controls and
Adaptive Networks**

Radhakisan Baheti

Embedded, Distributed and Adaptive
Control; Sensing and Imaging
Networks; Systems Theory;
Telerobotics

Dagmar Niebur

Power and Energy Systems and
Networks; Interdependencies of Power
and Energy on Critical Infrastructures;
Power Drives; Renewable and
Alternative Energy Sources

Paul Werbos

Adaptive Dynamic Programming;
Neuromorphic Engineering; Quantum
and Molecular Modeling and
Simulations of Devices and Systems

**Integrative, Hybrid and
Complex Systems**

Leda Lunardi

RF and Optical Wireless and
Hybrid Communications
Systems; Inter and Intra-chip
Communications ; Mixed Signals

Scott Midkiff

Cyber Systems; Signal
Processing

Yogesh Gianchandani

Micro and Nano Systems;
System-on-a-chip;
System-in-a-Package;
Diagnostic and Implantable
Systems



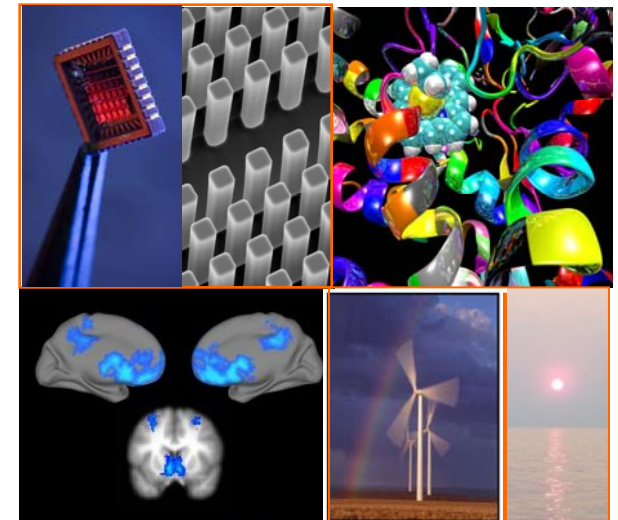
Directorate for Engineering

Research and Education Themes

Engineering Research Spans the Frontiers

- To more effectively support fundamental research and education, ENG identified five research and education themes:

- Cognitive Engineering: Intersection of Engineering and Cognitive Sciences
- Competitive Manufacturing and Service Enterprises
- Complexity in Engineered and Natural Systems
- Energy, Water and the Environment
- Systems Nanotechnology



Engineering contributes at all scales. Examples are nanotechnology, computational simulation, health, and alternative energy.

