An Overview of NSF and the ECCS Division

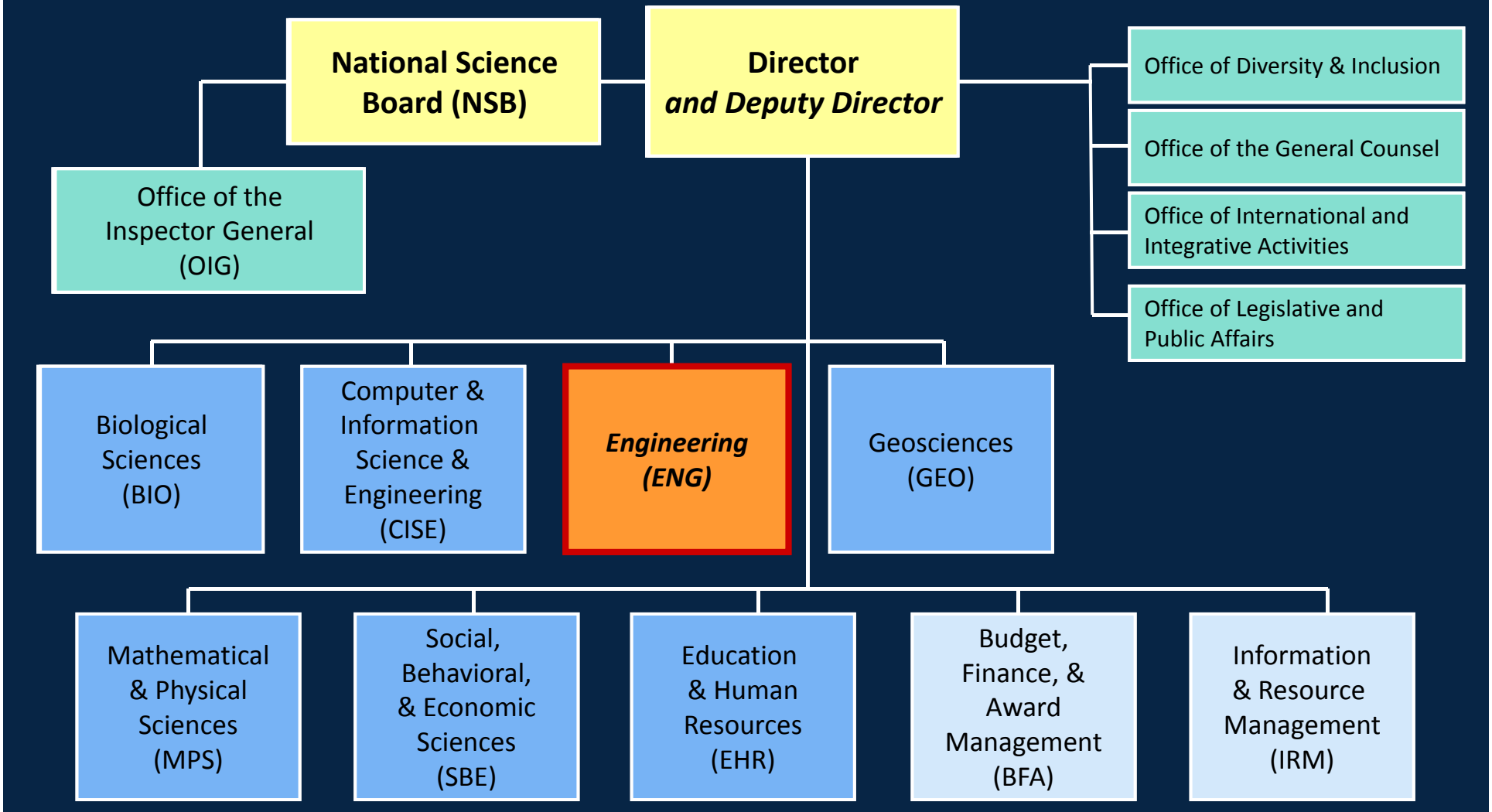
Samir El-Ghazaly

Division Director
Electrical, Communications and Cyber Systems (ECCS) Division
Engineering Directorate
National Science Foundation
Arlington, VA

