PFAS

The Risks, Regulations, and Responsibility to Develop Sustainable Solutions

WHITEPAPER

By Peter DeSanto Jr., Ph.D.

Actalent

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Introduction

Public concern regarding Per- and Polyfluoroalkyl Substances (PFAS) has grown over the past decade as the harmful impacts of "forever chemicals" continue to become more well-known.

As evidence of their dangers mount -- and substantial liabilities and stricter PFAS regulations continue to emerge -- businesses are assuming a greater moral and fiscal responsibility to adopt sustainable, safer solutions.

With many important decisions for businesses fast approaching, this paper is intended to be a resource that summarizes: the harms associated with PFAS; emerging regulations aimed at eliminating the impacts of those harms; producer liability regarding PFAS pollution; sustainability efforts; and solutions that Actalent can provide to support efforts around mitigating risks due to PFAS.

PFAS
THE RISKS

PFAS comprise a group of chemicals that contain at least one fully fluorinated methyl or methylene carbon atom (OECD) with a few exceptions. The strength of the carbon-fluorine bond imbues these molecules with useful combinations of properties including chemical inertness, hydrophobicity, and thermal stability. Consequently, PFAS have been incorporated into virtually every consumer and industrial product since being developed in the 1940s. PFAS can be solids, liquids, or gases, and possess different molecular structures and sizes which impart different behaviors leading to their usefulness in a wide range of applications. Some PFAS are used in final applications while others are used as processing agents, reactants, or found as intermediates in the production of fluoropolymers. Table 1 provides some examples of more common PFAS found in consumer products and manufacturing operations. They can be found in cosmetics, food packaging, waterproof textiles and footwear, firefighting foam, military and aerospace applications, artificial turf, chrome plating, and construction.

Table 1. Some common PFAS and their applications.

GAS	LIQUID	SOLID
HFC including R32, R134a, R125, R143a and R152a *Refrigerants, HVAC*	**Trifluoroacetic acid and Trifluoroacetic anhydride** *Precursor and reagent for other fluoropolymers*	**PFOA and PFOS** *Surfactants, firefighting foams*
HFO including R1234yf, R1234ze(E) and R1233zd(E) *Refrigerants, HVAC*	**HFPO-DA** *Processing aid for other fluoropolymers*	**Fluoropolymers (PTFE, PVDF, PFA, etc)** *Textiles, coatings, tubing, seals, membranes, filter media, etc.*
HFPO *Intermediate for fluoropolymers*		**Short-chain PFAS (PFNA, PFDA, PFBS, PFHxS, etc)** *Reactants, surfactants, coatings, etc.*

PFAS first became a concern in the 1970s. Studies have since found that PFAS spread and accumulate in all environmental niches with potentially harmful health and environmental effects (Figure 1). Essentially, we learned that the very properties that make PFAS useful – being highly durable, heat resistant, waterproof – also allow them the mobility and strength to accumulate in environmental systems without breaking down.

Today, we know that PFAS have infiltrated almost every ecological niche on earth at concentrations high enough to impact the organisms in those habitats. A summary of these environmental impacts is provided in Table 2. These effects begin with the contamination of ground waters from plant effluent, municipal water treatment facilities, and runoff from waste disposal sites and farmland fertilized with biosolids. As contaminated water permeates the ground, it leaves behind traces of PFAS that accumulate with time. This contaminated water can also carry PFAS to streams and estuaries that then flow to rivers, lakes, and oceans. PFAS are then carried by circulating ocean currents and contaminate regions far from the site of initial release. For instance, PFAS have been found in blood samples from penguins in Antarctica.

Although treatment of water in public water systems can help remove PFAS from circulation, the biosolids left over following such treatment have found increasing use as fertilizer for farmland. These biosolids have been found to be high in PFAS content leading to contamination of farmland on which it is applied. Recently, such farmland has been deemed unfit to grow crops and raise livestock resulting in significant financial loss for farmers. As more regulation on PFAS in enacted, levels in food will be limited resulting in the exclusion of more farmland for food production due to higher than allowable PFAS contamination. This will significantly impact our food supply unless appropriate actions are taken to limit PFAS release into the environment and remediate currently contaminated sites.