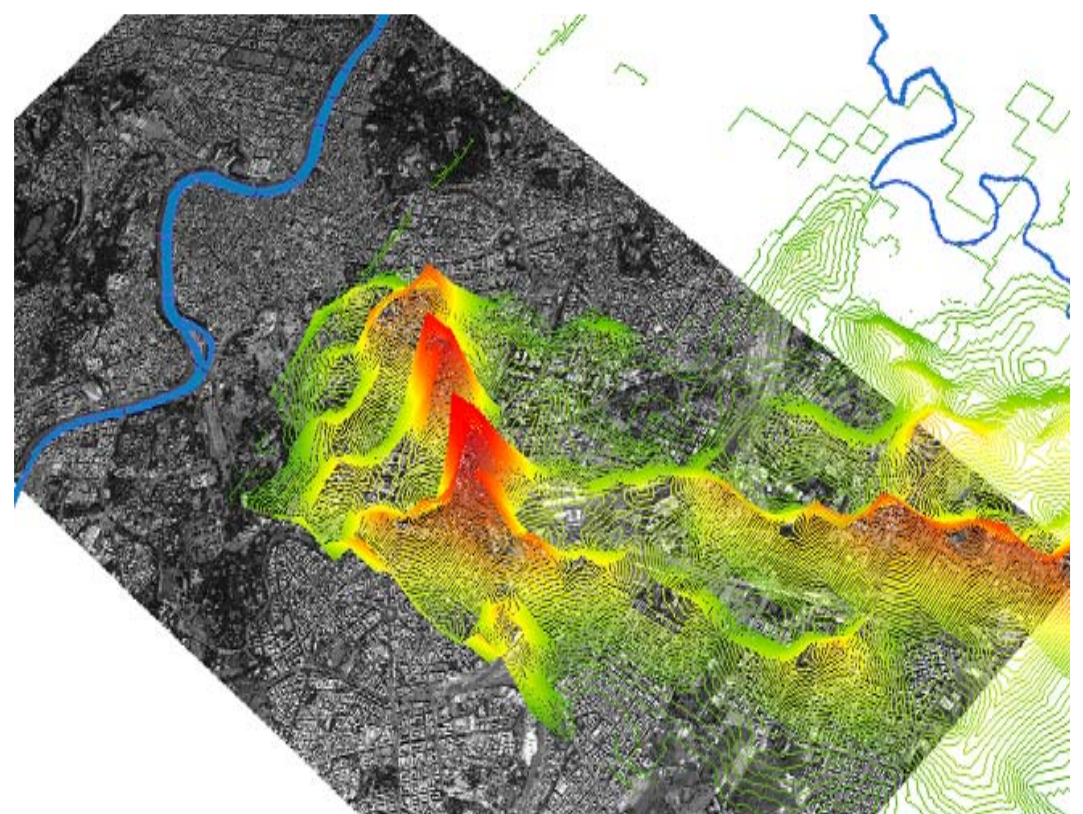
- Themes will evolve over time, reflecting the maturation of certain fields, the emergence of new fields, and engineering's crucial role in addressing increasingly complex challenges touching every sector of society.



Directorate for Engineering Research and Education Themes

Complexity in Engineered and Natural Systems

- Address unifying **principles** that enable modeling, prediction, and control of emergent behavior in complex systems.
- This research enhances our understanding of **natural systems, engineered systems, and the interface of natural and engineered systems.**



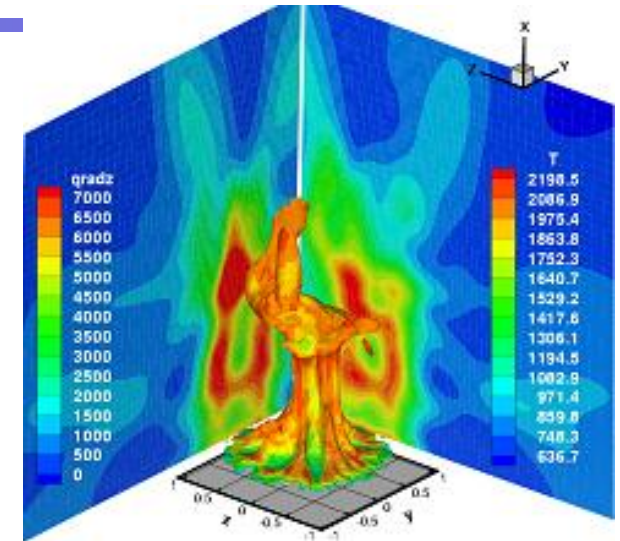
Cell phone usage during events and responses in Rome. This research builds understanding for designing systems that are resilient during unexpected events. *Dahleh, 0735956*



Directorate for Engineering Research and Education Themes

Energy, Water and the Environment

- Enable breakthroughs essential to harness, efficiently store, and economically distribute energy from alternative sources in a sustainable and secure manner.
- This research includes:
 - fundamental research to discover new methods of energy conversion and distribution,
 - understanding reaction pathways for energy systems,
 - understanding energy/environment interactions, and
 - enhancing the energy workforce.

