APRIL 2025

PFAS: The Invisible Threat

The topic.

PFAS: Essential, Yet Persistent and Harmful

Per- and polyfluoroalkyl substances (hereafter called 'PFAS') are synthetic chemicals widely used across industries for their water, grease, and stain-resistant properties, essential in some industries. In recent decades however, we discovered that these unique properties come with a downside: PFAS persist in the environment (soil, water) and bioaccumulate in living organisms, posing severe health risks.

There are around 15,000 types of PFAS that can be broadly categorised in two groups. Non-polymer PFAS, such as PFOA and PFOS, have been linked to severe health effects, including cancer and immune system suppression. These substances are the primary target of regulatory restrictions. On the other hand, Polymer PFAS are larger molecules that are generally more stable and less likely to bioaccumulate. However, during their production and degradation, they can release non-polymer PFAS, leading to increasing regulatory scrutiny.

This diversity within PFAS creates unique complexities in their risk assessment. Moreover, comprehensive independent research into the health effects of many PFAS variations remains limited.

1 - The IEP, Institute for Economics & Peace, an independent non-profit think tank. Global Peace Index 2024: Measuring Peace in a Complex World, Sydney, June 2024. Available from: http://visionofhumanity.org/resources (accessed 23/10/2024).
2 - United Nations, 'War's Greatest Cost Is Its Human Toll', Secretary-General Reminds Peacebuilding Commission, Warning of 'Perilous Impunity' Taking Hold | Meetings Coverage and Press Releases

CANDRIAM
A NEW YORK LIFE INVESTMENTS COMPANY

PFAS Double Materiality – A Growing Financial and Environmental Burden

Due to their widespread use and persistent nature, the environmental and health effects of PFAS will be global and long-lasting. Companies that fail to address PFAS risks may face regulatory penalties, litigation costs, and reputational damage, that may have material financial impact. It is thus crucial to integrate an assessment of these risks when analysing companies which manufacture or use these chemicals.

PFAS present a clear case of double materiality, affecting both financial and environmental aspects. On one hand, companies that produce or use PFAS negatively impact both living beings and the environment. On the other, they face increasing legal, regulatory, and financial risks.

The cumulative financial penalties imposed globally on companies for PFAS-related contamination have exceeded billions of dollars[1]. A major example is the settlement reached by 3M, amounting to $10.3 billion, to address claims related to PFAS pollution in US drinking water[2]. In Europe, estimates from the Forever Lobbying Project[3] suggest that the cost of cleaning PFAS contamination could exceed €2 trillion over a 20-year period, underlining the significance of these risks if they are not properly assessed.

The Double Materiality of PFAS

1 - PFAS Settlement Amounts Per Person: What to Expect?
2 - 3M's $10.3 billion PFAS settlement gets preliminary approval | Reuters
3 - The Forever Lobbying Project - The Forever Pollution Project

Where do we stand with PFAS Regulation?

EU: The European Union is moving towards a potential PFAS phase-out under the REACH * regulation. While lobbying efforts by corporate stakeholders may delay the process, consumer products remain a key target for restrictions. However, essential applications, such as medical devices (inhalers) and semiconductor manufacturing, may be granted exemptions in the absence of viable substitutes. Additionally, in February 2025, France has taken a leading role by passing a law banning PFAS in cosmetics, textiles, and ski waxes by 2026, with a broader ban on textiles by 2030. The legislation also introduces stricter PFAS monitoring in drinking water and financial penalties for industrial polluters, reinforcing the polluter pays principle **.

US: The Environmental Protection Agency (EPA) has designated PFAS as hazardous under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), imposing limits on their presence in drinking water. However, federal efforts to regulate PFAS have faced political challenges, with some administrations delaying enforcement actions. Despite these obstacles, state-level regulations continue to advance, making PFAS a critical issue for businesses operating in the US market.

For investors, understanding the evolving PFAS regulatory landscape is essential, as legislative changes can have profound financial and operational implications for companies with PFAS exposure. Firms that proactively address regulatory compliance and phase out PFAS use will be better positioned to manage financial risks and maintain investor confidence.