Additional environmental concerns exist around PFAS in the atmosphere as both health hazard and as greenhouse gases (GHG) affecting climate change. PFAS precursors and small molecule PFAS can be volatile and escape to the atmosphere during off-gassing and release during production or use. The precursors can then react to form additional PFAS in the environment and in the tissues of organisms. Once inhaled, these compounds accumulate in the respiratory systems of organisms and enter the bloodstream and are distributed to other tissues. In addition to their effects on organisms, many of these fluorinated hydrocarbons are known to be potent GHG with CO_2 equivalencies of 1000x or more (IPCC AR6, Ch. 7).

Figure 1. Environmental pathways for PFAS contamination.

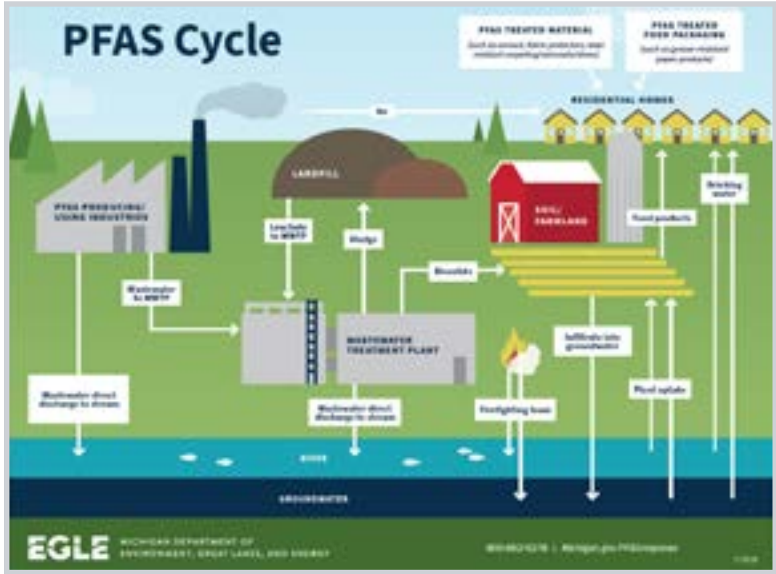

Table 2. PFAS contamination in environment.

WATER	Production effluent, flushable household products, grey water, farmland run off	+ Contamination of rivers, streams, lakes, and fish + Drinking water sources rendered unsafe + Ocean currents spreads PFAS to entire globe. PFAS found in penguins in Antarctica
LAND	Trifluoroacetic acid and Trifluoroacetic anhydride HFPO-DA	+ Contamination of farmland, crops, and livestock + Plants and trees take up PFAS in tissue, bioaccumulation and biomagnification + Biosolids from water treatment used as fertilizer contaminate farmland with PFAS + Loss of nutrients and aggregation in soil due to reduction in algal biomass
AIR	Degradation products, PFAS precursors, monomers, solvents	+ Air quality affected by particulates and volatile PFAS precursors or degradation products. + Atmospheric currents spread PFAS throughout troposphere
BIOTA	Uptake of contaminated food sources, absorption by tissue, respiration	+ Biomagnification up food chain + Contamination of food sources + Interferes with development and function
CLIMATE	Greenhouse gases (GHG) emitted during PFAS production (solvents, intermediates) and from PFAS degradation	+ Enhanced greenhouse gases potential (>1000x) relative to carbon dioxide.

Once released into the environment, PFAS contaminate virtually all habitats and can lead to significant impacts on organisms. Most studies on environmental toxicity have focused on perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) with fewer studies done on more complex mixtures of PFAS. More recent studies have also included alternative PFAS to these compounds and consistently show comparably harmful effects. Table 3 summarizes some of the observed effects on a range of organisms exposed to various levels of PFAS. Many of these effects are observed in reproductive systems and during development. Reductions in species populations near the bottoms of food chains can result in catastrophic impacts on species higher up in these food chains. The bioaccumulation of PFAS in one level of the food chain results in biomagnification as consumers eat contaminated food sources and PFAS levels in turn increase in their tissues. Eventually, PFAS concentrations become high enough to produce harmful effects in these consumers throughout the foodchain.

Table 3. Known PFAS effects on plant and animals.