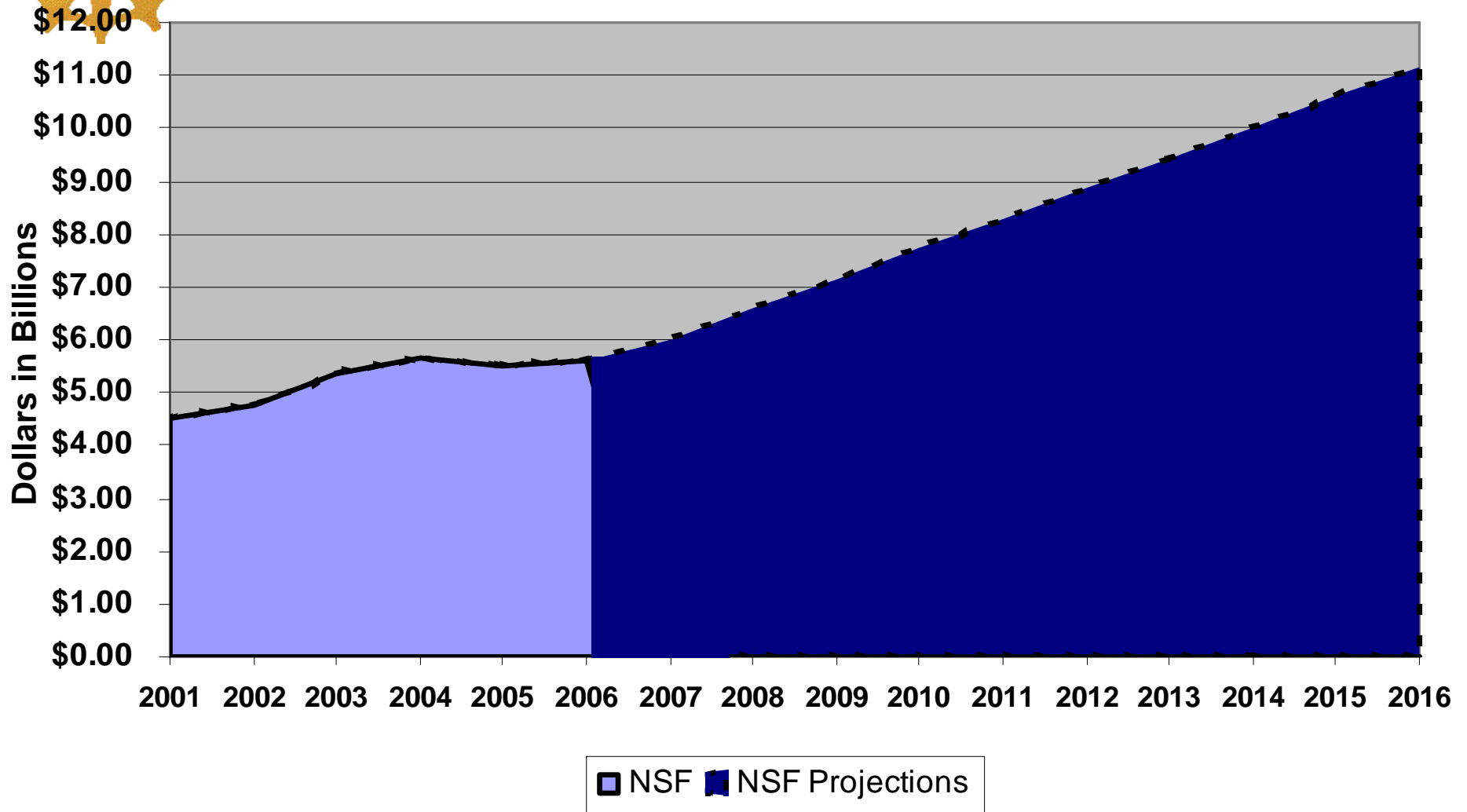


Combining knowledge from fluid and solid mechanics, thermal sciences, as well as advanced computer modeling, researchers are working to simulate fire phenomena.