* REACH is the European Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals. It entered into force in 2007. Link : https://environment.ec.europa.eu/topics/chemicals/reach-regulation_en
** Ministère de la Transition Écologique. (n.d.). Plan d'action interministériel PFAS. Retrieved March 17, 2025, from https://www.ecologie.gouv.fr/politiques-publiques/plan-daction-interministeriel-pfas

Engaging Companies to Address PFAS Risks

Managing PFAS exposure presents significant challenges for companies due to the widespread use of these substances and their complex supply chains. The existence of thousands of PFAS variations, each with different toxicity and persistence levels, makes tracking and regulation particularly difficult. Transitioning to safer alternatives is both costly and technically demanding, as scientific studies on the full extent of PFAS effects remain ongoing. Moreover, PFAS regulation is inconsistent across geographies, applications, and industries.

Over the past months, we launched an engagement campaign with PFAS manufacturers and users, in the aim to:

1. Deepen our knowledge of PFAS risks to better evaluate company- and industry-specific exposure. The goal is to integrate PFAS risks into our proprietary ESG research model, allowing us to anticipate and mitigate them.

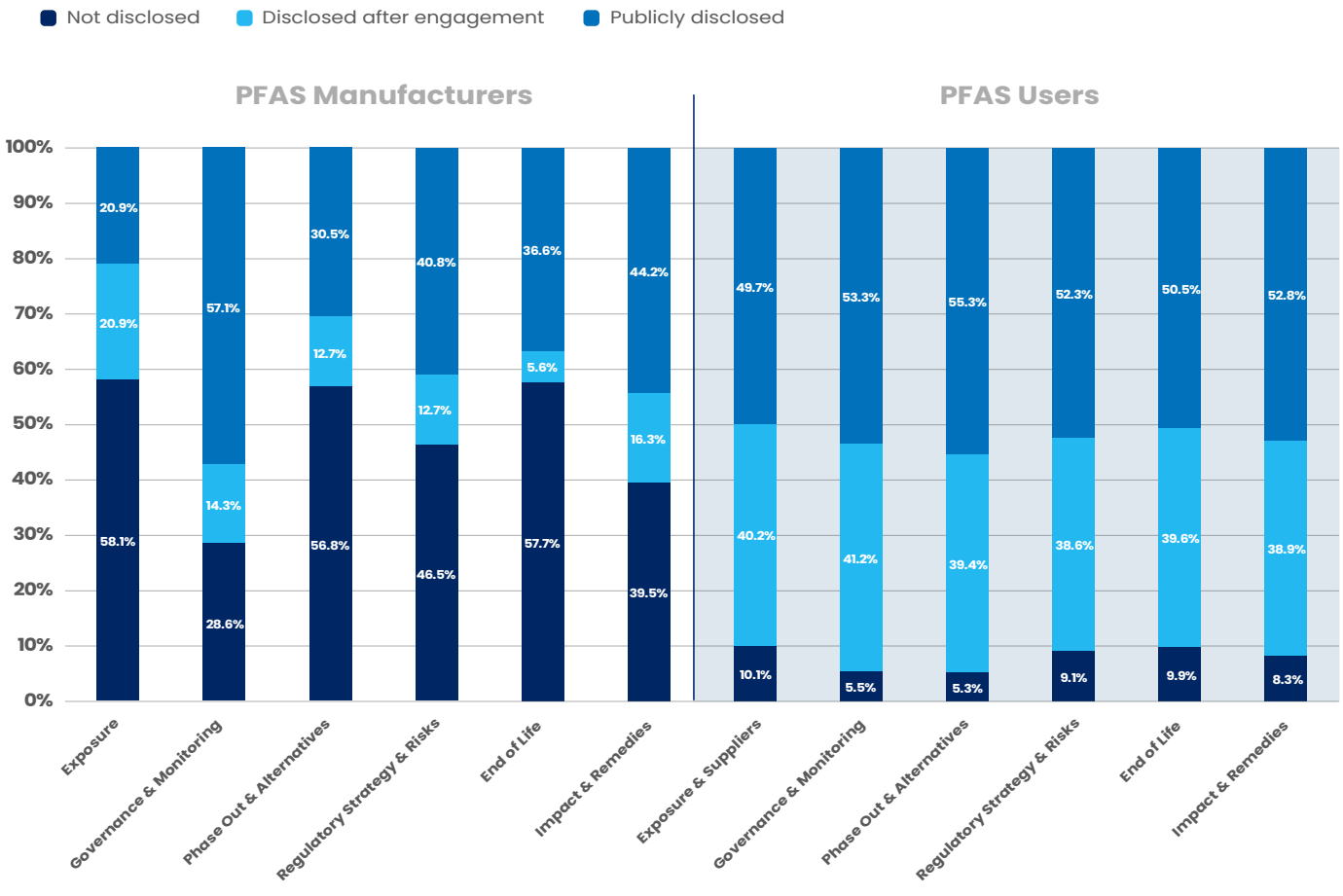
2. Push for improved corporate disclosure, raising investor and public awareness of PFAS contamination risks,