Animals

TYPE	OBSERVED EFFECT
Clams	Decrease blood cell count and size
Zebrafish	Oxidative liver stress, gut microbiota disruption, anti-inflammatory response, immune-related gene expression
Rice fish	Reduced egg production, reproductive toxicity including anti-estrogenic and estrogenic effects.
Worms	Decreased earthworm survival rate
Mice	Liver protein activity inhibition, decreased enzyme activity, oxidative stress, liver cell death
Mice	Decreased splenic and serum iron levels, anemia, autoimmune disorder
Mice	Decreased testicular and epididymis weight, PFOS leads to lower sperm count and impacts testosterone levels
Benthic organisms	Release of PFAS into surrounding habitats resulting in mortality of other organisms

Plants

TYPE	OBSERVED EFFECT
Rice, beans	Decreased seedling size and shoot growth
Algae	Reduction of population in PFAS contaminated soils
Lettuce	Metabolic disruption and defense pathway triggering

Bioaccumulation and biomagnification ultimately result in unsafe levels of PFAS in humans that have been associated with harmful health effects. Studies on health impacts from PFAS exposures have shown concerning associations between PFAS concentrations in humans and serious health effects. For example, the European Chemicals Agency (ECHA) classifies some PFAS as known reproductive toxins, meaning they reduce fertility and harm the unborn child (ECHA). Ongoing research on health impacts from PFAS exposure continue to add to the list of suspected effects to human health (CDC).

Some examples of these health impacts are provided on the next page in Table 4. These studies utilized a variety of in silico, animal models, and epidemiological approaches to assess the likelihood that PFAS exposure may be a significant contributor to various maladies. Additional studies are currently being developed to study more complex mixtures of the most prevalent PFAS and alternatives to gauge the risk to public health. As a result, public health researchers have raised concerns followed by public health officials and legislators proposing various regulations to minimize PFAS exposure.

Table 4. Known or likely health risks associated with PFAS exposure (NIEHS, NIH, CDC, ECHA).

- Known to damage the liver with repeated exposure
- PFOS and PFOA suppress antibody response, reduced ability to fight infections, reduced vaccine response
- Increased risk of prostate, kidney, and testicular cancer
- Increased cholesterol levels and/or risk of obesity

- Known reproductive toxin
- Increased high blood pressure in pregnant women
- Lower birth weight

- Impacts neurodevelopment including psychomotor, externalizing behavior, and comprehensive development
- Developmental impacts in children, accelerated puberty, bone variations, or behavioral changes

- Persistent organic pollutant aka POP (like PCBs and dioxins)
- Persistent, bioaccumulative, and toxic aka PBT

- Sex-specific effects on social behavior and sleep problems were identified
- Changes in hormone functioning

PFAS
THE REGULATIONS

Regulations around the world are focused on the reduction of PFAS levels in the environment below those that are considered harmful to human health. Consequently, regulatory bodies are developing guidelines and limits to the amounts of PFAS in water, soil, and air as well as limiting their use in all areas of production and consumption (see Figure 2). A consensus definition of regulated PFAS has garnered some debate amongst industry officials, but most agree that short chain (less than 12 carbons) PFAS should be considered for regulation. However, industries that rely on fluoropolymers contend that polymers are neither toxic nor mobile. Still, regulators have included fluoropolymers as restricted PFAS due to their environmental persistence and accumulation, lifecycle emissions (including manufacture and disposal), and their lack of removal from waste streams (C&EN).

The most stringent and impactful of these regulations is likely to be those pending approval in the EU under ECHA to prohibit the importation of any products and materials containing measurable PFAS levels. Given the size of the EU market, producers and suppliers will be forced to modify materials used in production to comply with these restrictions or risk their share of the EU market. Other countries are pursuing similar restrictions including North America and Asia, which will require every supplier to eliminate PFAS from their products in the coming years. Many of these countries already have stringent restrictions on PFAS levels in drinking water which will require the phasing out of specific PFAS in consumer and industrial goods.

Figure 2. Existing and proposed PFAS regulations around the world.

CHINA

Action Plan on New Pollutants Governance refers to "toxic and hazardous chemicals with the characteristics of biological toxicity, environmental persistence, bioaccumulation, etc. which pose great risks to the ecological environment or human health but have not been included in environmental management or existing management measures are not sufficient."

