The Alchemy of Anti-reflexivity:
The Countermovement to Undermine PFAS Science and Policy

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Abstract
The toxicity of PFAS was long hidden from public view, and despite revelations in industry studies in the late 1960s, the "social discovery" of the public health harms of PFAS did not congeal until the early 2000s. A broad multistakeholder debate over what chemicals count as PFAS has persisted, and the number of identified PFAS compounds has mushroomed in the last decade. Industry, lay, and regulatory scientific knowledge production have interacted in complex and contingent ways, and there is strong evidence of social movements and countermovement dynamics in this context. Environmental health researchers and embodied health movements have produced and mobilized scientific knowledge to hold PFAS polluters responsible, challenge the continued production and use of these chemicals, and promote legislation and regulatory action. In contrast, the misuse and abuse of science by key industry stakeholders have shaped public awareness and regulatory action on PFAS, as documented by journalists, scientists, social movement organizations, and policymakers. Scientific knowledge and ignorance production have been key aspects of this process. Significant concerns have been repeatedly raised about the impacts of industry efforts to undermine scientific integrity and stymie effective science translation for policymakers. The PFAS case provides a timely opportunity to examine multi-scalar, multistakeholder social movement and countermovement dynamics that shape U.S. chemical policy. There is a substantial empirical record of the American conservative countermovement's efforts to stall action on global climate change, but no researchers have examined the PFAS countermovement dynamics, even though the American conservative movement has mobilized similar strategies and taken pro-industry and anti-regulatory stances. We provide an overview of PFAS social movement mobilization and situate the structure of the PFAS countermovement and its strategic and tactical approaches to challenging PFAS science and policy. Our contribution extends research on countermovements, corporate activism, and anti-reflexivity by highlighting the contentious politics surrounding the PFAS problem.

Introduction

Per- and polyfluoroalkyl substances (PFAS) are a class of substances known as "forever chemicals" that are driving global ecological change and causing widespread human health impacts. PFAS contamination is both highly localized (near industrial and military sources) and ubiquitous due to widespread use in the food system, household products, and presence in drinking water (Garrett et al. 2022). PFAS have violated planetary boundaries of chemical pollution and are globally distributed in surface water, rainwater, and soil at levels that exceed numerous health-based guidelines (Cousins et al. 2022), and exhibit bioaccumulation and biomagnification in wildlife and the food chain (Giesy and Kannan 2001). Epidemiological

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studies of PFAS show links to several types of cancers, reproductive, developmental and immune system effects, and thyroid and liver impacts (Fenton et al. 2021), and measurable levels of PFAS are in the blood of entire populations of developed countries (Graber et al. 2019). The toxicity of PFAS was long hidden from public view, and despite revelations in industry studies in the late 1960s, the "social discovery" of the public health harms of PFAS did not congeal until the early 2000s (Graber et al. 2019; Lyons 2007). A broad multistakeholder debate over what chemicals count as PFAS has persisted, and the number of identified PFAS compounds has mushroomed in the last decade[3]. As of January 2025, the PubChem PFAS Tree identifies more than 22.5 million PFAS and fluorinated compounds, and the OECD PFAS definition yields 6.95 million PFAS, while there is "Use in Manufacturing" data for only 6,598 PFAS (Kim et al. 2024; Schymanski et al. 2023).

Industry, lay, and regulatory scientific knowledge production have interacted in complex and contingent ways, and there is strong evidence of social movements and countermovement dynamics in this context. Environmental health researchers and embodied health movements have produced and mobilized scientific knowledge to hold PFAS polluters responsible, challenge the continued production and use of these chemicals, and promote legislation and regulatory action (Ohayon et al. 2023; Richter, Cordner, and Brown 2018). Indeed, the rapid growth of activism on PFAS has surprised many who have witnessed other toxics activism. In contrast, the misuse and abuse of science by key industry stakeholders have shaped public awareness and regulatory action on PFAS, as documented by journalists, scientists, social movement organizations, and policymakers (Gaber, Bero, and Woodruff 2023; Rich 2016; U.S. House of Representatives 2019). Scientific knowledge and ignorance production have been key aspects of this process (Richter, Cordner, and Brown 2021; Wickham and Shriver 2021). Significant concerns have been repeatedly raised about the impacts of industry efforts to undermine scientific integrity and stymie effective science translation for policymakers (Gaber, Bero, and Woodruff 2023; U.S. Environmental Protection Agency 2021:154).

The PFAS case provides a timely opportunity to examine multi-scalar, multistakeholder social movement and countermovement dynamics that shape U.S. chemical policy. Currently, there is an erratic patchwork of state and federal laws defining and regulating PFAS, and a large variation in how states are communicating environmental health threats to the public (Caluwe et al. 2024; Zindel et al. 2021). The case also points to broader concerns about "*how* the 'irrational bases of society' might be caused to disappear in the shadows" (Freudenburg and Alario 2007:154). A key debate in sustainability discourses centers on the ability of modern societies to tame the environmental harms stemming from industrial activities.