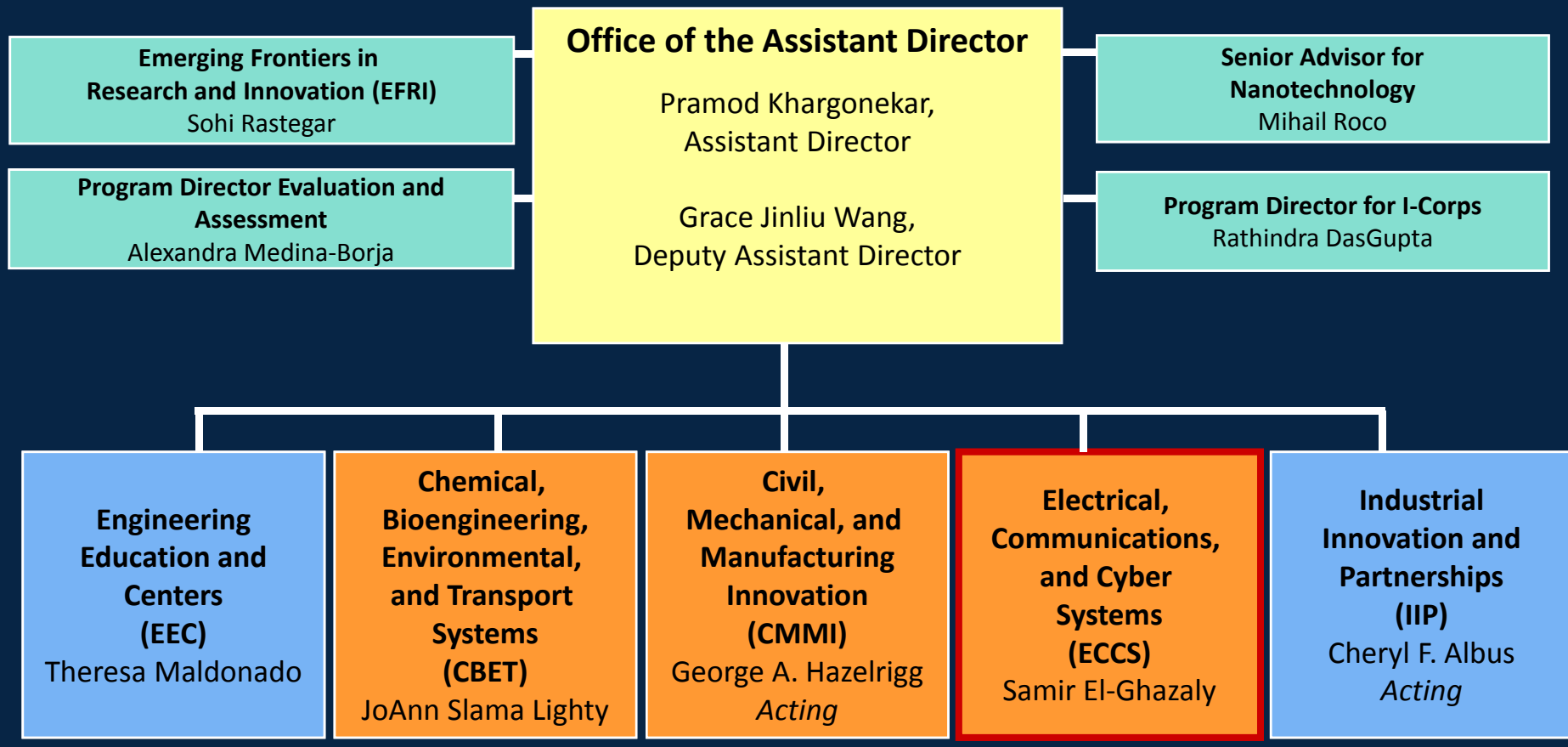
NSF's Origin, Mission, and Structure

- Independent federal agency established by Congress in the NSF Act of 1950
  - *"To Promote Progress of Science," and "Advance National Health, Prosperity, and Welfare," and "Secure the National Defense"*
- Supports fundamental research and education across all fields of science and engineering
- Sponsors research primarily through grant mechanism, but operates no laboratories
- Discipline-based structure with cross-disciplinary mechanisms
- Uses "rotators" or IPAs primarily from universities
- FY2013 budget of $5.6 billion for Research and Related Activities (R&RA) – FY2014 Budget for R&RA ~ $6.2 billion (~$7.6 Billion Operating Plan).

