Tackling Toxics:
The Chemical Class Approach Towards Healthier Products and Materials

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Chemistry, UC Berkeley
Green Science Policy Institute

April 2, 2018

GREEN SCIENCE POLICY INSTITUTE

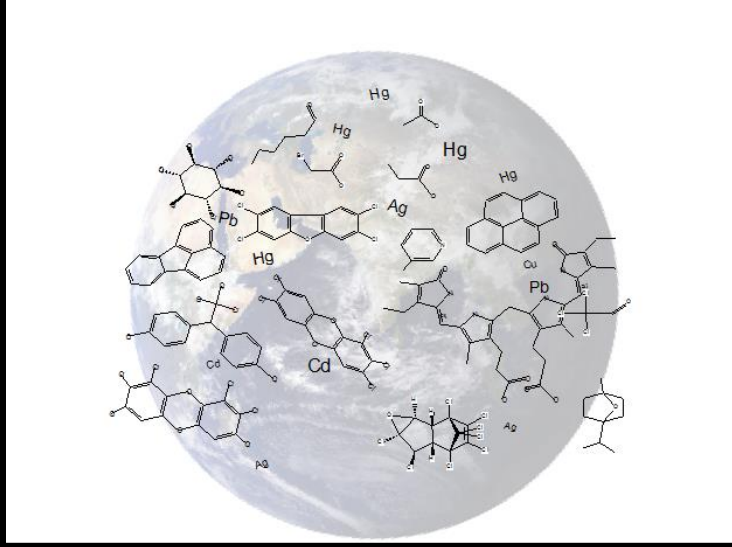
Education

Research

Retreats

Policy & Purchasing Change

A Planetary Boundary for Chemical Pollution



Chemical pollution is global:

- Rapidly increasing global production
- Persistence and long range transport
- Finite capacity of the earth to absorb toxics

Demands a globally coordinated response

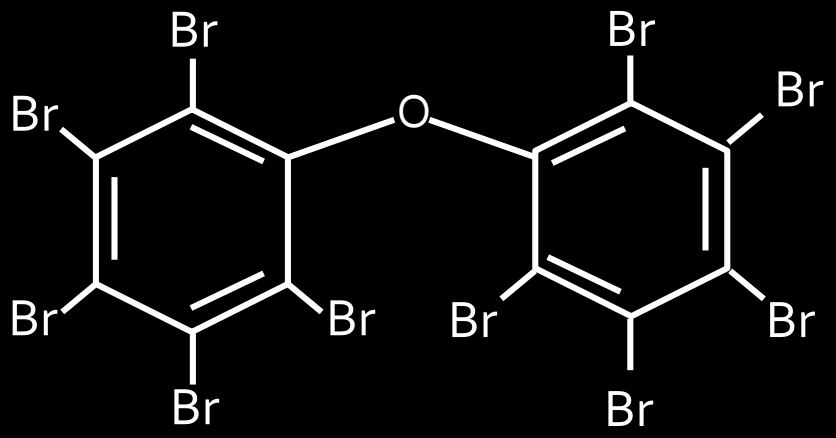
Diamond et al, 2015, Environment International

For a Green and Circular Economy, Whole Life Cycle should be Considered

U.S. Toxic Substances Control Act (1976)

- 62,000 previous chemicals "grandfathered"
- 23,000 new chemicals
  - 85% have no health data
  - 67% have no data at all

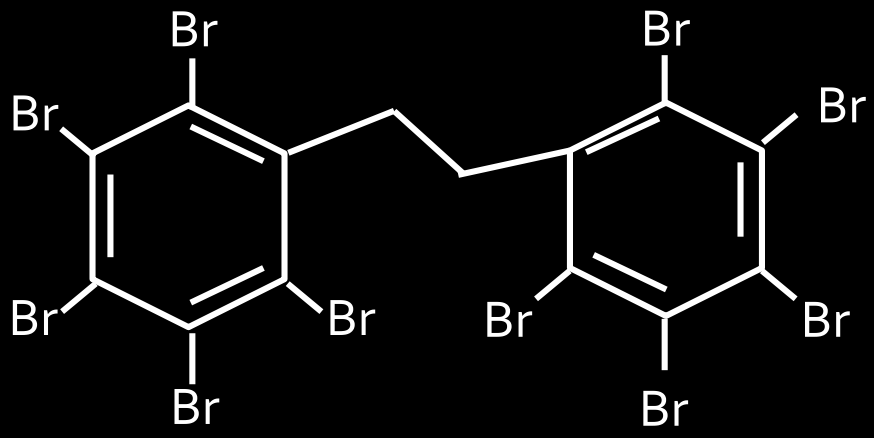
Regrettable Substitution



Decabromodiphenyl ether

Concerns:

- Persistence
- Bioaccumulation
- Toxicity



Decabromodiphenyl ethane

Concerns:

- Persistence
- Bioaccumulation
- Toxicity

Six Classes Videos

An innovative approach to reducing toxics

VIEW and SHARE: www.SixClasses.org

Healthier products, healthier people in four minutes!

Is it necessary?

Is it worth it?

Is there a safer alternative?

