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S C I E N T I F I C B R A I N D R A I N

Quantifying the Decline of the
Federal Scientific Workforce

A Majority Staff Report
Prepared for Members of the Committee on Science, Space, & Technology

March 2021

Summary of Findings

The Majority staff of the Committee on Science, Space, and Technology analyzed workforce data for seven science agencies within the Committee's jurisdiction: NSF, NASA, DHS S&T, NIST, NOAA, DOE and EPA. Among the staff's key findings are the following:¹

Environmental Protection Agency (EPA)

- EPA's workforce declined by 3.9% during the Trump Administration (Fiscal Year 2016-2020) and 16.6% from Fiscal Year (FY) 2009-2020;
- EPA's STEM workforce also declined by 3.9% during the Trump Administration. STEM losses accounted for roughly 60% of EPA's total Trump-era workforce decline;
- EPA STEM employment cuts during the Trump Administration were concentrated among environmental protection specialists (24.3% decrease) and environmental engineers (5.7% decrease), two vital STEM occupations;
- EPA's Office of Research and Development experienced a 7.6% workforce decline during the Trump Administration and a 17.2% decline between FY 2012-2019, losing nearly one-fifth of the office's total workforce in just seven years.

Department of Energy (DOE)

- DOE's civil service workforce declined by 3.1% during the Trump Administration and 7.2% from FY 2009-2020;
- DOE's civil service STEM workforce was flat during the Trump Administration. DOE lost 37 engineers during those years, including 32 nuclear engineers (13.2% decrease);
- Within DOE, the Offices of Energy Efficiency and Renewable Energy (8.7% decline), Fossil Energy (12.1% decline), and Nuclear Energy (21.2% decline) suffered deep civil service workforce losses during the first three years of the Trump Administration.

National Oceanic and Atmospheric Administration (NOAA)

- NOAA's workforce declined by 8.6% from FY 2009-2020;
- The NOAA STEM workforce declined by 1.6% during the same period;
- NOAA's STEM workforce experienced large declines in several critical scientific occupations during the Trump Administration, including fish biologists (8.1% decline), oceanographers (9.0% decline), and wildlife biologists (30.4% decline).

The combined civil service workforces of EPA, DOE and NOAA declined by 4,874 employees between FY 2009 and FY 2020.

¹ See the Methodology section for a description of data parameters and definitions.

Diversity in STEM

- Racial and ethnic employment gaps persist within most of the observed agency STEM workforces relative to their total workforces. Gender employment gaps are more pronounced within the STEM workforce specifically;
- Gender employment gaps are particularly glaring within the engineering workforce. At the end of FY 2020:
 - NOAA employed roughly 8.5 male engineers for every 1 female engineer;
 - DOE employed more than 4 male engineers for every 1 female engineer; and
 - EPA's engineering employment gap was responsible for more than half of the gender gap in the agency's entire STEM workforce;
- The Black / African American STEM workforce has seen little of the broader employment gains among historically underrepresented groups at several agencies:
 - NOAA's Black / African American STEM workforce only increased by 0.4% from FY 2016-2020 amidst a 13.6% increase in STEM employment among minority groups;
 - EPA's Black / African American STEM workforce experienced a 8.7% decline from FY 2016-2020 even as agency STEM employment among minority groups increased by a small amount.

These statistics are not dry facts. They represent research funded more slowly, laws and regulations less effectively enforced, morale weakened, perspectives narrowed, and opportunities missed to cultivate and support the next generation of great American scientists. They suggest a dangerous retrenchment of American scientific leadership.

Introduction and Discussion

Science is central to the ability of the United States to meet the great challenges of our time. Combating climate change, securing the nation against physical and cyber threats, transitioning to cleaner energy and transportation, protecting public health: science is an indispensable tool for the Federal Government as it navigates the crises and opportunities of the 21st century. But while the role of science in federal policymaking looms larger than ever, the scientific workforce charged with fulfilling that role is dangerously diminished.

The past decade has witnessed employment declines at critical federal science agencies. The declines, which extend back at least as far as the budget cuts of the early 2010's, were aggravated by the Trump Administration's open hostility towards federal scientists and the federal workforce in general. Several leading science agencies are smaller than a decade ago, with science, technology, engineering and mathematics (STEM) workforces that have declined or remained stagnant, and persistent gender and racial disparities in those workforces.² These trends threaten to weaken the ability of the federal scientific workforce to carry out the missions of their agencies.

The four years of the Trump Administration were devastating for the federal scientific workforce. Throughout many of the Federal Government's civilian scientific agencies, career scientists experienced political interference, bureaucratic obstruction, and personal retaliation. A few high-profile incidents that contributed to an impaired work environment include:

- Soon after President Trump took office in January 2017, agencies across the Federal Government removed climate research from their websites with little explanation;ⁱ
- For more than two years beginning in the summer of 2018, DOE blocked the release of the Interconnections Seam Study because it argued that greater connectivity between the eastern and western halves of the U.S. power grid would increase the country's use of renewable energy while reducing energy costs;ⁱⁱ
- At the end of 2018, EPA suppressed a draft toxicity assessment of the chemical formaldehyde that was expected to link formaldehyde exposure to leukemia.ⁱⁱⁱ The assessment remains suspended to this day;
- In September 2019, political leaders at the White House and Department of Commerce successfully pressured NOAA to publicly rebuke its own meteorological forecasters for presenting accurate scientific information that contradicted President Trump's erroneous description of the projected path of Hurricane Dorian across the southeast;^{iv}
- In September 2020, the White House ordered all federal agencies to cancel race-related diversity training sessions, an order that was quickly implemented by science agencies such as NOAA and EPA.^v

