Perspectives on PFAS Research and Development Needs

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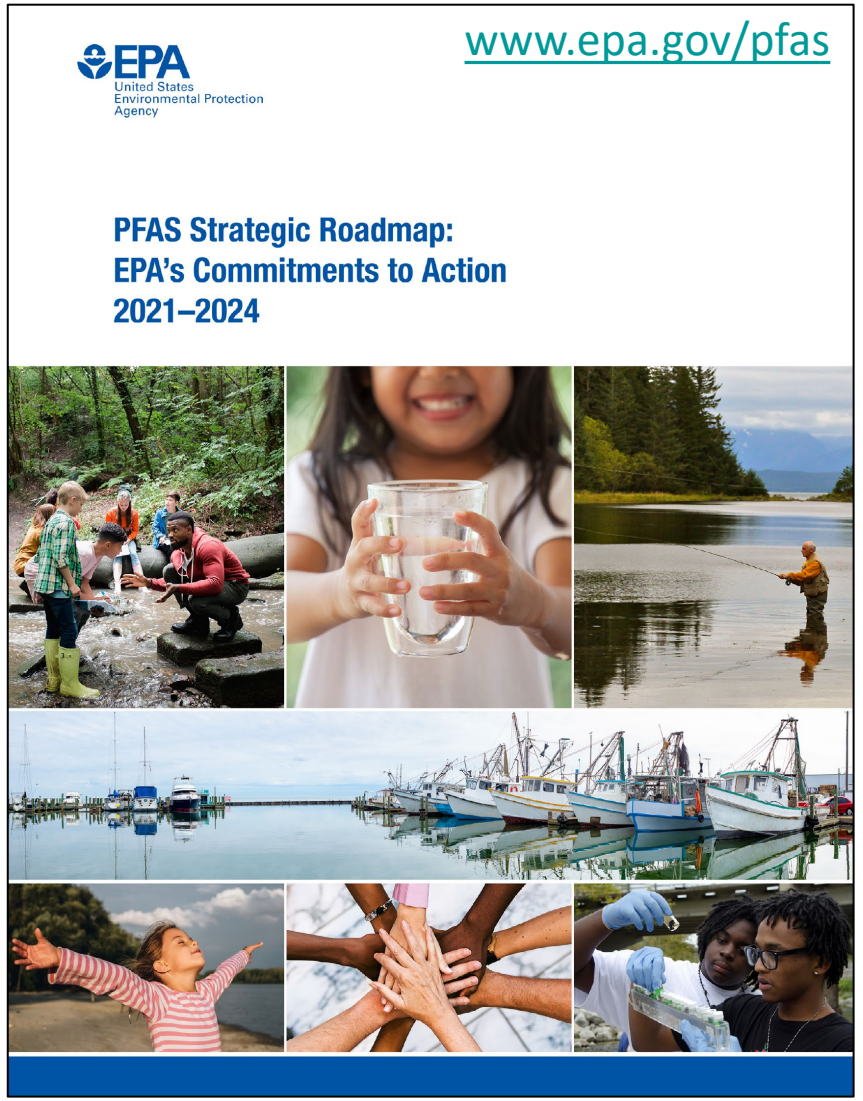
EPA PFAS Strategic Roadmap

- Released in October 2021
- Presents EPA's whole-of-agency approach to protect public health and the environment from the impacts of PFAS
- EPA's approach is centered around the following principles:
  - Consider the lifecycle of PFAS
  - Get upstream of the problem
  - Hold polluters accountable
  - Ensure science-based decision-making
  - Prioritize protection of disadvantaged communities



EPA PFAS Strategic Roadmap: Goals

RESEARCH

Invest in research, development and innovation to:

- Develop methods for measuring PFAS in the environment,
- Assess human health and environmental risks, and
- Evaluate and develop technologies for reducing PFAS.

RESTRICT

Pursue a comprehensive approach to proactively prevent PFAS from entering air, land and water at levels that can adversely impact human health and the environment.

