

**COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON ENVIRONMENT
SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES**

HEARING CHARTER

Forever Chemicals: Research and Development for Addressing the PFAS Problem

Tuesday, December 7, 2021
10:00 a.m. ET
Online via Zoom

Purpose

The purpose of this hearing is to discuss the role of federal research and development to better understand the class of man-made chemicals known as per- and polyfluoroalkyl substances (PFAS). There remains much uncertainty surrounding their toxicity and human health effects, how to safely and effectively remove them from the environment, and how to detect and quantify the thousands of different PFAS compounds that exist. The hearing will provide an opportunity to explore gaps in federal research efforts, methods for improved interagency coordination, opportunities to collaborate with state governments and non-government entities, and ideas for improving public understanding and education about PFAS. While there is a lot of attention on regulation and remediation of PFAS, there remains a great deal of work to better understand PFAS chemicals and the role the federal government can play to support the development of detection, monitoring, treatment, and destruction methods and technologies.

Witnesses

- **Dr. Elsie Sunderland**, Gordan McKay Professor of Environmental Chemistry, Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard T.H. Chan School of Public Health
- **Ms. Abigail Hendershott**, Executive Director, Michigan PFAS Action Response Team (MPART)
- **Ms. Amy Dindal**, Director of Environmental Research and Development, Battelle Memorial Institute
- **Dr. Peter Jaffé**, Professor, Department Civil and Environmental Engineering, Princeton University

Overarching Questions

- What are the ongoing research and development (R&D) efforts related to PFAS within and outside of the federal government?
- What are the current gaps in PFAS research?
- What are opportunities for further federal investment in PFAS R&D efforts?
- What is the role of collaboration and coordination within the federal government and with non-federal entities in advancing PFAS R&D?

Background

Per- and polyfluoroalkyl substances (PFAS) or “forever chemicals” are a class of man-made chemicals that have been in use since the 1940s and include Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS), GenX, and others. Products such as non-stick pans, firefighting foam, food packaging, paints, and many other everyday products contain PFAS. There are currently more than 5,000 types of registered PFAS compounds. Due to the strong molecular structure of the carbon-fluorine bond, PFAS are resilient against water and oil, which makes them appealing for commercial uses, but difficult to remove or destroy.

PFAS are widespread and persistent in nature. Surveys conducted by the Centers for Disease Control and Prevention (CDC) show that most people in the United States have been exposed to PFAS and have PFAS in their blood.¹ Research shows that people can be exposed through drinking contaminated water, eating animals that were exposed to contaminated water, eating foods packaged with PFAS-containing materials, breathing air contaminated with PFAS, or using the long list of items that contain PFAS.² PFAS can also be emitted and transported in the air—an area that needs further study.

There is growing evidence that PFAS adversely impact both human health and other living organisms. PFAS have been found to accumulate and remain in the body for a long time, and can lead to serious health effects including cancer, low infant birth weights, liver and kidney issues, reproductive and developmental problems, and more. PFAS contamination is also an environmental justice issue, as low-income communities and communities of color are more likely to live near PFAS-contaminated areas.³

Some PFAS have been more widely used and studied than others. PFOA and PFOS are two of the most widely used and studied PFAS chemicals, and they have been mostly replaced in recent years with new PFAS that were thought to be safer. However, these new short-chain PFAS compounds, like GenX, have been found to be “widely detected, more persistent and mobile in aquatic systems,” and may pose more risks to human and ecosystem health than earlier, long-chain PFAS compounds.⁴

While the PFAS chemical class is not generally restricted for commercial use nor regulated by the federal government, the EPA did announce on February 20, 2020, a proposal to regulate PFOS and PFOA in drinking water.⁵ The draft rule is expected in the fall of 2022, and a final rule is expected in 2023.⁶ The EPA is also taking steps to increase reporting of and transparency about the use and manufacturing of PFAS.⁷ Given the U.S. currently has no federally enforceable PFAS standards, many states have taken the lead in establishing legally enforceable standards for certain PFAS in drinking water and other environmental media, and have been conducting R&D to address PFAS. This has led to the emergence of patchwork quilt of state standards. This includes New Jersey, which was the first state to establish a Maximum Contaminant Level (MCL) for specific

¹ <https://www.atsdr.cdc.gov/pfas/health-effects/us-population.html>

² <https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas>

³ <https://www.ucsf.edu/sites/default/files/2019-10/abandoned-science-broken-promises-web-final.pdf>

⁴ <https://doi.org/10.1016/j.cej.2019.122506>

⁵ <https://www.epa.gov/newsreleases/epa-announces-proposed-decision-regulate-pfoa-and-pfos-drinking-water>

⁶ <https://www.epa.gov/pfas/pfas-strategic-roadmap-epas-commitments-action-2021-2024>

