Green Seal®
601 13th St NW, 12th Floor
202.872.6400 | greenseal@greenseal.org
greenseal.org

Call For Comments

Proposal for Chemical Class Prohibition: Per- and Polyfluoroalkyl Substances (PFAS) Prohibited in Paints & Coatings, Cleaning & Degreasing Agents, Adhesives, and Floor-Care Products

November 20, 2024. Green Seal® is inviting feedback on a proposed update to the criteria for Paints, Coatings, Stains, & Sealers; Cleaning & Degreasing Agents; Adhesives; and Floor-Care Products to prohibit per- and polyfluoroalkyl substances (PFAS) in product formulas. We are seeking input from all stakeholders including industry experts, public health researchers, product designers, raw material suppliers, product testing laboratories, purchasers, end users, and the public. To learn more or submit comments, please visit our PFAS Prohibition page.

Summary of Proposed Prohibition:
Products must be formulated without PFAS and cannot include PFAS as known contaminants from formula chemistry at more than 100 ppm. Added colorants to paint at a point-of-sale for relevant products also must be formulated without PFAS.

Green Seal Standards with Criteria Proposed for Revision:

- Paints, Coatings, Stains, and Sealers (GS-11)
- Cleaning and Degreasing Agents (GS-34)
- Adhesives for Commercial Use (GS-36)
- Floor-Care Products for Industrial and Institutional Use (GS-40)

Green Seal® is a global nonprofit committed to making sustainability everyone's business. The ecolabelling movement we pioneered decades ago has helped people make informed purchasing decisions and driven the marketplace toward healthier, greener choices. Hundreds of the world's leading companies carry our certification on their products, services, and spaces to quickly signal how they've met a high benchmark of health and environmental leadership. Look for, partner with, and lean on Green Seal, so you can make healthier, safer choices with confidence.

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Section I. Instructions for Submitting Comments

At Green Seal we believe that a collaborative approach leads to better solutions for everyone. We develop standards though an open, transparent process that prioritizes stakeholder input. Public comment periods are a mechanism for soliciting input and promoting the effectiveness of our proposed criteria toward achieving our intended outcomes.

Guidelines for Submitting Comment
Comments should:

- Be specific in nature
- Include a technical or market-focused justification
- Include references from reputable sources
- Include actionable solutions

Public Comment Closing Date
This comment period is open for 30 calendar days, closing on December 20, 2024.

Submit Comments via Email
Comments must be submitted online. The submission form can be found here, or on our standard project page.

Comment Review Process
We will confirm receipt of comments and may reach out to schedule a brief conference call to request clarification.

Within 90 days of the close of the comment period, we will publish a Response to Comments document that includes the text of all written comments submitted during the Public Comment Period and summarizes actions taken, as well as justifications for inaction regarding requested changes.

For Questions About this Process
For all other inquiries including questions about this public comment process, contact our team at standards@greenseal.org.

Section II. Proposal Overview

We are proposing to add a chemical class prohibition on per- and polyfluoroalkyl substances (PFAS) to the following Green Seal standards for formulated products: Paints, Coatings, Stains, & Sealers; Cleaning & Degreasing Agents; Adhesives for Commercial Use; and Floor-Care Products for Industrial and Institutional Use. Historically, we have restricted several long-chain PFAS chemicals (typically containing seven or more carbon atoms) in products certified to these standards due to their hazard classifications. A growing body of evidence indicates that all PFAS chemicals, including short-chain PFAS, may have the same harmful health and environmental effects as the legacy PFAS they are replacing. Therefore, using a precautionary approach, we are proposing to prohibit PFAS as an entire chemical class.

Green Seal began prohibiting PFAS as a chemical class in 2020 with the release of our certification criteria for hand sanitizers. At that time, we committed to taking this leadership position on PFAS in all our standards and have been making this update systematically. In June 2022, we strengthened the PFAS prohibitions in our cleaning and personal care product standards. Now, we are strengthening the PFAS criteria in our standards for paints & coatings, cleaning & degreasing agents, adhesives, and floor-care products. This additional requirement is intended to: raise the bar for health protections provided by product certifications; provide product transparency for purchasers and consumers; incentivize phasing out PFAS throughout the supply chain; and increase the demand for safer alternative chemicals that provide the same functions as PFAS.

Overview of PFAS

Per- and polyfluoroalkyl substances (PFAS) are a group of thousands of synthetic chemicals that share a structural similarity: strong carbon-fluorine bonds. This unique structure makes these chemicals highly stable and effective at repelling oil, water, and heat; however, it also makes them resistant to breaking down in the environment and in human bodies. PFAS have been used in a variety of industries dating back to the 1950s. They are found in everything from cookware, textiles, and food packaging to paints and coatings, cosmetics, and cleaning products. PFAS are now ubiquitous in the environment. Biomonitoring studies show that most humans have been exposed to PFAS [1] and that both PFOS and PFOA are found in most human blood samples. Exposure to PFAS is linked to several adverse health effects including cancer, reproductive harm, and decreased immune response.

PFAS Alternatives are Available

In 2023, we completed a feasibility assessment for a PFAS prohibition that included a review of the North American markets of impacted products, a review of product formulations, and outreach to relevant stakeholders. For floor-care products, specifically floor finishes, PFAS are widely prevalent. Almost all acrylic/wax floor finishes on the market contain either fluorotelomers or fluorosurfactants.[2] We received feedback that manufacturers are feasibly able to re-formulate floor finishes using alternatives to PFAS, largely driven by legislation in the U.S. and globally that soon will restrict PFAS in these product categories.

