Apple’s commitment to phasing out per- and polyfluoroalkyl substances (PFAS)

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Executive summary

At Apple, we have a long history of leading in the removal of potentially harmful substances. This means proactively restricting hazardous substances and using safer materials in Apple products and manufacturing processes to ensure the well-being of our employees, our customers, people in our supply chain, and the planet, while driving change that goes beyond what is required for regulatory compliance. We've done so since the late 1990s, rigorously assessing chemicals and removing those that don't align with our goals, such as replacing PVC with safer thermoplastic elastomers and eliminating brominated flame retardants from thousands of enclosures, cables, circuit boards, and connectors. As part of our long-standing commitment to design products that are better for the environment and for people, we're releasing this white paper to detail our commitment to phase out our use of per- and polyfluoroalkyl substances (PFAS). As part of this effort, we plan to engage all of our supply chain partners to restrict PFAS from our products and manufacturing processes and to develop safer alternatives that not only maintain, but may even enhance, the performance of Apple products.

The environmental implications of the use of PFAS are significant, and we're responding with focus and dedication. We want to thoughtfully phase out PFAS in a way that does not result in regrettable substitutions. We're prioritizing our phaseout activities on applications that result in the highest volumes of PFAS reductions and the most meaningful environmental impact. It will take time for Apple to completely phase out PFAS from our products and processes because of the challenges related to compiling a comprehensive catalog of PFAS use, identifying and developing non-PFAS alternatives that can meet the performance needs for certain critical applications, and taking into account the time needed for material qualification. This paper details our plan to phase out PFAS from our products.

Introduction

Apple has led the industry in removing harmful substances from our product designs, and we go to great lengths to make sure these substances stay out of our products. We've built an infrastructure to do this work, including the rigorous requirements defined in our Regulated Substances Specification (RSS), which describes Apple's global restrictions on the use of many chemical substances or materials in Apple products, accessories, manufacturing processes, and packaging used for shipping products to Apple's end customers. To find a replacement for PVC and phthalates, for example, we and our suppliers invested in four years of research and development to create power cords and headphone cables that had both the performance and the chemistry that met Apple standards. This deep commitment to safer chemistries led us to innovate new solutions, while other companies are still using PVC and phthalates in their cables.

We are proud and humbled to report that our work to develop and use safer chemicals in our products has been recognized. Apple has received the #1 rank and an A+ rating from Mind the Store, an external campaign that evaluates the largest retailers in North America on how they ensure the chemical safety of their products and packaging, for the past three years. In 2021, for the second year in a row, we received the EPA Safer Choice Partner of the Year Award, recognizing our work to scale the use of safer process chemicals and protect those working in our supply chain. Apple was the first consumer electronics company to receive this recognition.

Our commitment to creating the highest-quality products that are also better for the environment and for people requires diligent work, beginning with collecting comprehensive chemical composition information for the substances used to make our products, as well as the process chemicals. We do this in several ways. First, our Full Material Disclosure (FMD) program, which was launched in 2016, maps the chemicals in the materials used in our products. In addition to understanding our product chemistry, our Chemical Safety Disclosure (CSD) program advances disclosure around the chemistries used in manufacturing processes

by our suppliers for Apple products, identifying how chemicals are used, how they're stored, and how employees are protected. And at our Environmental Testing Lab, we evaluate the safety of our products and materials through chemical analyses, identifying potentially harmful chemicals so we can make the right decisions when it comes to potential toxicological risks. Our FMD and CSD programs and chemical analyses represent our ongoing efforts to monitor materials against the strict requirements of our Regulated Substances Specification.

The creation of our FMD and CSD programs has been a unique, innovative approach to a challenge faced across our industry. Identifying opportunities to reduce toxicological risk — and potentially develop new chemistries — requires deep knowledge of product and process chemistries. The data we collect from our disclosure programs and Environmental Testing Lab helps inform material selection decisions across our product life cycle. And we continue to innovate. We're using machine learning to digitize data from chemical tests so this information can be more easily assessed. We're also advocating for an industry standard to help encourage the digital exchange of this important information. Through these efforts and by sharing with others in the industry what we've learned in the process of creating these systems, we're not only improving the safety of our products, but we're also leading the push for transformational change across the broader electronics industry.

Background on PFAS

Per- and polyfluoroalkyl substances (PFAS) are a large class of thousands of synthetic chemicals. They all contain carbon-fluorine bonds, which are one of the strongest chemical bonds known. PFAS are widely used because they have unique performance properties. For instance, they're extremely chemically and thermally stable, with high resistance to degradation and oxidation. Many of them also have surfactant properties and functions that make them ideal as water and grease repellents.

Some of the major industry sectors using PFAS include aerospace and defense, automotive, aviation, food contact materials, textiles, leather and apparel, construction and household products, electronics, firefighting, food processing, and medical products (1). The same desirable physical and chemical properties that have led to their widespread use also have a troubling downside — because PFAS resist degradation and are highly persistent, they break down very slowly in the environment. Scientific studies have linked high-level exposure to some PFAS to harmful health effects in humans and animals, and more research is ongoing to understand adverse health outcomes from exposures to PFAS (2).