This type of political bullying compromised scientific integrity and caused morale among career scientists to plummet. A 2018 survey of federal scientists found that political interference, censorship and a fear of retaliation had weakened the morale of scientists in a number of critical

² U.S. Office of Personnel Management, "FedScope: Data Definitions," accessed here: <https://www.fedscope.opm.gov/datadefn/#stemocc>.

agencies.^{vi} The political marginalization of science was most apparent in episodes where upholding scientific integrity brought federal scientists into conflict with the Administration’s political objectives. Science agency staff who were directed to pursue deregulatory actions not supported by evidence and suppress the threat of climate change found themselves at the center of the fiercest scientific clashes of the Trump era. Many career employees at science agencies left government service in frustration. One recent analysis found that more than 1,000 scientists departed just three agencies during the Trump Administration.^{vii}

While the Federal Government’s scientific responsibilities are increasing, federal employment data reviewed by Committee staff reveal that the workforces of scientific agencies such as EPA, DOE, and NOAA declined or stagnated during the Trump Administration. This was true in terms of the overall civil service workforces and their STEM workforces specifically.

In addition, the presence of Presidential Management Fellows within science agencies declined precipitously over the last four years. The PMF program offers two-year fellowships to individuals who have earned an advanced degree within the last two years and have demonstrated exceptional leadership skills and academic achievements. While the absolute numbers of PMFs are small in the scheme of overall agency workforces, their impact on sustaining U.S. leadership in science fields is outsized. PMFs also represent an important workforce pipeline for young entrants to STEM positions in the civil service, as a significant percentage of PMFs traditionally convert to a permanent appointment or competitive service job in government at the end of their fellowships.

Presidential Management Fellows at Science Agencies

Science Agencies	FY 16	FY 17	FY 18	FY 19	FY 20
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	4	5	3	3	4
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY	0	0	0	2	3
DEPARTMENT OF ENERGY	23	23	9	2	2
ENVIRONMENTAL PROTECTION AGENCY	32	38	14	2	7
DEPARTMENT OF HOMELAND SECURITY	54	53	42	30	24
NATIONAL SCIENCE FOUNDATION	3	3	2	1	1
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	6	3	0	3	3
DEPARTMENT OF TRANSPORTATION	14	7	7	9	5
SCIENCE AGENCIES TOTAL	136	132	77	52	49

However, the diminishment of the federal scientific workforce did not begin with the Trump era. The imposition of sequestration in FY 2013 forced sweeping cuts to non-mandatory federal spending, and civilian scientific programs were fully exposed to the harmful budgetary consequences.^{viii} Subsequent austerity-minded federal budgets provided by Congress failed to restore the necessary funding for scientific activities and retained tight budgetary caps well into the middle of the decade. As a result, non-defense discretionary spending was lower in every year between FY 2013 and FY 2016 than it had been in FY 2012, the last year before

sequestration took effect, and the workforces of many science-based agencies declined during those years.^{ix}

Thus the 2010s witnessed a series of blows to the federal scientific workforce. In the middle of the decade, scientific agencies were starved of budgetary resources. Their workforces, already depleted by budget cuts, faced a political assault on their core scientific missions during the Trump era. The Trump Administration's threats against federal science exacerbated the challenges experienced by the STEM workforce, but it did not create them out of thin air. The reduced scientific workforce of today is the culmination of a decade-long trend.

A smaller scientific workforce undermines the ability of science agencies to fulfill their missions: research slows, work backlogs lengthen, grants take longer to award, regulation and enforcement suffer, and the remaining STEM employees must assume a larger burden to compensate. The loss of talented and experienced federal employees - scientists and non-scientists alike – threatens to deprive the Federal Government of vital institutional knowledge and expertise that took decades to develop and could require years to recover. The attacks on science over the past four years could have serious and lasting consequences for federal scientific capacity in the years ahead. Meanwhile, non-U.S. competitors are redoubling their own investments in research and development and have a pipeline of STEM talent to support them.

The damage done to our federal STEM workforce is real, but it is not irreversible. Restoring scientific integrity, increasing funding for science agencies, embracing proactive recruitment, hiring and retention policies, and deepening the Federal Government's commitment to diversity and equity in the workforce would bolster federal scientists and rebuild the workforce. Reversing the damage and restoring the scientific workforce – and the role of science in federal policymaking - will require sustained and long-term attention, support, and funding from both Congress and the executive branch.

Methodology

This report utilizes federal employment data to illustrate the size and nature of the reductions in the federal scientific workforce that have occurred over the past decade. Except where otherwise noted, the analysis is concerned with civil service employees.

There is no formal definition of the federal “scientific workforce” and no single comprehensive data source detailing federal scientific employment. This report’s workforce data parameters are designed to support two objectives: a broad assessment of the total workforces of science agencies and offices; and a targeted evaluation of critical scientific occupations within those agencies. The parameters are further shaped by the Committee’s jurisdiction and priorities. Under House Rule X, the Committee possesses oversight jurisdiction over “laws, programs, and Government activities relating to nonmilitary research and development.”^x The seven agencies assessed by this report fall squarely within the Committee’s jurisdiction. Additionally, promoting STEM education, strengthening the Federal Government’s STEM capabilities, and enabling gender and racial equality in STEM fields are longstanding priorities for the Committee.