DesJardin, 0348110



ACI-Driven NSF Budget Projections



Rev. 04/21/08 **FY 2006 through FY 2016 budgets are estimates based on White House data.** 10



NSF Budget by Research Directorate

Dollars in Millions

Directorate	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	FY 2009 Request			
				Change over FY 2007 Actual		Change over FY 2008 Estimate	
				Amt	%	Amt	%
BIO	\$608.54	\$612.02	\$675.06	\$66.52	10.9	\$63.04	10.3%
CISE	526.68	534.53	638.76	112.08	21.3	104.23	19.5
ENG (<i>less SBIR/STTR</i>)	521.33	527.50	632.33	111.00	21.3	104.83	19.9
SBIR/STTR	108.67	109.37	127.00	18.33	16.9	17.63	16.1
GEO	745.85	752.66	848.67	102.82	13.8	96.01	12.8
MPS	1,150.73	1,167.31	1,402.67	251.94	21.9	235.36	20.2
SBE	214.54	215.13	233.48	18.94	8.8	18.35	8.5
OCI	182.42	185.33	220.08	37.66	20.6	34.75	18.8
OISE	40.36	41.34	47.44	7.08	17.6	6.10	14.8
OPP	438.43	442.54	490.97	52.54	12.0	48.43	10.9
IA	219.45	232.27	276.00	56.55	25.8	43.73	18.8
U.S. Arctic Research Commission	1.45	1.47	1.53	0.08	5.5	0.06	4.1
Research & Related Activities	\$4,758.44	\$4,821.47	\$5,593.99	\$835.55	17.6%	\$772.52	16.0%



Engineering FY 2009 Budget Request

Dollars in Millions

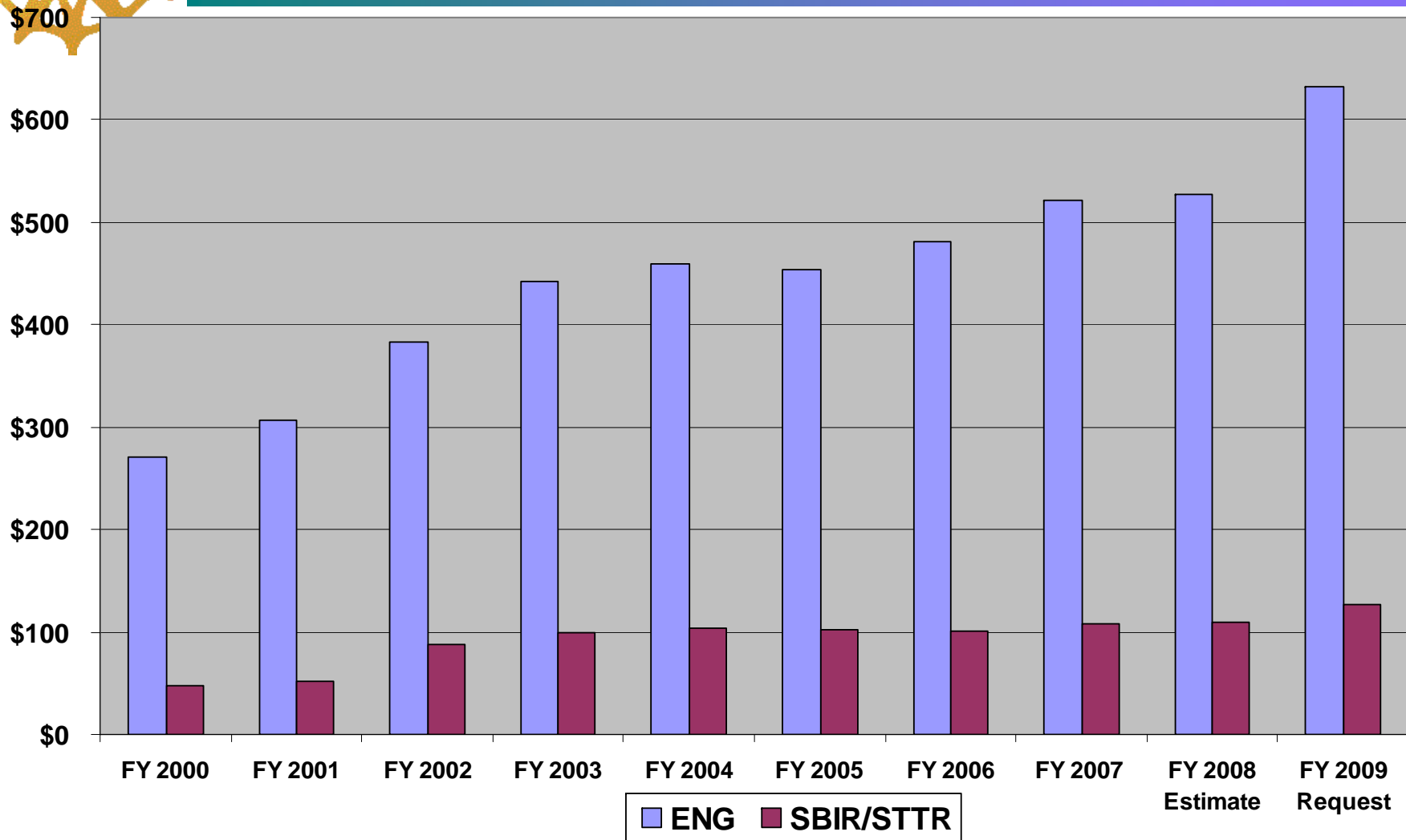
	FY 2007 Actual	FY 2008 Estimate	FY 2009 Request	Change over FY 2008 Estimate	
				Amt [\$M]	%
CBET	\$128.27	\$131.00	\$173.34	\$42.34	32.3
CMMI	157.30	159.81	201.88	42.07	26.3
ECCS	83.24	83.50	94.36	10.86	13.0
IIP	120.78	121.67	140.90	19.23	15.8
<i>Small Business Innovation Research (SBIR)</i>	<i>108.67</i>	<i>109.37</i>	<i>127.00</i>	<i>17.63</i>	<i>16.1</i>
EEC	115.16	115.89	119.85	3.96	3.4
EFRI	25.00	25.00	29.00	4.00	16.0
Total, ENG	\$630.00	\$636.87	\$759.33	\$122.46	19.2