National Science Foundation



NSF ENG Organization



Electrical, Communications, and Cyber Systems *(ECCS)*

Division Director
Samir El-Ghazaly

Acting Deputy Director
Dominique Dagenais[1]

Program Support Manager
Cynthia Greene

Senior Engineering Advisor
Lawrence Goldberg

Electronics, Photonics, and Magnetic Devices (EPMD)	***Communications, Circuits, and Sensing Systems (CCSS)***	***Energy, Power, Control and Networks (EPCN)*** [2]
Usha Varshney Dimitris Pavlidis (Vacant)	Zhi (Gerry) Tian George Haddad Mona Zaghloul	Kishan Baheti Paul Werbos Eyad Abed
Optics and Photonics Group [3] Mahmoud Fallahi Dominique Dagenais [4]		

1. Susan Kemnitzer is now serving as Deputy Division Director for CBET
2. Formerly Energy, Power and Adaptive Systems (EPAS)
3. New in FY14
4. Currently serving as Acting Deputy Division Director for ECCS

Electrical, Communications and Cyber Systems (ECCS)

Susan Kemnitzer, Division Deputy Director • Samir El-Ghazaly, Division Director • Lawrence Goldberg, Senior Engineering Advisor

Electronics, Photonics, and Magnetic Devices (EPMD)

Dimitris Pavlidis

- Microwave/mm-Wave/THz Devices & Components, Electromagnetic Effects and Components based on them
- Nanoelectronics & Next Generation Devices, Semiconductor Material - Device Interaction and Reliability
- Widebandgap Semiconductors and Devices, Circuits, Device/Circuit Simulation & Modeling
- Metamaterial and Plasmonic-Based Devices & Components

(Vacant)

- Flexible, Printed and Organic Electronics & Photonics
- Carbon-based Electronics
- "Beyond" graphene 2D materials and devices
- Nano-electronics and Energy-Efficient electronics

Usha Varshney

- Bioelectronic and Biomagnetic Devices
- Magnetics, Spin Electronics and Quantum Devices
- Sensor Device Technologies
- Next Generation Memories

Optics & Photonics Group (Mahmoud Fallahi & Dominique Dagenais)

- Nanophotonics, Metamaterials & Plamonics
- Advanced Optical Sources & Photo-detectors
- Nonlinear & Ultrafast Photonics
- Photonics Integrated Circuits
- Optical Communication Components
- Single-photon and Quantum Devices
- Optical Imaging & Sensing
- Solar Cells & Photovoltaic Components

Communications, Circuits, and Sensing-Systems (CCSS)

Zhi (Gerry) Tian

- RF/Wireless, Optical, and Hybrid Communications and Networking
- Integrated Sensing, Communication, and Computational Systems
- Spectrum Access and Spectrum Sharing, Cognitive Radio
- Signal Processing and Compressive Sampling
- Cyber Physical Systems and Security.

George Haddad

- Low Power, Low Noise, High Efficiency Communications
- Inter- and Intra-Chip Communications and Networking including THz and optical guided and wireless interconnects.
- Wireless Communications and Sensing circuits and systems.
- Integrated Circuit Design (Mixed-Signal, Fault-Tolerant, Self -Test and Repair, Stochastic Design)
- Real-Time Monitoring and Stimulation of the Brain and other Body functions in natural environments

Mona Zaghloul

- Micro, Nano, and Bio Systems (MEMS/NEMS)
- Chemical, Biological and Physical Diagnostics
- Sensors, Actuators and Electronic Interfaces (Brain and other Body functions, Health, Infrastructure and Environment)
- Ultra-Low power wearable and implantable sensing and imaging systems.

Energy, Power, Control and Networks (EPCN)

EPCN Group (Eyad Abed, Kishan Baheti, & Paul Werbos)

- Control Theory and Hybrid Dynamical Systems
- Distributed and Mobile Networked Control
- Cyber Physical Systems Modeling and Control
- Control and Optimization in Healthcare, Transportation and Robotics
- Adaptive and Intelligent Systems/Neural Networks
- Energy Harvesting and Storage Devices and Systems
- Solar, and Wind Energy and Integration of Renewables with Grid
- Monitoring, Protection and Cyber Security of Power Grid
- Advanced Power Electronics and Electric Machines
- Design and Operation of Microgrids
- Electric and Hybrid Vehicles Integration with Grid
- Policy, Economics and Engineering of Power Grid
- Quantum theory and modelling for systems and devices - QMHP (Paul Werbos)

ECCS Mission

- Address fundamental research issues at the nano, micro, and macro scales underlying device and component technologies, energy and power, controls, networks, communications, computation, sensing and cyber systems
- Support integration of systems principles in complex engineering systems and networks for a variety of applications areas
- Ensure education of a diverse workforce to meet the technological challenges of a 21st century global economy

ENG R&RA Budget ($M)