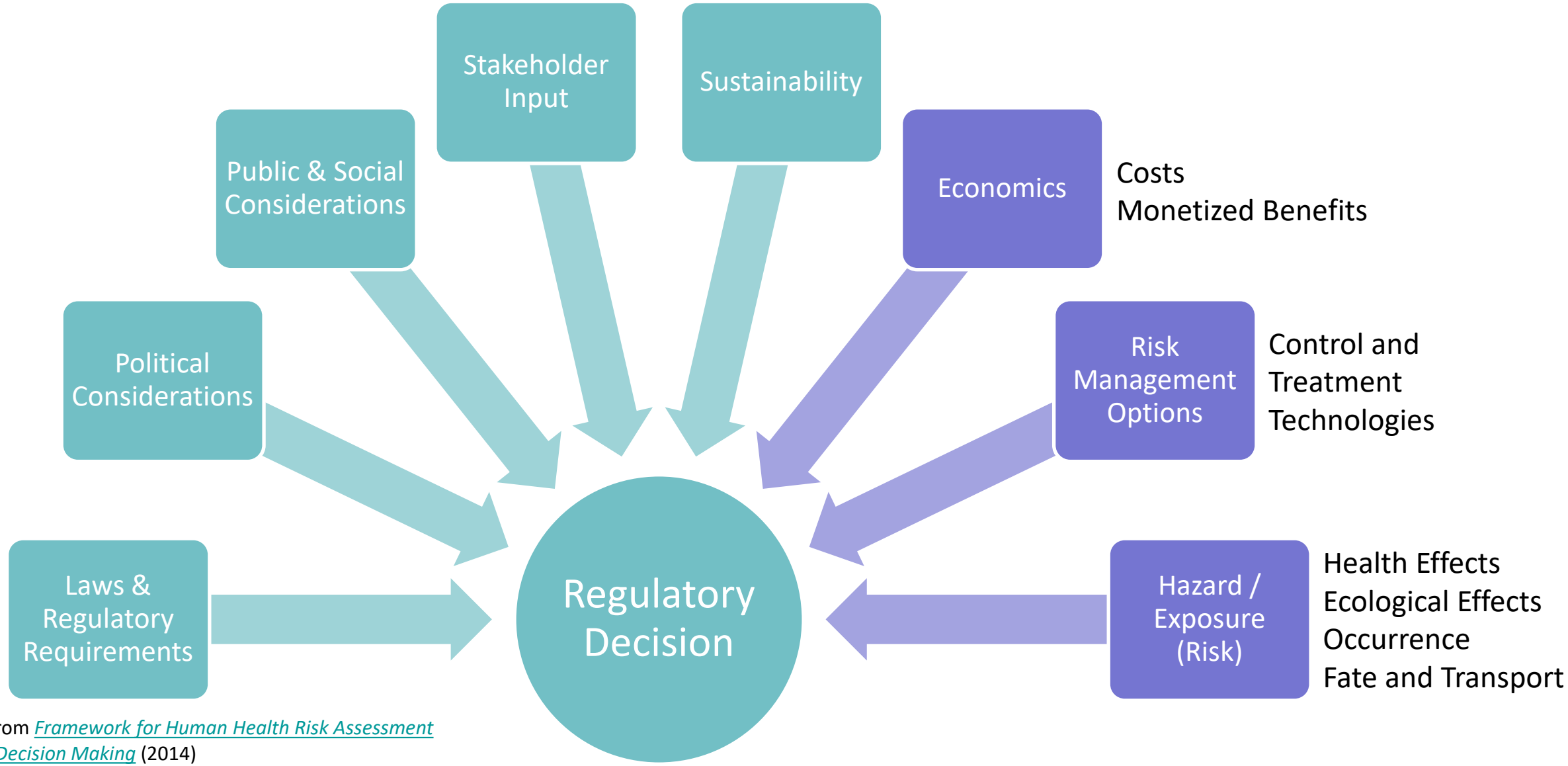
REMEDIATE

Broaden and accelerate the cleanup of PFAS contamination to protect human health and ecological systems.

Major Environmental Laws

Law	Summary
Clean Air Act (CAA)	Regulates air emissions from stationary (e.g., factories) and mobile (e.g., cars and trucks) sources
Clean Water Act (CWA)	Controls what pollutants can be released into waters of the United States
Safe Drinking Water Act (SDWA)	Addresses issues relating to the quality and safety of drinking water
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA; aka “Superfund”)	Focuses on cleaning up some of the nation's most contaminated land and responding to environmental emergencies, oil spills and natural disasters
Resource Conservation and Recovery Act (RCRA)	Regulates the proper management of hazardous and non-hazardous solid waste
Toxic Substances Control Act (TSCA)	Authorizes EPA to evaluate potential risks from new and existing chemicals and act to address unreasonable risks
Emergency Planning and Community Right-to-Know Act (EPCRA)	Provides public information on toxic chemical releases and pollution prevention activities from industrial and federal facilities

Some Factors to Consider



Adapted from *Framework for Human Health Risk Assessment to Inform Decision Making* (2014)

Some Factors to Consider

Hazard

- How harmful are PFAS to people and the environment?
- At what levels is harm anticipated to occur?