(Totals may not add due to rounding.)



ENG and SBIR/STTR Budget History

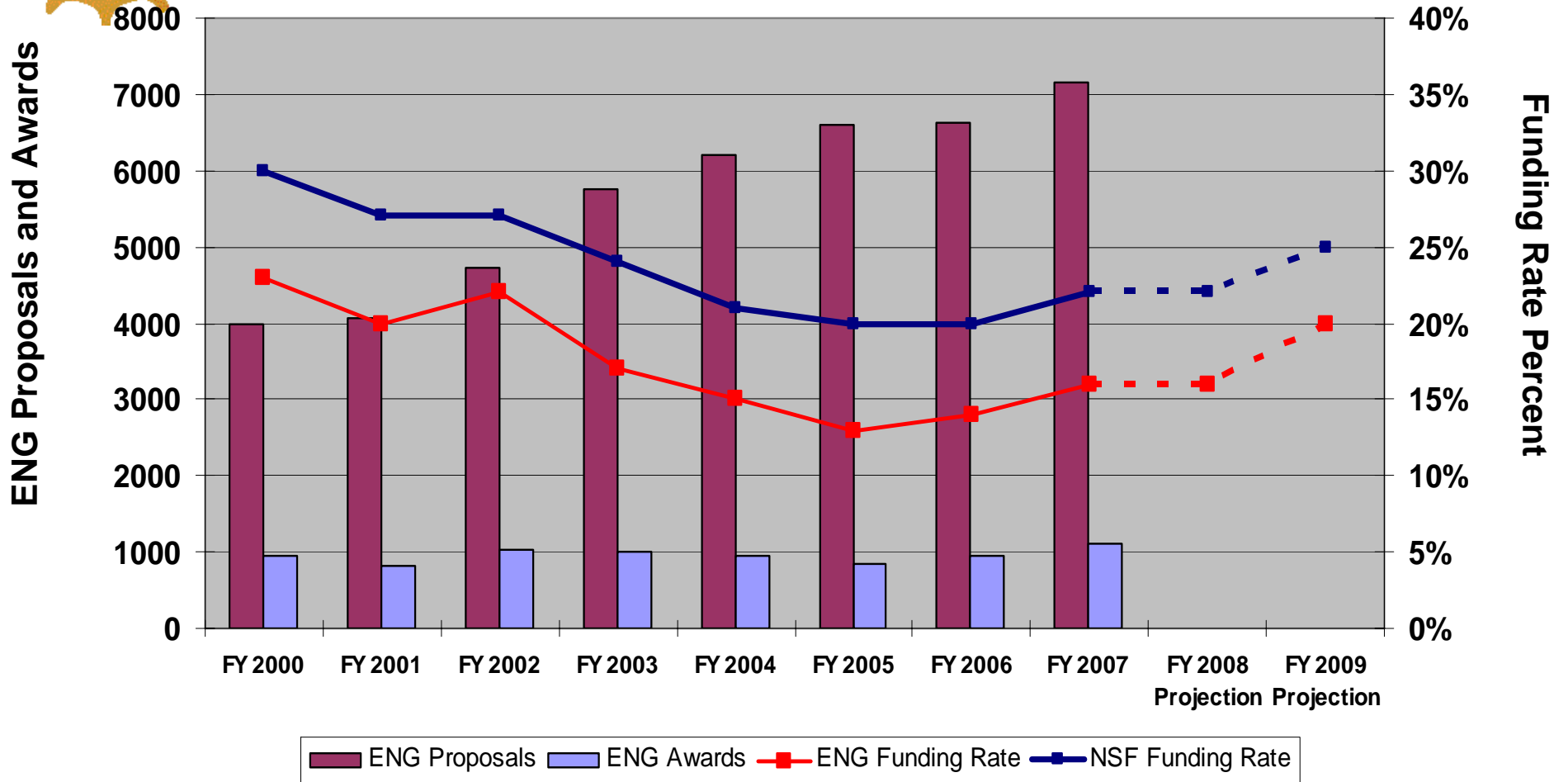
Dollars in Millions





ENG and NSF Funding Rates

Research Grants





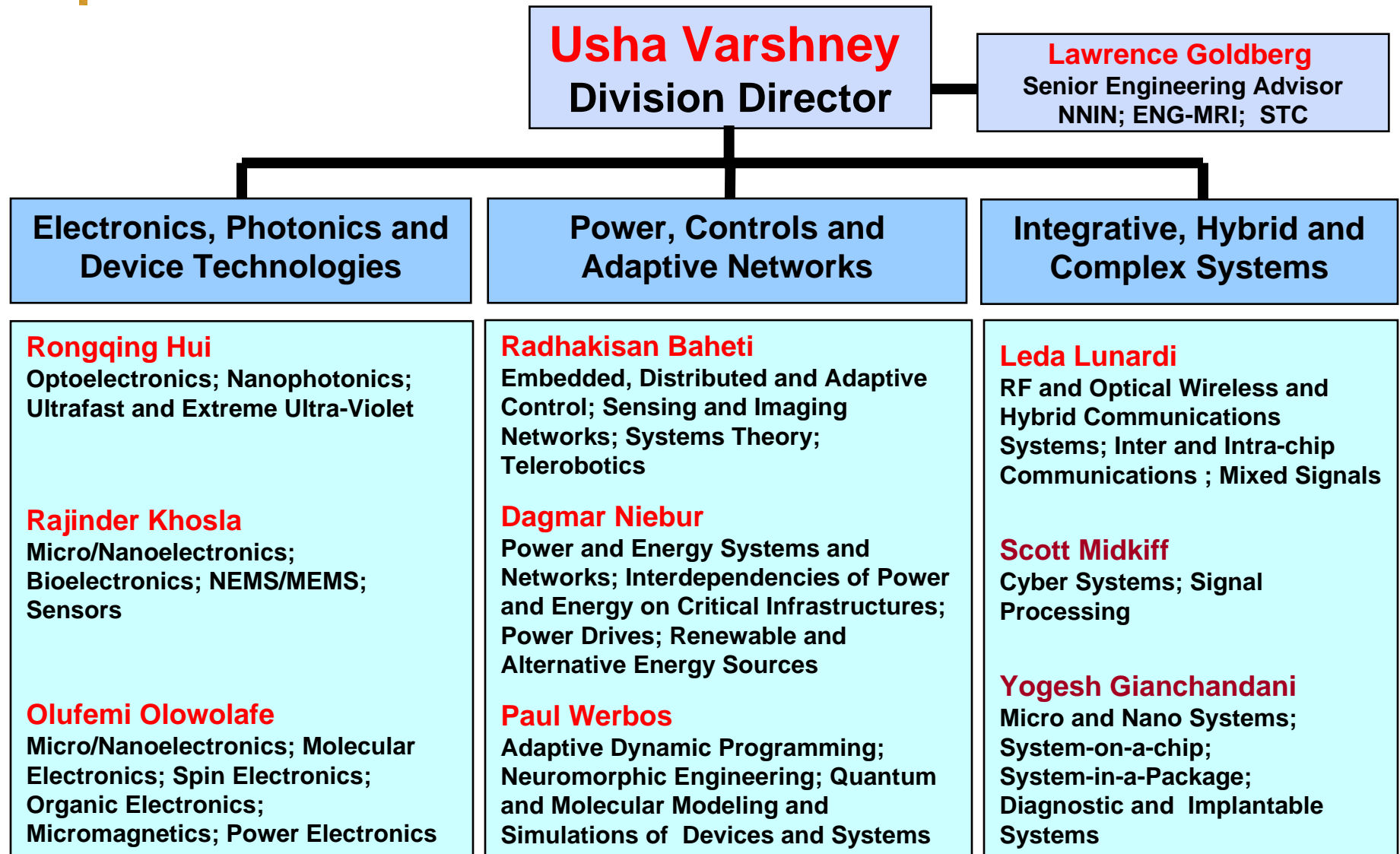
NSF Investment Areas

NSF Investment Totals

	FY 2007 Actual (millions)	FY 2008 Estimate (millions)	FY 2009 Request (millions)	Change over FY 2008	
				Amount (millions)	%
Adaptive Systems Technology (AST)	N/A	N/A	\$15.00	\$15.00	N/A
Climate Change Science Program	\$206.63	\$205.25	220.60	15.35	7.48%
Cyber-enabled Discovery and Innovation (CDI)	N/A	47.90	100.00	52.10	108.76
Cyberinfrastructure	617.44	644.09	682.05	37.96	5.89
Dynamics of Water Processes in the Environment (WATER)	N/A	N/A	10.00	10.00	N/A
Science & Engineering Beyond Moore's Law (SEBML)	N/A	N/A	20.00	20.00	N/A