[1] PFAS in the U.S. Population. https://www.atsdr.cdc.gov/pfas/health-effects/us-population.html
[2] Survey and environmental/health assessment of fluorinated substances in impregnated consumer products and impregnating agents. https://www2.mst.dk/udgiv/publications/2008/978-87-7052-845-0/pdf/978-87-7052-846-7.pdf

In the paint market, PFAS have been identified as replaceable ingredients in paints, coatings, stains & sealers. A recent study detected PFAS in about 50% of the tested paint samples.[3] Safer alternatives are commercially available.[4]

Adhesives, cleaners, and degreasers also have many commercially available products that do not contain PFAS.

A Phased Approach to PFAS Revisions

Eliminating PFAS from product supply chains is a critical pathway to protecting human health and preventing long-term environmental contamination from this chemical class. Our approach to prohibiting PFAS aims to achieve the following objective: All certified product formulas and product packaging will be verified to be formulated without PFAS and cannot include PFAS as known contaminants from formula chemistry at more than 100 ppm.

The scope of the project is separated into three phases, based on evidence that PFAS are widely used in many industries, including as functional ingredients in the paints and coatings industry[5] and as an unintentional byproduct of a strengthening process in the plastic product packaging industry.[6,7] The scope of each of the three phases is described below.

Phase I (Completed): This phase included prohibiting PFAS in cleaning and personal care products through updates to nine Green Seal standards. This phase was completed in 2022.

Phase II (Current Phase): This phase will set criteria for additional product categories such as floor care, paints and coatings, adhesives, and degreasers. Research and development began in 2023 and are anticipated to be completed in early 2025. A separate revision project for our Standard for Sanitary Paper (GS-1) is running in tandem and will explore adding criteria for PFAS.

Phase III: This phase will explore setting criteria for product packaging. Research and development are anticipated to begin in 2025.

Our standards are developed through a transparent, stakeholder-based process that welcomes ongoing feedback throughout every phase.

[3] PFAS in Paints. https://healthybuilding.net/reports/25-pfas-in-paints
[4] Eliminating Unnecessary PFAS in Building Materials. https://greensciencepolicy.org/docs/pfas-building-materials-2021.pdf
[5] An overview of the uses of per- and polyfluoroalkyl substances (PFAS). https://engrxiv.org/2eqac/
[6] Beyond paper; PFAS linked to common plastic packaging used for food, cosmetics, and much more. http://blogs.edf.org/health/2021/07/07/beyond-paper-pfas/
[7] Perfluorinated Carboxylic Acids in Directly Fluorinated High-Density Polyethylene Material. https://doi.org/10.1021/es1043968

Intended Outcomes

Stronger Protections for Human Health

Exposure to PFAS has been associated with serious health effects, including thyroid dysfunction,[8] altering hormone production and menstruation,[9] increased risk of certain cancers,[10] and impacting immunological processes, including reduced immune response to vaccinations.[11] Negative health outcomes have affected vulnerable populations such as children and women who are pregnant. Nearly all Americans have measurable levels of PFAS in their blood.[12] Health risks associated with long-term exposure in communities with PFAS contamination in drinking water sources is well documented.[13] There also is evidence that people are exposed to PFAS through food packaging, ingesting and inhaling household dust, and through personal care products. Eliminating PFAS as a chemical class from products will reduce people's exposure and therefore reduce the likelihood of negative health outcomes. Additionally, prohibiting PFAS in consumer products used routinely in schools, daycares, etc. will reduce exposure among these vulnerable populations.

Increased Transparency and Safer Supply Chains

PFAS use is widespread. Public health advocacy groups are uncovering how commonly these chemicals are intentionally included in product formulas, used as additives in the manufacturing process, or found as components in product packaging. While manufacturers have voluntarily phased out certain well-studied long-chain PFAS (seven or more carbon atoms), short-chain replacement chemicals have been shown to act similarly to their long-chain predecessors and, in some cases, may be just as harmful.[14] It can be challenging for consumers to ensure products do not include PFAS. By verifying that Green Seal-certified products are formulated without PFAS and do not include PFAS as contaminants from formula chemistry at more than 100 ppm, we will provide greater transparency for final manufacturers and buyers and encourage the elimination of PFAS from supply chains.

Prevention of Environmental Pollution

PFAS do not naturally biodegrade in the environment, and as a result, they are a problem throughout their product life cycle, from production to use and disposal.[15] PFAS are released into the environment from industrial sites, airports, military bases, landfills, and water treatment plants, as well as from the use of consumer products. Thus, PFAS are found in ecosystems around the globe and are known to bioaccumulate in plants and animals.[16,17] Today, nearly half of all drinking water supplies in the U.S. are