[3] The most widely used PFAS definition comes from the OECD: "PFASs are defined as fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it), i.e. with a few noted exceptions, any chemical with at least a perfluorinated methyl group (–CF3) or a perfluorinated methylene group (–CF2) is a PFAS." OECD. 2021. *Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances.*

There is a substantial empirical record of the American conservative countermovement's efforts to protect the industrial capitalist order and stall action on global climate change (Dunlap 2014; McCright and Dunlap 2000, 2010; McCright 2016). To our knowledge, no researchers have examined the PFAS case in terms of how this social movement has been responded to by countermovement dynamics, even though the American conservative movement has mobilized similar strategies and taken pro-industry and anti-regulatory stances that ultimately externalize the health and environmental costs of PFAS onto the public. Furthermore, critics have accused industry of using a broad range of practices that involve the misuse and abuse of science, including attacks on impact science. Table 1 shows the major works produced by non-governmental organizations, Congressional and government agencies, and journalists that illustrate broad social interest in the topic (see Table 1).

Table 1. Selected reports and media criticizing industry, regulatory, and political activities regarding science and PFAS contamination

Reports of non-governmental organizations
Environmental Working Group. September 2019. *For 50 years, polluters knew PFAS chemicals were dangerous.*
Union of Concerned Scientists. January 2021. *EPA rule restricting science puts agency's mission at risk.*
Environmental Defense Fund. January 2021. *Groups file lawsuit opposing Trump administration's censored science rule.*
Union of Concerned Scientists. April 2021. *EPA sidelined scientists and weakened PFAS assessment.*
Natural Resources Defense Council. February 2024. *The definition of PFAS should be science based.*
Common Dreams. August 2024. *Documents reveal plan to fight PFAS regulations with industry-backed research.*
Reports of Congressional committees and government agencies
United States Senate. September 2018. *The federal role in the toxic PFAS chemical crisis.* Committee on Homeland Security and Governmental Affairs.
United States House of Representatives. September 2018. *Perfluorinated chemicals in the environment: An update on the response to contamination and challenges presented*. Committee on House Oversight and Reform.
United States House of Representatives. February 2019. *Examining PFAS chemicals and their risks*. House Energy and Commerce Subcommittee on Environment.
United States House of Representatives. July 2019. *The devil they knew: PFAS contamination and the need for corporate accountability*. Committee on House Oversight and Reform.
United States House of Representatives. September 2019. *The devil they knew: PFAS contamination and the need for corporate accountability, part II*. Committee on House Oversight and Reform.
United States House of Representatives. November 2019. *Toxic, forever chemicals: A call for immediate federal action on PFAS*. Committee on House Oversight and Reform.
United States Senate. March 2024. *Examining PFAS as hazardous substances.* Committee on Environment and Public Works.
United States Senate. December 2024. *Examining the public health Impacts of PFAS exposures.* Environment and Public Works subcommittee on Chemical Safety, Waste Management, Environmental Justice, and Regulatory Oversight.
Journalism and Media

The New York Times. January 2016. *The lawyer who became DuPont's worst nightmare.*
Politico. May 2018. *White House, EPA headed off chemical pollution study.*
Politico. January 2021. *Trump's EPA team overrules career scientists on toxic chemical.*
The Guardian. August 2023. *EPA's new definition of PFAS could omit thousands of 'forever chemicals.'*
The Wall Street Journal. May 2024. *The EPA cop who became a warrior for 'forever chemicals.'*
The Guardian. August 2024. *Scientists tied to chemical industry plan to derail PFAS rule on drinking water.*
The Guardian. January 2025. *Industry using 'tobacco playbook' to fend off 'forever chemicals' regulation.*
The Forever Pollution Project. January 2025. *The Forever Lobbying Project exposes the real cost of PFAS pollution on the environment, science, and politics.*

Many analyses have discussed *how* PFAS science has been politicized, but few have taken on the issue of *why* it has occurred. This article employs sociological and STS insights to help explain how and why this movement/countermovement dynamic has occurred. We are guided by the following **research questions:**

1. In light of some social movement successes, what organizations and industry groups have mobilized as a countermovement to oppose health-protective actions and to attempt to institutionalize industry-protective actions?
2. *How* and *why* has this countermovement controlled, contested and attacked knowledge about PFAS?

We provide a brief overview of the PFAS social movement mobilization, to situate the structure of the PFAS countermovement and its strategic and tactical approaches to challenging PFAS science and policy. Our contribution extends research on countermovements, corporate activism, and anti-reflexivity by highlighting the contentious politics surrounding the PFAS problem. We draw upon key conceptualizations of environmental health and embodied health movements (Brown et al. 2004), agnotology (Proctor 2008), countermovements and industry activism (Dunlap 2014; McCright and Dunlap 2010), multi-scalar multi-stakeholder governance (Galle and Leahy 2008; Millimet 2013), and PFAS activism (Ohayon et al. 2023). Furthermore, we examine techniques of neutralization, the second dimension of power in Lukes' (1986) framework, attempts to limit the definition of what chemicals are in fact PFAS, and the logics of essential use and confidential business information that have been deployed in industry efforts at derailing PFAS action.

Theory

Social movements, environmental health, and embodied health movements

Social movements are an important force of social change and awareness in the modern world. They raise attention to socio-environmental problems and offer solutions to address those problems. The claims-making of organized social movements can compel the state to legislate on issues of public significance. But organized resistance movements make counterclaims that

reveal cleavages in the interests of industry, the state, and public and environmental health. Social problems framed around public health and environmental health have historically served as an important arena for social movement mobilization and social change (Brown et al. 2004; Brown and Fee 2014). This comes as no shock, given that environmental factors in health have been estimated by the World Health Organization to contribute to twenty-four percent of deaths worldwide (Prüss-Üstün et al. 2016). The health effects of PFAS fit into a broader categorization of what Brown (2007:2) terms environmentally induced diseases, which are "chemical- and radiation-related symptoms and diseases that impact groups of people in workplaces and communities."