3. Encouraging responsible corporate behaviour through promoting best practices by highlighting companies that successfully manage PFAS risks and implement sustainable alternatives.

The story thus far.

Our engagement campaign involved a dialogue with 12 of the largest international PFAS manufacturers - in the Chemicals sector - and 20 PFAS users – mainly in Textile and Consumer Discretionary sectors, that we evaluated according to seven pillars : PFAS-related disclosures, revenue exposure, governance and monitoring, impacts and remedies, phase-out strategies and alternatives, legal risks, and end-of-life management. The information used was either publicly available, disclosed during dedicated engagements (meetings, calls), or not disclosed. PFAS manufacturers withheld more information, particularly on exposure, phase-out & alternatives, and end-of-life processes, with 58% not disclosing any data. On the other hand, PFAS users were more willing to share information, particularly through public disclosure.

Figure 1 - PFAS Manufacturers versus Users: Disclosure Assessment

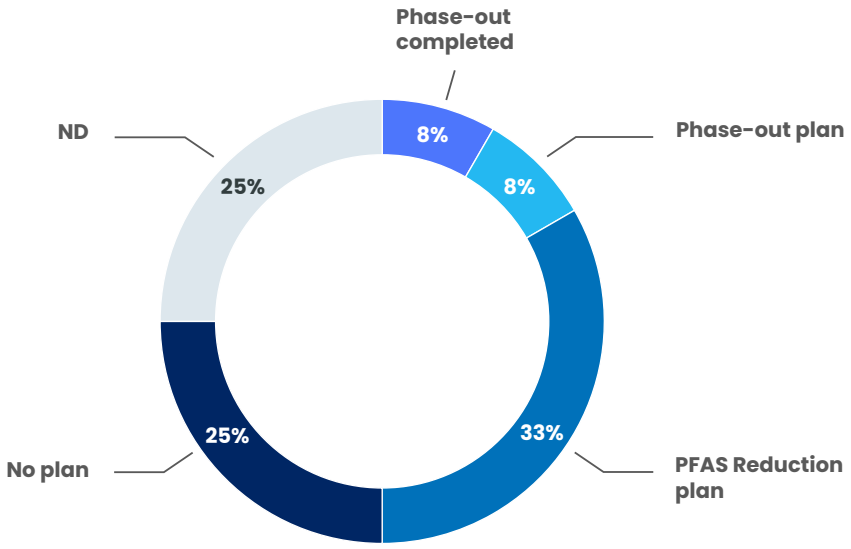


Source: Candriam PFAS engagement campaign, March 2025

PFAS Exposure – Gradual Decline but Challenging for Industrials

Across PFAS manufacturers in our sample, PFAS revenue exposure varies significantly, from less than 1% to 50% of total revenues. The types of PFAS produced and reported are mostly polymers and related compounds, **while the most harmful long-chain PFAS, have been significantly reduced** following the 2012 controversy and regulatory bans.

Figure 2 - PFAS phase-out strategy of PFAS manufacturers



Source: Candriam PFAS engagement campaign, March 2025

Half of the manufacturers engaged have adopted a PFAS phase-out or reduction strategy and 8% have successfully phased-out PFAS variants. In contrast, **25% plan to continue producing PFAS chemicals.** While being the most impacted by PFAS regulations, producers with the highest revenue exposure to PFAS are also the ones with either no PFAS reduction plan or no disclosure on the matter.

The lack of transparency in the supply chain was cited as a major challenge for industries using PFAS. Only some of the companies we analysed implement regular supplier audits and independent laboratory testing, while many still struggle with full visibility into upstream PFAS usage. While PFAS only account for a minor fraction of their revenues (often below 10%), technical dependency on PFAS remains a point of concern.

