CLEAN ENERGY TECHNOLOGY

Clean Energy Technology Funding[1]
(Dollars in Millions)

	FY 2020 Actual	FY 2021 Estimate	FY 2022 Request
BIO	$18.00	$45.00	$59.28
CISE	18.50	23.50	31.12
ENG	113.54	123.03	178.57
MPS	92.62	90.00	118.56
TIP[2]	48.47	52.47	52.47
Total	**$291.13**	**$334.00**	**$440.00**

[1] Funding displayed may have overlap with other topics and programs.

[2] FY 2020 and FY 2021 funding for TIP is shown for comparability across fiscal years.

Overview

NSF's clean-energy investments create new understanding and innovations for increasing energy efficiency, enhancing sustainability and resilience, and reducing and mitigating climate change. NSF-supported areas of fundamental research and education include the production, conversion, storage, and distribution of diverse electricity and fuel sources; the science and engineering of energy materials, energy use, and energy efficiency, including novel data and computational approaches to advance these frontiers; and the ways that people think about and use energy. Clean-energy investments also create vital research and education partnerships in response to national and international developments in sustainability science.

NSF's investments in clean energy span longstanding programs as well as focused new solicitations. For example, NSF has made long-term investments in multidisciplinary clean-energy research centers through the Centers for Chemical Innovation, Expeditions in Computing, Engineering Research Centers, and Industry-University Cooperative Research Centers programs. To serve researchers and students across the country, NSF has established research infrastructure, such as the Grid-Connected Testing Infrastructure for Networked Control of Distributed Energy Resources (DERConnect).

NSF's future investments will continue to advance the fundamental science and engineering underlying clean-energy technologies and infrastructure, including:

- Generation of renewable and alternative energy sources for electricity (solar, wind, geothermal, harvesting, and ocean waves, currents and tides), fuels (chemical, biomass, and biofuels), and energy-conversion technologies (e.g., advanced fuel cells);
- Manufacture, storage, distribution, and management of renewable and alternative energy sources and systems, including smart grids, efficient power transmission and conversion systems, grid-scale energy storage, and carbon capture;
- Energy materials, use and efficiency, including research on low-power and green electronics, energy-intelligent and sustainable computing and communication systems (including wireless systems), eco-manufacturing of diverse products (including materials and chemicals), and the remediation and reduction of legacy pollution; and
- Societal and environmental aspects of clean energy, such as research on sustainable energy systems that preserve essential ecosystems and environmental services, promote positive and equitable social and economic outcomes, and prepare individuals and communities to responsibly adopt them.

The above advances require related investments in novel data and computational approaches; for example, new computational modeling techniques to simulate renewable and alternative energy sources, transmission, and storage; novel materials supporting energy efficiency and sustainability; sustainable computing and communication; and societal aspects.

NSF also will support multidisciplinary research in areas such as affordable green housing, and sustainable systems for clean water, clean transit, and other infrastructure. Added NSF investments will help build the future clean-energy workforce and advance the translation and deployment of innovative technologies.

Goals

1. *Foundational Research:* Support foundational research in science and engineering that will fuel innovations in clean-energy supply, distribution, and use.
2. *Clean-Energy Infrastructure:* Development of energy generation and distribution infrastructure, as well as the associated computing and communications infrastructure, necessary to generate fundamental knowledge and development of accompanying clean-energy technology.
3. *Workforce Development*: Attract, educate, train and reskill/upskill workers, from K-12 to college and industry, for the clean-energy workforce of the future.

FY 2022 Investments

Foundational Research

NSF will invest in fundamental clean-energy research related to increasing the efficiency of generation, conversion, storage, and distribution of electricity and fuel; clean-energy sources that are renewable or alternatives to traditional fossil fuels; energy materials, use, and efficiency; and related infrastructure and systems, such as sustainable transit and vehicle technologies that improve engine efficiency and fuel economy, building efficiency, more effective transmission of electricity, decarbonized manufacturing, ecosystem services, and interconnected natural, human-built, and social systems.

Clean-Energy Infrastructure

Investments in research infrastructure enabling sustainable energy generation and distribution will allow for the creation of more energy-efficient energy systems, from generation to distribution, for all uses spanning industry, transportation, and buildings. Investments in computing and communication research infrastructure will enable the creation of more efficient and sustainable hardware, software, and systems for computing and communication—a significant and growing component of U.S. electricity consumption. This investment will support full-stack hardware and software research to consider increased energy sustainability and reduced e-waste through innovations in recyclable materials and manufacturing; and develop more energy-efficient technologies for communications systems. Importantly, computing research infrastructure will also support data and computation affording insights into energy-efficient and sustainable approaches and techniques more generally.

Workforce Development

To prepare the clean energy workforce, NSF invests in the Advanced Technological Education, Faculty Early Career Development, Grant Opportunities for Academic Liaison with Industry, Research Experiences for Undergraduates Sites and Supplements, and Research Experiences for Teachers in Engineering and Computer Science programs, as well as clean-energy education in research projects. NSF support for Non-Academic Research Internships for Graduate Students (INTERN) and NSF Innovation Corp (I-Corps™) provides students with industrial and entrepreneurship experience.

Transition to Practice

NSF speeds translation of fundamental discoveries in clean and renewable energy into technologies and systems through its Centers for Chemical Innovation, Expeditions in Computing, Engineering Research Centers, Industry-University Cooperative Research Centers, and Partnerships for Innovation programs, as well as through Transition-to-Practice, Innovation Transitions, and Small Business Innovation Research and Small Business Technology Transfer investments. In addition, NSF coordinates with other agencies such as the Department of Energy and the Department of Defense to transition fundamental research further towards application.