CANADA

Draft report provides a qualitative assessment of PFAS on the environment and human health. This report provides the basis for a class-based approach to inform decision-making on PFAS. The report also proposes to conclude that PFAS as a class are harmful to human health and the environment. Regulations to follow.

UNITED STATES

EPA mandate now requires all manufacturers and importers of PFAS to comply with stricter reporting requirements by May 2025. EPA has also set advisory limits on ppt levels for certain PFAS, with additional PFAS being added each month. Individual states have also enacted their own regulations ranging from reporting rules to outright bans on products made with intentionally added PFAS.

AUSTRALIA

PFAS National Environmental Monitoring Plan now on v3.0 and will lead to guidance on allowable levels in drinking water, material, and products.

EUROPE

ECHA ban on all PFAS containing materials and products produced and imported to Europe.

SOUTH KOREA

Expanding organic pollutants and PFAS categories.

JAPAN

Limits on PFOS and PFOA in drinking water.

REGULATIONS IN EUROPE

ECHA is currently in the late phases of adopting regulations that would effectively ban the presence of PFAS in any product imported into the EU. The limits proposed are 25 ppt for individual PFAS and 250 ppt for total PFAS. ECHA defines PFAS as any substance that contains at least one fully fluorinated methyl (CF3-) or methylene (-CF2-) carbon atom that is not fully degradable. This encompasses more than 10,000 substances produced in quantities of about 300,000 ton per year. The ECHA regulation also includes a ban on any future PFAS yet to be developed.

In its current proposed form, this ban will affect almost every product and process category across multiple sectors, including the use of PFAS in textiles, coatings, packaging, medical devices, and electronics. With the exception of derogated materials in critical applications, all intentionally added PFAS will need to be eliminated from products imported to the EU. Proposed material derogations are dependent on the criticality of the end use and the availability of suitable alternatives to the intentionally added PFAS. These derogations allow for temporary exemptions that expire after time periods up to 13 years to allow for the identification and substitution of alternative materials. Some of these product categories include certain medical devices, protective clothing for firefighters, and refrigerants for specialized laboratory uses. However, the vast majority of products containing intentionally added PFAS will be required to find substitute materials following the enactment of the proposed regulations. For derogated products, EU regulations will require documentation and annual reporting of PFAS levels. Many companies will require additional product stewardship efforts to comply or lose access to the EU market and associated revenue.

The timeline for voting on EU regulation is anticipated to take place sometime in 2025 (ECHA). ECHA's regulatory committees are currently reviewing comments and proposals and will provide opinions to the EU in 2024. Once opinions are provided, the European Commission has three months to prepare a draft amendment, which tend to be substantially similar to the opinions of the regulatory committee. If there is not opposition to the amendment after review by various committees, member states, and the WTO, then the amendment is adopted. Companies may be hoping that additional derogations for their products will be added following the comment period and review of additional data. However, prudence suggests that it is in the best interests of the affected industries to consider the current proposal when deciding how best to proceed regarding PFAS regulation.

REGULATIONS IN UNITED STATES

PFAS regulations in the US are being enacted and proposed by both national and state authorities. The presence of PFAS in ground waters and soil are of primary concern as these are affected by PFAS in run-off, discarded materials, and biosolids applied as fertilizers. Individual state bans with different limits will result in a complex maze of restrictions that typically results in the most stringent regulation being the one that most industries will focus on. Once enacted, producers and importers will be required to eliminating PFAS from their products. Producers in states with water regulations will be responsible for monitoring, reducing, and reporting PFAS levels in their effluent streams.

The most common targets of regulation are PFAS commonly found in drinking water including PFOS and PFOA. Many states within the US have already adopted maximum contamination limits (MCLs) on PFAS in drinking water and banned their use in fire-fighting foams. Other states like California and New York have also passed more restrictive limits on PFAS in items such as food packaging and children's products. A list of US states that have enacted or proposed legislation setting limits on PFAS in a variety of uses and products is provided in Table 4. At least one state, Maine, has banned intentionally added PFAS from all products of any kind sold in the state with intermediate deadlines designed to allow industry to adapt. It is expected that similar bans will soon be enacted on a state-by-state basis with possible concurrent or future federal regulation.