For each science agency listed above, Committee staff analyzed four categories of data:

- Overall agency employment
- Agency STEM employment
- Gender employment
- Racial and ethnic employment

Staff used data from three primary sources: the U.S. Office of Personnel Management (OPM) FedScope database; selected budget appendix tables from the Office of Management and Budget (OMB); and selected Congressional budget justifications. All employment data is expressed through full-time equivalent employment, or FTEs, a standard workforce metric that quantifies employment by the number of regular straight time-hours worked (excluding overtime and holiday hours) in relation to the number of compensable hours in a fiscal year. One FTE is considered one work year. This report refers to FTE data interchangeably with federal employment levels.

FedScope data was refined to include only non-seasonal, full-time permanent employees; part-time and seasonal employees were excluded from the data set. FedScope data is organized by fiscal year and refers to the number of employees in pay status on the last day of the fiscal year. FedScope data was analyzed for all fiscal years between 2009 and 2020. For the purposes of this report, employment data for the Obama Administration refers to FY 2009-2016, or the period from September 30, 2009 through September 30, 2016. Employment data for the Trump Administration refers to FY 2016-2020, or the period from September 30, 2016 through September 30, 2020.

FedScope provided data for agency employment, agency STEM employment, gender employment and racial and ethnic employment. However, FedScope does not contain data breakouts for all of the accounts within the Committee’s jurisdiction at DOE and EPA. In those instances, the data analysis was supplemented by budget appendix tables and Congressional

budget justifications detailing employment levels for selected offices such as DOE's Office of Energy Efficiency and Renewable Energy (EERE), DOE's Office of Fossil Energy (FE), DOE's Office of Nuclear Energy (NE), and EPA's Office of Research and Development (ORD). Budget appendix tables were identified for fiscal years 2009-2019, while Congressional budget justifications pertaining to EPA ORD were identified for fiscal years 2012-2019. Workforce analyses for those offices were limited to those years.

For the discussion on DOE contracting staff, Committee staff examined data collected from DOE by the Congressional Research Service and self-reported numbers from the prime contractors supporting DOE site offices and national laboratories. The Office of Personnel Management aggregated data from agencies on Presidential Management Fellows.

Each section of this report presents employment data for all seven agencies reviewed by Committee staff. Further data analysis focuses upon three agencies in particular: EPA, DOE and NOAA.

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Overall Agency Employment

No single narrative neatly captures the diverse range of employment trends at the seven science agencies reviewed in this report. Despite cross-cutting budgetary and political pressures, a few scientific agencies managed to maintain or enlarge their workforces. Other scientific agencies saw devastating employment cuts.

NSF, DHS S&T and NIST enjoyed significant workforce increases over the past decade, although the rate of growth slowed for NIST and reversed entirely for DHS S&T during the Trump Administration. NASA's workforce remained largely flat over the decade and during the Trump Administration, experiencing small increases and ending the decade less than 1% larger than at the onset.

On the other hand, EPA, DOE and NOAA saw dramatic employment declines over the decade. NOAA curtailed its workforce decline somewhat during the Trump era. The EPA and DOE workforces continued to shrink even further during the Trump era.

Total Agency Employment, FY 2009-2016-2020 (FTEs)

	FY 2009	FY 2016	FY 2020	% Change (2016-2020)	% Change (2009-2020)
NSF	1,180	1,208	1,283	+ 6.2%	+ 8.7%
NASA	16,970	16,985	17,099	+ 0.7%	+ 0.8%
DHS S&T	359	442	421	- 4.8%	+ 17.3%
NIST	2,605	2,919	2,980	+ 2.1%	+ 14.4%
EPA	16,456	14,287	13,732	- 3.9%	- 16.6%
DOE	15,134	14,499	14,047	- 3.1%	- 7.2%
NOAA	12,323	11,148	11,260	+ 1.0%	- 8.6%

EPA Total Employment

EPA has suffered nearly a decade of workforce cuts, and the agency is substantially diminished as a result. The 16.6% decline between FY 2009-2020 does not fully depict the extent of the Agency's retrenchment. Since reaching its recent employment peak of 16,702 FTEs in FY 2011, EPA has lost 2,970 employees, a 17.8% (one-sixth) decrease in less than a decade. The most far-reaching employment losses occurred during the second half of the Obama Administration, as sequestration and restrictive budgetary caps forced deep budget cuts at EPA and slashed the agency's workforce sharply, resulting in a 13.2% employment decrease between FY 2009-2016. But the agency's workforce decline continued through the Trump Administration with an additional 3.9% decrease from FY 2016-2020. For an agency with complex and high-profile regulatory, enforcement, research and educational responsibilities, a 16.6% workforce decline over the course of a single decade is disastrous.

EPA Office of Research and Development Total Employment and Budgets, FY 2012-2016-2019 (FTEs)

	FY 2012	FY 2016	FY 2019	% Change (2016-2019)	% Change (2012-2019)
EPA ORD FTEs	1,903	1,704	1,575	- 7.6%	- 17.2%
EPA Enacted Appropriations: Science & Technology	\$901 million	\$784 million	\$708 million	- 9.7%	- 21.4%
EPA Actual Budget Authority: Research & Development	\$627 million	\$516 million	\$479 million (estimated)	- 7.2%	- 23.6%

ORD is the scientific research arm of EPA. It oversees ORD laboratories and manages the agency’s regional laboratories, manages grant programs for environmental research, develops gold standard chemical toxicity assessments, and conducts scientific research that underpins regulatory policymaking by agency program offices.^{xi} ORD is a key pillar of EPA’s mandate to use the best available science to protect public health and the environment. Between FY 2012-2019, however, ORD’s workforce declined sharply. The office employed 328 fewer employees at the end of FY 2019 than seven years earlier, a 17.2% decline. During the first three years of the Trump Administration, ORD’s workforce declined by 7.6%.