Social movement protest and action centered on environmental contamination and toxics have emphasized the need for corporate and government accountability. A major point of tension lies in the significant limitations in existing regulatory frameworks meant to identify, mitigate, and remediate chemical contamination (Bond 2021; Richter, Cordner, and Brown 2018). Contaminated communities mobilize scientific knowledge, legal activism, and grassroots organizing in attempts to demand appropriate regulatory action and corporate accountability (Menegatto and Zamperini 2024). This form of mobilization around toxics, public health, and the exposure experience is an *embodied health movement*. Such movements "address disease, disability, or the experience of illness by challenging accepted scientific and medical perspectives on etiology, diagnosis, treatment, and prevention… often mobilize around 'contested illnesses' that are unexplained or unacknowledged by current medical science or whose purported environmental cause is disputed" (Wilder and Brown 2021:255; see also Brown 2007).

PFAS activists have also responded to "scientific opportunities" (Ohayon et al. 2023), mobilizing research findings from the C8 Science Panel and EPA's Unregulated Contaminant Monitoring Rule (UMCR3) program to identify and frame PFAS contamination as a public health crisis, push for regulatory reforms, and hold polluters accountable. They have also changed scientific opportunity trajectories, including influencing the selection of research sites for a multi-site exposure study (Agency for Toxic Substances and Disease Registry 2025) and contributing directly to the National Academies of Science, Engineering, and Medicine report on PFAS and health (National Academies of Sciences and Medicine 2022). Contaminated communities face ongoing challenges in understanding the health risks of PFAS, consistent with broader environmental justice struggles that grapple with the role of scientific uncertainty and corporate responsibility while responding with grassroots activism (Pearson 2020). For example, community-based participatory research with the PFAS-REACH study shows how a small number of affected residents in contaminated communities in Pease Tradeport and Hyannis, while facing structural barriers to community action and environmental justice concerns, have successfully influenced both local and national outcomes through community knowledge production and civic science (Garrett et al. 2024). There was variation in the response and mitigation of PFAS in each community in terms of contamination sources, government action,

and activism, in particular, more robust activism was associated with a more affluent and more white community. But importantly, both communities provided the key impetus for the respective state PFAS governance approaches and have influenced federal PFAS policy by pushing the US EPA to promulgate national drinking water regulations for six PFAS, and in both cases activism was driven by exposure experiences (Garrett et al. 2024).

Countermovements

A countermovement is "a conscious, collective, organized attempt to resist or to reverse social change" (Mottl 1980:620). Countermovements attempt to minimize or silence environmental movement critiques of industrial capitalism by exploiting science and scientific uncertainty (Gleeson 2000; McCright and Dunlap 2010). While social movements typically challenge top-down structures of power and authority, the countermovement orientation focuses on challenges from below (Mottl 1980). An important aspect of understanding countermovements lies in movement-countermovement interaction, and how each side can influence the political opportunity structure of the other side (Meyer and Staggenborg 1996). Furthermore, countermovement claims often involve diversionary reframing of the problem, ranging from accusing opponents of being anti-science, to accusing them of being anti-patriotic (Freudenburg and Alario 2007).

Key political economy perspectives in environmental sociology, the treadmill of production (ToP) and ecological modernization theory (EMT), take opposing perspectives on environmental change regarding the role of corporations, social movements and the regulatory state (Pulver and Manski 2021). The ToP views corporate shareholder profit-seeking, suppression of environmental movements, and a co-opted regulatory state as the central mechanisms driving environmental harm; EMT situates social movements and corporate reflexivity as key vectors of environmental reform that shape state regulatory activity (Buttel 2004; Gould, Pellow, and Schnaiberg 2015; Mol and Spaargaren 2000). Much of this literature, along with political process theories of social movements, emphasizes challenges to the exclusionary politics of the state (Harrison 2023; Pellow 2016; Pellow 2017).

Our research aligns with recent scholarship that moves beyond this focus on the state by recognizing the broader multi-institutional political field of contention in which social movements and countermovements operate (Armstrong and Bernstein 2008; Cordner and Brown 2015). For example, the multisector alliance that successfully challenged and promoted policy change around flame retardants involved a nexus of environmental social movements and supporters from business and occupational sectors, and aimed at a broad range of targets beyond the state, such as the media, corporate firms, and bureaucratic and administrative regulatory processes (Cordner and Brown 2015). "Analyzing the production of targets requires one to unpack bases of material and symbolic power in different social fields (e.g., states and markets)

and among different actors in the field (e.g., particular firms in a market)" (Bartley and Child 2014:656). We can anticipate that countermovement mobilization will involve coalition-building among different networks of social power, including economic, military, political, and ideological sources (Mann 2012). Within these networks, we anticipate countermovement collaboration among industrial sectors (plastics, pharmaceuticals, microelectronics, etc.), firms (3M and DuPont), and government agencies that rely on PFAS products, such as the Department of Defense, Federal Aviation Administration, and National Aeronautics and Space Agency (Green 2024). Broadly speaking, these countermovements may attempt to target a broad range of social actors and movement organizations that make claims against what Brown et al (2004) term the "dominant epidemiological paradigm."