⁷ <https://www.epa.gov/newsreleases/epa-continues-take-action-pfas-protect-public>

PFAS in drinking water.⁸ Other states that have established MCLs include Michigan,⁹ New Hampshire,¹⁰ Massachusetts,¹¹ and Vermont.¹²

Federal PFAS Research and Development Activities¹³

Environmental Protection Agency (EPA) – On April 27, 2021, EPA Administrator Regan established a new “EPA Council on PFAS” that was charged with building on the agency’s ongoing work to better understand and ultimately reduce the potential risks caused by PFAS.¹⁴ The Council released a PFAS Strategic Roadmap on October 18, 2021 that laid out the EPA’s approach to tackling PFAS and set timelines for concrete actions to be taken by the agency over the next three years.¹⁵ According to the Roadmap, the EPA is focused on three central directives to address PFAS: (1) research, (2) restrict, and (3) remediate. The EPA is investing in research, development, and innovation to increase understanding of PFAS exposures and toxicities, effects on human and ecological health, and effective interventions. Within the EPA, the Office of Research and Development (ORD) plays a major role in carrying out the Roadmap. It collaborates across different levels of government and with utilities and academia to develop better PFAS detection methods, assess human health and environmental risks from PFAS, and develop better technologies to reduce PFAS in the environment.

Department of Defense (DOD) – DOD manages the largest research and development program in the nation devoted to PFAS detection, treatment, and destruction—with over \$150 million in investments and another \$70 million devoted to a PFAS-free replacement firefighting foam.¹⁶ The DoD has utilized Aqueous Film Forming Foam (AFFF) to extinguish fires since the 1970s. AFFF mixtures contain significant quantities of PFAS, which have accumulated at DOD sites. DOD is currently conducting PFAS cleanup assessments at the nearly 700 military installations where PFAS was used. EPA and DOD research efforts also resulted in expanded testing capabilities to detect more types of PFAS in a variety of environmental media (soil, groundwater, etc.).¹⁷

DOD sponsors the Strategic Environmental Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP), both of which are engaged in PFAS research and development. SERDP is carried out in partnership with the Department of Energy and the EPA. It invests in basic and applied research, as well as advanced technology development. ESTCP is the DOD’s demonstration and validation program that promotes the

⁸ https://www.nj.gov/dep/newsrel/2020/20_0025.htm

⁹ <https://www.michigan.gov/som/0,4669,7-192-47796-534660--,00.html>

¹⁰ <https://www4.des.state.nh.us/nh-pfas-investigation/?p=1185>

¹¹ <https://www.mass.gov/info-details/per-and-polyfluoroalkyl-substances-pfas#massachusetts-drinking-water-standard-and-health-information->

¹² <https://dec.vermont.gov/water/drinking-water/pfas>

¹³ Several federal agencies are involved in PFAS R&D activities, including many outside of the Science Committee’s jurisdiction. The information in this charter should not be considered an exhaustive list of all federal PFAS R&D efforts.

¹⁴ <https://www.epa.gov/newsreleases/epa-administrator-regan-establishes-new-council-pfas>

¹⁵ <https://www.epa.gov/pfas/pfas-strategic-roadmap-epas-commitments-action-2021-2024>

¹⁶ <https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/18/fact-sheet-biden-harris-administration-launches-plan-to-combat-pfas-pollution/>

¹⁷ <https://www.epa.gov/newsreleases/epa-announces-first-validated-laboratory-method-test-pfas-wastewater-surface-water>

transfer of technologies from proof of concept to field or production use. Both programs issue annual solicitations for proposals from the federal government, academia, and industry.¹⁸

National Institutes of Standards and Technology (NIST) – NIST work on PFAS is conducted by both NIST’s Material Measurement Laboratory and Engineering Laboratory. As part of the work done by the Material Measurement Lab, NIST researchers work to create reference materials and data resources that can be used by government, academic, and industrial labs to increase confidence in quantitative and qualitative PFAS measurements, as there are limited chemical standards for PFAS measurements and a wide range of PFAS structures in existence. As of May 2021, NIST provides nine different reference materials that have measured amounts of PFAS and are developing more.¹⁹ Work done by the Material Measurement Lab also helps to ensure measurement quality by performing inter-lab comparison studies. NIST collaborates with other agencies such as the Department of Defense, NOAA, EPA, the Army Corps of Engineers, and the CDC. NIST is currently working with FDA to develop reference materials for PFAS in commercial meat products and is exploring other food and agricultural products. Additionally, NIST is developing a reference material for low levels of PFAS in municipal drinking water and reference data for the identification of novel PFAS.²⁰ As part of the work done by the Engineering Lab, NIST researchers are examining firefighter gear to determine the type, prevalence, and concentration of PFAS in firefighting gear. They are also examining the concentration and source of the PFAS and the mechanism of its release.²¹ NIST researchers have also received SERDP funding to create reference materials for AFFF.