The leading cause of ORD’s workforce reductions since FY 2012 are the cuts to EPA’s science budget that have occurred over the same period. Actual budget authority for R&D programs fell 23.6% in real dollars from FY 2012-2019. Adjusted for an average inflation rate of 1.55 per year, the decrease is over 30%. EPA’s S&T account saw a very slight increase since FY 2019, with an enacted appropriations amount set at \$716 million for FY 2021.

ORD provides an indispensable service to the agency and the entire country as a premier source of landmark environmental research. The office is a global leader in pushing the frontiers of environmental knowledge forward, and it has a vital role to play in EPA’s ongoing mission to strengthen environmental protections, combat climate change, and promote environmental justice for vulnerable communities. But the sustained employment cuts of the 2010’s place a punishing burden on ORD’s remaining workforce.

DOE Total Employment

DOE’s sprawling portfolio extends from managing the country’s nuclear arsenal to promoting a range of energy sources to overseeing the National Laboratory system. Unfortunately, DOE similarly underwent a decade of reductions to its civil service employees. The DOE workforce, bolstered by a surge of funding under the American Recovery and Reinvestment Act of 2009 (ARRA), reached its recent peak in FY 2010 at 15,757 FTEs. Since then, DOE has lost 1,710 employees. Once again, the largest annual declines followed the budget cuts of the early 2010’s, and DOE’s workforce decreased by 4.2% between FY 2009-2016. But steep employment cuts continued at a similar pace during the Trump Administration, and the agency workforce declined

by an additional 3.1% between FY 2016-2020, even while Departmental budgets increased substantially. DOE's civil service workforce decline is undermining its ability to fulfill Congressional objectives for advancing clean energy technologies.

Department of Energy Enacted Budgets (in millions)

Year	Department of Energy	Energy Efficiency & Renewable Energy	Fossil Energy	Nuclear Energy
FY09	33,856	2,157	1,097	1,357
<i>ARRA</i>	<i>36,725</i>	<i>16,800</i>	<i>3,400</i>	--
FY10	26,426	2,216	939	858
FY11	25,693	1,772	573	806
FY12	26,320	1,781	854	555
FY13	25,137	1,692	699	798
FY14	27,225	1,901	779	888
FY15	27,402	1,841	791	822
FY16	29,603	2,073	632	986
FY17	30,087	2,090	668	1,017
FY18	34,518	2,322	727	1,205
FY19	33,534	2,379	740	1,326
FY20	38,600	2,848	750	1,493
FY21	38,657	2,864	750	1,508

DOE Program Office Employment, FY 2009-2019 (FTEs)

Year	Department of Energy	Energy Efficiency & Renewable Energy	Fossil Energy	Nuclear Energy
FY09	15,143	536	602	366
FY10	15,757	815	628	350
FY11	15,548	741	621	367
FY12	15,041	723	570	404
FY13	14,739	729	581	386
FY14	14,341	680	579	387
FY15	14,443	615	582	378
FY16	14,499	634	569	359
FY17	14,249	675	553	339
FY18	13,809	604	517	304
FY19	13,774	579	500	283
FY20	14,047	<i>not available</i>	<i>not available</i>	<i>not available</i>
% Change (FY16-19)	-3.1%	-8.7%	-12.1%	-21.2%
% Change (FY09-19)	-7.2%	+8.0%	-16.9%	-22.7%

DOE's employment losses manifested within the agency's applied energy programs. Three program offices vital to DOE's clean energy mission are EERE, FE and NE. EERE promotes the country's transition to a clean energy economy through research and development initiatives that support domestic clean energy manufacturing, assist the growth and integration of renewable energy sources within the electricity grid, and energy efficiency and sustainability for the Federal Government and the private sector.^{xii} FE oversees research programs to significantly reduce environmental impacts of the country's development and use of domestic fossil fuel resources. NE manages research and development programs to bolster the country's domestic nuclear energy sector, including the funding of advanced nuclear reactor projects and the development of advanced nuclear fuel cycles.^{xiii}

All three program offices are critical components of America's effort to remain a global leader in energy development. But all three experienced severe workforce declines in recent years. EERE benefited from funding increases in the early years of the Obama Administration and increased its workforce significantly between FY 2009-2016, but the Trump Administration oversaw a reversal in employment that cut EERE's workforce by 8.7% during its first three years in office. After reaching peak employment in FY 2010 at 815 FTEs, EERE's workforce lost 236 employees and decreased by 28.9% over the next nine years. Indeed, EERE employed only 43 more staffers in FY 2019 than it did a decade earlier, despite the global boom in clean energy deployment and steadily-increasing appropriations from Congress.

The FE and NE workforces saw even greater declines than EERE. FE's workforce decreased somewhat during the Obama Administration, but the trend accelerated during the Trump Administration with large annual employment cuts that produced a 12.1% decline from FY 2016-2019 and a 16.9% decline from the start of the decade. NE's workforce witnessed an even more dramatic turnaround: after eight years of stability and mostly minor fluctuations during the Obama Administration, NE's employment precipitously dropped during each of the first three years of the Trump Administration. NE lost 76 employees over those three years from FY 2016-2019, a 21.2% workforce decline with no parallel earlier in the decade. At the end of FY 2019, NE's workforce was 22.7% smaller than ten years prior, a decline of more than one-fifth of its overall size. Both of these offices support programs that are critical innovation engines to address the global climate crisis while ensuring low-cost and reliable electricity for Americans. It is remarkable that FE, NE and EERE civil service staffs have been depleted so substantially when all three programs have demonstrated their utility as job creators and enjoy substantial bipartisan support in Congress.

