NATIONAL SCIENCE FOUNDATION CENTERS

NSF supports a variety of centers programs that contribute to the Foundation's mission and vision. Centers exploit opportunities in science, engineering, and technology in which the complexity of the research program or the resources needed to solve the problem require the advantages of scope, scale, duration, equipment, facilities, and students. Centers are a principal means by which NSF fosters interdisciplinary research.

NSF Centers
(Dollars in Millions)

	Program Initiation	Number of Centers in FY 2017[1]	FY 2017 Actual	FY 2018 (TBD)	FY 2019 Request	Change Over FY 2017 Actual Amount	Change Over FY 2017 Actual Percent
Centers for Analysis & Synthesis	1995	3	$16.00	-	$4.40	-$11.60	-72.5%
Centers for Chemical Innovation[2]	1998	9	20.87	-	20.00	-0.87	-4.2%
Engineering Research Centers	1985	21	57.49	-	56.00	-1.49	-2.6%
Materials Centers[3]	1974	24	62.13	-	56.00	-6.13	-9.9%
Nanoscale Science & Engineering Centers[4]	2001	2	5.83	-	-	-5.83	-100.0%
Science & Technology Centers	1987	12	58.83	-	53.65	-5.18	-8.8%
Totals		**71**	**$221.14**	**-**	**$190.05**	**-$31.09**	**-14.1%**

[1] Counts include centers that received no-cost award extensions in FY 2017 but no additional funding.

[2] This presents Phase II CCI awards only. The smaller, developmental Phase I awards do not meet the criteria as formal NSF Centers and so are not captured here.

[3] Includes forward funding of $6.13 million in FY 2017. Without this action, FY 2019 Request would be level with FY 2017 Actual.

[4] The NSEC program sunset as planned in FY 2017.

Description of Major Changes

Centers for Analysis and Synthesis – BIO

The FY 2019 Request of $4.40 million funds one Center for Analysis and Synthesis—the National Social-Environmental Synthesis Center (SESYNC**)**. Both CyVERSE and the National Institute for Mathematical and Biological Synthesis received their final year of funding in FY 2017 and sunset as planned.

SESYNC, located at the University of Maryland, is dedicated to accelerating scientific discovery at the interface of human and ecological systems. This center allows scientists from diverse disciplines to transform approaches for identifying solutions to society's most challenging and complex environmental problems. Workshops sponsored by this Center engage philosophers, sociologists, political scientists, psychologists, anthropologists, and environmental biologists (together with policy makers) to integrate broad disciplines from the outset and to set precedence for all subsequent activities. This center underwent external review in FY 2016, and was granted a five-year renewal award that started in FY 2016 and will continue through FY 2020. FY 2019 funding will provide continued support for staff and core research activities.

Centers for Chemical Innovation (CCI) - MPS

The FY 2019 Request of $20.0 million funds five Phase II CCIs, four continuing, and one potential renewal. Funding for each of these CCIs will be $4.0 million per year.

The CCI program makes awards at two levels: smaller Phase I (three-year awards) for center development,

and larger Phase II for full centers (five-year awards with the potential for renewal for up to a total of ten years). Phase I awards are considered part of the NSF Division of Chemistry's core research program investments as they fall under the threshold for formal NSF center awards; thus, their funding is not captured here. In FY 2019, a Phase I CCI competition will be held, supporting up to three new developmental awards. No Phase I CCIs are eligible to compete for Phase II in FY 2019. An independent CCI evaluation was funded in FY 2017 and is expected to be completed in FY 2019.

Engineering Research Centers (ERC) - ENG

The FY 2019 Request of $56.0 million funds 14 ERCs. The total includes four Nanosystems Engineering Research Centers, three first funded in FY 2012 and one in FY 2017. NSF's ERCs enable innovation, bridging the energy and intellectual curiosity of university research focused on discovery with real-world engineered systems and technology opportunities through partnerships with industry. These centers also are successful in educating a technology-enabled workforce with hands-on, real-world experience.