At the federal level, the Environmental Protection Agency (EPA) recently finalized a rule through the Toxic Substances Control Act (TSCA) providing a definition for PFAS and establishing a database of compounds under that definition. The rule also mandates that any manufacturer (including importers) of these compounds in any year since 2011 must report PFAS data by May 8, 2025. Information that must be reported includes chemical identity, uses, volumes made and processed, byproducts, environmental and health effects, worker exposure and disposal. This represents the most comprehensive list of PFAS compounds to date in the US, which EPA will use to research, monitor, and regulate PFAS.

Additionally, the EPA has proposed National Primary Drinking Water Regulation (NPDWR) for six PFAS that is expected to be finalized by the end of 2023. This regulation will limit the MCL for each PFAS to 4 ppt or less. Public water systems will be required to monitor PFAS levels and notify the public of these levels. If levels are found to exceed the EPA regulated MCLs, then public water utilities will be required to reduce these levels via water treatment and remediation. Consequently, consumer and industrial effluent streams will be required to not introduce higher levels of PFAS and may need to be treated prior to release into municipal streams.

However, it is estimated that the public costs from the environmental and health impacts far exceed the costs associated with PFAS regulation. While it is difficult to estimate the total financial impact of PFAS effects on the environment and public health, several researchers have estimated the total annual costs at around $100 billion in the US alone (Cordner et al. and Langone et al.). Worldwide, the total cost costs connected to healthcare from exposure to PFAS and environmental remediation are estimated to be in the trillions (ChemSec).

U.S. regulation of PFAS will have significant impacts on just about every company in the global marketplace. These impacts include:

+ R&D efforts to replace PFAS in products
+ Retooling production lines to eliminate sources of PFAS and process new materials
+ Costs associated with litigation including legal fees and regulatory fines
+ Loss of market share and revenue due to product registration and release delays
+ Increased commercial general liability insurance costs or the loss of coverage for PFAS-specific risks
+ Continued health and safety risks to employees and the general public
+ Permitting issues for production facilities
+ Loss of investors from missed sustainability goals

PFAS
THE RESPONSIBILITY
Legal, Reputational, and Financial

In the U.S., legal and financial risk to companies that produce PFAS compounds or use PFAS in their products are already impacting major chemical companies around the world. Recently, 3M entered into a settlement agreement to pay $10.3 billion over 13 years to provide funds for the testing and treatment of PFAS contamination in local public water systems around the United States (Reuters). However, the settlement includes language for water authorities to estimate their expected share of the settlement before deciding whether to opt out. In addition, states can still pursue separate lawsuits over PFAS contamination. As the costs to remediate water supplies are expected to far exceed the settlement, 3M and other PFAS producers remain at risk for future litigation. To reduce such risk, many companies who use PFAS materials in their products are seeking to eliminate those materials from their products or operations even before bans are enacted.

Many companies are also seeking protection from civil liability for PFAS contamination and its impacts under commercial general liability insurance. This has resulted in legal battles between companies and their insurers as many PFAS were not originally considered as part of insurance coverage when policies were written. Both litigation costs and insurance premiums for PFAS liability are expected to increase exponentially as more suits are filed by both public and private groups and companies battle with insurers to offset those liabilities. Reducing liability by documenting and limiting PFAS levels in all facets of operations is critical to reducing legal risk.

Publicity around regulatory actions, class action lawsuits, and consumer driven campaigns against "forever" and "GenX" chemicals is increasing public awareness and there is resulting pressure on companies to reduce or eliminate PFAS from their products. Those that are proactively addressing PFAS in their product lifecycles and protecting their consumer base are seeing positive impacts on consumer confidence and increased brand recognition. Similar to the consumer driven elimination of PABA from sunscreen in the 1980s, campaigns against PFAS are expected to have significant influence in driving producers towards alternatives. The influence of social media on consumers will accelerate this trend toward the elimination of PFAS in many products with early adopters enhancing their public profile by leading the way.

Table 5. Examples of Proposed and Enacted PFAS Restrictions in U.S. states.

