PFAS

Per- and polyfluoroalkyl substances

What are PFAS?

Per- and polyfluoroalkyl substances (PFAS) are a large class of thousands of synthetic chemicals that are commonly used in society. One of the reasons for their widespread use is because these chemicals are fire resistant, as well as possessing the ability to repel oil, stains, grease, and water. PFAS chemicals are capable of this because the PFAS molecules hold a chain of bonded carbon and fluorine atoms, well known as a strong chemical bond. For this reason, these substances do not easily breakdown, and can be found in the air, water, and soil. Given their extremely long lifespan, PFAS substances are often called forever chemicals. The removal of PFAS substances from contaminated sites is possible in some circumstances but is difficult and very costly.

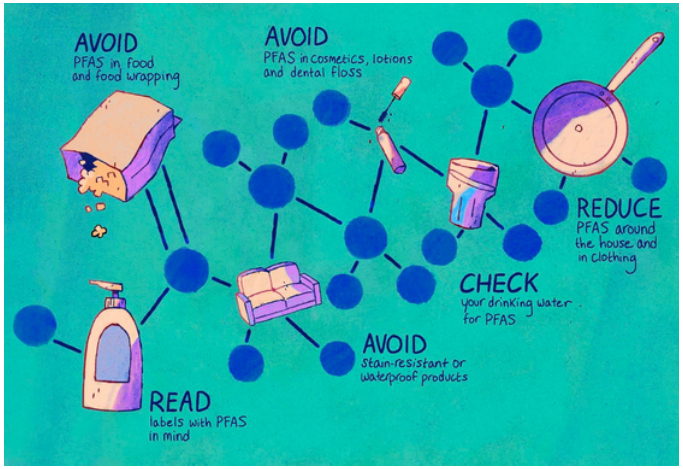


Figure 1: Sophie Morse for WBUR

What's being done about PFAS?

The EPA has begun taking steps to regulate PFAS use to mitigate environmental damage and protect human health. Since February 2021, the EPA has taken certain steps to address the current PFAS issue, starting with monitoring drinking water, proposing regulations to control the use of PFAS and including certain PFAS in contamination cleanup services.

Currently, only a limited number of PFAS subgroups are subject to regulation in Canada. The Government of Canada is continuing to:

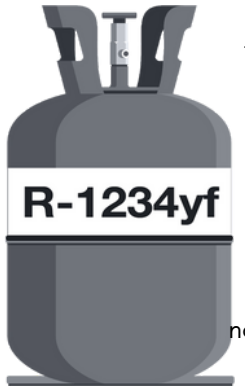
- collect and examine information on PFAS
- review what other countries are doing about PFAS
- conduct regular monitoring and surveillance of certain PFAS, both in humans and the environment

On January 13th 2023, the Netherlands, Germany, Denmark, Sweden and Norway took the first formal step towards a European ban on PFAS by jointly submitting a restriction proposal to the European Chemicals Agency (ECHA).

Where are they found?

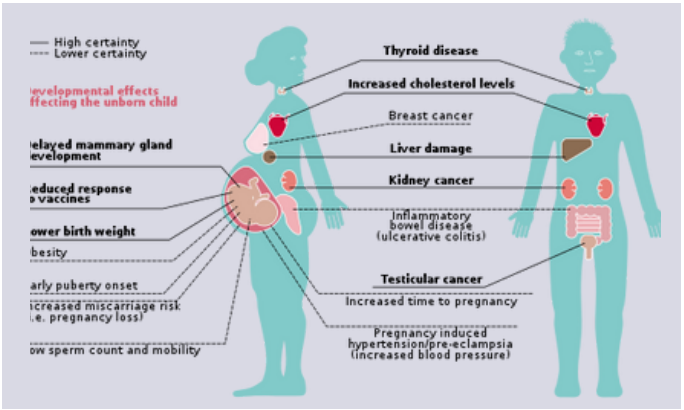
PFAS chemicals are present in fire fighting foams, stain repellants, Teflon and other nonstick cookware, water repellant clothing and shoes (DWR), food packaging, stain resistant carpeting and upholstery, waterproof care products and many other commonly used household products. PFAS are found in nearly all fluorinated refrigerants but are most concentrated in HFOs, such as the most prominent HFO-1234yf that is used in mobile AC units and nearly all new vehicle AC systems.

Given the recently discovered health impacts of HFO's and the forthcoming phase-out of HFC's, natural refrigerants are unquestionably the refrigerants of the future. Common natural refrigerants include carbon dioxide (R744, CO2), ammonia (R717, NH3) and hydrocarbons such as propane (R290) or isobutane (R600a). These refrigerants have no ozone depletion potential (ODP), minimal or no global warming potential (GWP), and contain no PFAS chemicals.



Health and Environmental Effects

Adverse health effects of PFAS chemicals includes: increased cholesterol levels, which can lead to reduced blood flow and stiffening of blood vessels, risk of high blood pressure or pre-eclampsia in pregnant women, changes to liver enzymes, a decrease to infant birth weights, a raised risk of kidney, thyroid, prostate and testicular cancer, and a lowered vaccine response. The decreased vaccine response may be attributed to the fact that high PFAS levels can cause impaired immune system function. Some other effects noted in lab animals includes birth defects, delayed development, and neonatal deaths. PFAS chemicals bioaccumulate in human tissue which means that overtime, exposure to even small amounts of PFAS can be detrimental to health. Agency for Toxic Substances and Disease Registry (ATSDR).



Sources: US National Toxicology Program, (2016); C8 Health Project Reports, (2012); WHO IARC, (2017); Barry et al., (2013); Fenton et al., (2009); and White et al., (2011).

After HFOs are released into the atmosphere, they breakdown and return to earth in the form of forever chemicals known as PFAS. The emissions of PFAS chemicals are contaminating our natural resources and drinking water supplies. Another path of exposure is through much of the food we eat. After fouling soil or water, levels of PFAS can be monitored in fish, meat from both livestock, wild game animals, and agricultural products such as wheat or corn. There is also a known risk of possible contamination from working with or around PFAS substances, such as PFAS chemical manufacturing.

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