National Nanotechnology Initiative	388.69	388.69	396.79	8.10	2.08
Networking and Information Technology R&D	908.45	931.48	1,090.25	158.77	17.04



ECCS Program





Funding Opportunities in Power and Energy

■ Research Programs

- ENG/ECCS Power, Controls & Adaptive Networks Program
- ENG/CBET Energy for Sustainability Program
Thermal Transport Processes
Combustion, Fire, and Plasma Systems
- ENG/ECCS Information Technology & Infrastructure Sys.
Infrastructure Management & Hazard Resp.
Control Systems Program
Dynamical Systems Engineering Design

■ Education Programs

- EHR/DUE Course, Curriculum, and Laboratory Improvement (CCLI)
- EHR/DGE Integrative Graduate Education and Research Traineeship Program (IGERT)

■ Industry Collaboration and Centers

- ENG/EEC Engineering Research Centers
- Industry/University Cooperative Research Centers Program (I/UCRC)
Science and Technology Centers
- ENG/IIC Small Business Innovation Research & Small Business Technology Transfer (Program Description) (SBIR/STTR)

- Cross-cutting Science and Technology Centers



EFRI TOPICS

EFRI Topics for FY 2009

- **1. BioSensing & BioActuation: Interface of Living and Engineering Systems (BSBA)**
 - **2. Interfaces for In-vivo Systems**
- **3. Hydrocarbons from Biomass (HyBi)**
 - **4. Renewable Electric Energy Integration for a Sustainable Environment**

- **Letter of Intend Due Mid September**

- **Expected Awards: 11 Awards at \$2M for 4 years**



NSF Center Awards in Power

- **ENG Division of Engineering Research Centers**
 - **CPES: Center for Power Electronics Systems**
 - 5 Universities and about 80 Companies led by Virginia Tech
 - NSF Funding Period: up to 10 years, 1998-now
 - \$30M