However, DOE is an outlier among federal agencies in that the vast majority of the staff supporting its mission are contractors and not civil servants. In FY2019, when DOE had 13,774 civil servants on staff, DOE and the Federal Energy Regulatory Commission (FERC) together had 102,348 contractor employees.³ These contractors work hand-in-hand with civil servants across all of the Department's program offices. The national laboratories and other DOE site offices are almost entirely staffed by contractors, with the exception of the National Energy Technology Laboratory (NETL). DOE headquarters also hosts a substantial number of

³ As with the civil servant statistics for DOE employees, the contractor data reported by DOE in their annual Agency Financial Reports include data for FERC, which is administratively situated within DOE. FERC's share of these figures is relatively small as it listed only 165.2 contractors in the FY19 Service Contract Inventory.

contractees. A large segment of DOE contract employees perform both STEM and non-STEM functions for environmental remediation at legacy Cold War sites and other nuclear weapons-related activities. The figures below reflect the full breadth of DOE contractors under large Management & Operations (M&O) and other types of contracts. At the end of FY19, 50,144 of the 102,348 DOE contractors were working under the National Nuclear Security Administration (NNSA).

Table 3. Department of Energy Contractor Employees

Fiscal Year	Contractor Personnel
2009	91,294
2010	99,370
2011	100,072
2012	92,419
2013	100,294
2014	94,302
2015	93,485
2016	96,286
2017	97,981
2018	99,222
2019	102,348

Source: DOE, *Agency Financial Report Fiscal Year 2019*; DOE, *Fiscal Year 2016 Agency Financial Report*; DOE, *Fiscal Year 2013 Agency Financial Report*.

Notes: Contractor personnel numbers are reported for the entire department and include data from FERC. Data reported by DOE as FTEs as of the end of the fiscal year.

As the DOE civil service workforce declined by 7.2% / 1,100 employees from FY09-19, its contractor workforce increased by about 11,000. An apples-to-apples breakdown of DOE contracting staff across program offices was not available, but data provided by DOE for specific sites noted:

- The National Renewable Energy Laboratory (NREL) receives 95% of its funding from EERE. It grew by 1,067 contractors from 2009 to 2020, a 75% increase;
- The functions of Idaho National Laboratory managed by Battelle Energy Alliance are the primary engine of DOE research for the Office of Nuclear Energy and accounts for roughly half of the DOE NE budget as of FY20. Battelle contractors at INL increased by 696 from 2009 to 2020, a 65% increase;
- Ames National Laboratory, which received about \$20 million from the DOE Office of Science and \$26 million from EERE in FY2020, grew from 188 employees in 2009 to 427 in 2020, a 227% increase.

NOAA Total Workforce

NOAA also experienced sizable workforce reductions over the decade. NOAA's workforce was stable from FY 2009-2011, reaching a peak in FY 2011 at 12,371 FTEs. Since FY 2011, however, NOAA's workforce fell by 1,111 employees, a 9.0% decrease over nine years. The decline was concentrated from FY 2012-2016, and after FY 2016 NOAA did manage to increase its workforce by 1.0%. But this addition of 112 employees, while welcome, only restored about one-tenth of the over 1,000 employees lost during the preceding years.

NOAA's leadership in federal climate research and its role in helping to protect Americans from the growing incidence of extreme weather events will increasingly position the agency at the center of the Federal Government's scientific activities. But an 9.0% workforce decline threatens to impact NOAA's scientific capacity and hinder its scientific mission.

Agency STEM Employment

NSF, NASA, NIST and even DOE experienced significant increases in STEM employment over the past decade. However, the decade-long trends for these agencies mask a noticeable slowdown in STEM employment growth during the Trump era. At all four agencies, STEM employment growth slowed during the Trump Administration. STEM employment patterns over a given period, regardless of the size of an agency’s STEM workforce, should always be determined based upon agency workforce requirements.

STEM employment growth at DOE halted entirely, and the DOE STEM workforce was exactly the same size at the end of FY 2020 as at the end of FY 2016. NOAA’s STEM workforce increased slightly during the Trump Administration, but not enough to recover completely from employment cuts earlier in the decade. NOAA’s STEM workforce was smaller at the end of FY 2020 than a decade prior. EPA’s STEM workforce declined substantially during the Trump Administration, and DHS S&T saw a sizable STEM employment decline during the same period, reversing the employment growth of the Obama era.

Agency STEM Employment, FY 2009-2016-2020 (FTEs)

	FY 2009	FY 2016	FY 2020	% Change (2016-2020)	% Change (2009-2020)
NSF	355	423	492	+ 16.3%	+ 38.6%
NASA	10,479	11,133	11,548	+ 3.7%	+ 10.2%
DHS S&T	181	194	166	- 14.4%	- 8.3%
NIST	1,378	1,696	1,802	+ 6.3%	+ 30.8%
EPA ⁴	**	8,632	8,294	- 3.9%	**
DOE	4,703	4,993	4,993	0.0 %	+ 6.2%
NOAA	7,191	6,939	7,076	+ 2.0%	- 1.6%

EPA STEM Employment

EPA’s STEM workforce declines manifested throughout the different STEM occupational series. Employment in science, technology, engineering and mathematics occupations at the agency decreased by 338 employees between FY 2016-2020, a 3.9% decline in the overall STEM workforce. Roughly 60% of EPA’s overall employment decrease during the Trump Administration was concentrated among STEM employees. The fact that more than half of the agency’s total workforce decline occurred among career scientists indicates the extent of the damage that EPA’s scientific workforce experienced over the past four years, and the scientific capacity that must be restored as rapidly as possible.