ENG Division	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	Change over FY 2014 Estimate	
				Amount	Percent
CBET	$167.01	$173.00	$174.99	$1.99	1.2%
CMMI	200.81	209.20	210.40	1.20	0.6%
ECCS	104.58	110.06	110.41	0.35	0.3%
EEC	115.21	122.24	117.38	-4.86	-4.0%
IIP	202.41	205.97	213.69	7.72	3.8%
SBIR/STTR	*161.34*	*159.39*	*164.99*	*5.61*	*3.5%*
EFRI	30.16	30.60	31.30	0.70	2.3%
ENG TOTAL	$820.18	$851.07	$858.17	$7.10	0.8%

Totals may not add due to rounding

Funding Activities

Core programs

- **Unsolicited: One window (October 1 – November 1 Annually)**
- **Early-concept Grants for Exploratory Research (EAGER)**

- **Current Initatives**
  - Faculty Early Career Development (CAREER)
  - Emerging Frontiers in Research and Innovation (EFRI)
  - Cyber-Physical Systems (CPS)
  - Major Research Instrumentation (MRI)
  - Broadening Participation Research Initiation Grants in Engineering (BRIGE)
  - Enhancing Access to the Radio Spectrum (EARS)
  - National Nanotechnology Infrastructure Network (NNIN)
  - Science and Technology Centers (STC)