Exposure

- Which PFAS are in the environment, at what levels and where do they come from?

Risk Management Options

- What technology solutions are available and how effective are they?
- What other options exist for reducing risk?

nomics

Costs
Monetized Benefits

Risk Management Options

Control and Treatment Technologies

Hazard / Exposure (Risk)

Health Effects
Ecological Effects
Occurrence
Fate and Transport

Adapted from *Framework for Human Health Risk Assessment to Inform Decision Making* (2014)

EPA PFAS Research and Development

Advance the science to assess human health and environmental risks from PFAS

Hazard

- Human health and ecological effects
- Dose-response

Exposure

- Chemical identity and concentration
- Source-to-receptor pathways

Risk Assessment

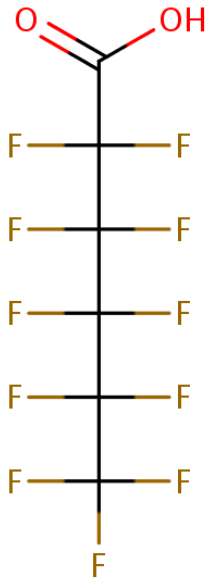
Evaluate and develop technologies for reducing PFAS in the environment

- Drinking water and wastewater treatment
- Site remediation
- Destruction (e.g., incineration)
- Disposal (e.g., landfills)

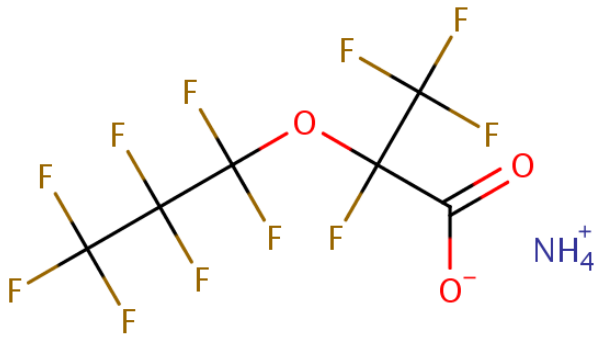
Develop methods and approaches for measuring PFAS