A detailed review of each STEM occupational series further reveals the pernicious impact of STEM workforce losses upon scientific professions that are essential to the agency’s mission.

⁴ Due to an apparent reclassification of certain STEM occupations during the Obama Administration, it is difficult to utilize STEM workforce data to reliably compare EPA STEM employment over the course of the entire decade. Therefore, this report will only assess STEM workforce data between the years FY 2016 and FY 2020, for which the data can be consistently applied.

The sweeping scope of career federal scientist departures over the past four years could undermine EPA’s broader capabilities due to the centrality of the scientific workforce to many core agency functions.

EPA STEM Employment by Function (Full Time Employees at end of Fiscal Year)

	FY 2016	FY 2020	% Change (2016-2020)
Science	6,178	5,922	- 4.1%
Technology	600	627	+ 4.5%
Engineering	1,789	1,695	- 5.3%
Mathematics	65	50	- 23.1%

The EPA science workforce, which refers specifically to science occupational series, declined by 4.1% (256 scientists) during the Trump Administration. The impact of the decline was not evenly distributed. Most notably, the number of environmental protection specialists employed by EPA plummeted from 2,152 to 1,630, a 24.3% decline. The loss of nearly one-quarter of the agency’s environmental protection specialists, 522 in all, represents a blow to the heart of the EPA workforce and a loss of institutional knowledge and expertise that must be rebuilt to revitalize a core agency function. While no other science occupation saw a comparable decrease in real terms, other types of agency scientists did experience high relative decreases. Between FY 2016-2020, EPA hydrologists declined by 33.3%, microbiologists declined by 22.2%, geologists declined by 17.5%, ecologists declined by 12.2%, chemists declined by 10.5%, and toxicologists declined by 8.2%.

The EPA engineering workforce, while smaller than the science workforce, actually underwent a larger relative decline. The agency lost 94 engineers over the course of the Trump Administration, a 5.3% decline. Engineering employment cuts were largely concentrated in three engineering occupations: environmental engineering, which constitutes 85% of the agency engineering workforce, mechanical engineering and chemical engineering. Environmental engineering lost 88 staffers (5.7%) from FY 2016-2020. Other types of engineers suffered even larger relative declines, with mechanical engineers decreasing by 15.4% and chemical engineers decreasing by 11.5% over the same period of time.

DOE STEM Employment

DOE’s STEM workforce avoided the large-scale personnel cuts that characterized broader employment at the agency during the Trump Administration and over the past decade. However, recent trends in STEM employment at DOE are not encouraging, particularly in certain segments of the engineering workforce. STEM workforce employment increased during the Obama Administration and peaked at 4,993 FTEs at the end of FY 2016. STEM employment then declined under President Trump to 4,850 FTEs by the end of FY 2019. The trend reversed again in a positive direction in FY 2020, and STEM employment recovered its previous losses to end the last fiscal year of the Trump era at 4,993 FTEs, exactly the same size as four years earlier. Given the increasingly prominent DOE role in the rapid transformation of the global energy sector, allowing STEM employment to remain flat over four years seems like a missed

opportunity. The size of civil service at DOE does not seem proportional to the critical responsibilities that DOE must assume in the years ahead. The Trump Administration’s failure to build upon the gains achieved earlier in the decade enhances the need to make up for lost time and strengthen DOE’s scientific workforce capacity quickly.

A detailed review of DOE STEM occupational categories confirms the general lack of growth over the past four years, as well as particularly concerning trends in certain specific occupations that are central to DOE’s agenda.

DOE STEM Employment by Function (Full Time Employees at end of Fiscal Year)

	FY 2016	FY 2020	% Change (2016-2020)
Science	1,432	1,438	+ 0.4%
Technology	635	674	+ 6.1%
Engineering	2,694	2,657	- 1.4%
Mathematics	232	224	- 3.4%

DOE’s civil service science occupations remained essentially flat during the Trump Administration, with a 0.4% employment increase. Some scientific occupations experienced significant decreases. Parallel to their more numerous counterparts at EPA, the number of environmental protection specialists at DOE decreased by 7.1% between FY 2016-2020. Chemists - few to begin with in FY 2016, at only 37 FTEs – declined by 18.9%. The much larger number of scientists employed in general physical science declined by 1.2%. Meanwhile, the agency’s mathematics workforce largely consisted of mathematicians employed in operations research, an occupation that constituted more than half of the entire math workforce throughout the Trump era. But operations research employment declined by 8.8% during the Trump Administration, accounting for more than the entire net reduction in the DOE mathematics workforce. As a result, despite gains in other math occupations, the DOE mathematics workforce experienced an aggregate decline of 3.4% between FY 2016-2020.

DOE’s engineering workforce, the largest of the agency’s four STEM occupational categories, declined by 37 engineers, or 1.4% during the Trump Administration. Specific engineering occupational series experienced deeper declines from FY 2016-2020:

- 4.8% decline among general engineers
- 20.0% decline among environmental engineers
- 32.0% decline among chemical engineers
- 45.8% decline among safety engineers.

Perhaps most notably, given DOE’s responsibilities for maintaining America’s nuclear arsenal and promoting research into advanced nuclear technologies, DOE lost 32 nuclear engineers during the Trump Administration, a loss of 13.2%.