  - National Robotics Initiative (NRI)
  - Revolutionizing Engineering Departments (RED)
  - Rapid Response Grants (RAPID)
  - BRAIN Initiative
  - Grant Opportunities for Academic Liaison with Industry (GOALI)
  - Cyber Science, Engineering and Education for Sustainability (Cyber SEES)
  - Designing Materials to Revolutionize and Engineer our Future Program (DMREF)
  - Engineering Research Centers (ERC)
  - Scalable Nanomanufacturing (SNM)
  - Failure-Resistant Systems (FRS)
  - Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE)
  - Research Experiences for Teachers (RET), Undergraduates (REU), and Veterans (REV)

The Merit Review Process at a Glance

Proposal Preparation and Submission (90 Days)

1 Opportunity Announced → 2 Proposal Submitted → 3 Proposal Received

- Withdrawn
- Noncompliant *(Returned)*
- Compliant

Proposal Review and Processing (6 months)

4 Reviewers Selected → 5 Merit Review* → 6 Program Officer Recommends → 7 Division Director Review

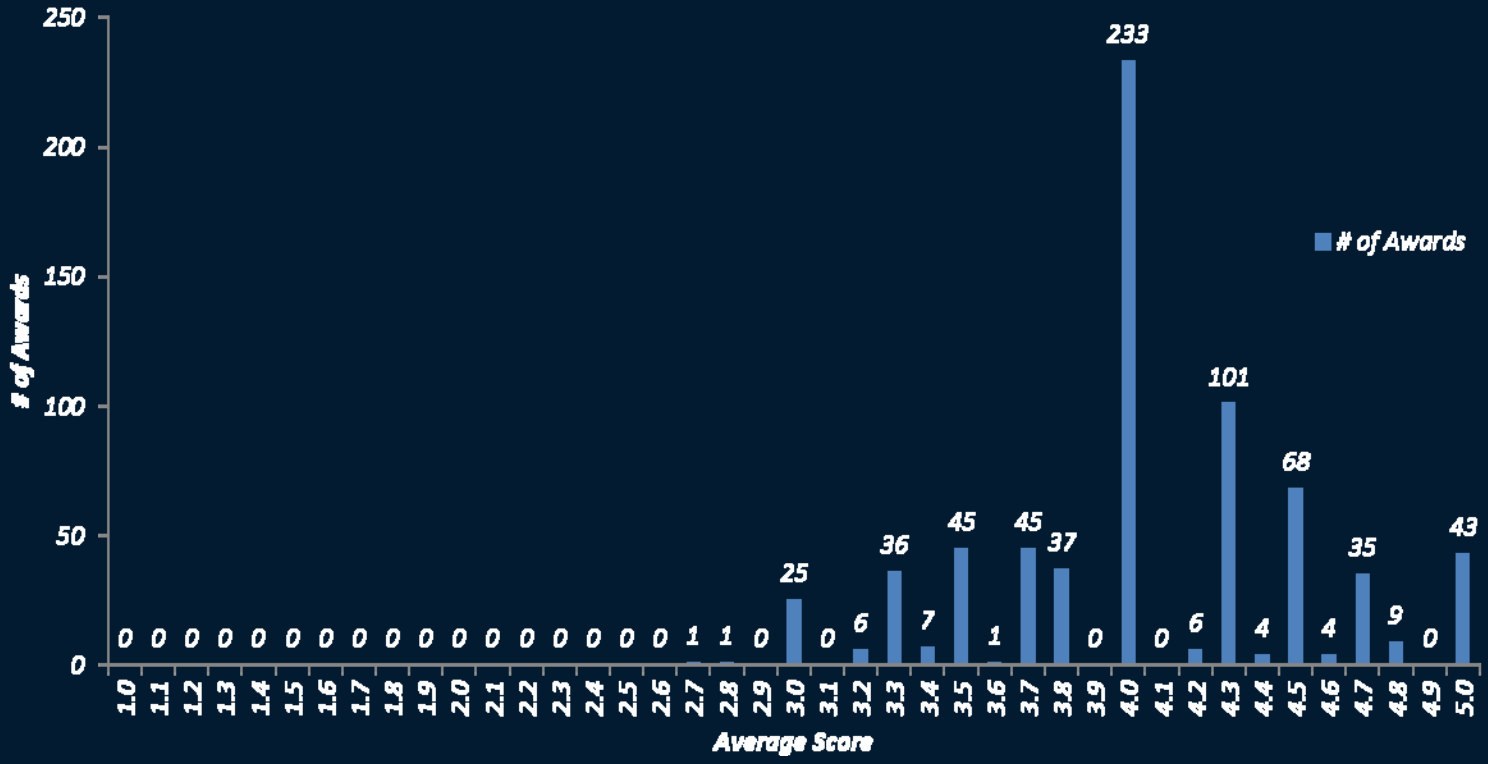
* Merit Review Criteria:

- Broader Impacts
- Intellectual Merit

Award Processing (30 Days)

8 Business Review → 9 Award Finalized

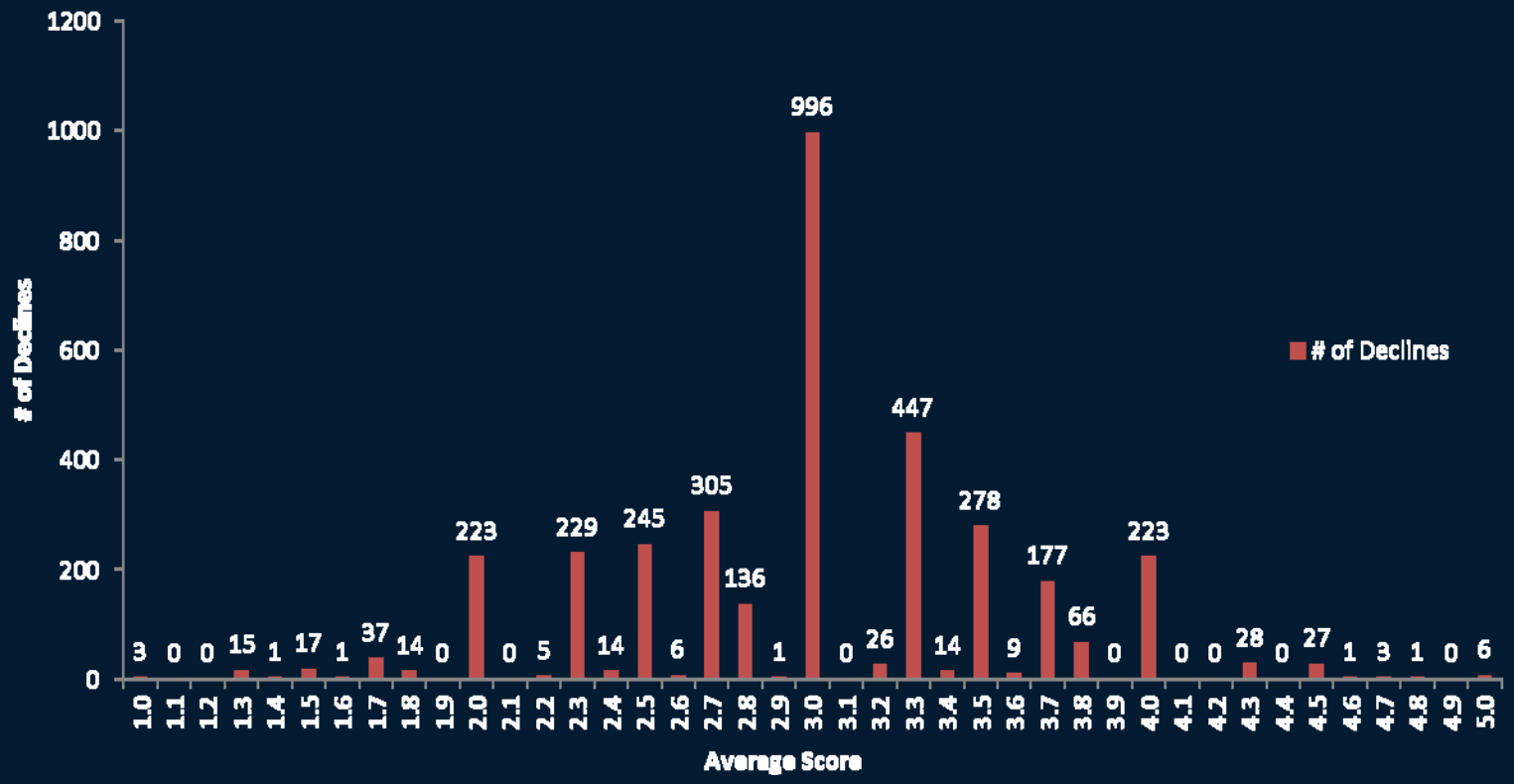
Average Reviewer Score and Awards



1=	Poor
2 =	Fair
3=	Good
4=	Very Good
5=	Excellent

Mean	Mode	Standard Deviation
