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Australia

I am Dr. Linda S. Birnbaum, a Scientist Emeritus at NIH and the former Director of the National Institute of Environmental Health Sciences as well as the US National Toxicology Program. Prior to NIH, I directed the largest health research division of the US Environmental Protection Agency. Currently, I am a Scholar in Residence at Duke University, as well as am adjunct professor at Duke, the University of North Carolina, Yale University, and the University of Queensland. I am a member of the National Academy of Medicine, have multiple honorary doctorates, and have published more than 1000 peer-reviewed publications.

Thank you for giving me the opportunity to provide testimony on PFAS, perfluoroalkyl and polyfluoroalkyl substances, generally known as FOREVER chemicals. The vast group of synthetic chemicals comprising over 15,000 unique compounds, are all extremely persistent in the environment and many in people and other animals. In addition they are extremely mobile in the environment, bioaccumulate in living organisms, and many are highly toxic. Today, they are present in every corner of the globe, in thousands of commercial products, and in all of us.

Why are they forever? Because the key chemical bond involves the elements, carbon and fluorine. This bond does NOT occur in nature. It is extremely difficult to break down, even in controlled laboratory settings. successfully
PFAS are used as surfactants and stain repellants and in many electronics. They are present in more than 200 use categories, from computer chips to cell phones to non-stick pans to plastic coatings to water repellants. A major use has been in the generation of polymers which are also PFAS. They have been used in AFFF, air film forming foam. Today they are present in the water we drink, the air we breathe, and the food we eat.

Only a small number of the PFAS have undergone extensive testing. The most well known are long chain PFAS with 8 carbon atoms and multiple fluorine atoms, such as PFOA and PFOS. They are considered likely human carcinogens by the US EPA and known or possible carcinogens by the International Agency for Research on Cancer. In addition, they cause a plethora of adverse health effects in animals and in people – liver and kidney toxicity, immune suppression, preterm birth, reduced fertility, increased risk of Type 2 diabetes, and more. I should stress that the multitude of effects observed are NOT from one study by one group of investigators using one kind of animal or a single human population. There are now thousands of animal studies in multiple species throughout the animal kingdom, and hundreds of observational human (epidemiology) studies. The more we look, the more we find problems with this entire class.

Others such as PFNA and PFDA and PFUnDA – these are other long chain PFAS with 9, 10, or 11 carbons each with 2 fluorines. And bigger ones exist, especially in fish and seafood. Shorter chain PFAS such as PFHxA and PFBA are among common replacements for PFOA, and PFHxS and PFBS are short chain replacements for PFOS. I should mention that PFOS and PFHxS have been used extensively in AFFF. Other unfortunate substitutions include things like GenX, another PFOA replacement, and ADONA, instead of PFOS. All of these have some toxicity data and ALL are toxic, both in animals and people. Hundreds of other PFAS have been shown to be active using *in vitro* testing and computer simulations. But all PFAS will NOT go away.

The legacy PFAS are NOT very volatile, but if you live near a production or use facility, they have been emitted into the air. They have been directly released into water and have migrated from wastewater treatment plants into biosolids which have been used as fertilizer. Some of the "newer" PFAS are volatile but get transformed in living organisms and in the environment to the end products such as PFOA and PFOS. PFAS polymers can break down and release the ultrashort chain PFAS such as trifluoroacetic acid, TFA. This is also the product of transformation of PFAS-containing pesticides and pharmaceuticals. TFA has been recently classified by the German Risk Assessment Agency as a reproductive hazard. And it has only very recently been looked for in environmental samples and found to represent 90% of the total PFAS in house dust!

There is growing consensus that this entire class of chemicals pose a problem. But they are very useful, and they make industry billions of dollars. What should we do? I suggest we consider the principle of essentiality, which has been successfully used in the Montreal Protocol to reverse the ozone hole. If the use is not essential, such as in stain-resistant textiles, we stop using it. If the use is essential, but there are SAFE alternatives, we move to the alternative. If the use is essential, for example a certain pharmaceutical, we continue to use it but keep looking for a safe alternative. This "essentiality" approach would rapidly reduce the production and use of newly synthesized PFAS.

But what about PFAS which are already contaminating our world? We can use intensive filtration techniques to remove PFAS from drinking water, but that won't work for ground water or our contaminated rivers. We can incinerate at VERY high temperatures contaminated materials including soil and sludge, but this can generate other toxic compounds. There are major efforts looking at remediation and destruction. I would suggest some efforts to reuse what can be recovered from filters rather than making MORE carbon-fluorine bonds.

20 years ago the international Stockholm Convention went into effect to regulate persistent organic pollutants. We knew then that POPs should be avoided – so why do we continue to allow PFAS to be made and used???

Linda S. Birnbaum, PhD