Targeted methods | "Total PFAS" methods | Non-targeted methods

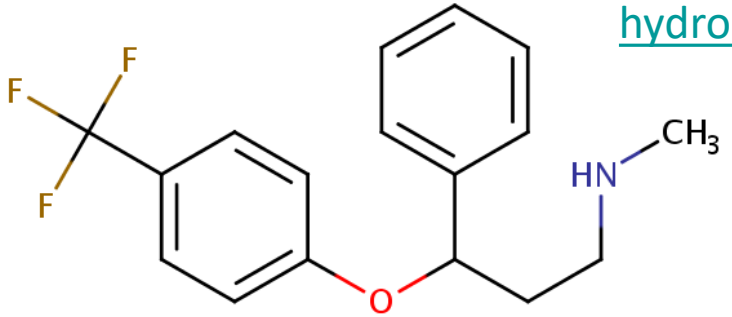
Moving Beyond PFOA and PFOS



PFHxA

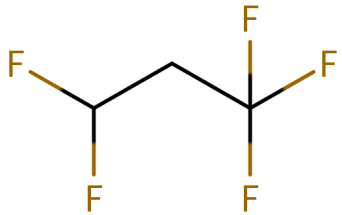


HFPO-DA

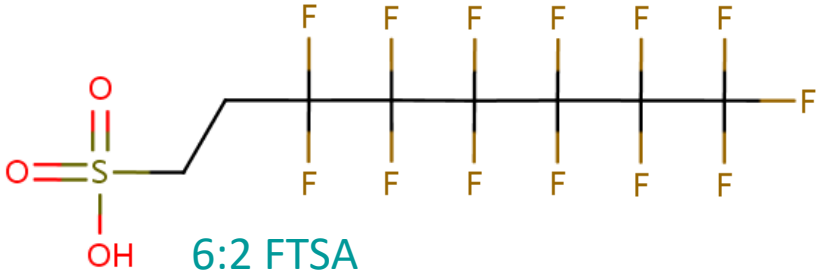


Fluoxetine hydrochloride

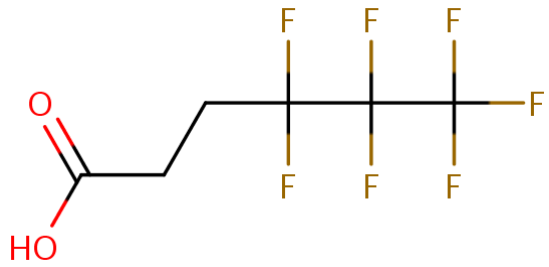
HCl



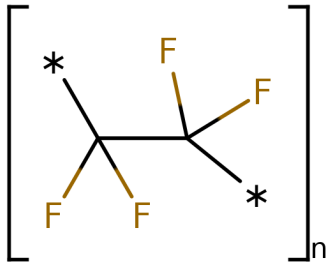
HFC-245fa



6:2 FTSA



3:3 FTCA



PTFE

Links to EPA CompTox Chemicals Dashboard

Environmental Measurement

Reliable analytical methods are needed to identify and measure PFAS in air, water and land

Targeted Methods measure a defined set of known analytes

- OTM-45 and OTM-50 (air emissions)
- Methods 533 and 537.1 (drinking water)
- SW-846: Methods 3512 and 8327 (water)
- Method 1633 (water, solids, tissue)

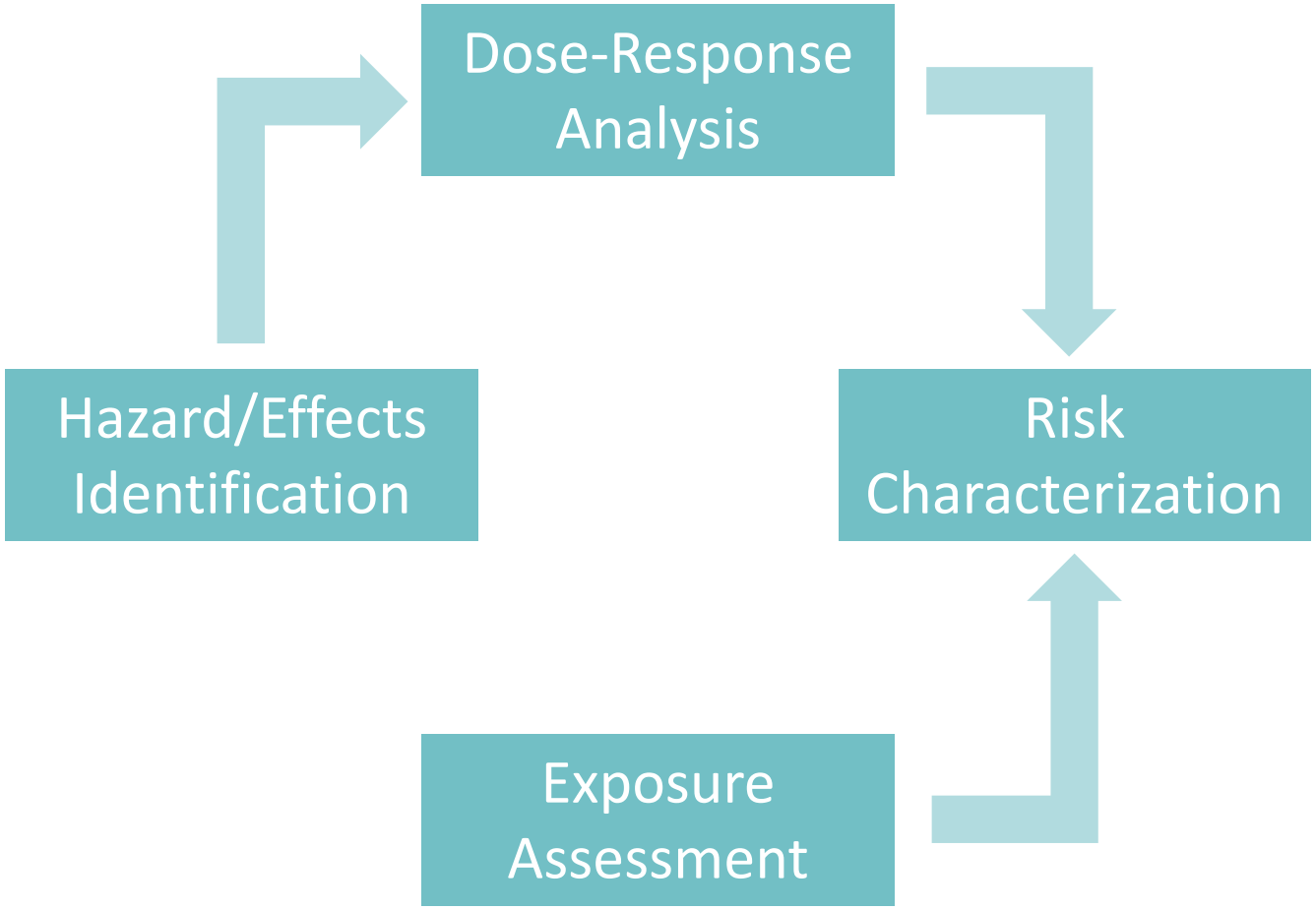
"Total PFAS" Methods provide information beyond targeted analytes