4.1	4	0.5

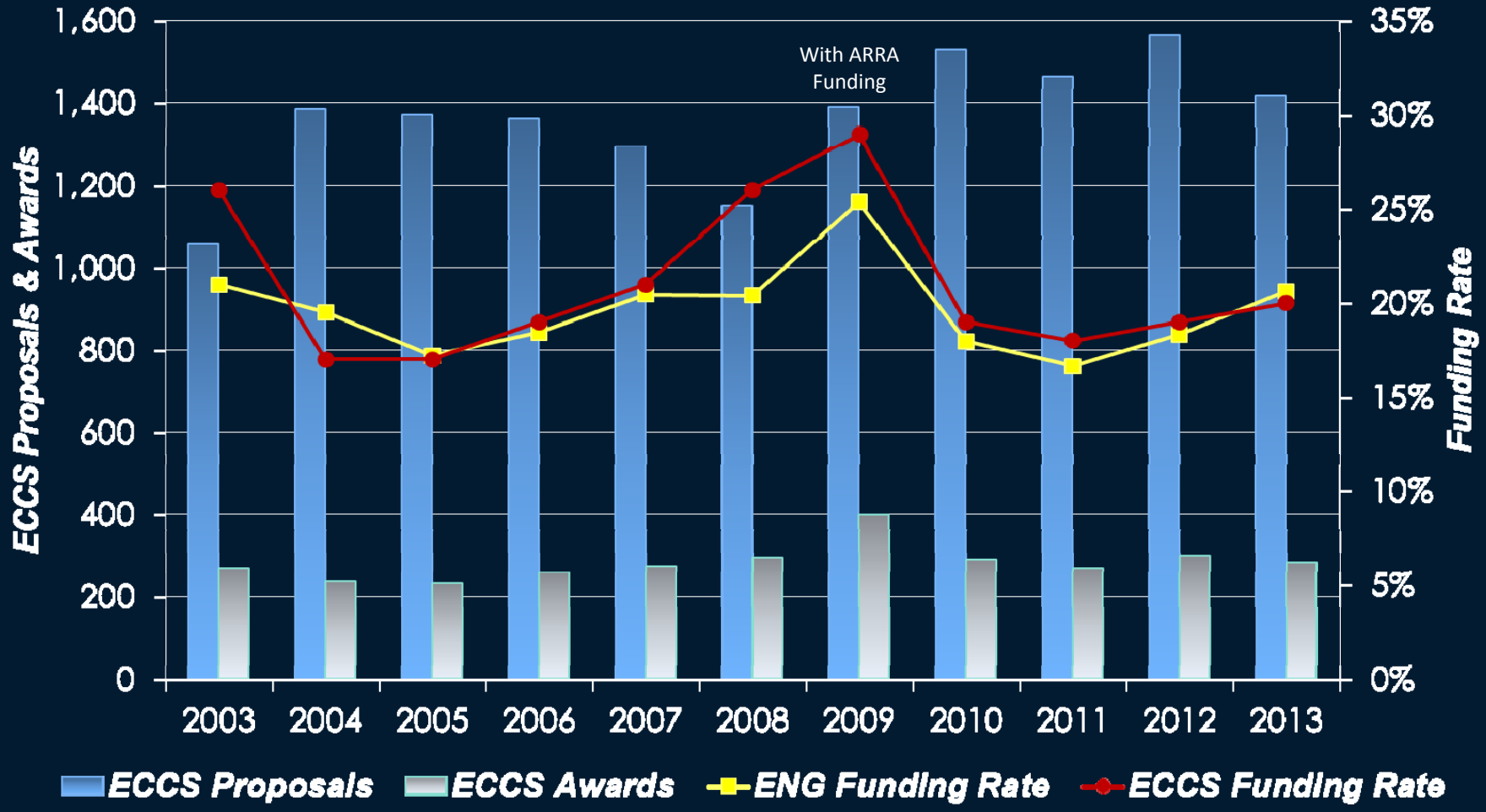
Average Reviewer Score and Declines



1=	Poor
2 =	Fair
3=	Good
4=	Very Good
5=	Excellent

Mean	Mode	Standard Deviation
3.0	3	0.6

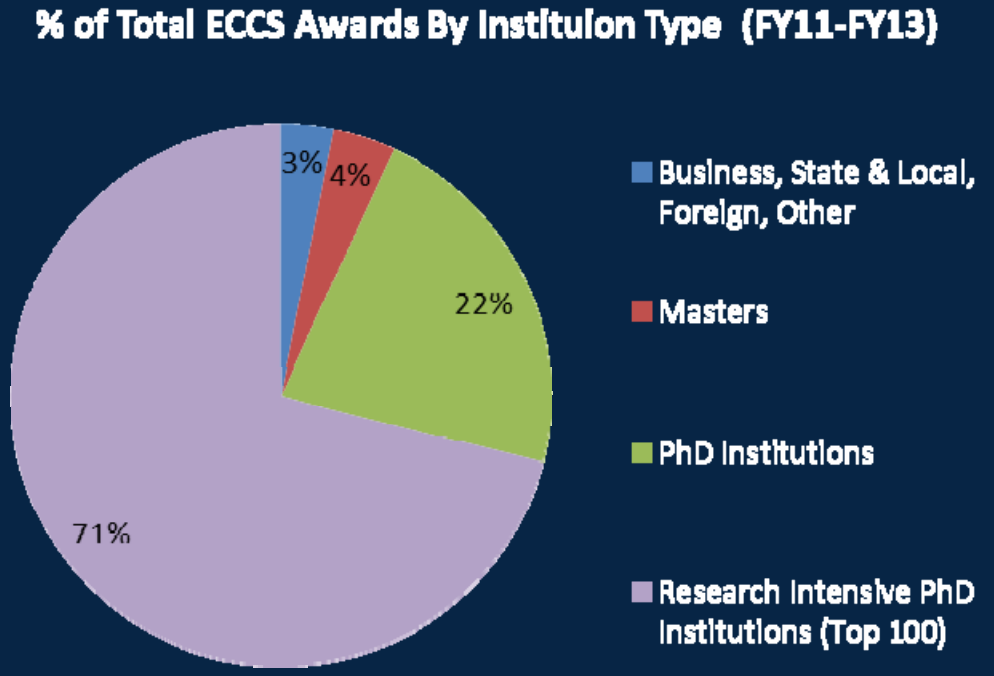
ECCS & ENG Research Grant Proposals and Awards