Reflexivity, Anti-reflexivity and Industry Activism

Environmental social movements can emerge from local communities and environmental justice organizations. These groups have increasingly played a central part in illuminating corporate harm to the environment, yet overall, corporations successfully avoid the crosshairs of social movements or broader public awareness of their environmental harm (Bartley and Child 2014; Pulver and Manski 2021). Industry activism aimed at undermining social movement claims and avoiding corporate accountability is not a new phenomenon. Organized corporate behavior has been documented in shaping regulatory policy, attacking "sound science", and denying links between corporate activities and broad public health and environmental outcomes. Notable recent examples include the tobacco industry and lung cancer (Baba et al. 2005; Bero 2005; Landman and Glantz 2009), fossil fuels and climate change (U.S. House Committee on Oversight and Accountability and Senate Committee on the Budget 2024), and professional football and chronic traumatic encephalopathy (U.S. House of Representatives 2009).

Specifically concerning environmental social movements and state regulatory activity, corporations have manipulated science to produce ignorance through a broad array of tactics (Oreskes and Conway 2011). Ghost-writing, where paid professional writers author industry-supportive scientific articles and attribute authorship to academic scientists, has been recognized as a serious threat to scientific integrity and public health (Bosch 2011; Bosch and Ross 2012; Minority Staff of the U.S. Senate Committee on Finance 2010). Corporations have also been caught manipulating the academic peer-review process by using specialty academic journals to publish industry-friendly research while obscuring editorial ties to corporate firms (Guterman 2002), submitting contrarian industry-friendly commentaries in legitimate journals that publish science they disagree with, and harassing scientists – all part of the industry "disinformation playbook" (Reed et al. 2021). Another common approach has been the exploitation of judicial rules through the use of strategic lawsuits against public protest – SLAPPs – which rely on civil tort to kneecap citizen efforts to influence legislation, regulation, and action on public social problems (Canan and Pring 1988; Canan 1989).

Prior research has examined the fossil fuel industry and the American Conservative movement's efforts to protect the industrial capitalist order and prevent action on climate change have been well documented, especially in their challenges to environmental movements and the use of impact science (McCright and Dunlap 2010). At the core of this argument is the countermovement's aversion to impact science and its attempts to stymie the identification of the harmful effects of continued economic growth and expansion. The anti-reflexivity thesis "attributes conservatives' (and Republicans') denial of anthropogenic climate change and other environmental problems and attacks on climate/environmental science to their staunch commitment to protecting the current system of economic production" (Dunlap 2014:1). Reflexive modernization broadly conceives of reflexivity "… as a critical form of self-evaluation – a self-confrontation with the unintended and unanticipated consequences of modernity's industrial capitalist order" (McCright and Dunlap 2010:103).

The PFAS Lab's prior work on activism has identified examples of industry attempts to disrupt and delay state- and federal-level PFAS governance by inhibiting protective measures and equitable outcomes (Garrett et al. 2024). For example, many of these approaches place financial, protective, and remediation burdens on contaminated communities. Limited legislative PFAS definitions that constrain regulatory capacity have been proposed in Indiana (Lindauer 2024) and adopted in West Virginia (Riley et al. 2023), and legislation explicitly protecting polluters and industry by preventing private property environmental testing and prohibiting polluter-pay funding structures have been proffered in a Wisconsin PFAS bill (Wimberger et al. 2023). Moreover, the Department of Defense claims immunity in dozens of state lawsuits on PFAS pollution stemming from the use of commercial PFAS-containing firefighting foams at military bases (Mindock 2024).

U.S. States as sites of environmental and health policy-making, experimentation, and fragmentation

Environmental federalism theory looks for optimal levels of government for delegating environmental policymaking (Millimet 2013). This can encourage competition, improve efficiency, or facilitate innovation (Galle and Leahy 2008; Millimet 2013). However, it is also possible that states may lack the resources, expertise, or incentives to be effective (Tyler and Gerken 2022). We might expect that formal environmental federalism, such as having states responsible for monitoring and enforcing the Safe Drinking Water Act and the Clean Air Act, would make it possible for powerful industry actors in certain states to more readily mount a counteroffensive than if they had to deal with it at a federal level. For example, 3M sued NH over its MCLs on the basis that the state agency failed to take proper steps in the process, and 3M also sued MI EGLE on a similar basis; this litigation would have been less feasible at the EPA level. Moreover, states with a strong historical PFAS industry presence may face more stringent barriers to advancing PFAS legislation that would disrupt or harm those industries.

Data and Methods

We utilize data collected as part of the PFAS Governance Database Project (NSF Award SES 2120510) and our larger research project on social and scientific debates and conflicts over PFAS. Our tripartite approach involves interviews, in-depth policy analysis, and case studies. We draw on qualitative interviews conducted as part of our larger research project that investigates the production of scientific knowledge and ignorance, governance issues, and activism around PFAS. Within this larger project, we have conducted 247 total interviews with scientists, impacted residents, regulators, legislators, environmental and health advocates, lawyers, journalists, industry representatives, and other stakeholders. These interviews were conducted between 2016 and 2025. Questions were semi-structured and focused on knowledge and perspectives on PFAS contamination, activism, research efforts and gaps, and challenges. This research was approved in several phases by the Institutional Review Board at Northeastern University. To protect confidentiality, interviewees are not identified and any information that identifies specific people is drawn from publicly available information.