PFAS usage varies across industries based on available alternatives and necessity. In the industrial sector, notably Semiconductors, PFAS remain essential to the manufacturing process, although harmful long-chain variants have been largely phased out. Risks are mitigated through stringent chemical management. In contrast, consumer-facing industries have eliminated most PFAS, with residual exposure making up less than 1% of product formulations. Their phase-out was driven by strict regulations and high reputational risks – as they are in direct contact with end users -, rather than necessity.

PFAS Disclosures – Consumer Brands Lead, Most Exposed Firms Lag

While most manufacturers emphasise their compliance with regulations, only a minority of them provide transparent disclosures regarding their PFAS exposure. Instead of proactively reducing their reliance on these chemicals, they focus on meeting minimum legal requirements. Companies with lower PFAS exposure are more willing to provide detailed disclosures about their transition efforts. Notably, two companies with high exposure declined to answer our questions, citing ongoing regulatory developments and legal uncertainty as primary concerns.

As regards PFAS users, disclosure practices are inconsistent across industries. They are influenced by the regulatory environment, and thus more stringent in Europe.

Consumer-Facing Brands: Leading in Transparency

- Actively publish accessible reports and public statements on PFAS reduction.
- Transparency driven by strong consumer expectations and regulatory pressures.
- Often highlight phase-out achievements and sustainable alternatives.

Industrial & Semiconductor Companies: More Guarded

- Tend to reference industry-wide initiatives rather than company-specific data.
- Limited disclosure on exact PFAS usage and phase-out commitments.
- Transparency varies based on regulatory requirements in different regions.

BEST PRACTICES

Using dedicated webpage on their website and/or a dedicated section intheir sustainability report

PFAS producers should disclose:

Type of PFAS produced % of revenue and/or quantity Locations of productions sites

PFAS users should disclose:

Type of PFAS used % of products concerned

BEST PRACTICES

Among the companies part of our engagement campaign, one, in the consumer goods sector, has set a benchmark in PFAS transparency by publicly sharing detailed information on its corporate responsibility webpage, which entails a PFAS-dedicated section.

Key elements include:

- Chemical composition – PFAS-type fabrication and application.
- Testing & compliance – Independent verification of safety.
- Regulatory adherence – Compliance with global safety standards.
- Sustainability commitments – Measurable efforts to eliminate harmful chemicals.
- Product safety – Explanation of product performance.

By openly addressing PFAS concerns, the company enhances consumer trust and aligns with investor expectations for responsible chemical management.

Governance and Monitoring – Stronger Where Risks Are Higher

42% of PFAS manufacturers have implemented safety measures for employees handling PFAS, including protective equipment, exposure monitoring programs, medical checks for workers, workplace ventilation improvements and comprehensive training programs on PFAS handling and contamination prevention. However, most of the companies with a lower PFAS exposure do not have specific safety measures but implement a general SoC (Substance of Concern) safety policy.

Despite growing regulatory pressures, only 35% of manufacturers have invested in PFAS-specific contamination reduction initiatives. These include advanced wastewater filtration systems to contain PFAS discharge, process redesigns aimed at lowering PFAS emissions at the source (closed loop, impermeable walls around factories), active implementation of alternative chemicals to reduce environmental contamination risks, and incineration of PFAS byproducts generated during the manufacturing process.

Finally, companies facing higher litigation risks tend to have stronger governance frameworks and to provide more transparency. Manufacturers involved in regulatory lobbying are more likely to have formal PFAS policies.

Among the twenty PFAS-using companies we analysed, seven do not have a formal strategy for tracking PFAS in their supply chains and instead rely on supplier-provided certifications and disclosures. Companies with higher PFAS exposure tend to have stricter supplier oversight mechanisms, including:

- Strong **supplier policies** requiring chemical commitments, regular engagement, and independent audits,
- Structured **supplier reporting frameworks** to align external manufacturers with internal compliance standards,
- **Certification programs** to monitor PFAS compliance at the supplier level.

Once again, European-based firms exhibit more structured PFAS governance due to stringent EU regulations (e.g., REACH, POPs[4] Regulation).

BEST PRACTICES

A PFAS policy that clearly outlines **exposure, phase-out or reduction strategies**, and **risk mitigation measures** including solid **grievance mechanisms**.