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[8] Thyroid Disrupting Effects of Old and New Generation PFAS. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7851056/
[9] PFAS and female reproductive outcomes: PFAS elimination, endocrine-mediated effects, and disease. https://www.sciencedirect.com/science/article/pii/S0300483X2100353X
[10] What are the health effects of PFAS? https://www.atsdr.cdc.gov/pfas/health-effects/index.html
[11] Serum vaccine antibody concentrations in children exposed to perfluorinated compounds. https://doi.org/10.1001/jama.2011.2034
[12] ATSDR, Understanding PFAS Exposure and your Body. https://www.atsdr.cdc.gov/pfas/health-effects/PFAS-exposure-and-your-body.html#:~:text=Nearly%20all%20people%20in%20the,carpeting%20and%20water%20repellent%20clothing.
[13] USGS, Tap water study detects PFAS 'forever chemicals' across the US. https://www.usgs.gov/news/national-news-release/tap-water-study-detects-pfas-forever-chemicals-across-us
[14] EPA: GenX Nearly as Toxic as Notorious Non-Stick Chemicals It Replaced. https://www.ewg.org/news-insights/news-release/epa-genx-nearly-toxic-notorious-non-stick-chemicals-it-replaced
[15] Disposal of products and materials containing per- and polyfluoroalkyl substances (PFAS): A cyclical problem. https://doi.org/10.1016/j.chemosphere.2020.127659
[16] Perfluorinated compound (PFC) concentrations in northern gannet eggs 1977-2014: a Predatory Bird Monitoring Scheme (PBMS) report. https://pbms.ceh.ac.uk/sites/default/files/PBMS_Gannet_PFCs_report_2013.pdf
[17] Plant uptake and translocation of perfluoroalkyl acids in a wheat-soil system. https://pubmed.ncbi.nlm.nih.gov/30178412/

estimated to contain one or more PFAS.[15] Some PFAS are likely to take centuries to fully degrade, [18] so the contaminant levels are only expected to increase over time unless these chemicals are removed from the supply chain. Removing PFAS from supply chains and ensuring that they are not in consumer products will slow and prevent additional environmental contamination.

[18] Investigation of the Biodegradation Potential of a Fluoroacrylate Polymer Product in Aerobic Soils https://doi.org/10.1021/es0710499

Section III. Red-Lined Tracked Changes

Text in the boxes below show the details of the proposed revisions.
The red text shows proposed additions.
Any text ~~with strikethrough lines~~ are proposed deletions.

Our proposed revisions to the identified standards are below. The language prohibiting PFAS will be added as a criterion in the Safer Chemicals section and a definition for PFAS will be added to the Annex A of each standard. Relevant defined terms in each standard will be italicized.

This proposed revision affects the following standards:

- Paints, Coatings, Stains, and Sealers (GS-11)
- Cleaning and Degreasing Agents (GS-34)
- Adhesives for Commercial Use (GS-36)
- Floor-Care Products for Industrial and Institutional Use (GS-40)

GS-34 and GS-40:

Per- and Polyfluoroalkyl Substances (PFAS). The undiluted product shall not contain any ingredients or components that are Per- and Polyfluoroalkyl Substances (PFAS).

GS-11 and GS-36:
As paints, coatings, and adhesives are usually sold ready to use, rather than as a concentrate, the term 'undiluted product' is redundant for the purposes of Green Seal's formula review, so the below text will be used.

Per- and Polyfluoroalkyl Substances (PFAS). The product shall not contain any ingredients or components that are Per- and Polyfluoroalkyl Substances (PFAS).

All standards:

ANNEX A – DEFINITIONS (Normative)

Per- and Polyfluoroalkyl Substances (PFAS). A class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom.

Related Standard Updates
If the PFAS Prohibition is enacted, additional minor updates will be made to individual standards to account for differences in defined terms and ensure a consistent implementation across multiple standards. A summary of these revisions is below.

GS-11 Standard: (1) The term "component" and its definition will be added to this standard. The definition will be consistent with the definition in the GS-37 Standard. In addition, language indicating that Added Colorants at a point-of-sale are within scope will be added to the Safer Products Section.

2.2.2 Colorant Added at Point-of-Sale. The criteria below apply to colorants specified by the manufacturer to be added to the product.

2.2.2.1 VOCs. The VOC concentration of the product including the colorant added at the point-of-sale shall not exceed 50 grams of VOC per liter of product above the levels allowed for the product without colorant.

An average VOC level calculation for a colorant shall be applied unless a manufacturer can provide documentation of the VOC levels of the colorant(s) and assurance that only those colorant(s) tested shall be used with the product.

2.2.2.2 PFAS. Colorant added at the point-of-sale shall not contain Per- and Polyfluoroalkyl Substances (PFAS).

GS-34 Standard: (1) The term “component” and its definition will be added to this standard. The definition will be consistent with the definition in the GS-37 Standard.

GS-36 Standard: (1) The term “component” and its definition will be added to this standard. (2) The term “ingredient” and its definition will be added to this standard. These definitions will be consistent with the definition in the GS-37 Standard.

GS-40 Standard: (1) The term “component” and its definition will be added to this standard. The definition will be consistent with the definition in the GS-37 Standard.

Section IV. Research Record

The following section summarizes research focused on the composition, function, and prevalence of PFAS. This section also summarizes adverse health risks and environmental impacts associated with PFAS, chemical exposure pathways, testing methodology, and current regulatory policy.