National Science Foundation (NSF) – NSF supports fundamental research through multiple Foundation directorates to understand PFAS and chemicals like PFAS. This work includes funding research to better understand the fate and transport of PFAS in environmental systems, the transformation of PFAS in natural and engineered systems, and impacts of PFAS contamination on communities, including social impacts. NSF also funds research on potential technologies to degrade, destroy, or permanently sequester PFAS in the environment. One example of this is a special funding focus announced in June 2020 on Engineering Research to Advance Solutions for Environmental PFAS (ERASE-PFAS) focused on new science and technologies for the treatment and remediation of PFAS.²² In August 2021, NSF announced the funding of 13 awards under the special funding focus.²³ NSF also supports STEM education to train the next generation of PFAS researchers.

National Oceanic and Atmospheric Administration (NOAA) – Researchers at NOAA’s National Centers for Coastal Ocean Science (NCCOS) are working to evaluate the ecotoxicity of formulations intended to replace PFAS-containing AFFFs in marine and estuarine organisms.²⁴

¹⁸ <https://www.serdp-estcp.org/About-SERDP-and-ESTCP/About-SERDP>

¹⁹ <https://www.nist.gov/programs-projects/measurement-science-and-polyfluoroalkyl-substances-pfas>

²⁰ Ibid.

²¹ Ibid.

²² <https://www.nsf.gov/pubs/2020/nsf20090/nsf20090.jsp>

²³ https://www.nsf.gov/news/news_summ.jsp?org=NSF&cntn_id=303258&preview=false

²⁴ <https://coastalscience.noaa.gov/project/ecotoxicity-of-perfluorooctane-sulfonate-and-fluorine-free-fire-fighting-foams-in-estuarine-organisms/>

Department of Health and Human Services (HHS) – HHS reviews the rapidly evolving science on human health and PFAS, including through a groundbreaking study by Centers for Disease Prevention and Control (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR) in eight states that will provide information about the health effects of PFAS exposure. The CDC has collected biomonitoring data from humans for a long-term study of chemical exposure, including PFAS. The CDC’s studies indicate widespread exposure to PFAS in the U.S. population.²⁵

National Institutes of Health (NIH) – At NIH, the National Institute of Environmental Health Sciences (NIEHS), in collaboration with the National Toxicology Program, supports research to better understand the health impacts of PFAS exposure. It also provides over \$10 million in extramural grants annually for research on the PFAS health effects.²⁶

Food and Drug Administration (FDA) – The FDA works with other federal agencies to identify routes of PFAS exposure, understand associated health risks, and reduce the public’s exposure to those health risks.²⁷ The FDA is also engaging with industry to phase-out the use of certain PFAS substances, or it can revoke food contact authorizations when the agency determines there is no longer a reasonable certainty of no harm.²⁸ The FDA is working to develop new methods of detecting PFAS in foods at low concentrations and assess exposure to PFAS through food.²⁹

United States Department of Agriculture (USDA) – The USDA is currently engaging in research to determine the impacts of PFAS on agriculture. PFAS can accumulate in agricultural products through the application of biosolids to soils, and the usage of PFAS-contaminated groundwater.³⁰

Federal Aviation Administration (FAA) – The FAA is conducting research on the use of firefighting foam containing PFAS in emergencies and using technology to reduce PFAS discharges in testing of firefighting equipment. Additionally, the FAA and DOD are working to find a PFAS-free firefighting foam alternative. While the FAA no longer mandates use of firefighting foam containing PFAS at airports,³¹ the FAA is still conducting research at its Aircraft Rescue and Fire Fighting Research Facility to authorize foam alternatives that can meet the same standard. This research has encountered delays due to COVID-19 disruptions.³²

National Aeronautics and Space Administration (NASA) – While NASA does not conduct dedicated PFAS R&D activities, the agency is investigating and addressing PFAS that has been associated with its history of space and aeronautics hardware development, testing, and flight

²⁵ https://www.cdc.gov/biomonitoring/PFAS_FactSheet.html

²⁶ <https://www.niehs.nih.gov/research/programs/pfas/index.cfm>

²⁷ <https://www.fda.gov/food/chemical-contaminants-food/and-polyfluoroalkyl-substances-pfas>

²⁸ <https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/18/fact-sheet-biden-harris-administration-launches-plan-to-combat-pfas-pollution/>

²⁹ <https://www.fda.gov/food/chemical-contaminants-food/testing-food-pfas-and-assessing-dietary-exposure>

³⁰ <https://conservationwebinars.net/webinars/pfas-in-agricultural-operations/?searchterm=PFAS>

³¹ https://www.faa.gov/airports/airport_safety/certalerts/media/part-139-cert-alert-21-05-Extinguishing-Agent-Requirements.pdf