The ERC program periodically commissions program-level evaluations by external evaluators to determine the effectiveness of ERC graduates in industry, the benefits of ERC membership to industry and others. In FY 2015, NSF funded the National Academies of Sciences, Engineering, and Medicine to study The Future of Center-Based, Multidisciplinary Engineering Research. To help inform the study, the National Academies held a public symposium on April 6, 2016, and published a proceedings.[1] The study report,[2] delivered May 2, 2017, articulates a vision for the future of NSF-supported center-scale, multidisciplinary engineering research, which ENG will carefully consider for the path ahead. A new solicitation for the next generation of ERCs is expected in FY 2018.

Reports include *Post-Graduation Status of Engineering Research Centers—2010* (SciTech Communications). This study, augmented by a recent update, found that of the 35 ERCs that have graduated from NSF support after 10 years, 29 (83 percent) are self-sustaining with strong financial support and most ERC features in place. The ERCs are successful at engaging a broader participation from underrepresented groups. For example, across an average of the currently active ERCs, approximately 32 percent of all those involved in the activities are women—in comparison to the national average of 16 percent across all engineering. In addition, the percentage of underrepresented minorities is more than three times that of engineering's national average. ERC products of innovation include 2,305 inventions disclosures, 1,909 patent applications filed, 790 patents awarded, and 1,345 licenses issued since the inception of the program. As for workforce development, ERCs have graduated 4,171 Bachelor's, 4,064 Master's, and 4,644 Doctoral degrees and impacted a total of 63,317 Pre-college K-12 Teachers and K-12 Students.

Materials Centers - MPS

The FY 2019 Request of $56.0 million is expected to fund 20 Materials Research Science and Engineering Centers (MRSECs). FY 2019 will be spent preparing for the next MRSEC competition in FY 2020. This includes stimulating the seeding efforts built within each MRSEC to start addressing DMR emerging research areas. These include the Quantum Leap, the Future of Work at the Human Technology Frontier, and Harnessing the Data Revolution for 21st-Century Science and Engineering Big Ideas, as well as Materials Sustainable Development research.

MRSECs exists to solve complex grand challenge materials problems requiring broad complementary multidisciplinary expertise within the physical sciences and engineering to understand materials phenomena, exploit materials behavior, and to create and discover new materials. Through the collaborative efforts involving academics, industrial, international and educational partners, MRSECs are a primary example of what is known as transdisciplinary convergent research.

[1] www.nap.edu/catalog/23645/a-vision-for-the-future-of-center-based-multidisciplinary-engineering-research
[2] www.nap.edu/catalog/24767/a-new-vision-for-center-based-engineering-research

MRSECs have five major components: interdisciplinary research thrusts, education and outreach, industrial outreach/partnerships, the materials research facilities network, which provides access to nearly 1,200 state-of-the art equipment instrumentation to materials researchers across the Nation, and the SEED program which enable MRSECs to rapidly react/move into new high risk and potentially transformative areas not yet fully explored. Each year, MRSECs produce about 210 PhDs in STEM fields, mentor over 450 research experience for undergraduate students and 60 research experience for teachers, and impact nearly 1 million students and parents through outreach activities such as summer camps, K-12 science curriculum development, K-12 in-school science demos, development and deployment of science kits, and partnering with the Nation's top museums to create STEM-related exhibits that impact the public. Since 1994, the program has created over 150 startups and produces yearly about 50 awarded patents and 30 patent licensures. MRSECs engage and assist about 220 industrial partners per year in advancing fundamental materials research that can be translated into the market place.

Science and Technology Centers: Integrative Partnerships (STC) - multi-directorate

The FY 2019 Request of $53.65 million will support twelve STCs and the administrative costs ($150,000) associated with management and oversight of the program. All are continuing awards from the FY 2010, FY 2013, and FY 2016 cohorts. Awards are for five years, with possible renewal for an additional five years, or 10 years total. Award sizes are typically $4.0 million to $5.0 million per year. Funding for the five centers in the 2010 cohort will sunset in FY 2020, with support beginning to ramp down in FY 2019. The STC program has developed a network of evaluators working with the centers to share information and lessons learned about the most effective way to measure progress at the centers.