Overview of PFAS as a Chemical Class

PFAS are a large group of man-made chemicals used in industrial processes since the 1940s. Thousands of PFAS have been identified and sub-grouped, with the most well-studied being perfluoroalkyl acids and perfluroalkylether acids (PFAA). One organization of those sub-groups with common names is presented below.[19]

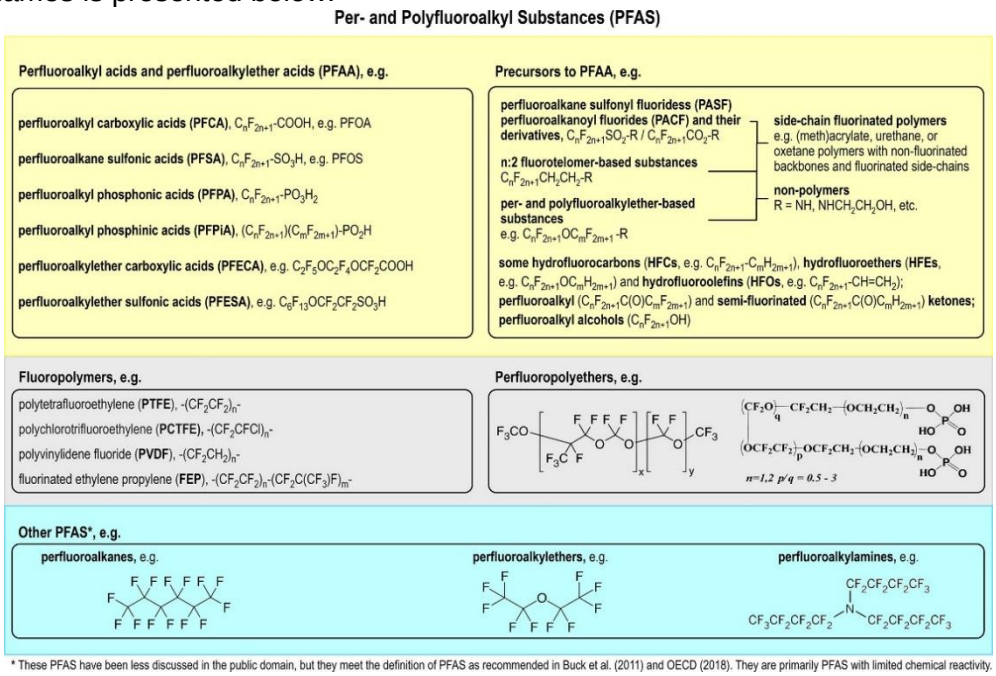

Figure 1. Examples of PFAS chemistries

Chemical Structure. The defining characteristic of PFAS is that they contain bonds between carbon and fluorine atoms – one of the strongest bonds in organic chemistry.[20] The perfluoroalkyl portion (C_nF_{2n+1}–) of PFAS is also hydrophobic and lipophobic meaning it repels water and fats.[21] This chemical structure makes PFAS useful in industry applications because as "extremely stable chemicals, they resist high temperature and degradation and most notably, they repel both grease and water."[22] As a result, they often function as repellents of water, dirt, and oil and are used as surfactants and friction reducers.

[19] Scientific Basis for Managing PFAS as a Chemical Class. https://doi.org/10.1021/acs.estlett.0c00255
[20] Smart BE, Dixon DA. Bond-energies and stabilities of poly(perfluoroethers). In: Abstracts of papers of the American chemical society, vol. 207. 1994. p 31–FLUO
[21] Kissa E. Fluorinated surfactants and repellents, vol. 97. 2nd ed. New York: Marcel Dekker, Inc.; 2001
[22] PFAS the 'Forever Chemicals' Invisible threats from persistent chemicals. https://chemtrust.org/wp-content/uploads/PFAS_Brief_CHEMTrust_2019.pdf

A distinction has been made between “long-chain” and “short-chain” PFAS with the “chain” referring to the number of carbon atoms in some sub-groups of PFAS. Long-chain PFAS are generally regarded to have seven or more carbon atoms, and short-chain six or less[23] The two most well-studied and regulated PFAS are long-chain: Perfluorooctanoic acid (PFOA) and Perfluorooctane sulfonic acid (PFOS). PFOA and PFOS are often referred to as “legacy” PFAS, since they have been phased out of production by numerous manufacturers and market sectors.[24] Short-chain PFAS can also be referred to as “emerging” PFAS, due to their rapid development as potential successors to long-chain or legacy PFAS.[25] However, research has indicated that these short-chain or emerging PFAS have the potential to be even worse for the environment and human health than the legacy or long-chain PFAS.[26, 27]

PFAS Definition. Because PFAS are a broad group of thousands of chemicals, there have been many attempts to define them.[22,28,29] Green Seal has aligned with entities including the European Union (EU) European Chemicals Agency (ECHA),[30] the States of California,[31] Colorado,[32] Maine,[33] Minnesota,[34] New York,[35] Oregon,[36] Vermont,[37] and Washington,[38] GreenScreen Certified,[39] and Cradle to Cradle[40] by proposing to prohibit PFAS as a chemical class, or “a class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom.” This broad definition allows us to ensure that all Green Seal-certified products will continue to meet any state, national, or international laws or regulations which have a PFAS prohibition, and to encourage removing all PFAS from supply chains so they cannot cause long-term environmental pollution and potential human health impacts. The number of PFAS chemicals identified has continued to rise over recent years, with some estimates now at more than 14,000 chemicals.[29]

