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Tax Incentives for Industrial PFAS Mitigation: A Potential Environmental Policy Pathway

Saisantosh Vamshi Harsha Madiraju[1*] | A M Duddu[2]

[1]*Civil and Environmental Engineering, The University of Toledo, Toledo, OH 43606, USA.*
[2]*Business Administration Department, University of People, Pasadena, CA 91101, USA.*

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ABSTRACT

Per- and polyfluoroalkyl substances (PFAS) pose a substantial challenge to industrial regulation and environmental policy due to their persistence and documented adverse health impacts. Existing regulatory approaches have largely emphasized bans, use restrictions, and financial penalties, with comparatively limited reliance on proactive economic incentives. This theoretical case study explores the potential effects of introducing tax incentives for verifiable PFAS mitigation activities undertaken by industry, including the substitution of alternative substances, capital investment in remediation technologies, and process modifications that reduce PFAS emissions. Drawing on parallels with tax credit frameworks used for renewable energy deployment and contaminated land remediation, the analysis conceptually evaluates the economic, technological, and regulatory implications of such incentives. The findings suggest that well-designed fiscal measures could accelerate industrial participation in PFAS reduction, stimulate innovation in safer substitutes, and generate tangible environmental and public health benefits. The study also outlines essential safeguards for policy design, including stringent eligibility thresholds, robust monitoring, and transparent third-party verification. Overall, this work contributes to ongoing policy discussions by assessing the opportunities and limitations of shifting from predominantly punitive approaches toward incentive-based instruments for PFAS management in industrial systems

1. INTRODUCTION

Per- and polyfluoroalkyl substances (PFAS) have emerged as a global environmental and public health concern due to their remarkable chemical stability and persistence in natural and engineered systems [1]. Widely used in industrial and consumer applications

ranging from firefighting foams to non-stick cookware, PFAS have been detected in water resources, soil, wildlife, and human populations across the globe [2]. Their resistance to degradation, coupled with evidence linking exposure to adverse health outcomes, has propelled PFAS regulation to the forefront of environmental policy debates[3], [4], [5].

Traditionally, regulatory approaches to PFAS in the United States and internationally have emphasized bans, restrictions on use, and financial penalties for noncompliance. While such measures aim to curb future contamination and ensure accountability, they may not always provide sufficient motivation for industries to adopt proactive PFAS reduction strategies or invest in costly remediation technologies [5]. Moreover, the financial burden associated with compliance may disproportionately impact smaller manufacturers and hinder technological innovation [6], [7], [8].

Emerging discourse in environmental policy now considers whether fiscal policy mechanisms, such as tax incentives, could accelerate PFAS mitigation efforts in the industrial sector. Tax incentives have successfully driven progress in other fields, notably in the adoption of renewable energy and remediation of contaminated sites, suggesting the potential for analogous approaches in PFAS management [5], [7], [8].

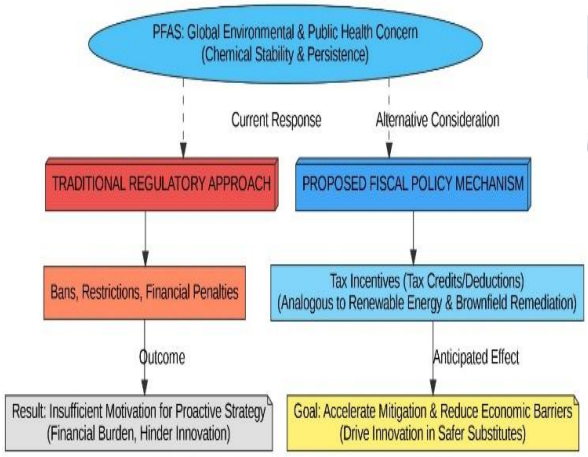

Figure 1. Policy Shift: From Punitive Compliance to Proactive Incentive

Despite growing interest, research remains limited on the prospective effectiveness, implementation challenges, and economic consequences of using tax incentives to drive PFAS reduction. This study addresses this knowledge gap by presenting a theoretical analysis of tax-based incentives for industrial PFAS mitigation, examining how such policies could influence industry behavior, technology adoption, and environmental outcomes.