The STC program advances interdisciplinary discovery and innovation in science and engineering through the integration of cutting-edge research, excellence in education, targeted knowledge transfer, and the development of a diverse workforce. The STC portfolio reflects NSF-supported disciplines. Examples include: engineering biological systems; energy-efficient electronics; new ways of handling the extraction, manipulation, and exchange of information; and new nano-atomic scale imaging modalities. STCs engage the Nation's intellectual talent and collaborate with partners in academia, industry, national laboratories, and government. STCs strengthen the caliber of the Nation's science, technology, engineering, and mathematics workforce through intellectually challenging research experiences for students, postdoctoral fellows, researchers, and educators; they advance public scientific understanding through partnerships with K-12 and informal education communities.

Estimates for Centers Participation in 2017

	Number of Participating Institutions	Number of Partners	Total FY 2017 NSF Support ($ in millions)	Total Leveraged Support ($ in millions)	Number of Participants
Centers for Analysis & Synthesis	2,163	954	$16	$0	12,666
Centers for Chemical Innovation	74	63	21	4	788
Engineering Research Centers	550	204	57	86	3,177
Materials Centers	516	372	62	47	5,070
Nanoscale Science & Engineering Centers	42	20	6	6	523
Science & Technology Centers	14	170	59	33	1,913

Number of Participating Institutions: All academic institutions participating in activities at the centers.

Number of Partners: The total number of non-academic participants, including industry, states, and other federal agencies at the centers.

Total Leveraged Support: Funding for centers from sources other than NSF.

Number of Participants: The total number of people who use center facilities, not just persons directly support by NSF.

Centers Supported by NSF in FY 2017

Center	Institution	State
Centers for Analysis and Synthesis		
National Institute for Mathematical & Biological Synthesis	U of Tennessee	TN
CyVERSE	U of Arizona	AZ
Socio-Environmental Synthesis Center	U of Maryland	MD
Centers for Chemical Innovation (Phase II awards only)[3]		
Center for Aerosol Impacts on Climate and the Environment	U of California-San Diego	CA
Center for Chemical Evolution	Georgia Institute of Tech	GA
Center for Chemical Innovation in Solar Fuels	California Institute of Tech	CA
Center for Enabling New Technologies through Catalysis	U of Washington	WA
Center for Selective C-H Functionalization	Emory	GA
Center for Sustainable Materials Chemistry	Oregon State	OR
Center for Sustainable Nanotechnology	U of Wisconsin	WI
Center for Sustainable Polymers	U of Minnesota	MN
Chemistry at the Space-Time Limit	U of California-Irvine	CA
Engineering Research Centers		
Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST)	North Carolina State	NC
Bio-mediated and Bio-inspired Geotechnics (CBBG)	Arizona State	AZ
Biorenewable Chemicals	Iowa State	IA
Center for Ultra-wide-area Resilient Electric Energy Transmission Network (CURENT)	U of Tennessee	TN
Compact and Efficient Fluid Power (CCEFP)[1]	U of Minnesota	MN
Engineering Research Center for Innovative and Strategic Transformation of Alkane Resources (CISTAR)	Purdue	IN
Engineering Research Center for Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP)	Texas A&M	TX
Future Renewable Electric Energy Delivery and Management Systems (FREEDM)	North Carolina State	NC
Integrated Access Networks (CIAN)	U of Arizona	AZ
Nanomanufacturing Systems for Mobile Computing and Mobile Energy Technologies (NASCENT)	U of Texas	TX
Nanosystems Engineering Research Center for Directed Multiscale Assembly of Cellular Metamaterials with Nanoscale Precision (CELL-MET)	Boston College	MA
Nanotechnology Enabled-Water Treatment Systems (NEWT)	Rice University	TX
NSF Engineering Research Center for Cell Manufacturing Technologies (CMaT)	Georgia Tech	GA
Optimization for Electro-thermal Systems (POETS)	U of Illinois	IL
Quantum Energy and Sustainable Solar Technologies (QESST)	Arizona State	AZ
Re-inventing the Nation's Urban Water Infrastructure (ReNuWit)	Stanford	CA
Revolutionizing Metallic Biomaterials (RMB)	North Carolina A&T U	NC
Sensorimotor Neural Engineering (CSNE)	U of Washington	WA
Smart Lighting	Rensselaer Polytechnic Institute	NY
Structured Organic Particulate Systems[1]	Rutgers	NJ
Translational Applications of Nanoscale Multiferroic Systems (TANMS)	U of California-Los Angeles	CA
Materials Centers		
Brandeis Bioinspired Soft Materials Center	Brandeis	MA
Center for Dynamics and Control of Materials	U of Texas at Austin	TX
Center for Emergent Materials	Ohio State	OH
Center for Multifunctional Materials	Northwestern	IL
Center for Nanoscale Science	Pennsylvania State	PA