 - **ENG Division of Industrial Innovation and Partnerships**
 - **PSERC: Industry/University Cooperative Research Center (I/UCRC) for Power Systems Engineering**
 - Initially 5, now 12 universities and now over 40 companies originally led by UIUC&Cornell, leadership rotates
 - NSF Funding 1998-2008 (several proposals)
 - \$8.8M

- **CISE/CNS – ENG/ECSS**
 - **Cybertrust: Trustworthy Cyber Infrastructure for the Power Grid**
 - 4 University led by UIUC, over 30 companies and national labs
 - NSF Funding 2005-2008
 - \$4.1M



Women Interest in Engineering and CS

Table 1: College Major Choice

College Bound Juniors Taking the PSAT/NMSQT Middle States (National) Figures

	2000-01		2001-02		2002-03		2003-04		2004-05	
Engineering	6.9% (8.3%)		7.0% (8.4%)		7.0% (8.2%)		6.8% (8.2%)		7.0% (8.3%)	
Computer/ Info Sciences	6.3% (5.3%)		5.1% (4.5%)		4.0% (3.6%)		3.3% (3.0%)		2.5% (2.3%)	
	M	F	M	F	M	F	M	F	M	F
Engineering	13.0%	1.7%	13.3%	1.8%	13.4%	1.6%	13.3%	1.5%	13.6%	1.5%
Computer/Info Sciences	11.4%	2.2%	9.3%	1.7%	7.5%	1.1%	6.2%	0.9%	4.8%	0.6%

Data from College Board PSAT/NMQST State Summary Reports

http://www.collegeboard.com/researchdocs/2005_psat.html, viewed 2/3/06



College Major Decisions: from collegeboard.com

Law: It helps to be fascinated by the relationship between law and society.

Are you ready to

- Engage in intense discussion of thorny legal problems
- Study actual court cases
- Join your school's legal studies association

Did you know?

- During the colonial period in parts of North America, prison was meant to be a penitentiary, a place where prisoners spent time alone with the Bible, doing penance.

EE: It helps to be a fan of science and math who's curious about the way things work.

Are you ready to

- Juggle projects, lab exercises, and reading assignments
- Spend hours building detailed, complicated systems
- Design your own gadgets or software
- Try, try, and try again when at first a project doesn't succeed

Rev. 04/21/08 **Did you know?**

Source: M. Kam, The Interface, IEEE-ASEE Joint Newsletter, Nov. 2005



College Major Decisions: from collegeboard.com

Comp. Lit.: It helps to be articulate, creative, analytical, and open to different cultures.

Are you ready to

- Learn another language well enough to read its literature
- Immerse yourself in another country's culture -- perhaps by studying abroad
- Write a senior thesis (long research paper) comparing, for example, how Russian and American films each portray the Cold War.

Did you know?

- Comparative literature majors may explore the connections between literature and art, anthropology, history, or film.

Physics: It helps to be a person who likes learning how things work, in the natural world.

Are you ready to

- Struggle with complex concepts
- Take a lot of math -- beyond calculus
- Work with other physics students on difficult assignments

Did you know?

Rev. 04/21/08

Source: M. Kam, The Interface, IEEE-ASEE Joint Newsletter, Nov. 2005

- **Albert Einstein's theory of relativity unites space, time, matter, and energy.**



STEM Community according to collegeboard.com

- Exclusive society
- Definition by topic
- Qualification by work ethics and attitude
- Macho attitude, “if I can do it, you can do it.”
- Intimidation (“hours and hours”)
- Decoupling and alienation from society welfare – egocentrism

It backfires not only for women and minorities, even our traditional customer numbers (white males) are down.

- ⇒ We need institutional and community change to become inclusive and encouraging
- ⇒ We need to admit and accommodate, that not all engineers need to be rocket scientists; neither autocad-based electric building system designers nor technical writers will solve Maxwell’s Equations on a daily basis



Thanks!

Questions?