2. FRAME WORK

The proposed framework incorporates key ideas from current tax policy discussions and environmental regulatory approaches:

Simple Flow Chart: What if PFAS Mitigation Gets Tax Incentives for Industries?

1. PFAS Problem Identified: Industrial site, land, or water is found to be contaminated with PFAS.

2. Tax Incentive Policy Introduced: Government offers tax credits or deductions for PFAS cleanup, technology adoption, or land redevelopment.

3. Industry Decision Point: Industry evaluates whether to undertake PFAS mitigation to claim tax benefits.

If Yes →

- *Invests in mitigation (alternative chemistries, filtration/treatment, site cleanup)*
- *Documents actions and compliance*
- *Applies for and receives tax incentive*

If No →

Continues with standard regulatory compliance (no additional tax benefit)

4. Results of Participation

- *Lower net cost of PFAS mitigation for industry*
- *Increased adoption of cleanup technologies and safer alternatives*
- *Productive reuse of previously contaminated land*
- *Improved environmental and public health outcomes*

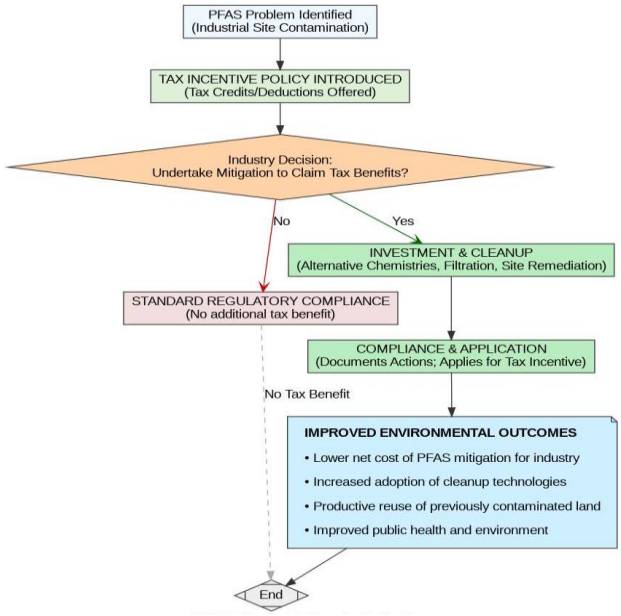

Figure 2. PFAS Mitigation Tax Incentive Policy Framework

3. INFLUENCE ON INDUSTRY BEHAVIOR

Empirical studies and policy analyses have shown that fiscal incentives, such as tax credits and deductions, can play a decisive role in shaping industrial responses to environmental challenges [7], [9]. In the context of PFAS (per- and polyfluoroalkyl substances) mitigation, the introduction of targeted tax incentives is anticipated to elicit several behavioral shifts in the affected industries.

First, tax incentives have the potential to reduce the economic barriers to substituting PFAS with less persistent and toxic alternatives. Consistent with findings from renewable energy policy [10], [11], industries facing high upfront costs for process reformulation may become more willing to invest in PFAS-free materials and advanced treatment technologies when fiscal rewards offset such expenditures. This is particularly salient for small- to medium-sized enterprises, which are often disproportionately affected by compliance costs but stand to benefit most from financial relief.

Second, similar to the observed effects of tax credits in brownfield remediation [12]Incentives linked to PFAS cleanup could accelerate the remediation of contaminated sites and promote productive land use. These policies not only expand voluntary participation in environmental remediation but have also been associated with increased rates of private investment and earlier site redevelopment [13].

Moreover, industries engaged in proactive mitigation in response to tax incentives may accrue reputational benefits, facilitating market differentiation and increased access to environmentally conscious buyers [14]. Such dynamic effects can create a positive feedback loop, wherein consumer preference reinforces corporate environmental governance.