Among PFAS-users, Best-in-class companies extend PFAS governance to their supply chains. They enforce supplier reporting frameworks, chemical phase-out commitments, and independent audits to ensure compliance. Relying on suppliers' self-disclosures leaves gaps in accountability.

4 - The Pops regulation is a regulation managed by the European Chemicals Agency (ECHA) that bans or restricts the production or use of persistent organic pollutants (POPs) within the EU market. POPs substances have particularly serious health and environmental properties. The regulation applies to both chemical products and articles. In-scope companies are required to report on their use of POPs in articles or mixtures to their respective Member States (https://www.pops.int/)

Impacts and Remedies – Reactive Measures, Cost Challenges, and Prevention Gaps

Despite increasing environmental and legal liabilities risk, only 35% of the manufacturers we engaged with have implemented contamination reduction measures. The most common remediation technologies mentioned are granular activated carbon (GAC) filtration, membrane separation, and reverse osmosis. PFAS treatment effectiveness varies by site due to unique contamination levels and conditions, preventing the emergence of a universal solution. Nanofiltration and reverse osmosis are highly effective and emerged as leading membrane technologies, but are costly, energy-intensive, and require pretreatment – hence a limited scope of application[5]. Indeed, for some companies with lower exposure, their high costs were reported as prohibitive.

The majority of companies investing in PFAS remedies are reacting to past contamination and legal liabilities rather than proactively preventing future exposure. Almost half of PFAS manufacturers engaged are involved in ongoing lawsuits. Moreover, many companies focus on separation and capture, while the real challenge remains elimination, which is still rare.

Among PFAS-users too, remediation remains a rare practice. Only 30% of companies have implemented site-specific remediation initiatives, such as participation in industry-led cleanup efforts. On average, PFAS users expect that regulatory compliance alone is sufficient and they do not take additional voluntary measures to mitigate long-term PFAS contamination.

Waste management costs are currently reported as low for most companies but may rise as new regulations take effect. Some industrial firms expect disposal costs to increase, should PFAS-containing materials be classified as hazardous waste.

BEST PRACTICES

Remedy strategies that focus on **early intervention, regulations monitoring, and investment in remediation technologies**. Best practices include:

- **PFAS remediation plans**, including R&D in prevention technologies.
- **Engagement with environmental agencies** to ensure compliance and prevent future contamination.
- **For PFAS-users, engagement on waste reduction**.

Managing PFAS risks proactively, rather than reactively, is key to reduce financial liabilities.