Our in-depth policy analysis draws on our PFAS Governance Database, which includes 1,761 PFAS-related governance actions collected from all fifty U.S. states over a 15-year period (10/29/2009 - 11/1/2024). This data has been coded to capture different types of governance action, topics, legislative outcomes, PFAS definitions, and key agencies and players involved (PFAS Project Lab 2025). We draw from our completed case studies, which contribute to qualitative interviews and policy analysis by providing a rich context for defining and analyzing a problem, and by articulating questions of relevance for policymakers (Pal 2005). Case selection is a theoretically driven and empirically focused process where the researcher seeks out cases bearing the absence, presence, or intersection of theoretical concepts (Ragin 1992; Walton 1992). When examining PFAS movements and countermovements, focusing on the scientific harms of PFAS (whether there is certainty or uncertainty) and the costs (of action or inaction) offers nuance. By emphasizing both uncertainty and inaction, we deepen sociological understanding of how political and economic dimensions of chemical regulatory structure shape social movements that challenge, or delay justice, on environmental inequality. We seek variation-finding comparisons and thus select cases that demonstrate a broad range of outcomes related to PFAS movements and countermovements. Our project has collected extensive data on nine cases: Alaska, California, Maine, Michigan, Massachusetts, Minnesota, North Carolina, Washington, and West Virginia (we draw from a subset of these cases in this paper).

Analysis: The PFAS Countermovement's Attack on PFAS Science and Policy

Our analysis examines a network of domestic U.S. and international industry groups, from several sectors, involved in the PFAS countermovement. Major players in the U.S. domestic chemical industry and trade associations (The American Chemistry Council; The

National Association of Manufacturers; U.S. Chamber of Commerce; Chemours Du Pont; 3M; Honeywell) and international groups (The Alliance for Sustainable Management of Chemical Risk; the European Chemical Industries Council; American Chamber of Commerce to EU; the European Regulation and Innovation Forum) represent a number of these industries. The Environmental Council of the States (2025) has collected data identifying specific industries that rely on PFAS. The top industries prioritized in their list include chemical manufacturers and processors; solid waste landfills; sewage treatment; textile manufacturing and coating; urethane and foal product manufacturing (AFFF); airport operations and fire training centers; paper manufacturing and food service industries; electronics and semiconductor industries; paint and coating manufacturing; plastics and resins; tanneries; and metal manufacturing and fabrication. Other important players are the fossil fuel industry (Exxon), groups representing water utilities (The American Water Works Association, the Association of Metropolitan Water Agencies); broadwoven fabric mills; textiles; pharmaceuticals; and consultants and law firms. Our analysis highlights the coordinated role of many of these groups and firms in the PFAS countermovement. We divide our analysis into four broad strategic categories which encompass the various countermovement tactics: (1) *ideological appeals to higher loyalties;* (2) *strategic manipulation of social institutions;* (3) *internal corporate strategies;* (4) *non-decision making techniques.*

Ideological appeals to higher loyalties

The countermovement has made *ideological appeals to higher loyalties* by citing national security and essential use concerns. For example, the U.S. military uses PFAS in every major weapon category and relies on numerous PFAS products. DoD has cited military readiness and disruption of supply chains as a national security concern related to the regulation of PFAS through 2024 (DoD 2023; Kime 2023). The National Association of Manufacturers and the US Chamber of Commerce has joined this chorus, claiming that access to fluoropolymers and F-gases as "at-risk due to overly broad regulations" which would undermine national security and economic stability (Durbin 2024; National Association of Manufacturers 2025; NC Chamber of Commerce 2024). Related to PFAS releases at the Red Hill fuel facility in Hawaii, the Navy refused to release its own Situation Report, citing release of the "Controlled Unclassified Information (CUI)" document as national security threat (Elder 2023). As of June 2024, DoD had not started long-term cleanup any of its 718 known or suspected release sites (U.S. Government Accountability Office 2025).

The chemical industry has also established international groups to organize an attack on the concept of essential use and promote "safe use". Essential use refers to "when it is justified, from a societal point of view, to use the most harmful substances" (European Commission 2024). The Alliance for Sustainable Management of Chemical Risk, the European Chemical Industries Council, American Chamber of Commerce to EU, and the European Regulation and Innovation

Forum have used several tactics to undermine essential use: attempting to conflate essential use with “safe use”; arguing that all products are essential; reducing the broad regulatory utility of essential use to a case-by-case evaluation that weighs socio-economic interests; arguing that PFAS are irreplaceable, a claim disputed by companies across various economic sectors who are already finding substitutions for PFAS; and asserting that essential use is anti-democratic and should be left to the free market (Corporate Europe Observatory 2024).

Strategic manipulation of social institutions

A broad feature of the PFAS countermovement, consistent with prior research on the climate change countermovement, has been to mobilize countermovement tactics across numerous social institutions within societies. One tactic of this strategy has been to challenge and attempt to shape *definitions* through the attribution of selected characteristics to PFAS for the purposes of constructing a social boundary that distinguishes some chemicals as "non-PFAS" (e.g., falsely claiming there is a broad consensus about ‘grouping’ approach to PFAS; military claims that F-gases aren’t PFAS even though Canada/Europe classify them as PFAS). The American Chemistry Council has spearheaded industry efforts to undermine a “grouping” approach to defining PFAS together as a chemical class. They have propped up and repeatedly cited industry-friendly “objective” scientific papers, for example, one article “widely quoted by stakeholders to influence decision-makers.” The article begins “Most experts agreed that 'all PFAS' should not be grouped together,” and hidden in the end of the paper, it identifies the ACC as the study sponsor and notes that “some of the individual expert panelists/coauthors do not agree with the majority views expressed in some sections of the paper” (Horel 2025).