Finally, research suggests that well-designed incentives have the potential to shift decision-making paradigms within firms, reframing environmental mitigation from a compliance-driven requirement to a strategic investment [8]. In the specific case of PFAS, tax incentives could help cultivate an innovation-oriented business culture while contributing to the achievement of public health and regulatory goals.

Overall, insights from the broader literature on environmental tax policy support the conclusion that fiscal incentives for PFAS mitigation would likely enhance industry engagement, accelerate adoption of safer alternatives, and facilitate more rapid and cost-effective cleanup efforts, provided that such programs are implemented with robust eligibility and verification standards

4. TECHNOLOGY ADOPTION

Decades of environmental policy research demonstrate that fiscal incentives can play a pivotal role in accelerating the industrial adoption of advanced environmental technologies [15]. In the context of PFAS mitigation, tax incentives such as credits, accelerated depreciation, or deductions linked to verified pollution control investments are anticipated to lower the financial and operational barriers that often impede the uptake of innovative treatment and process substitution technologies [7].

Empirical studies from related sectors, such as hazardous waste remediation and renewable energy deployment, have shown that tax credits reliably increase private investment in emerging technologies [13], [16]. Applying these insights to PFAS, targeted tax incentives could facilitate the introduction of state-of-the-art water treatment systems (e.g., high-capacity ion exchange resins, novel membrane filtration, or advanced oxidation processes) and encourage long-term phaseout of PFAS compounds in industrial processes in favor of safer alternatives.

Moreover, evidence suggests that the availability of fiscal rewards can shorten the timeline for technology diffusion. For example, Greenstone and Gallagher (2008) documented accelerated redevelopment and technology deployment at brownfield sites following the introduction of financial incentives [9]. By analogy, industries faced with potential tax benefits for PFAS mitigation may not only adopt proven technologies more rapidly but may also invest in pilot studies and early-stage deployment of promising but as-yet-unscalable solutions [17].

It is important to note that the effectiveness of such incentives depends on robust policy design, including clear eligibility criteria, quantifiable performance standards, and adequate monitoring to ensure that incentives are linked to demonstrable reductions in PFAS loadings [8]. Without these safeguards, the risk of free-riding or technology lock-in may undermine policy objectives.

In summary, scientific literature strongly suggests that well-structured tax incentives could substantially increase the rate and breadth of technology adoption for PFAS mitigation within industry, catalyze investment in research and demonstration projects, and contribute to the more rapid realization of public environmental and health goals.

5. ENVIRONMENTAL OUTCOMES

Empirical research and policy evaluations indicate that fiscal instruments, such as tax incentives, can substantively enhance environmental outcomes by motivating pollution abatement and remediation activities [6], [7], [12]. Applying these frameworks to PFAS (per- and polyfluoroalkyl substances), tax incentives are anticipated to yield several positive environmental impacts.

First, the provision of tax incentives for verified PFAS remediation could significantly accelerate the cleanup of contaminated sites. Evidence from brownfield redevelopment studies suggests that financial incentives lead to higher rates of site restoration and lower barriers to land revitalization [12], [13]. By incentivizing investment in advanced remediation technologies and site management, such fiscal measures may reduce the prevalence and mobility of PFAS in environmental media, subsequently limiting their bioaccumulation and persistence in affected ecosystems.

Second, tax-incentivized mitigation activities have been shown to reduce concentrations of hazardous substances in drinking water supplies, a change closely correlated with improved public health outcomes [5], [18]. Decreases in PFAS exposure can translate to lower incidence of health problems linked to these chemicals, including various cancers, immune system effects, and adverse developmental outcomes [4], [19].

Third, land value studies reveal that effective environmental cleanups can restore or enhance property values, reduce community health risk perception, and support local economic development [13], [20]. These broader social benefits, in conjunction with ecosystem improvements, point to the potential for tax incentives to align private investment with public interest in sustainable land management [21].

However, the literature also emphasizes that the realization of these benefits depends on robust program design, monitoring, and enforcement. Clear eligibility standards and performance verification must accompany effective tax incentive schemes to ensure that environmental outcomes are genuine and not merely administrative [7], [22].