Our goal is always to ensure that everyone who makes, uses, or recycles an Apple product can do so safely, and our efforts to phase out PFAS from our products and processes is in line with this broader commitment. We're focusing our efforts on actions that have the potential for the greatest impact, triggering positive ripple effects both inside and outside of Apple. This is why we're prioritizing our phaseout activities on applications that result in the highest volumes of PFAS reduction and the most meaningful environmental impact.

[1] European Union. (n.d.). *Perfluoroalkyl chemicals (PFASs).* ECHA. https://echa.europa.eu/hot-topics/perfluoroalkyl-chemicals-pfas.

[2] US EPA. (2022). *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.

Apple's PFAS phase out commitment

Apple eliminated two PFAS members, perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), from our products by restricting their use in 2010 and 2013, respectively. We were proactive on this step, taking action ahead of global requirements, because research at the time showed that these chemicals remain persistent in the environment, and exposure to high, unsafe levels of PFOA or PFOS in drinking water may result in adverse health effects.

In our 2021 update of the Regulated Substances Specification, Apple added restrictions for perfluorocarboxylic acids C9-C14 (PFCA), their salts, and related substances, as well as perfluorohexanoic acid (PFHxS), its salts, and related substances, from use in all homogeneous materials in Apple products. We also updated restriction thresholds for PFOA and updated the restriction group to include "its salts, and PFOA-related compounds," and expanded the scope of the PFOS restriction.

In our ongoing effort to ensure the safety of our products, our assessment system alerted us that PFAS as a class of substances would not meet our stringent life-cycle requirements for materials used in our products. We started with an assessment of the PFAS class with the highest use volume in our products — the fluoropolymers. While our analysis indicated that these materials are safe during product use, we felt it important to broaden our scope to consider manufacturing along the supply chain. We concluded that our goal needs to restrict the use of all PFAS compounds.

A complete phaseout of PFAS from Apple products and processes will take time. We need to compile a comprehensive catalog of PFAS use in electronics, identify and develop non-PFAS alternatives that can meet the performance needs for certain critical applications, and take into account the time needed for material qualification. Lastly we need to ensure that the non-PFAS alternatives do not result in regrettable substitutions — where alternatives are as harmful as, or even more harmful than, the PFAS being replaced. These steps are described in more detail below:

1. Compiling a comprehensive catalog of PFAS use in electronics

Through the FMD and CSD disclosure programs, as well as our direct supplier engagement, we're creating a comprehensive, detailed inventory of PFAS used to make our products. Our current understanding, which will continue to evolve as we capture more data through FMD, supplier reporting, and material mapping, is that PFAS are used across the following applications: coatings for durability, ingress protection, oleophobic properties, and corrosion protection; plastics for water repellency, insulation, lamination, water sealing, and flame safety; technology-specific applications in batteries, image sensors, displays, light management films, and capacitors; and other materials such as adhesives, inks, and pressure-sensitive tapes.

We're engaging with policymakers to ensure that rigorous restrictions are placed on discretionary uses of PFAS, while providing time-limited exemptions for critical applications where no alternatives exist yet, and leveraging the time-limited status of the exemptions to challenge industry to expedite research into alternatives.

We're also helping the industry prepare guidance to make it easier for small and medium-size companies to find out where PFAS may be used in components and manufacturing processes in their supply chains. We're working with the NGO ChemSec and industry associations in Europe and the U.S. to prepare comprehensive lists of all known uses of PFAS in electronics. In addition, we've presented case studies on the complexity of PFAS uses in the electronics industry at workshops with the European Commission and the chemicals industry.

2. Identifying and developing non-PFAS alternatives that can meet the performance needs for critical applications

We're implementing detailed plans with our existing suppliers on the stages and timeframes needed to establish possible substitute materials for specific applications, and we're partnering with new suppliers to develop new materials and technologies. We're also conducting a search to identify current academic and industry research projects developing viable non-PFAS alternatives for electronics applications.

As possible alternatives are identified and we have line of sight on material qualification and build integration, we'll commit to targets for specific phaseout of select PFAS applications

We're also engaging with research and development projects led by expert research institutes across the world to prototype innovative alternative technologies that may be able to replace PFAS. Our analysis of current academic and industry research projects has also identified areas where new innovations are needed to develop the next generation of PFAS-free alternatives in the electronics industry. To build these future technologies, Apple is committing to drive innovation to develop solutions for prioritized applications by funding the needed research.

3. Ensuring that non-PFAS alternatives do not result in regrettable substitutions

We're generating comprehensive chemical hazard assessments using globally recognized methodologies like the U.S. EPA Safer Choice Standard and Criteria, GreenScreen® for Safer Chemicals, and the ChemFORWARD GHS-based hazard banding system to characterize chemical hazards of non-PFAS alternatives across a suite of human health and environmental endpoints. Chemical selection decisions made without a thorough understanding of the potential health and environmental hazards of the substances of interest can lead to unintended consequences of regrettable substitutions. We'll drive innovation to ensure that safer materials are used, in line with our commitment to smarter chemistry.

Conclusion

The well-being of our employees, our customers, people in our supply chain, and the planet is our top priority, which is why we're committed to using safer materials. As with our other efforts to phase out chemistries that don't meet our goals, phasing out PFAS from our products and manufacturing processes requires focus and leadership. We're committed to working with our suppliers and material manufacturing partners to create safer and sustainable alternatives to PFAS for use in our products and across the entire industry.