- Method 1621 (wastewater)
- TOP Assay: Best practices, capabilities and limitations for PFAS site investigation and remediation (2023)

Non-Targeted Methods identify known and unknown analytes

- Best practices for non-targeted analysis (BP4NTA)
- Establishing performance metrics for quantitative non-targeted analysis: A demonstration using PFAS (2024)
- Practical application guide for the discovery of novel PFAS in environmental samples using high resolution mass spectrometry (2023)

Understanding PFAS Risk



Research Needs

- Human health toxicity and toxicokinetic studies
- Ecotoxicity and bioaccumulation studies
- Occurrence studies
- Fate and transport studies
- Exposure studies

Research Approaches

- Data curation
- Toxicity testing
- Toxicity assessments
- Modeling

National PFAS Testing Strategy

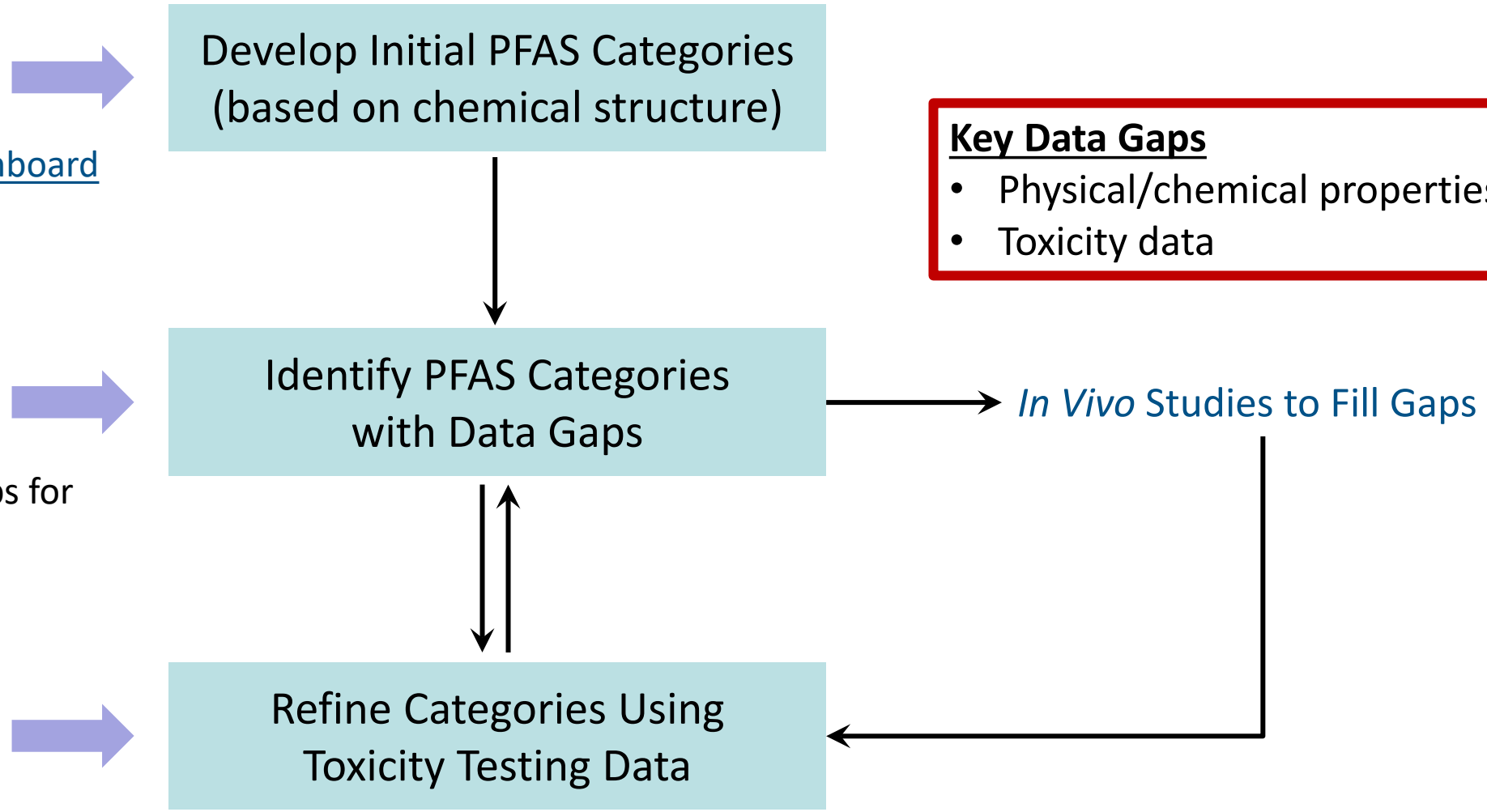
Chemistry Curation Activities

- CompTox Chemicals Dashboard