In summary, scientific studies support the hypothesis that tax incentives for PFAS mitigation can yield meaningful environmental benefits, including more rapid and extensive remediation of contaminated sites, reduced health risks, enhanced property and ecosystem values, and increased societal willingness to invest in environmental quality, provided implementation is accompanied by rigorous oversight.

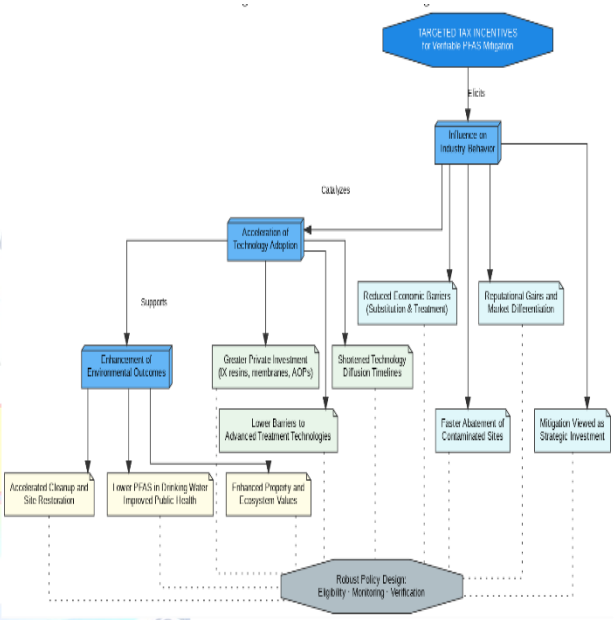

Figure 3: Influence of Targeted Tax Incentives on PFAS Mitigation

6. FUTURE SCOPE AND CONCLUSION

This theoretical case study examines the potential role of tax incentives as an alternative and complementary policy instrument for mitigating per- and polyfluoroalkyl substances (PFAS) in industrial systems. PFAS are persistent environmental contaminants associated with significant public health risks, and current regulatory frameworks rely predominantly on bans, use restrictions, and penalties. While these measures aim to limit future contamination, they often impose substantial compliance costs and provide limited motivation for proactive mitigation or technological innovation.

Drawing on established tax incentive models from renewable energy adoption and contaminated land remediation, the study conceptually evaluates how fiscal

incentives could influence industrial behavior, technology adoption, and environmental outcomes related to PFAS management. The analysis suggests that well-designed tax incentives could lower economic barriers to PFAS substitution and remediation, encourage earlier and broader adoption of advanced treatment technologies, and stimulate private investment in safer chemical alternatives. Such incentives may be particularly beneficial for small- and medium-sized enterprises, which often face disproportionate compliance costs.

The study further highlights that incentive-based policies can reframe PFAS mitigation from a compliance obligation into a strategic investment, yielding reputational benefits and market advantages for participating firms. From an environmental perspective, tax-incentivized mitigation is expected to accelerate cleanup of contaminated sites, reduce PFAS concentrations in environmental media and drinking water, and generate associated public health and ecosystem benefits. Additionally, restored land value and community revitalization emerge as important co-benefits.

However, the effectiveness of tax incentives depends critically on robust policy design. The study emphasizes the need for clear eligibility criteria, quantifiable performance standards, transparent third-party verification, and strong monitoring mechanisms to prevent free-riding and ensure genuine environmental gains. Overall, this work contributes to environmental policy discourse by assessing the opportunities and limitations of shifting PFAS management toward incentive-based regulatory instruments that align private economic interests with public health and environmental protection goals.

Future research should empirically evaluate the effectiveness of PFAS-specific tax incentives using real-world industrial case studies, cost–benefit analyses, and longitudinal environmental monitoring data. Additionally, comparative assessments of incentive-based and punitive regulatory frameworks across different industrial sectors and jurisdictions would help identify optimal policy designs that maximize PFAS reduction while minimizing economic burden.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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