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[23] Perfluoroalkyl and polyfluoroalkyl substances in the environment: Terminology, classification, and origins. https://doi.org/10.1002/ieam.258
[24] Legacy and Emerging Per-And Polyfluoroalkyl Substances. https://pmc.ncbi.nlm.nih.gov/articles/PMC7863963/
[25] Short-Chain perfluoroalkyl acids: environmental concerns and a regulatory strategy under REACH. https://pmc.ncbi.nlm.nih.gov/articles/PMC5834591/
[26] Characterizing biopersistence potential of the metabolic 5:3 fluorotelomer carboxylic acid after repeated oral exposure to the 6:2 fluorotelomer alcohol. https://www.sciencedirect.com/science/article/abs/pii/S0041008X20300028?via%3Dihub
[27] Comparative analysis of the toxilogical databases for 6:2 fluorotelomer alcohol (6:2 FTOH) and perfluorohexanoic acid (PFHxA) https://www.sciencedirect.com/science/article/abs/pii/S0278691520300983?via%3Dihub
[28] Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance.www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/CBC/MONO(2021)25&docLanguage=en
[29] EPA CompTox Chemicals Dashboard 2.0 Navigation Panel to PFAS Substance Lists. https://comptox.epa.gov/dashboard/chemical-lists/PFASSTRUCT
[30] ECHA, Annex XV Restriction Report. https://echa.europa.eu/documents/10162/f605d4b5-7c17-7414-8823-b49b9fd43aea
[31] AB-1200 Plant-based food packaging: cookware: hazardous chemicals. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB1200
[32] Colorado Revised Statues Section 25-5-1302. https://casetext.com/statute/colorado-revised-statutes/title-25-public-health-and-environment/products-control-and-safety/article-5-products-control-and-safety/part-13-firefighting-foams-and-personal-protective-equipment/section-25-5-1302-definitions
[33] Maine Revised Statues Tile 32, Chapter 26-A, Section 1732. https://www.mainelegislature.org/legis/statutes/32/title32sec1732.html
[34] 2023 Minnesota Statutes Section 325F.075. https://www.revisor.mn.gov/statutes/cite/325F.075
[35] New York Assembly Bill A3556C. https://www.nysenate.gov/legislation/bills/2023/A3556/amendment/C
[36] Oregon Senate Bill 543. https://legiscan.com/OR/text/SB543/2023
[37] Vermont Act 36. https://legislature.vermont.gov/Documents/2022/Docs/ACTS/ACT036/ACT036%20As%20Enacted.pdf
[38] Revised Code of Washington 70A.222.010. https://app.leg.wa.gov/rcw/default.aspx?cite=70A.222.010
[39] GreenScreen Certified™ Standard for Food Service Ware. https://www.greenscreenchemicals.org/certified/food-service-ware
[40] Cradle to Cradle Certified® Product Standard. https://www.c2ccertified.org/resources/detail/cradle_to_cradle_certified_product_standard

PFAS Consumer Presence. PFAS's unique chemical structure allows them to confer waterproof, stainproof, greaseproof, and low-friction properties to a variety of products and processes. PFAS are used in many industries, including as stain repellants in textiles, coatings for cookware and food packaging, fluoropolymers in surgical meshes, and protective coatings in several manufacturing applications. The use of PFAS in this revision's four categories of interest are described below in more detail.

Paints, Coatings, Stains, and Sealers: Architectural paints and coatings utilize fluorosurfactants, (i.e. PFAS) which act as levelling, wetting, and stain blocking agents.[5] PFAS are often used to impart additional benefits that are not essential to the function of the product, such as stain-resistance.

Cleaning and Degreasing Agents: The most documented use of PFAS in cleaning products is as surfactants, which lower the surface tension of water so the molecules in the product are more likely to react with oil and grease. However, cleaning product formulas do not require fluorinated surfactants because their product chemistry does not need them to perform their intended function. Hundreds of product formulas perform well without the use of these chemicals, indicating sufficient alternatives are available.[41]

Adhesives: Adhesives, which are used to bond two materials together, sometimes contain PFAS to increase adhesion strength. Many adhesive formulations are made from non-fluorinated chemicals due to other materials performing sufficiently to aid adhesion.[42]

Floor-Care Products: Floor finishes can utilize fluorinated surfactants to aid in spreading a finish across a floor and maintaining performance over time. Historically, many acrylic/water-based floor finishes in the U.S. contained PFAS. While replacements for PFAS continue to be challenging, more alternatives are becoming available[43] and feedback from manufacturers has noted reformulating is feasible to comply with upcoming regulatory legislation.

Exposure Pathways. Common PFAS exposures include dermal and inhalation exposure via the use of consumer products and ingestion of contaminated food and water. PFAS have been found in drinking water sources across the globe (discussed further below) and ingesting drinking water contaminated with PFAS is considered the primary chronic exposure pathway.[44] Additionally, because of their use in paper-based food packaging as grease-proofing agents,[45] people are also exposed to PFAS when eating food contaminated by PFAS-treated food packaging: "Studies on food contact materials have reported the migration of PFAS, including PFOA, PFBA, perfluorohexanoic acid (PFHxA), PFNA, and fluorotelomer alcohols (FTOHs), from materials such as microwave popcorn bags and paper bowls into