In Vivo Toxicity Study Curation Activities

- Systematic evidence maps for 150 PFAS and 345 PFAS

In Vitro Toxicity and Toxicokinetic Testing Activities



Key Data Gaps

- Physical/chemical properties
- Toxicity data

EPA National PFAS Testing Strategy (2021)

Potential Exposure Pathways

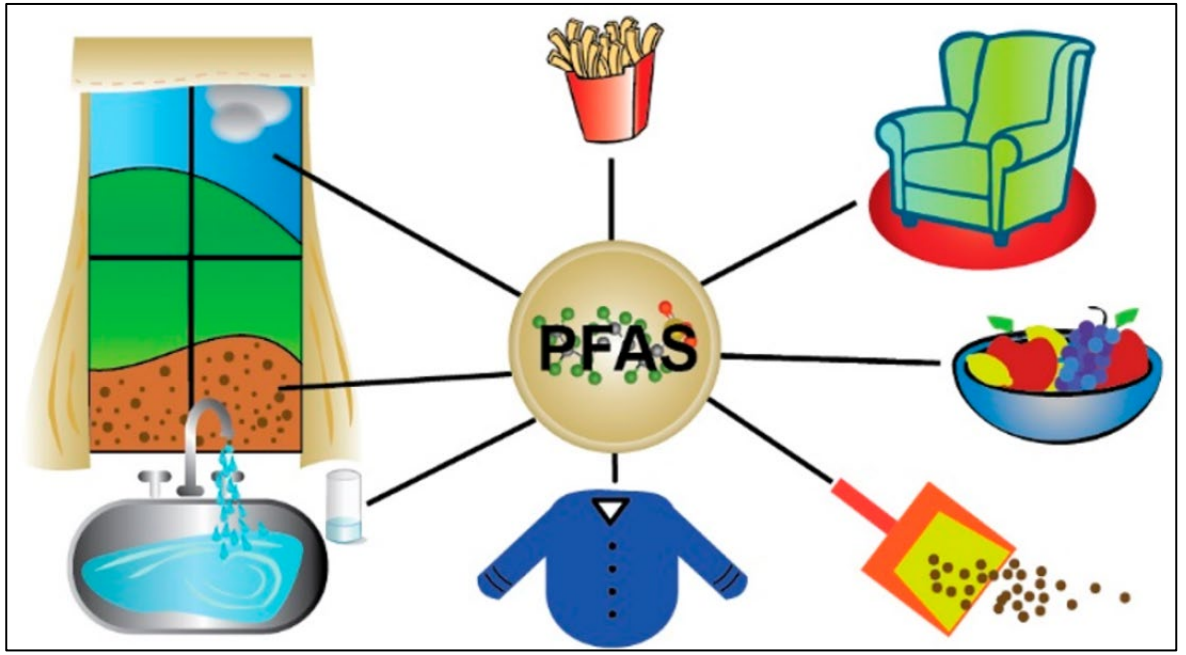
Data on sources, occurrence, environmental fate and transport, and human exposure are needed to identify key exposure pathways

Approach

- Identified real-world occurrence data for 20 PFAS in media commonly related to human exposure
  - Outdoor/indoor air, indoor dust, drinking water, food/food packaging, articles and products, soil
- Extracted relevant data into comprehensive evidence databases

Results

- Studies were most abundant for PFOA and PFOS
- Many studies analyzed additional PFAS, particularly PFNA and PFHxS
- Food, drinking water were the commonly studied media
- Many data gaps exist