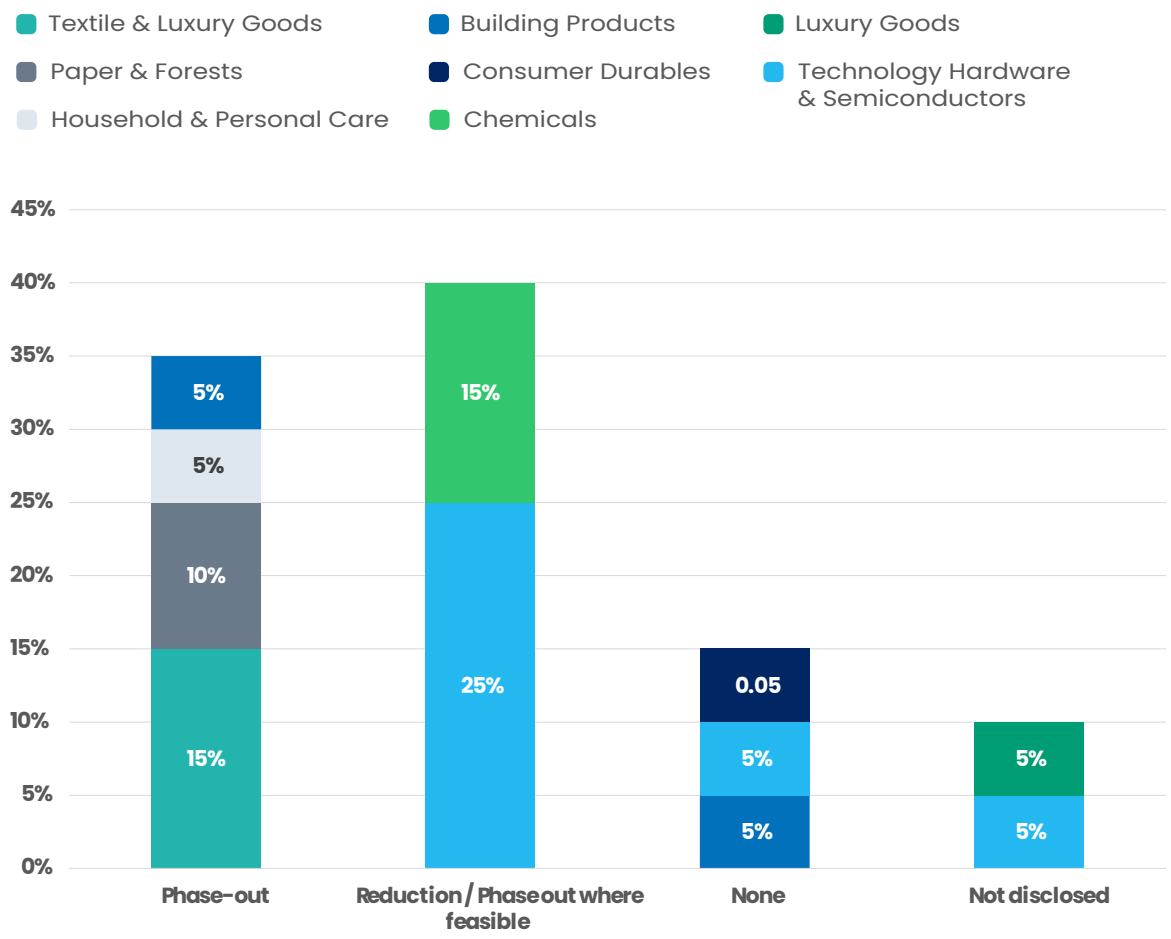
5 - Tushar, M.M.R., Pushan, Z.A., Aich, N. et al. Balancing sustainability goals and treatment efficacy for PFAS removal from water. npj Clean Water 7, 130 (2024). https://doi.org/10.1038/s41545-024-00427-1

Phase-out and Substitutes – The Very Start of a Long Journey

Only 41% of the engaged PFAS manufacturers disclosed phase-out plans, setting deadline commitments or investment roadmaps. Similarly, 35% of PFAS users we engaged with have implemented a full phase-out strategy, while 40% aim at reducing PFAS usage to a minimum where no alternatives with the same properties could be found. 15% of users currently have no PFAS reduction plans and 10% did not disclose about it.

Among PFAS users, industries with direct consumer exposure, which are both more exposed to health effects and regulation, tend to prioritise phase-out, including Textile and Luxury, Household and Personal Care, and Paper & Forest sectors. On the other hand, industries with essential applications (Semiconductors and Chemicals) focus on partial and gradual reduction rather than immediate elimination due to a current lack of available alternatives. Also, companies collaborating directly with suppliers tend to phase-out PFAS faster, emphasising the role of supplier engagement. Finally, we note a lack of disclosure in some sectors, including the luxury segment.

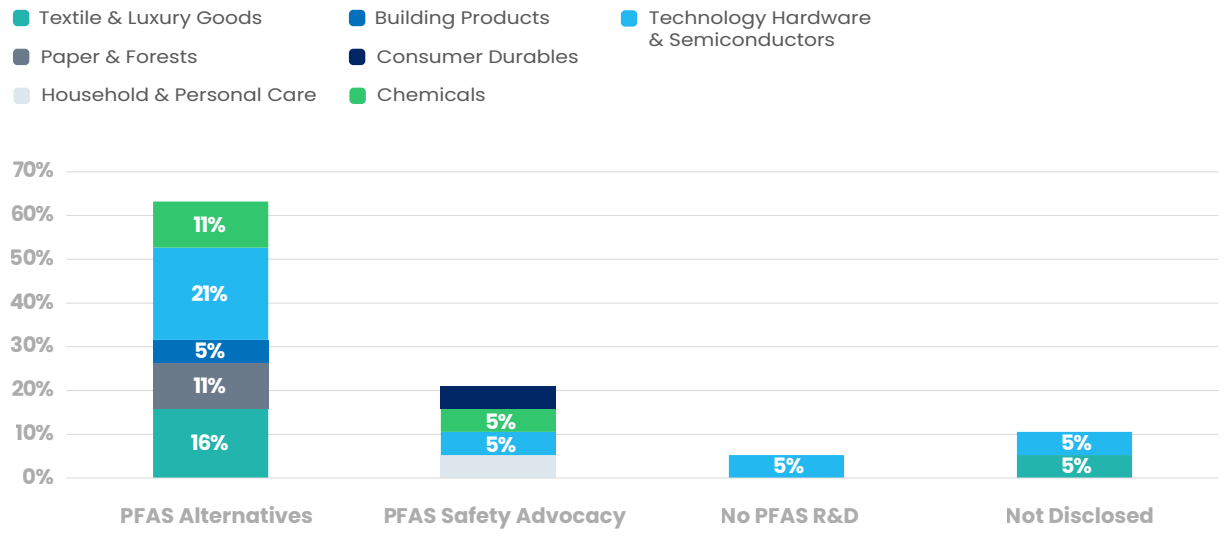
Figure 3 - Phase-out strategies among PFAS-using industries