[41] Industry feedback received in outreach process.
[42] Handbook of Adhesives and Sealants. https://users.fs.cvut.cz/libor.benes/vyuka/lepeni/Handbook%20of%20Adhesives%20and%20Sealants.pdf
[43] Alternatives to PFAS in Floor Polish Formulations. https://bcgc.berkeley.edu/sites/default/files/pfas-in-floor-polish-final-report.pdf
[44] PFAS Contamination of Drinking Water Far More Prevalent Than Previously Reported. https://www.ewg.org/research/national-pfas-testing/
[45] The Regulation (and Deregulation) of Additives for Use in Food Contact Paper in the U.S. https://www.martindale.com/legal-news/article_keller-and-heckman-llp_2505182.htm

foods and food simulants…leading to PFAS contamination of food."[46] There is also some evidence that short-chain PFAS can accumulate in vegetables grown in contaminated soil, further highlighting food as a PFAS exposure pathway.[47,19] Additionally, when PFAS are present in other consumer products that are used regularly in indoor spaces, they can be found in dust, which can then also be ingested or inhaled.[48] Occupational exposure is another pathway. In a pilot study, elevated levels of PFAS in airborne particulate matter were measured during floor finish application and stripping activities.[49] Inhalation exposure is possible from volatile PFAS, and dermal absorption is possible via direct exposure to products containing PFAS, and wastewater where relevant.[50]

Impacts on Human Health

As noted above, humans are exposed to PFAS through several avenues, including drinking water, food, and the use of consumer products. This potential chronic exposure, coupled with the fact that many PFAS do not leave the human body for years,[51] has led to PFAS being found in the blood of nearly all humans, even newborns, in the U.S. and other countries around the globe.[52,53]

Of the overall PFAS chemical class, PFOA and PFOS have received the most study and are both associated with several adverse health outcomes. PFOA has been designated as a probable carcinogen[54] and has been associated with increased risk of testicular and kidney cancer, as well as several other conditions such as ulcerative colitis, thyroid disease, and impacts on pregnancy.[55] PFOS has been shown to cause "hepatotoxicity, neurotoxicity, reproductive toxicity, immunotoxicity, thyroid disruption, cardiovascular toxicity, pulmonary toxicity, and renal toxicity in laboratory animals and many in vitro human systems."[56] Both chemicals have been found to cause "reproductive effects such as decreased fertility…; developmental effects or delays in children…; , increased risk of some cancers, including prostate, kidney, and testicular cancer…; reduced ability of the body's immune system."[57] While the manufacturing and use of PFOA and PFOS has been mainly phased out in the US, many of the short-chain chemicals meant to replace these two chemicals also display concerning health impacts. For example, Perfluorobutane sulfonic acid (PFBS), meant to replace PFOS, has been shown

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[46] Emerging Issues in Food Waste Management Persistent Chemical Contaminants. https://www.epa.gov/system/files/documents/2021-08/emerging-issues-in-food-waste-management-persistent-chemical-contaminants.pdf

[47] Uptake of Perfluorinated Alkyl Acids by Hydroponically Grown Lettuce (*Lactuca sativa*). https://doi.org/10.1021/es302398u

[48] A review of the pathways of human exposure to poly- and perfluoroalkyl substances (PFASs) and present understanding of health effects. https://www.nature.com/articles/s41370-018-0094-1

[49] Per- and polyfluoroalkyl substances (PFASs) in airborne particulate matter (PM2.0) emitted during floor waxing: A pilot study. https://www.sciencedirect.com/science/article/abs/pii/S1352231021006671

[50] Paints: A Source of Volatile PFAS in Air ─ Potential Implications for Inhalation Exposure. https://pubs.acs.org/doi/full/10.1021/acs.est.2c04864#

[51] Breaking It Down: Estimating Short-Chain PFAS Half-Lives in a Human Population. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7657368/#c4

[52] Maternal serum concentrations of perfluoroalkyl acids in five international birth cohorts. https://pubmed.ncbi.nlm.nih.gov/28063899/

[53] Fourth National Report on Human Exposure to Environmental Chemicals Updated Tables, March 2021, Volume three. https://stacks.cdc.gov/view/cdc/105344

[54] Perfluorooctanoic Acid (PFOA), Teflon, and Related Chemicals. https://www.cancer.org/cancer/cancer-causes/teflon-and-perfluorooctanoic-acid-pfoa.html

[55] Probably Link Evaluation of Birth Defects. http://www.c8sciencepanel.org/pdfs/Probable_Link_C8_Birth_Defects_5Dec2011.pdf

[56] Assessing the human health risks of perfluorooctane sulfonate by in vivo and in vitro studies. https://doi.org/10.1016/j.envint.2019.03.002

[57] Our Current Understanding of the Human Health and Environmental Risks of PFAS. https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas

to have impacts on the thyroid,[58] and a chemical by the trade name of GenX, meant to replace PFOA, has been associated with "hepatic and renal effects and suppressed immune function in mice." [21]

Of particular concern is the effects of PFAS on human development and thus vulnerable populations, such as those who are pregnant and children. Many studies have documented associations between PFAS and "adverse immune outcomes" in children.[54] For example, exposure to PFAS has been associated with reduced antibody responses to vaccinations: "children exposed to higher levels of PFAS during development had a reduced immune response to routine tetanus vaccination."[13] Additional impacts on children and pregnancy include delayed puberty in children exposed to PFAS while in utero,[24] lower birthweights,[58] and pregnancy-induced hypertension.[56]