Numerous groups have engaged in *lobbying* in attempts to directly influence legislators, regulatory agencies, or the judiciary. Corporate Europe Observatory collaborating with the Forever Lobbying Project, has collaborated to document corporate PFAS lobbying in Europe, exposing “a massive, orchestrated lobbying and disinformation campaign that has the ears of leading decision makers in Europe…”, including the Commission and member state governments (Cann 2025; Corporate Europe Observatory 2025; The Forever Lobbying Project 2025). The Forever Lobbying Project, examining 1,178 lobbying arguments, identified three overarching categories: scientific arguments, “no alternative” arguments; and economic arguments. Globally, Chemours (Du Pont) has spearheaded PFAS lobbying, in concert with a network of trade associations, lobby consultants, law firms, and other companies and industry lobby groups. These allied groups have led the PFAS lobbying blitz in Europe, where in 2024 alone there was between €24.9 - 28.4 million ($29.02 – 33.1 million USD) in lobbying, a 44% increase from the prior year (Corporate Europe Observatory and the Forever Lobbying Project 2025). From 2019-2022, 145 bills with PFAS language were introduced. Eight in total were passed, and four of those were related to DoD cleanup of military sites funded through the

annual National Defense Authorization Act; two were large bills that included PFAS provisions; only two were stand-alone PFAS bills that focused on contamination from AFFF.

In the U.S. the PFAS Action Act of 2019/2021 was a major target for lobbying and donor activity. Food and Water Watch (2023) found that PFAS lobbying in the U.S. between 2019-2022 totaled at least $114.4 million USD, with seven companies filing lobbying expenditures totaling $55.7 million USD, and the American Chemistry Council's lobbying for $58.7 million. Lobbying of key Congressional Committees by four major donor groups (leading PFAS manufacturers; U.S. Chamber of Commerce-led coalition; American Chemistry Council; and Top Fossil Fuel Companies) was a targeted and non-partisan effort. After PFAS Action Acts of 2019/2021 passed the U.S. House and were referred to the Senate Committee on Environmental and Public Works, and $456,500 in total campaign contributions donated across these Committee members. The donations occurred on both sides of the aisle, with the bulk going to Republicans. Committee Chair Thomas Carper (D-DE, $38,300) led Democratic donor recipients, while Ranking Member Shelley Capito (R-WV, $85,900) was the leading Republican recipient. Delaware, Carper's constituency, is the home state of Du Pont Chemours. West Virginia, Capito's constituency, has brought legal action against manufacturers and introduced its own PFAS legislation with many similar provisions to the PFAS Action Act of 2021, which she did not support.

Another key tactic involves *postponing* significant regulation by emphasizing uncertainty or claiming a lack of scientific consensus. In Michigan, EGLE has been the target of corporate litigation that has stalled action on PFAS, with 3M winning a lawsuit against EGLE over its rulemaking authority in the State Appellate courts, which was overturned in 2024 by the State Supreme Court who ruled in favor of EGLE (Solis 2024). In 2021, as part of the Nessel v. 3M et al. litigation concerning liability over AFFF, Michigan alleged that defendants removed the suit to federal court to avoid the Michigan state court's rulings, but a Judicial Panel on Multidistrict Litigation rejected Michigan's attempt to keep the lawsuit in the state and sent the suit to multidistrict litigation in South Carolina (U.S. Judicial Panel on Multidistrict Litigation 2021). At the national level, in 2025 Administrator Lee Zeldin announced that EPA will delay compliance deadlines for drinking water MCLs for PFOA and PFOS by two years, and that EPA will rescind the regulations and compliance standards for PFHxS, PFNA, HFPO-DA (GenX), and the Hazard Index mixture of these three plus PFBS (Harvard Law School 2025; EPA 2025). Three separate times, the Zeldin EPA has delayed a court case that would establish a Superfund designation for PFOA PFOS, which would enable EPA to hold polluters responsible for cleanup costs (Clark 2025).

Relying on *legal defense* has involved deploying specific legal strategies to delay or undermine action on PFAS. This includes challenging causation; preempting liability by claiming regulatory compliance; claiming statute of limitations; choosing settlement or alternative dispute resolution to avoid public trial; attempting to remove lawsuits to multi-district litigation (see South Carolina MDL); and bringing Strategic Lawsuits Against Public Protest (SLAPP) or libel suits against detractors. The chemical industry has pursued several legal tactics

to stall or void the implementation of PFAS legislation and regulation at both the national and state levels. In 2024 the Biden Administration established PFAS drinking water MCLs that would have required removal of these chemicals from drinking water systems. The American Water Works Association, the Association of Metropolitan Water Agencies, the National Association of Manufacturers, and the American Chemistry Council immediately filed court challenges (Frazin 2024). These entities broadly represented water utilities and chemical and manufacturing industries. Commenting on the situation, Erik Olson at NRDC said "What's incredibly ironic is that it's the people paying through their water bills to pay for a water utility trade association that's hiring fancy lawyers to sue to make their water less safe" (Frazin 2024). In Michigan, 3M has been involved in numerous lawsuits attempting to undermine the state's PFAS contamination rules to prevent responsibility for groundwater cleanup (House 2024 ; Solis 2024; U.S. Judicial Panel on Multidistrict Litigation 2021).