[3] Smaller, developmental Phase I awards do not meet the criteria as formal NSF Centers and so are not captured here.

Center for Photonic and Multiscale Nanomaterials	U of Michigan	MI
Center for Plasmonics and Organic Spintronics	U of Utah	UT
Center for Polarization and Spin Phenomena in Nanoferroic Structures	U of Nebraska	NE
Center for Research on Interface Structures and Phenomena	Yale	CT
Chicago Materials Research Centers	U of Chicago	IL
Columbia Center for Precision Assembly of Superstratic and Superatomic Solids	Columbia	NY
Cornell Center for Materials Research	Cornell	NY
Harvard Materials Research Center	Harvard	MA
Illinois Materials Research Center	U of Illinois at Urbana-Champaign	IL
Laboratory for Research on the Structure of Matter	U of Pennsylvania	PA
Materials Research Science and Engineering Center at UCSB	U of California-Santa Barbara	CA
Materials Research Science and Engineering Center	U of Minnesota	MN
MIT Center for Materials Science and Engineering	Massachusetts Institute of Tech	MA
NYU Materials Research Science and Engineering Center	New York U	NY
Princeton Center for Complex Materials	Princeton	NJ
Research Triangle Materials Research Science and Engineering Center	Duke, North Carolina State, NC Central U, U of North Carolina	NC
Soft Materials Research Center	U of Colorado	CO
UW Molecular Engineering Materials Center	U of Washington	WA
Wisconsin Materials Research Center	U of Wisconsin	WI
Nanoscale Science and Engineering Centers		
Center for the Environmental Implications of Nanotechnology (CEINT)	Duke	NC
Predictive Toxicology Assessment & Safe Implementation of Nanotechnology in the Environment (CEIN)	U of California-Los Angeles	CA
Science and Technology Centers		
BEACON: An NSF Center for the Study of Evolution in Action	Michigan State	MI
Biology with X-Ray Free Electron Lasers	SUNY Buffalo	NY
Center for Brains, Minds, and Machines: The Science and the Technology of Intelligence	Massachusetts Institute of Tech	MA
Center for Bright Beams	Cornell	NY
Center for Cellular Construction	U of California-San Francisco	CA
Center for Dark Energy Biosphere Investigations	U of Southern California	CA
Center for Emergent Behaviors of Integrated Cellular Systems	Massachusetts Institute of Tech	MA
Center for Energy Efficient Electronics Science	U of California-Berkeley	CA
Center for Engineering MechanoBiology	U of Pennsylvania	PA
Center for Integrated Quantum Materials	Harvard	MA
Science and Technology Center on Real-Time Functional Imaging	University of Colorado	CO
Center for Science of Information	Purdue	IN