Source: Candriam PFAS engagement campaign, March 2025

PFAS users have two distinct approaches with regards to potential alternatives: they either develop them, or strive to demonstrate the safety of the PFAS they continue to use.

Figure 4 - PFAS users: Approach to PFAS-related R&D across sectors



Source: Candriam PFAS engagement campaign, March 2025

Among the companies we engaged with, 63% have implemented or are actively researching alternatives. Consumer brands lead this shift, while industrial and tech firms primarily focus on controlled use and compliance with regulations. European companies are generally more proactive.

Implementation challenges remain. The most frequently cited alternatives - siloxane-based coatings, hydrocarbon-based materials, and biodegradable polymers – are facing high costs, supply limitations, and performance challenges that hinder their widespread adoption and prevent a seamless transition.

Thus, industries like Semiconductors and Industrial materials still rely on PFAS for performance, but are increasingly involved in industry-wide efforts to develop more sustainable chemicals. The industries struggling the most with PFAS alternatives include medical devices (sterility and biocompatibility-related concern), aerospace coatings (performance requirements in extreme conditions) and semiconductors (PFAS are essential for chemical resistance in microchip production).

Alternatively, around 20% of companies invest in R&D to demonstrate that the specific PFAS compounds they use are safe for human health and the environment.

Unsurprisingly, we observed that firms that invest more heavily in PFAS substitutes are those who have higher exposure to litigation risk, suggesting a **correlation between regulatory pressure and innovation in sustainable materials.**

BEST PRACTICES

Phase-out strategies should incorporate:

- Clear commitment timelines and structured transition plans.
- Investment in PFAS-free R&D, e.g. Fluorine-free surfactants, biodegradable polymers, and hydrocarbon-based substitutes.
- Regulatory collaboration to secure the development of safer materials.

Firms leading the PFAS phase-out process demonstrate proactive investment in sustainable alternatives, positioning themselves ahead of regulatory mandates and reducing legal and reputational risks.

Legal Risks - Manufacturers Under Pressure, Users Increasingly Affected

PFAS manufacturers face the highest legal risks due to their direct involvement in producing fluorinated chemicals, many of them being linked to environmental contamination and adverse health effects. While some companies defend their PFAS use by citing low-concern polymers and a lack of contrary studies, others anticipate an inevitable ban and are actively looking for alternatives.

41% of PFAS manufacturers we engaged with in this campaign are actively adapting production processes to comply with anticipated REACH restrictions, while another 30% have acknowledged exposure to future PFAS bans but have not (yet?) committed to a phase-out strategy. This latter group is primarily composed of non-European manufacturers that supply PFAS-based products globally and anticipate reduced demand from European markets due to regulatory tightening.

In terms of past legal actions, 42% of manufacturers have faced or are facing PFAS lawsuits, with financial liabilities ranging from several million to multi-billion dollar settlements. The most common types of litigation include: water contamination, product liability for supplying PFAS-containing materials, and worker exposure lawsuits.

Meanwhile, in order to minimise regulatory risks, half of manufacturers we talked to have dedicated regulatory compliance teams actively tracking PFAS-related legislation - and all companies with a high PFAS revenue exposure do. One of them established task forces specifically focused on monitoring policy changes and compliance developments. However, only 30% have board-level oversight of PFAS risks; the lack of executive-level accountability for PFAS exposure remains a challenge for many firms.