Additionally, firms and advocacy groups have engaged in SLAPP- counter-SLAPP dynamics. In the case *Grassroots Envtl. Educ. v. Polyloom Corp. Am., No. 611197/2025 (N.Y. Sup. Ct., Nassau Cnty. May 23, 2025*), an advocacy group has filed anti-SLAPP countersuits against the Polyloom Corporation of America. Polyloom filed an initial federal lawsuit against the Grassroots Environmental Education group, claiming the group defamed Polyloom and interfered with its business of making "PFAS-free artificial turf". The group countersued, asserting that the claims were baseless and that Polyloom's lawsuit was meant to undermine their first amendment right to speak about the public health concerns related to PFAS in artificial turf (Dechert LLP 2025). What's more, attorneys have sought to identify legal strategies for PFAS manufacturers to defend themselves by mining scientific findings about PFAS. In one instance, a law firm published a web page that appeared to use AI-generated writing and fabricated a citation to nonexistent research about these legal strategies, which have since been edited and corrected (see McGlinchey 2025). One of the co-authors on the current paper was involved in an email exchange in which the author of the online article said he had "push[ed] out the article before double checking the citations" but did not directly admit to using AI. The piece was quickly republished to remove all citations.

Revoking regulations has long been a tactic of industry. With the political appointment of Lee Zeldin as EPA Administrator under Trump, countermovement attacks on PFAS regulation have come from within the very agency charged with protecting public and environmental health. In 2025, EPA Administrator Lee Zeldin announced that EPA intends to "rescind the regulations and reconsider the regulatory determinations for PFHxS, PFNA, HFPO-DA (GenX), and the Hazard Index mixture of these three plus PFBS to ensure that the determinations and any resulting drinking water regulation follow the legal process laid out in the Safe Drinking Water Act" (EPA 2025 ; Perkins 2025).

Internal Corporate Strategies

Missing Sections on Organizational Structures; Constraining Knowledge Production

Historically, in company towns across America, there is a legacy of *pro-industry culture.* This is characterized by a culture w/in a firm or host community that promotes general reluctance to pursue or accept findings that challenge the safety of products: intimidation of corporate scientists; economic community influences; compensation-related loyalties to the company. Journalist Mariah Blake (2025) has documented the story of PFAS contamination in the manufacturer Saint-Gobain's company town in Hoosick Falls, showing how a deep pro-industry culture in the town spurred the conflict between jobs and environmental protection. Describing the failure of the Hoosick Falls Mayor to take early action in response to PFAS contamination, she writes "for Hoosick Falls, where the firm was the largest private employer and the leading source of tax revenue, these factories were a lifeline...Borge [Hoosick's Mayor] had been negotiating with the company to expand its local operations" (Blake 2025:53). Borge met with company executives to discuss the contamination and public health concerns, while the representatives lauded their firm's contributions to the village and plans to expand local operations. Borge attempted to keep negotiations friendly, and "both sides agreed not to involve lawyers and to exclude most other village officials. That way, the board didn't have to inform the public under the state's open-meeting laws. This approach succeeded in keeping negotiations friendly... But it also made it easy for Saint-Gobain to stall meaningful action" (Blake 2025: 58-59).

Non-decision Making

Research suppression and misrepresentation have been common in the history of PFAS. This includes activities and claims that misrepresent or suppress research, such as: promoting pro-industry research at odds with scientific consensus; funding contrarian non-peer reviewed reports; false interpretations of results or errors of omission; ghostwriting by paid professional writers who author industry-supportive scientific articles and attribute authorship to academic scientists; false counter-arguments by industry representatives authoring contrarian industry-friendly commentaries in legitimate journals that publish science they disagree with. Numerous researchers have documented the decades-long chemical industry cover-up of internal research on PFAS contamination and its human health harms, and attacks and misrepresentation of legitimate scientific findings (Cordner et al 2019; Gaber et al 2020; Renfrew and Pearson 2021; Richter, Corder, and Brown 2018; Wickham and Shriver 2020). In 2025, the Zeldin EPA boasted about developing PFAS science to help rural economies, while slashing more than $15 million in funding for congressionally appropriated PFAS research grants (Clark 2025).

Conclusion: Incomplete

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Table 2. Key techniques employed by the PFAS countermovement to challenge PFAS science and policy