³² https://www.faa.gov/about/office_org/headquarters_offices/ang/redac/media/full/2021/april/fullComm-apr2021-AirportsSubcommitteeReport.pdf

operations.³³ For example, NASA conducts ongoing monitoring of the groundwater at and around its Wallops Flight Facility, in Wallops Island, VA, to ensure continued success of a treatment system installed after PFOA and PFOS were detected there in 2017.³⁴ As of July 2021, the Agency has undertaken work to begin a Preliminary Assessment effort, under CERCLA guidelines, to identify areas of potential concern for the presence of PFAS at all NASA Centers, which will be followed by on-site investigations and sampling.³⁵

Interagency Coordination – The 2021 National Defense Authorization Act directed the Director of the Office of Science and Technology Policy (OSTP), acting through the National Science and Technology Council (NSTC), to establish an interagency working group to coordinate federal activities related to PFAS research and development.³⁶ The interagency working group in the bill is responsible for coordinating the activities of the federal government to identify and address important research gaps and policy implications. It would include 19 different federal agencies, including the EPA, DOD, NIST, OMB, and more. It is charged with developing a strategic plan that will assess the current state of PFAS R&D at the federal level, associated federal funding, and scientific and technological challenges that must be addressed. It is also charged with establishing goals, priorities and metrics for federally funded PFAS R&D and developing an implementation plan for federal agencies. OSTP recently stood up the Joint Subcommittee on Environment, Innovation, and Public Health that would be responsible for carrying out this mandate. The Joint Subcommittee held its first meeting on November 8, 2021.

Research Gaps and Opportunities

Despite two decades of research on PFAS fate and transport, biological effects, and environmental emissions, critical gaps in our fundamental understanding of PFAS remain. Several challenges have hindered our ability to fill these knowledge gaps, including the diversity of the PFAS class of chemicals; analytical challenges in detecting, characterizing, and quantifying PFAS; and a lack of transparency by industry on the chemical identity, use location, and production quantities of PFAS.³⁷ A number of urgent questions for PFAS in the 21st century remain and include topics related to global production volumes of PFAS, locations where are PFAS used, PFAS hotspots in the environment, safe management of PFAS-containing waste, and understanding the health effects of PFAS exposure.³⁸

Detection and Measurement – One of the greatest PFAS research needs is developing analytical techniques to detect and measure PFAS and validate the methods to understand the types and quantities of PFAS that are present. Detection falls into two broad categories of targeted and non-targeted methods.³⁹ *Targeted analysis* is used when researchers have a defined analyte to compare a sample to. *Non-targeted analysis* uses high resolution mass spectrometry to identify novel PFAS, for which there is no standardized comparable sample. Current techniques typically measure

³³ <https://www.gao.gov/products/gao-21-205>

³⁴ <https://www.nasa.gov/feature/background-latest-information-on-pfas-at-nasa-wallops/>

³⁵ <https://science.house.gov/imo/media/doc/Gibbs%20Testimony.pdf>

³⁶ <https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title15-section8963&num=0&edition=prelim>

³⁷ *Ibid.*

³⁸ <https://pubs.acs.org/doi/pdf/10.1021/acs.est.1c03386>

³⁹ <https://www.epa.gov/water-research/pfas-analytical-methods-development-and-sampling-research>

individual PFAS chemicals in certain media, particularly in drinking water.⁴⁰ More work is needed to develop reliable analytical methods to identify and measure additional PFAS in air emissions, ambient air, and land.⁴¹ There is also a need to develop “total PFAS” detection methods as a potential rapid, low-cost screening tool.⁴²

Human Health and Environmental Impacts – More research is needed to understand the occurrence, fate, transport of PFAS, as well as exposure pathways. Additionally, more research is needed to collect toxicity data to inform hazard assessments. Similarly, relatively little is known about the ecological effects of PFAS contamination in the environment.

Treatment and Remediation – While some methods have been developed to remove or reduce PFAS in drinking water and wastewater, knowledge gaps remain to further advance PFAS treatment and remediation. This includes determining fate and transformation in conventional wastewater treatment, identifying approaches for site characterization and remediation, and evaluating treatment efficacy and approaches for managing residuals and spent materials.

Destruction and Disposal – Safe and effective disposal of PFAS through destruction or containment in a way that prevents re-introduction of PFAS into the environment is an area of active research. Some “conventional” methods of destruction or disposal include incineration, landfilling, underground injection control, and granular activated carbon (GAC) reactivation. However, additional research is needed to understand the efficacy and potential byproducts of current removal strategies and to develop new technologies and strategies.

⁴⁰ <https://www.epa.gov/pfas/epa-pfas-drinking-water-laboratory-methods>

⁴¹ Ibid.

⁴² <https://www.epa.gov/water-research/pfas-analytical-methods-development-and-sampling-research>