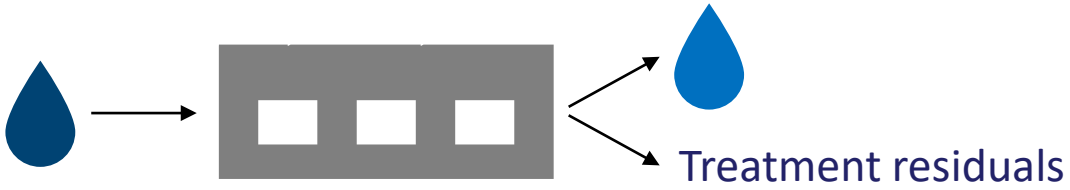


Systematic evidence mapping of potential exposure pathways for PFAS based on measured occurrence in multiple media (2023)

Removing PFAS from the Environment

Water Treatment

Goal: Remove or reduce PFAS in drinking water and wastewater



Example Technologies

Granular activated carbon (GAC), ion exchange resin, reverse osmosis (RO)

Research Highlights

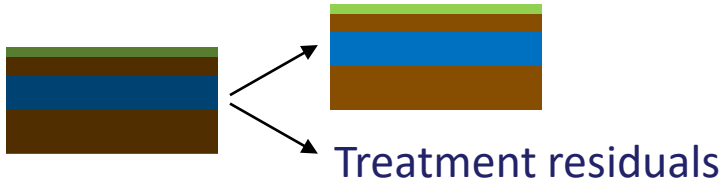
- Drinking Water Treatability Database
- Polanyi adsorption potential theory for estimating PFAS treatment with activated carbon (2023)

Research Needs

- Treatment technologies and materials that are effective in full scale applications

Site Remediation

Goal: Remove or reduce PFAS at contaminated sites (e.g., in soil, sediment, groundwater)



Example Technologies

Soil excavation, stabilization, pump and treat

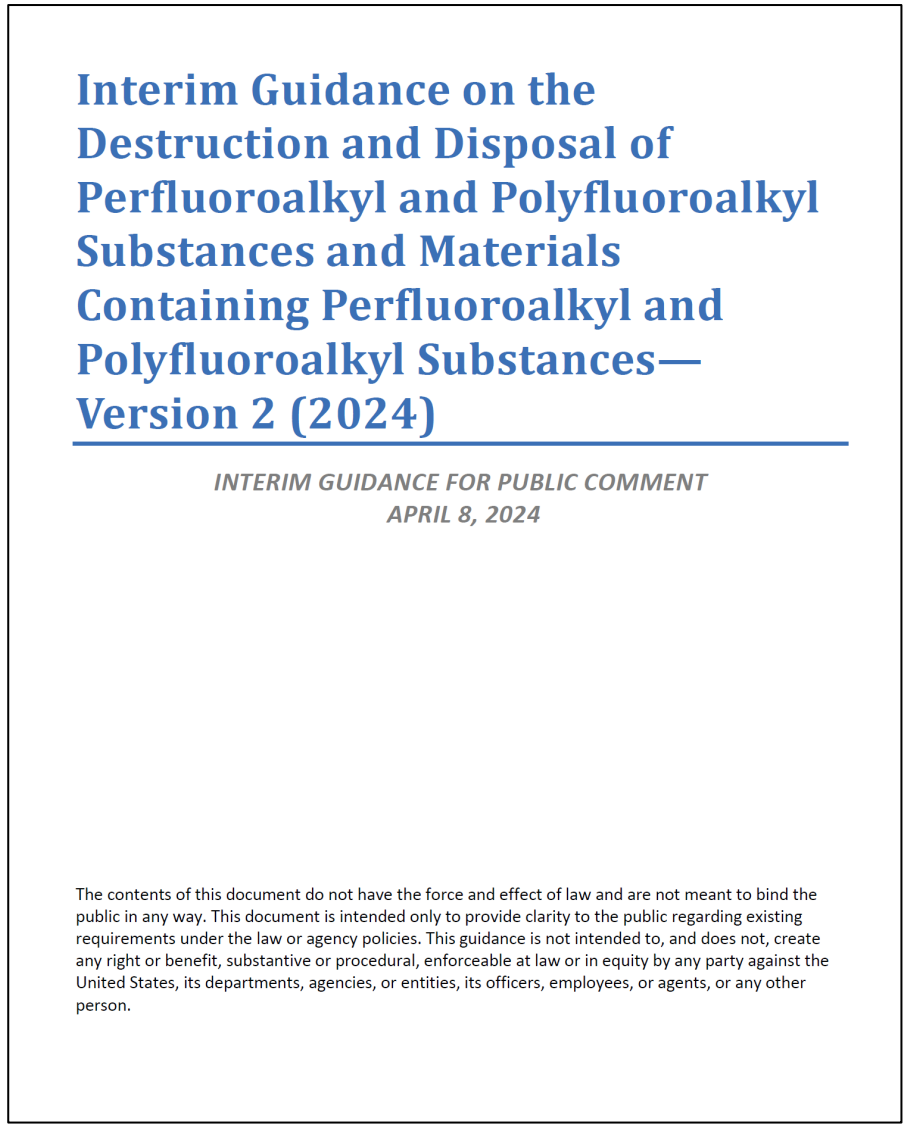
Research Highlights

- Investigation of an immobilization process for PFAS-contaminated soils (2021)
- Remediation and mineralization processes for PFAS in water: A review (2021)