STATE	RESTRICTION	STATUS
Alaska	Drinking water standards	Pending
California	CA laws prohibit food packaging with intentionally added PFAS; requires cookware manufacturers to disclose PFAS and BPA; bans PFAS in children's products	Took effect 10/5/2021 and 7/1/2023
Colorado	Law prohibits use of foams with intentionally added PFAS in aircraft hangars; creates capture and disposal standards, requires fire departments to register PFAS use and storage.	Took effect 1/1/2023
Connecticut	Bans PFAS in fire-fighting foam and PFAS intentionally added to food packaging.	Took effect 2021 and 2023
Delaware	Passed law mandating that DNREC and DPH establish drinking water standards for PFOA and PFOS.	Took effect 2021
Florida	Passed laws mandating FL Dept. of Environmental Protection to set target clean-up levels by 2025; proposed clean-up actions will go to vote in FL legislature.	Mandate took effect 6/20/2022; outcome pending
Georgia	PFOA and PFOS restrictions and use in AFFF	Took effect in 2019
Hawaii	Bans manufacture, distribution, and sale of certain food packaging that contain PFAS.	Takes effect 12/31/2024
Illinois	Illinois law bans class B firefighting foam that uses PFAS; limits drinking water levels	Took effect 8/6/2021
Maine	Full ban - all products with intentionally added PFAS phased out by 2030; exempts essential use.	Took effect 1/1/2023
Maryland	MD law bans intentionally added PFAS in firefighting foam, rugs, carpets, and food packaging	Takes effect 1/1/2024
Massachusetts	Drinking water standards established; a ban on intentionally added PFAS in a host of products has been proposed.	Products ban awaits action in legislature
Minnesota	Bans intentionally added PFAS in carpets, rugs, cleaning products, cookware, cosmetics, dental floss, fabric treatments, juvenile products, menstruation products, textile furnishings, ski wax, upholstered furniture.	Takes effect 1/1/2025
New York	Prohibits food packaging with intentionally added PFAS; limits amounts allowed in household cleaning and personal care products. Additional NY laws ban or restrict used of tris phosphate, asbestos, and benzene in children's products.	Took effect 12/31/22
Oregon	Prohibits sale or distributions of food packaging with intentionally added PFAS	Goes into effect 1/1/2025
Pennsylvania	Drinking water standards	Took effect 1/1/2023
Rhode Island	Drinking water standards	Went into effect 7/1/2023
Vermont	Bans PFAS in firefighting foam; Bans intentionally added PFAS from food packaging, rugs and carpets, and ski wax.	Phase 1 took effect 7/1/2022; Phase 2 took effect 7/1/2023
Virginia	Bans use of firefighting foam with PFAS in training but not emergencies.	
Washington	WA law restricts use of PFAS in firefighting foam (2018); Bans PFAS in food packaging.	Food packaging phase 1 took effect 2/1/2023; phase 2 takes effect 5/1/2024
West Virginia	Requires state DEP to develop action plan to identify and address PFAS sources in raw-water	Took effect 2023

Achieving Sustainability

Many companies have undertaken extensive efforts to address sustainability in their operations guided by ESG scorecards that consider environmental, social, and governance factors in their evaluations. Scores account for not only the public effects from PFAS in effluent and products, but also the effects on the local workforce, buildings, and grounds in which operations occur. As such, sustainability efforts should include site assessments and reduction in PFAS-containing products like furnishing materials, wall coverings, office products, and other incidentals that employees are exposed to in their daily work routines. It should be noted that while ESG scores are an assessment of a company's sustainability, the most important outcome from improving ESG scores should be the focus on reducing and eliminating public risk for harmful impacts from PFAS as reflected in the discussion of the individual scoring factors that follow.

The environmental factor (E) includes pollution and other environmental factors that are affected by the entire product lifecycle from production to disposal. Reduction of PFAS in raw materials, processing, plant equipment, reagent, intermediates, effluents, and finished products will enhance a company's environmental assessment. In addition, companies can take advantage of multiple remediation strategies to eliminate current soil and water contamination onsite. Remediation technologies can be evaluated against the site with PFAS contamination to determine the most appropriate measures to deploy. Remediation can immediately reduce environmental spread of PFAS when done properly and reduce the impact on wildlife, food sources, water sources, and farmland.