Risk mitigation strategies cited by companies are: proactive phase-out, regulatory lobbying, compliance monitoring systems (around 50% of engaged manufacturers report using internal regulatory tracking tools, while 32% undergo third-party legal audits), and early legal settlements, to reduce prolonged legal risks.

Among PFAS users, in terms of expected impact on their business, consumer-facing companies report minimal operational disruptions from a PFAS ban. Industrial firms, however, anticipate challenges, highlighting the significant transition costs away from PFAS, as substitute products may not yet offer sufficient performance.

Litigation risks for PFAS users arise from several sources:

- Failure to disclose PFAS content (leading to potential litigation).
- Occupational exposure claims, particularly in industries handling PFAS-treated materials.
- Supply chain liability, where users of PFAS-based components may share responsibility for contamination.

Consumer companies have already faced class-action lawsuits over misleading "PFAS-free" claims, signalling that product transparency will become a key legal risk.

BEST PRACTICES

Adopt structured legal compliance frameworks that prioritise:

- Early phase-out commitments and PFAS restriction policies
- Active regulatory monitoring – Using internal compliance teams to track legal developments and third-party audits for the firm and its suppliers.
- Participating in public legal consultations to stay ahead of regulations.
- For PFAS users, actively engaging with suppliers.

End of Life – Research Advances, but Scalable Solutions Lag

PFAS being persistent, managing their end-of-life is complex. While some companies actively implement processes to reduce PFAS exposure, others delay action, waiting for regulatory updates. PFAS manufacturers use various technologies in function of the products involved, mainly waste management systems with dedicated facilities for the collection, reuse, destruction of fluorochemicals, and their incineration - which may release byproducts.

Research into effective PFAS destruction is still ongoing. Processes such as chemical and enzymatic degradation or supercritical water oxidation (SCWO) and electrochemical oxidation are being tested but their scalability, cost and complexity remain barriers to widespread adoption.

BEST PRACTICES

While there is no "one-size-fits-all" approach, effective PFAS end-of-life management in-house relies on three key pillars: **collection and recycling, destruction technologies, and enhanced monitoring**. Some of the practices used by industry leaders are the following:

- **Closed-loop recycling**: controlled collection and purification of used fluoropolymers, followed by chemical reprocessing to reintegrate them into manufacturing streams.
- **On-site destruction technologies**: emerging advanced oxidation processes, such as plasma-assisted pyrolysis and hydrothermal alkaline treatment, show significantly higher PFAS degradation rates than traditional incineration but remain in pilot stages.
- **Enhanced monitoring & compliance**: firms conducting third-party audits, stringent waste tracking, and independent verification of PFAS destruction are better positioned to mitigate regulatory risks.

For PFAS users, we encourage vendor / consumer take-back programs, enabling the re-use and responsible disposal of PFAS-containing materials.

Additional best practice is to engage in **regulatory and industry collaboration** with solution providers and waste treatment experts. This can help drive safer disposal methods and align companies with evolving compliance standards.

Next steps?

Investing in sustainable progress

PFAS have been a ground-breaking innovation of the twentieth century, offering exceptional properties that enhance modern life and comfort. However, these same properties that fuelled their widespread use are now causing serious harm to human health and the environment. We are only beginning to uncover the full extent of their impacts and risks. As regulatory scrutiny intensifies and public awareness grows, companies producing or using PFAS face mounting risks. Those that fail to adapt may encounter significant legal and financial consequences, while proactive industry leaders who phase out PFAS and invest in sustainable alternatives will gain a competitive edge. Through our campaign, we have identified several alternatives that outperform their fluorinated counterparts in certain applications, which presents encouraging opportunities for further innovation.

Looking ahead, Candriam will continue to monitor the risks associated with PFAS exposure and engage proactively with both manufacturers and users to mitigate these risks and reduce the consequences on human health and the environment. PFAS exemplify a broader challenge for companies, investors and society: companies have a responsibility to ensure that innovation is pursued with careful consideration of potential unintended consequences, balancing progress with long-term safety and sustainability. Regulations play – and will continue to play - a crucial role in this effort. True sustainable progress comes from leading with foresight, accountability, and purpose, recognizing that success is measured not only by the products created, but also by how responsibly they are managed.