Research Needs

- Site characterization and remediation approaches for PFAS and for multi-component mixtures

Destruction and Disposal



Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances— Version 2 (2024)

INTERIM GUIDANCE FOR PUBLIC COMMENT
APRIL 8, 2024

The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies. This guidance is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

- Updated interim guidance released April 9
  - Opportunity for public comment
- Three waste management approaches
  - Thermal treatment
  - Landfilling
  - Underground injection
- New tools and information
  - Section 6: Technology evaluation framework
  - Appendix A: PFAS field testing guidance (thermal treatment)
- Prioritized research needs captured in Section 5
  - Thermal treatment, landfills, underground injection, emerging technologies
  - Priority ranking based on the potential for results to inform future versions of the guidance

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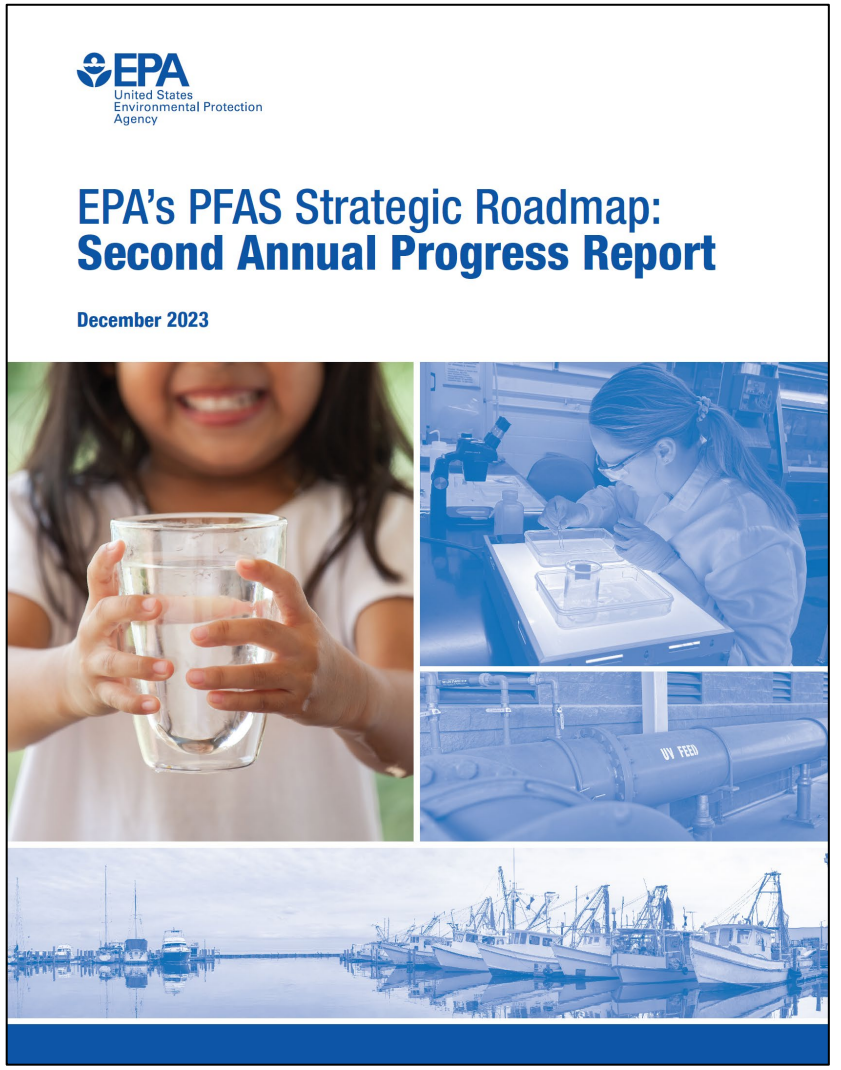
EPA Science Inventory: Publications on PFAS

QUESTIONS?



EPA PFAS Activities – www.epa.gov/pfas
EPA PFAS Research and Development