Social factors (S) include health and safety and social capital, i.e. how public perception is affected by a company's efforts and progress toward protection health and safety. The immediate concerns around health and safety are of paramount importance and can be objectively measured by large scale studies on PFAS levels in tissue and blood samples correlated with health outcomes over time. Health and safety factors can be immediately improved by eliminating or reducing the release of PFAS into the environment via products and effluents. Social capital is driven by consumer sentiment that can be affected by public perception based on a company's actions to act responsibly in the face of those health and safety concerns. Public concern around PFAS is rapidly growing and will likely spike due to public debate and discussion around pending legislation and as additional health impact studies are published. Companies should capitalize on real efforts toward PFAS reduction by publicizing their actual impacts rather than resorting to "greenwashing."

Reduction of PFAS in raw materials, processing, plant equipment, reagent, intermediates, effluents, and finished products will enhance a company's environmental assessment.

Corporate governance (G) factors include ratings for risk management and transparency. Managing risks around liability for PFAS impacts will significantly impact this score for clients who rely on PFAS as critical components in their products and operations. Avoidance can be done by replacing or eliminating PFAS from existing products and processes with less harmful materials and operations while considering the net impact to future financials. Mitigating existing risk can be done by spreading that risk if insurance litigation finds that PFAS must be covered under current coverages. For products in which PFAS is an unintended contaminant, risk may be shared with material vendors and will likely involve litigation to fully resolve liability. Proactive efforts to manage risk from PFAS liability can enhance a company's ESG rating as well as provide investors with peace of mind that their loved ones are being protected from harm.

The Actalent Solution

We've made it our mission at Actalent to leverage our capabilities and expertise in proactive support of our clients' strategic initiatives. Actalent support can contribute to efforts to meet regulatory requirements, protect the public from PFAS health and environmental effects, and improve sustainability by eliminating PFAS from products. Whether your goal is to improve sustainability or meet regulatory demands, Actalent's services supporting your PFAS efforts may include:

Project Assessment	+ What is current state vs goals? + Assess current progress on PFAS + Identify stakeholders & needs + Determine timelines/effort/access	+ Business objectives & prioritization + Review required and existing documentation + Create statement of work (SOW)
Evaluation	+ Identify data sources, data structure, software tools available + Assess programs, systems, & processes + Discuss objectives with stakeholders & SMEs	+ Determine Actalent resources required for subsequent phases + May require change order to SOW after this phase
Data Collection	+ Documentation review + Product catalogue review + Gap assessment	+ Data entry + Review products & processes + Data consolidation
Data Analysis and Management	+ Database design & management + Data integrity best practices	+ Third party software selection & onboarding + Trend analysis & reporting
Report Generation	+ Report submission setup (ECHA derogations require annual reporting of PFAS content and quantity) + Quality checks & validation + Provide marketing with updates to inform consumers	+ Investor relations information on pioneering progress + ESG scoring templates
Program Creation and Launch	+ Data-based program design + Coordinate with stakeholders & cross-functional teams + Set business objectives & prioritization + Iterate based on feedback + Notify vendors	+ Develop training & documentation + Design changes & validation + Training & procedure roll-outs + Testing & prototyping + Supplier relations & code of conduct
Monitoring and Maintenance	+ Updating database: test data, new materials and products, vendors, supporting documentation	+ Annual reporting + Consulting & technical expertise + On-demand support

Once in place, Actalent can continue to maintain your PFAS efforts through our expert program managers to ensure that you remain in compliance with evolving regulations and criteria for sustainability.

Table 6. Actalent solution matrix for PFAS programs.

Actalent Solution	Client Need: COMPLIANCE	Client Need: SUSTAINABILITY	Client Need: PRODUCT REPLACEMENT	Client Need: PRODUCT STEWARDSHIP
ASSESSMENT	+	+	+	+
PROGRAM DEVELOPMENT	+	+	+	+
INVENTORY	+	+	+	+
DOCUMENTATION	+	+	+	+
DATA COLLECTION	+	+	+	+
DATA MANAGEMENT	+	+	–	+
REPORTING	+	+	–	+
REPLACEMENT	–	+	+	+
PROGRAM MAINTENANCE	+	+	+	+

FOR MORE INFORMATION

To discover how Actalent can help your organization comply with PFAS regulations and other chemical restrictions, contact Peter DeSanto directly at pdesanto@actalentservices.com or feel free to submit a general inquiry here.