Environmental Impacts

Because of their resistance to breaking down naturally, and their widespread use, PFAS contamination in the environment is well documented throughout the chemical life cycle. For example, during manufacturing and product use, PFAS can be released into the air, soil, and water.[59] PFAS used as raw materials or processing agents can be released as emissions or into wastewater streams, and "current emission filters do not completely capture them, nor is there an effective means of disposing of captured PFAS."[21] PFAS can also enter the environment through a products' end-of-life, or disposal, phase: "incineration of PFAS wastes can release toxic air pollutants and greenhouse gases" and consumer products can leach PFAS when disposed in landfills.[17] It's estimated that over 45,000 tons of Perfluorooctane sulfonate (PFOS) — just one of the many PFAS chemicals — were released into air and water sources between 1972 and 2002.[60]

Releases of PFAS in the environment have long-term consequences because PFAS can have such long half-lives – the time in which 50 percent of the chemical is expected to degrade. For example, some PFAS polymers have estimated half-lives of over 1,000 years in soil.[15,61] These long half-lives also mean PFAS can travel far distances from their original release into the environment[62,63] — a problem not specific to long-chain PFAS. Short-chain PFAS have also been detected in waterbodies and, in some cases, were found to be more persistent in aquatic systems.[64,65] PFAS contamination has been widely documented in waterbodies across the U.S. and globally. It is estimated that some level of PFAS is now found in all U.S. drinking water supplies that use surface water, with one study finding 1,400 sites in 49 U.S. states containing PFAS contamination in drinking water.[33] A report from 2023 estimates that almost half of the nation's drinking water sources have one or more types of PFAS.[15] The widespread contamination of PFAS has also been shown to result in bioaccumulation in plants and

[58] Learn about the Human Health Toxicity Assessment for PFBS. https://www.epa.gov/chemical-research/learn-about-human-health-toxicity-assessment-pfbs
[59] What are PFAS? https://www.atsdr.cdc.gov/pfas/health-effects/overview.html
[60] A First Global Production, Emission, And Environmental Inventory for Perfluorooctane Sulfonate. https://doi.org/10.1021/es802216n
[61] Degradability of an acrylate-linked, fluorotelomer polymer in soil. https://doi.org/10.1021/es9002668
[62] A global survey of perfluorinated acids in oceans. https://pubmed.ncbi.nlm.nih.gov/15913661/
[63] Atmospheric perfluorinated acid precursors: chemistry, occurrence, and impacts. https://link.springer.com/chapter/10.1007%2F978-1-4419-6880-7_1
[64] Short-chain per- and polyfluoroalkyl substances in aquatic systems: Occurrence, impacts and treatment. https://doi.org/10.1016/j.cej.2019.122506
[65] Chapter 14 - Analysis of GenX and Other Per- and Polyfluoroalkyl Substances in Environmental Water Samples. https://www.sciencedirect.com/science/article/abs/pii/B9780128157305000144

animals. For example, PFOS can build up in fish, birds, and other marine mammals,[66] and it is expected that some PFAS would be found in samples from any wild animal.[67] Plants can also accumulate PFAS when grown in contaminated soil or irrigated with contaminated water. [47, 19] While less is known about effects on wildlife than in humans, exposure to PFAS has been associated with adverse effects such as toxicity, effects on immune function,[68,69] and even impacts on subsequent generations of organisms.[70]

In addition to the ecological consequences, the presence of PFAS as an environmental pollutant ultimately becomes another exposure pathway for human health through the ingestion of drinking water and contaminated food sources like fish and game. Green Seal has determined that eliminating PFAS from the supply chain is critical to preventing pollution that will persist for decades and continue to be a challenge to remediate.

Current Regulatory Efforts

The majority of regulatory efforts in the U.S. and the European Union have focused on limiting PFAS exposure in drinking water, with recent efforts including setting "legally enforceable levels" for five PFAS in drinking water in the U.S.[71] In April 2024, the EPA published the PFAS National Primary Drinking Water Rule, which created legally enforceable Maximum Contaminant Levels (MCLs) for PFOA, PFOS, PFHxS, PFNA, and HFPO-DA. Under the same Rule, the EPA reduced the advisory level from 70 parts per trillion (ppt) to 0 ppt for PFOA and PFOS combined. PFHxS, PFNA, and HFPO-DA have a 10 ppt MCL.[72] Over 20 states in the U.S. have imposed regulatory limits on drinking water.[73] Some U.S. states have stricter regulations for other individual PFAS of concern.[74,75]

In the past few years, a growing number of U.S. states have also started focusing on restricting intentionally added PFAS in consumer products. Thirty states have adopted bills that limit or prohibit PFAS in a variety of consumer product categories.[76] Below are the regulatory efforts relevant to the product categories covered under this revision:

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[66] U.S. EPA Long-Chain Perfluorinated Chemicals (PFCs) Action Plan. https://www.epa.gov/sites/default/files/2016-01/documents/pfcs_action_plan1230_09.pdf
[67] Environmental and Health Impacts of PFAS. https://dnr.wisconsin.gov/topic/PFAS/Impacts.html
[68]Immunotoxicity in green mussels under perfluoroalkyl substance (PFAS) exposure: Reversible response and response model development. https://setac.onlinelibrary.wiley.com/doi/10.1002/etc.4060
[69] Elevated levels of per- and polyfluoroalkyl substances in Cape Fear River Striped Bass (*Morone saxatilis*) are associated with biomarkers of altered immune and liver function. https://www.sciencedirect.com/science/article/pii/S0160412019334762
[70] Fate and effects of poly- and perfluoroalkyl substances in the aquatic environment: A review. https://setac.onlinelibrary.wiley.com/doi/10.1002/etc.2663
[71] Biden-Harris Administration Finalizes First-Ever National Drinking Water Standard to Protect 100M People from PFAS Pollution. https://www.epa.gov/newsreleases/biden-harris-administration-finalizes-first-ever-national-drinking-water-standard
[72] EPA, Final PFAS National Primary Drinking Water Regulation. https://www.epa.gov/sdwa/and-polyfluoroalkyl-substances-pfas
[73] Safer States Bill Tracker, State Polices on PFAS in Drinking Water. https://www.saferstates.org/bill-tracker/?toxic_chemicals=PFAS&issue_sectors=Water
[74] Per- and Polyfluoroalkyl Substances (PFAS) in drinking water. https://www.mass.gov/service-details/per-and-polyfluoroalkyl-substances-pfas-in-drinking-water
[75] Drinking Water Facts: Per- and Polyfluoroalkyl Substances (PFAS) in drinking water. https://www.nj.gov/health/ceohs/documents/pfas_drinking%20water.pdf
[76] Safer States Bill Tracker. https://www.saferstates.org/bill-tracker/?status=Adopted&toxic_chemicals=PFAS

- In 2021, Maine passed legislation that requires disclosure for products containing PFAS and bans the intentional use of PFAS in certain products beginning January 1, 2023.[77] There will be a ban on all products, with few exceptions, containing PFAS by January 2030.
- In 2022, Washington State passed HB 1694, which allows the state to accelerate work on setting limits for PFAS in priority products, including cleaning and floor-care products[78].
- In 2023, Minnesota's HF 2310 was signed into law in and will ban PFAS from being intentionally added to certain consumer products, including cleaning and floor care products, beginning January 1, 2025.[79] Minnesota will also prohibit PFAS for all non-essential product uses beginning in 2032.

At a federal level in the U.S., there has been action to limit PFAS exposure, such as the Food and Drug Administration's (FDA) efforts to ban three PFAS for use in food packaging in 2016.[80] The FDA is also monitoring the use of PFAS in cosmetics through efforts such as its Voluntary Cosmetic Registration Program in which manufacturers can self-report uses of PFAS in cosmetics.[81] Additionally, the U.S. federal government has recently taken steps including efforts to regulate PFAS as hazardous substances; address PFAS contamination at military sites; and commit to continued testing to assess the existing contamination of the U.S. food supply.[82] The extent of these efforts highlights the importance of addressing PFAS across supply chains to eliminate the source of environmental pollution so that costly remediation efforts are not needed after chemicals have accumulated and caused adverse health and environmental effects.

PFAS Testing

Analytical testing methods can be useful tools in determining the presence and amount of a compound in a product. However, with PFAS, Green Seal has identified challenges with requiring analytical testing in the standard language. The current testing methods are insufficient either by only testing a limited number of PFAS or are not yet accurate enough to be used as the basis for our conformity assessment process given our existing requirements for a full chemical review, on-site audit, and batch ticket confirmation. For example, test methods that try to measure PFAS individually can "on average…measure a discrete list of 40 PFAS compounds," [83] out of the thousands that could meet the industry-leading definition. Conversely, Total Organic Fluorine testing – the most widely used method to detect potential PFAS in consumer products – measures the overall concentration of fluorine-containing compounds, which can result in identifying compounds from the product chemistry that are not PFAS or are only present due to background contamination. For example, municipal water sources contaminated with high levels of PFAS would be present in Total Organic Fluorine testing.

Green Seal's intended outcomes are to ensure products are formulated without PFAS to encourage its removal from supply chains and to reduce the overall environmental burden. As a result, the proposed criteria for this revision do not include testing requirements to achieve certification. However, we are

[77] H.P. 1113 - L.D. 1503. https://www.mainelegislature.org/legis/bills/getPDF.asp?paper=HP1113&item=5&snum=130
[78] Washington PFAS Law Takes Aim at Consumer Goods. https://www.natlawreview.com/article/washington-pfas-law-takes-aim-consumer-goods
[79] Bill Summary H.F.2310. https://www.house.mn.gov/hrd/bs/93/HF2310.pdf
[80] "Forever Chemicals" Called PFAS Show Up in Your Food, Clothes, and Home. https://www.nrdc.org/stories/forever-chemicals-called-pfas-show-your-food-clothes-and-home
[81] Per and Polyfluoroalkyl Substances (PFAS) in Cosmetics. https://www.fda.gov/cosmetics/cosmetic-ingredients/and-polyfluoroalkyl-substances-pfas-cosmetics
[82] Fact Sheet: Biden-Harris Administration Launches Plan to Combat PFAS Pollution. https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/18/fact-sheet-biden-harris-administration-launches-plan-to-combat-pfas-pollution/
[83] EuroFins, A Practitioner's Guide to PFAS Testing. https://www.eurofinsus.com/media/dgelt4du/3000_pfas-prac-guide.pdf

committed to closely monitoring the availability of cost-effective and accurate test methods for detecting intentionally added PFAS in formulated materials. Future standard updates may incorporate testing criteria as methodologies improve. Additionally, Green Seal plans to implement random spot-check sampling during our ongoing monitoring to test and validate our compliance process.