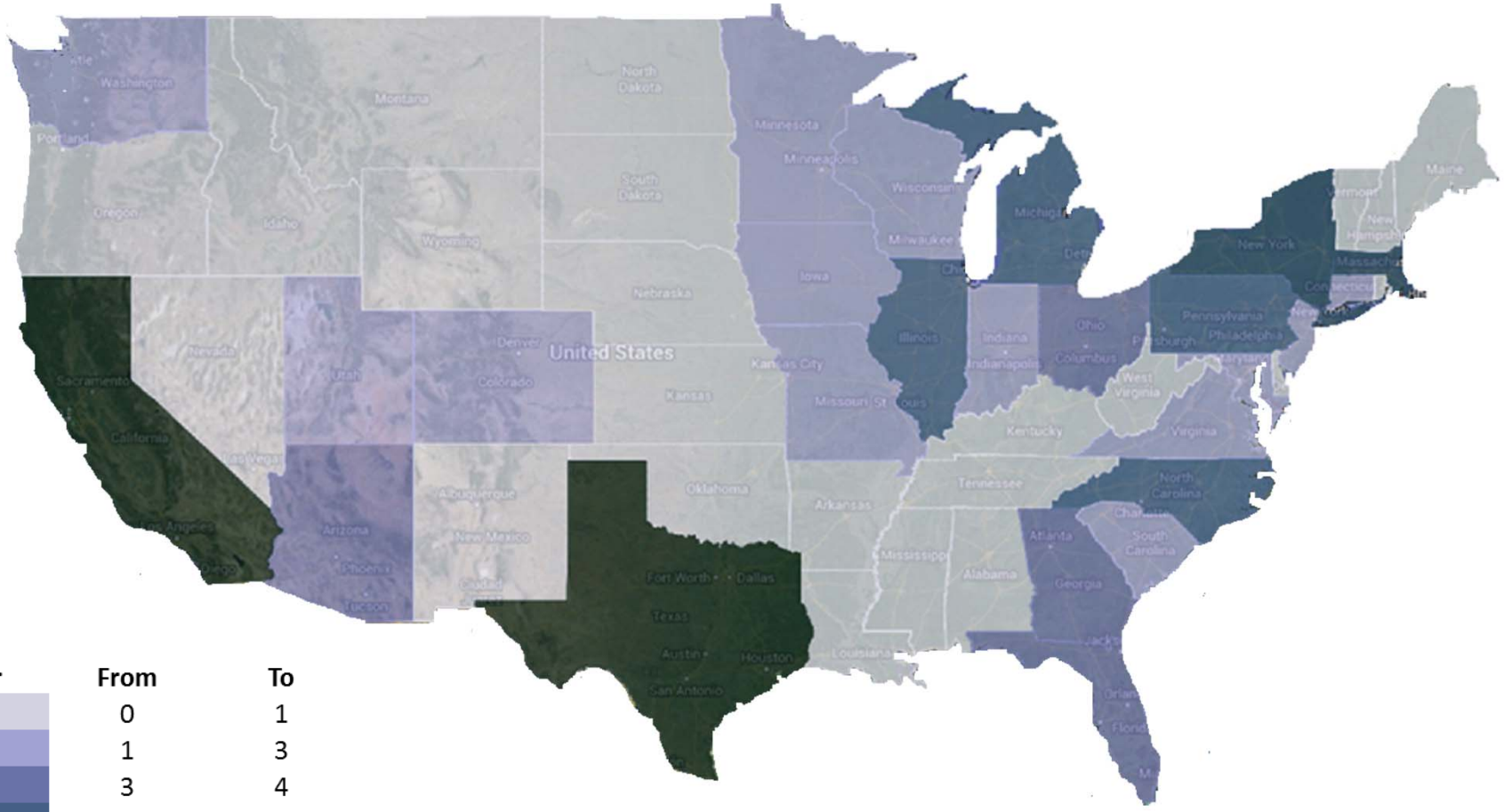
ECCS Awards (FY11-FY13)

For FY11-FY13:

- Average Total Award $338,309
- Average Award Duration (Yrs) 2.89
- PIs roughly awarded 85% of requested budget (less as the requested budget nears $2M)



% of Total ECCS Awards by State (FY11-FY13)



Color	From	To
	0	1
	1	3
	3	4
	4	6
	6	7
	7	8
	8	10

FY14 ENG Priorities

- Advanced Manufacturing
- Clean Energy
- National Nanotechnology Initiative
- Cognitive Science and Neuroscience
- Communications & Cyber-infrastructure
- Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS)
- Education and Career Development
- Interdisciplinary Research
- Research Centers

ECCS Strategic Plan

- Advance sensor- and model-based smart manufacturing and robotics
- Advance semiconductor and optical device design, fabrication and processing for use in biomedical, communications, computing, energy and sensing systems
- Advance research and engineering of energy materials, use, distribution and efficiency
- Focus on composite nanomaterials, two-dimensional nanolayers, nano-electronic logic devices, metamaterials, plasmonics and nanomedicine
- Advance noninvasive or minimally invasive imaging technologies, neuroprosethetics and new neural engineering & technology research
- Advance "smart" systems that can sense and adapt to environmental change for energy, manufacturing, or infrastructure needs
- Emphasize support for CAREER, NRT, IGERT, IUSE and broadening participation at all levels
- Invest in fundamental research that may overcome scientific and/or national challenges and lead to breakthrough technologies (EFRI)
- Maintain support of ECCS funded STCs

Engineering Education

- **Professional Formation of Engineers: Revolutionizing Engineering Departments (RED)**
- Nanotechnology Undergraduate Education (NUE) in Engineering
- Research in Engineering Education & Research Initiation Grants in Engineering Education
  - how students best learn to become creative and innovative engineers, and how this learning is measured
  - how cyber-learning resources can be used to develop tools and systems that significantly improve learning
  - integration of sustainability into engineering education
  - future directions of U.S. engineering doctoral programs

Thank you!

Questions?