Strategy and Techniques	*Illustrative empirical case*
Ideological appeal to higher loyalties	
1. National Security	DoD has cited military readiness and disruption of supply chains as a national security concern related to the regulation of PFAS through 2024 (DoD 2023; Kime 2023). The National Association of Manufacturers has joined this chorus, claiming that access to fluoropolymers and F-gases is "at-risk due to overly broad regulations" which would undermine national security and economic stability (Durbin 2024; National Association of Manufacturers 2025; NC Chamber of Commerce 2024). Related to PFAS releases at the Red Hill fuel facility in Hawaii, the Navy refused to release its own Situation Report, citing release of the "Controlled Unclassified Information (CUI)" document as national security threat (Elder 2023).
2. Essential Use	The chemical industry has established international groups (e.g., The Alliance for Sustainable Management of Chemical Risk; the European Chemical Industries Council; American Chamber of Commerce to EU; the European Regulation and Innovation Forum) to attack the concept of essential use and promote "safe use" (Corporate Europe Observatory 2024).
Strategic Manipulation of Social Institutions	
3. Definition	The American Chemistry Council has spearheaded industry efforts to undermine a "grouping" approach to defining PFAS together as a chemical class. They have propped up and repeatedly cited industry-friendly "objective" scientific papers, for example, one article "widely quoted by stakeholders to influence decision-makers." The article begins "Most experts agreed that 'all PFAS' should not be grouped together," and hidden in the end of the paper, it identifies the ACC as the study sponsor and notes that "some of the individual expert panelists/coauthors do not agree with the majority views expressed in some sections of the paper" (Horel 2025).
4. Lobbying	Corporate Europe Observatory collaborating with the Forever Lobbying Project, has collaborated to document corporate PFAS lobbying in Europe, exposing "a massive, orchestrated lobbying and disinformation campaign that has the ears of leading decision makers in Europe…", including the Commission and member state governments (Cann 2025; Corporate Europe Observatory 2025; The Forever Lobbying Project 2025), . Globally, Chemours (Du Pont) has spearheaded PFAS lobbying, in concert with a network of trade associations, lobby consultants, law firms, and other companies and industry lobby groups. In 2024 alone there was between €24.9 - 28.4 million ($29.02 – 33.1 million USD) in lobbying, a 44% increase from the prior year. In the U.S. the PFAS Action Act of 2019/2021 was a major target for lobbying and donor activity. PFAS lobbying in the U.S. between 2019-2022 totaled at least $114.4 million USD, with seven companies filing lobbying expenditures totaling $55.7 million USD, and the American Chemistry Council's lobbying for $58.7 million. Lobbying of key Congressional Committees by four major donor groups (leading PFAS manufacturers; U.S. Chamber of Commerce-led coalition; American Chemistry Council; and Top Fossil Fuel Companies) donated $456,500 in total campaign contributions to individual members of the Senate Committee on Environmental and Public Works (Food and Water Watch 2023).
5. Postponing	In Michigan, EGLE was a target of corporate litigation stalling action on PFAS, with 3M winning a lawsuit against EGLE over its rulemaking authority in the State Appellate courts, which was overturned in 2024 by the State Supreme Court who ruled in favor of EGLE (Solis 2024). Nationally, in 2025 Administrator Lee Zeldin announced that EPA will delay compliance

	deadlines for drinking water MCLs for PFOA and PFOS by two years, and that EPA will rescind the regulations and compliance standards for PFHxS, PFNA, HFPO-DA (GenX), and the Hazard Index mixture of these three plus PFBS (Harvard Law School 2025; EPA 2025). Three separate times, the Zeldin EPA has delayed a court case that would establish a Superfund designation for PFOA PFOS, which would enable EPA to hold polluters responsible for cleanup costs (Clark 2025).
6. Legal Defense	The chemical industry has pursued several legal tactics to stall or void the implementation of PFAS legislation and regulation at both the national and state levels, such as challenges to drinking water regulations by American Water Works Association, the Association of Metropolitan Water Agencies, the National Association of Manufacturers, and the American Chemistry Council immediately filed court challenges (Frazin 2024). 3M has been involved in numerous lawsuits attempting to undermine Michigan's PFAS contamination rules to prevent responsibility for groundwater cleanup (House 2024; Solis 2024; U.S. Judicial Panel on Multidistrict Litigation 2021).
7. Revoking Regulations	In 2025, EPA Administrator Lee Zeldin announced that EPA intends to "rescind the regulations and reconsider the regulatory determinations for PFHxS, PFNA, HFPO-DA (GenX), and the Hazard Index mixture of these three plus PFBS to ensure that the determinations and any resulting drinking water regulation follow the legal process laid out in the Safe Drinking Water Act" (EPA 2025; Perkins 2025).
8. Media	In 2018, a widely reported incident involved and EPA PFAS contamination summit in which journalists from CNN and Associated Press were not allowed to enter, and then were forcibly ejected from the building. Condemnation from Politico, Associated Press, E&E News, CNN, and Congressional Democrats followed the incident (Science AF 2018; Holden 2018).
Internal Corporate Strategies	
9. Organizational Structures	
10. Constraining Knowledge Production	
11. Pro-industry Culture	A microcosm of many small rural company towns, Hoosick Falls, a Saint-Gobain company town, was caught in a conflict between jobs and environmental protection. "For Hoosick Falls, where the firm was the largest private employer and the leading source of tax revenue, these factories were a lifeline…Borge [Hoosick Mayor] had been negotiating with the company to expand its local operations" (Blake 2025:53).
Non-decision making	
12. Research suppression or	Decades-long chemical industry cover-up of internal research on PFAS contamination and its human health harms, and attacks and misrepresentation of legitimate scientific findings (Cordner et al 2019; Gaber et al 2020; Renfrew and Pearson

misrepresentation	2021; Richter, Corder, and Brown 2018; Wickham and Shriver 2020). The Zeldin EPA cuts more than $15 million in funding for congressionally appropriated PFAS research grants (Clark 2025).
13. Harassing Scientists	
14. Rules and Procedures	
15. Media Bias	
16. Other	