Flame Retardants
Summary of TURI's work with the Science Advisory Board, 2023-2024

Some of TURI's work on flame retardants was in response to the Massachusetts Law, "An Act To Protect Children, Families, And Firefighters From Harmful Flame Retardants," 2020. (Proposed regulations can be found here.) This law prohibits manufacturers and retailers from selling, manufacturing for sale, offering for sale, distributing in commerce, or importing into Massachusetts any product that contains any of 11 named flame retardants or their chemical analogues, the total weight of which is greater than 1000 PPM for any component part. The law applies to the following product categories: bedding, carpeting, children's products, residential upholstered furniture or window treatments.

This law stipulates that the Massachusetts Department of Environmental Protection (MassDEP) consult with TURI and the Toxics Use Reduction Act Science Advisory Board (SAB) to "review, identify and recommend, if applicable, other chemical flame retardants that should be prohibited" based on being known or reasonably anticipated to present a toxic hazard to people such as: harming the normal development of a fetus or child or causing other developmental toxicity, causing cancer, genetic damage or reproductive harm, disrupting the endocrine system, damaging the nervous system, immune system or an organ, or causing other systemic toxicity, being persistent bioaccumulative and toxic, or having other health and environmental impacts.

In addition to the 11 flame retardants named in the law, chemical analogues of those named are also covered. MassDEP's Office of Research and Standards developed the following definition of "chemical analogue."

> *Chemical Analogue: A compound having a structure similar to that of another compound, but differing from it in respect to a certain aspect. It can differ in one or more atoms, functional groups, or substructures, which are replaced with other atoms, groups, substructures, or in their arrangement.*

Using this definition, TURI researched flame retardants in general as well as the specific chemical flame retardants named in the law and those likely to be applicable to the product categories covered by the law to identify "close analogues" (25) for review by the SAB. TURI also identified many isomers and additional CAS numbers of the original 11.

Organized by the subclasses identified in the 2019 National Academy of Sciences report "A Class Approach to Hazard Assessment of Organohalogen Flame Retardants", the Science Advisory Board reviewed 7 subclasses as follows:

NAS Subclass	Chemical named in the law	CAS Numbers	# of analogues proposed
Polyhalogenated Diphenyl Ethers	PentaBDE OctaBDE	32534-81-9 32536-52-0	8

Inorganics	Antimony trioxide	1309–64–4	2
Polyhalogenated Bisphenol Aliphatics	Tetrabromobisphenol A (TBBPA)	79-94-7	4
Polyhalogenated Phthalates/Benzoates/Imides	Bis(2-Ethylhexyl)-3,4,5,6-tetrabromophthalate (TBPH) 2-Ethylhexyl-2,3,4,5-tetrabromobenzoate (TBB)	26040–51–7 183658– 27–7	4
Polyhalogenated Alicycles	Hexabromocyclododecane (HBCD)	25637–99–4	2
Polyhalogenated Aliphatic Chains[1]	Chlorinated paraffins (SCCPs)	85535–84–8	0
Polyhalogenated Organophosphates(**need link**)	Tris(1,3-dichloro-2-propyl)phosphate (TDCPP) Tris(2-chloroethyl)phosphate (TCEP) Tris (1-chloro-2-propyl) phosphate (TCPP)	13674–87–8 115–96–8 13674–84–5	5

The TURI document, Proposed FR CAS numbers, Isomers and Analogues for SAB Consideration, updated version 5.4.23 provides CAS numbers and structures for all of these chemicals. TURI also prepared a document, Additional CAS Numbers for and Isomers of Named Flame Retardants, in CAS Order

At eight meetings between March 2023 and June 2024, for each identified subclass, the SAB took up the questions of isomers, additional CAS numbers, and analogues. At MassDEP's request, they also considered whether the analogues were sufficiently similar to the named flame retardants such that they would be reasonably anticipated to have similar concerns re: toxic hazard, persistence, bioaccumulation. The SAB provided advice and summary statements for MassDEP on the questions posed. These can be found in the meeting minutes and are summarized in the SAB Flame Retardant Advice and Summary Statements document. *(need to link)*

To assist the SAB in responding to the "similar concerns" question, TURI prepared environmental health and safety summaries for each subclass focusing on the chemical named in the law and the chosen analogues. These are linked to the subclass names in the table above. In addition to environmental health and safety summaries, relevant data (measured, modeled and predicted) from EPA databases were also provided, such as Cheminformatics Hazard data, Bioactivity and Physical Properties data from CompTox, ECOTOX data and EpiSuite data.

This work will provide a template for the SAB's future review for MassDEP of proposed additional flame retardants, required in 3 years under the law.

[1] The law lists "chlorinated paraffins" with a CAS number for short chain chlorinated paraffins (SCCPs). Medium and long chain chlorinated paraffins were known to be present in some additional CAS numbers of chlorinated paraffins with various chain lengths. At their April 29, 2024 meeting the SAB took up the question of whether medium and long chain chlorinated paraffins fit the analogue definition.