NOAA STEM Employment

NOAA’s STEM workforce experienced a 1.6% decline over the past decade, with 115 fewer STEM employees at the end of FY 2020 than at the end of FY 2009. The decline occurred between FY 2012-2016, as strict budgetary caps placed downward pressure on the entire NOAA workforce. The Trump era witnessed a partial recovery, with the STEM workforce increasing by 2.0% between FY 2016-2020 and surpassing 7,000 employees once again after falling to 6,939 at the end of FY 2016. However, STEM workforce gains over the past four years were only able to restore slightly more than half of the losses from the earlier part of the decade. As one of the Federal Government’s premier climate research agencies, the fact that NOAA’s STEM workforce was smaller at the end of the decade than it was at the beginning is alarming.

Within NOAA’s STEM occupational categories, an ambiguous picture emerges from recent years: limited but insufficient workforce recovery, further offset by damaging employment cuts among critical scientific employees. The data indicates that while more recent trends have been positive, a great deal of work lies ahead to fully restore NOAA’s scientific capacity.

NOAA STEM Employment by Function (Full Time Employees at end of Fiscal Year)

	FY 2016	FY 2020	% Change (FY16-FY20)
Science	5,538	5,707	+ 3.1%
Technology	1,043	999	- 4.2%
Engineering	247	257	+ 4.0%
Mathematics	111	113	+ 1.8%

NOAA’s science occupations increased by a fair amount during the Trump Administration, gaining 169 scientists, or 3.1%. However, these gains were barely enough to undo earlier employment losses. The science occupations only increased by 1.0% over the course of the entire decade. Moreover, certain segments of the science workforce experienced employment decreases during the Trump era that diverged from the larger trend, particularly oceanic and biological scientists:

- NOAA lost 69 fish biologists, a decrease of 8.1%, from FY 2016-2020.
- NOAA’s oceanography workforce fell by 9.0%.
- NOAA’s wildlife biology workforce, while small in real terms, plummeted 30.4%.
- Chemists declined by 12.3%.
- Physicists declined by 11.4%.

Given NOAA’s role in understanding the state of the world’s oceans and marine life and developing forecasts critical to protecting life and property from more frequent and intense weather events due to climate change, the departure of many scientific experts in these fields during the Trump Administration strike at the heart of one of NOAA’s core scientific missions.

Other STEM occupational categories did not demonstrate the same dramatic internal divergences as the science workforce, but they nevertheless affirm that NOAA’s STEM workforce has struggled to recover to earlier employment levels. The engineering workforce, despite increasing by 4.0% since FY 2016, has declined overall by 5.9% since FY 2009. The technology workforce, which mostly consists of information technology experts, declined by 4.2% during the Trump

Administration and 14.6% over the course of the entire decade. Finally, the mathematics workforce only gained two additional mathematicians during the Trump era, a slowdown in its rate of growth from earlier in the decade. Overall, the NOAA STEM workforce's small increase over the past four years did not overcome the broader declines of the early-mid 2010's, suggesting that long-term investments will be necessary to sustain workforce growth and bolster NOAA's career scientists.

Agency STEM Diversity

For the Federal Government, achieving a diverse and inclusive federal STEM workforce is both a moral necessity and a practical imperative. An extensive body of research demonstrates that diversity within scientific groups enhances scientific innovation by fostering greater creativity through a wider range of perspectives.^{xiv} Diverse scientific teams, benefiting from their ability to elevate talented scientists from a broader cross-section of society and the complexity of insight that results, achieve better outcomes than homogenous teams.^{xv} Additionally, the increasing diversity of the U.S. population will make greater STEM participation across historically underrepresented groups, including women and communities of color, a central pillar of the Federal Government's ability to meet its rising demand for STEM employees in the decades to come.^{xvi} Finally, it is a fundamental moral responsibility for the Federal Government to advance the core American values of fairness and equality by embracing equal opportunity within the federal STEM workforce. For the sake of their own scientific capabilities, as a model for the nation, and as a driver of change, federal agencies with STEM activities must do more to embrace diversity within their ranks.

All seven agencies had gender, racial and ethnic disparities in their STEM workforces at the end of FY 2020. The size and nature of the disparities varied between agencies, but the overall pattern was clear: agency STEM workforces are less diverse than the agencies as a whole.

At NSF and EPA, majority female agency workforces failed to translate to STEM workforces, which are majority male. At NASA, DHS S&T and NIST, the gender employment gaps within STEM workforces – which all featured ratios of male to female employees above 3 to 1 - were substantially larger than the corresponding gaps within overall agency workforces. DOE and NOAA STEM workforces had nearly 3 men for every 1 woman, ratios that were also significantly higher than their total agency workforces.

Employment disparities among racial and ethnic minority groups exhibited similar patterns at most agencies.⁵ DHS S&T and DOE had the smallest employment gaps, with members of minority groups employed at nearly the same levels in their STEM workforces as in their overall workforces. NASA, NIST and EPA contained larger racial and ethnic employment gaps, as STEM workforces featured significantly lower ratios of minority employees to white employees than agency workforces as a whole. Racial and ethnic employment disparities were most significant at NSF and NOAA.

⁵ Racial and ethnic data for this report was derived from OPM's FedScope database and is subject to OPM's definitions of racial and ethnic identification. FedScope defines "Minority" employees as those federal employees identifying as: Hispanic or Latino; American Indian or Alaska Native; Asian; Black or African American; or Native Hawaiian or Other Pacific Islander. Additionally, FedScope's "Minority" employment data includes federal employees who identify as "more than one race."

Agency Gender Employment, FY 2020 (FTEs)

	Male Employment	Female Employment	Workforce Male : Female Ratio	STEM Male Employment	STEM Female Employment	STEM Male : Female Ratio
NSF	503	780	1 : 1.5	268	224	1.2 : 1
NASA	11,229	5,870	1.9 : 1	8,721	2,827	3.1 : 1
DHS S&T	262	159	1.6 : 1	130	36	3.6 : 1
NIST	1,904	1,076	1.8 : 1	1,375	427	3.2 : 1
EPA	6,591	7,141	1 : 1.1	4,445	3,849	1.2 : 1
DOE	8,967	5,080	1.8 : 1	3,693	1,300	2.8 : 1
NOAA	7,380	3,880	1.9 : 1	5,180	1,896	2.7 : 1

Agency Racial and Ethnic Employment, FY 2020 (FTEs)

	White Employment	Minority Employment	Workforce White : Minority Ratio	STEM White Employment	STEM Minority Employment	STEM White : Minority Ratio
NSF	700	579	1.2 : 1	351	138	2.5 : 1
NASA	12,095	4,994	2.4 : 1	8,657	2,885	3 : 1
DHS S&T	282	139	2 : 1	116	50	2.3 : 1
NIST	2,181	799	2.7 : 1	1,393	409	3.4 : 1
EPA	8,934	4,782	1.9 : 1	5,829	2,458	2.4 : 1
DOE	10,174	3,868	2.6 : 1	3,687	1,303	2.8 : 1
NOAA	8,959	2,301	3.9 : 1	6,084	992	6.1 : 1

EPA, DOE and NOAA STEM Diversity: Gender

Unlike the majority of federal agencies, EPA employed 550 more female than male career employees at the end of FY 2020. While the agency has been buffeted with massive employment cuts in recent years, female employment declined less severely than male employment during the Trump Administration and over the entire decade. EPA’s STEM workforce, however, included 596 more male than female STEM employees at the end of FY 2020. A majority-male STEM workforce in a majority-female agency represents a clear gender gap. The disparity is especially pronounced in the engineering workforce. EPA employed 1,060 male engineers and 635 female engineers in FY 2020, a gender gap of 425 staffers that accounted for more than two-thirds of the gender employment gap in the entire STEM workforce. Recent trends have been encouraging, as the proportion of female STEM employees did increase from FY 2016-2020. But gender diversity must continue to be an agency STEM priority.

DOE’s gender disparity grew over the past decade. The agency’s total workforce employed 1.8 men for every 1 woman in FY 2020. DOE’s female workforce declined by 3.8% during the

Trump Administration and 12.0% since FY 2009, whereas the agency's male workforce only declined by 2.8% and 4.2%, respectively, during the same periods. The DOE gender gap was even wider in STEM fields, although it did contract somewhat over the past four years. At the end of FY 2020, DOE employed 2.8 male STEM employees for every 1 female STEM employee, compared to 1.8 male employees for every 1 female employee in the entire agency. The STEM gender gap was again pronounced among engineering occupations, the largest segment of the DOE STEM workforce. Male engineers outnumbered female engineers at DOE by more than 4 to 1 in FY 2020.

NOAA's total workforce saw a similar gender disparity as DOE, but the workforce is trending in a more equitable direction. While the agency employed 1.9 men for every 1 woman at the end of FY 2020, the size of the employment gap declined significantly over the course of the decade. The status of the agency's STEM workforce, however, is less encouraging. NOAA's STEM workforce employed 2.7 men for every 1 woman in FY 2020, a wider gender gap than the agency at large. Astonishingly, in FY 2020, NOAA only employed 27 female engineers alongside 230 male engineers, a ratio of 8.5 to 1. NOAA's female STEM workforce did experience relative growth between FY 2016-2020.

EPA, DOE and NOAA STEM Diversity: Race and Ethnicity

Racial and ethnic minority groups saw troubling workforce trends at EPA in recent years. Overall agency employment among minority groups fell 9.2% between FY 2009-2020. The agency STEM workforce was left with a larger diversity gap than the overall workforce: in FY 2020, EPA employed 2.4 white STEM employees for every 1 STEM employee from a minority group, compared to just 1.9 white employees for every 1 employee from a minority group in the agency at large. The impact was particularly acute among Black / African American STEM employees, who declined by 8.7% (85 employees) during the Trump Administration and 22.4% over the course of the decade. Black / African American environmental protection specialists at EPA declined by 25.6% during the Trump Administration. Black / African American environmental engineers at EPA declined by 10.6% during the same period.

FY 2009-2020 saw a precipitous decline in the size of DOE's overall workforce, due in part to an increasing reliance on contractors. During this period, however, agency employment among minority groups defied the broader trend and increased slightly. Alongside overall agency employment, DOE's STEM workforce achieved a smaller employment gap than other scientific agencies. But recent employment trends demonstrate serious shortcomings as well. For example, DOE's Black / African American workforce underwent an enormous 10.4% decline over the course of the decade, including a 2.2% decline during the Trump Administration.

NOAA oversaw the largest racial and ethnic disparities, in terms of overall and STEM workforces, of the seven observed agencies. At the end of FY 2020, NOAA employed 3.9 white employees for every 1 employee from a minority group. In STEM fields, NOAA employed 6.1 white STEM employees for every 1 STEM employee from a minority group. Again, the disparity in NOAA's STEM workforce was most acute for Black / African American STEM staffers. During the Trump Administration, as STEM employment among minority groups increased by

13.7% and the size of the overall STEM workforce increased slightly, Black / African American STEM employment actually declined by a single employee.

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