Green Chemistry

Green chemistry is the design of chemical products and processes that reduce or eliminate the use and/or generation of hazardous substances.

Courtesy: Dr. Bob Peoples

Purchasers are Key

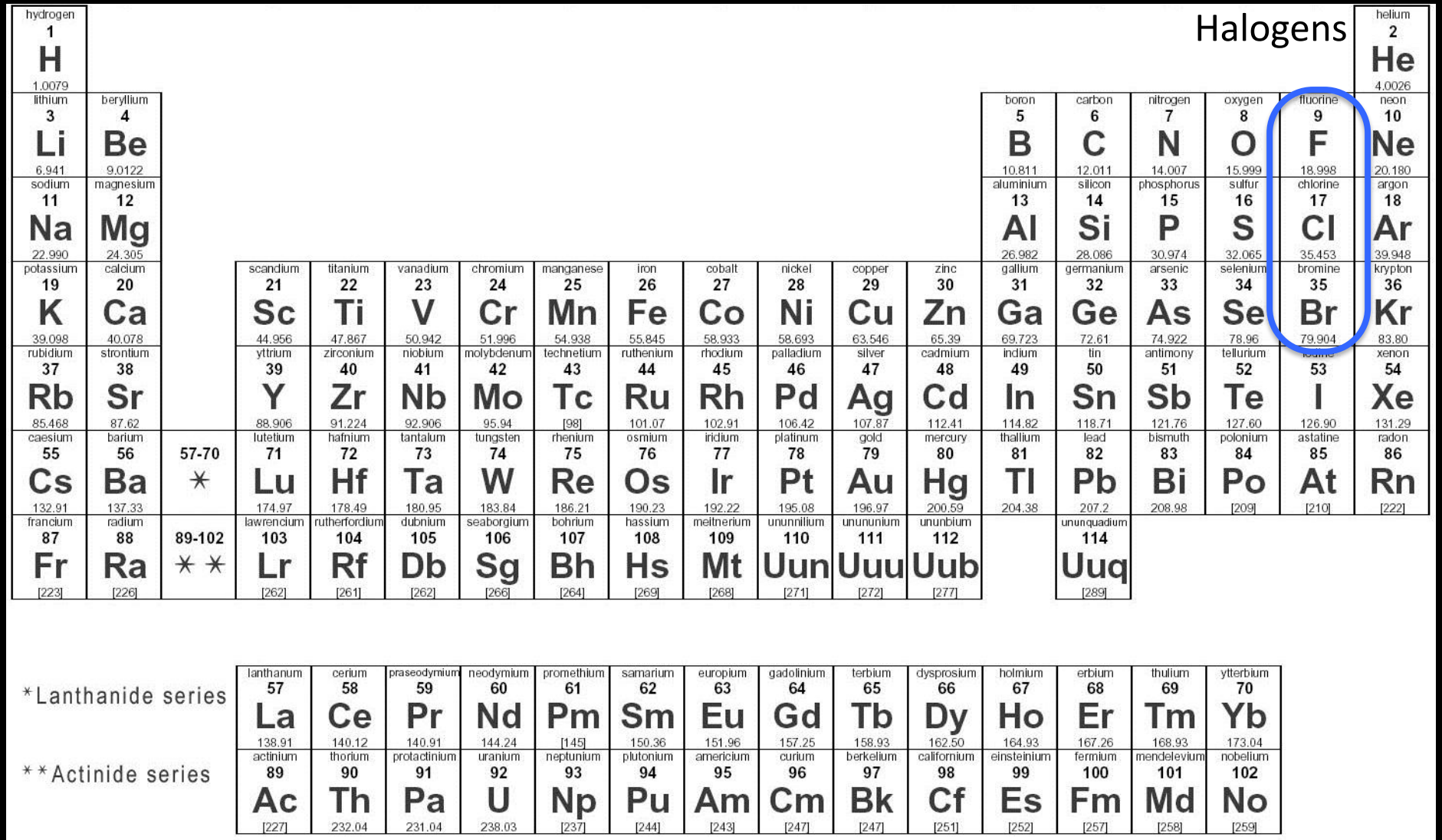
- Manufacturers of consumer products
- Large retailers
- Educational, institutional & governmental
- Designers and specifiers
- Consumers

Material Buyer's Club

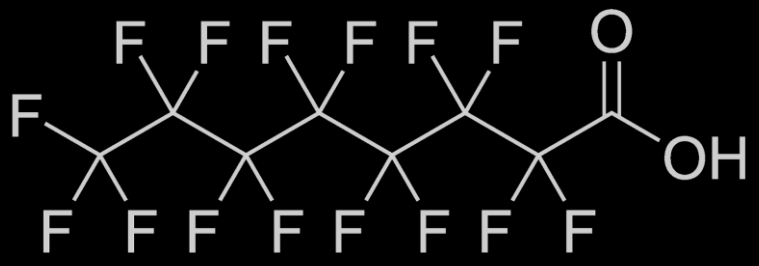
- Require transparency from manufacturers
- Utilize collective purchasing power to create a demand for healthier products and materials

Classes I to 3

Periodic table of elements



Class 1:
Highly Fluorinated Chemicals



PFOA or C8

Carbon-Fluorine bond strength:

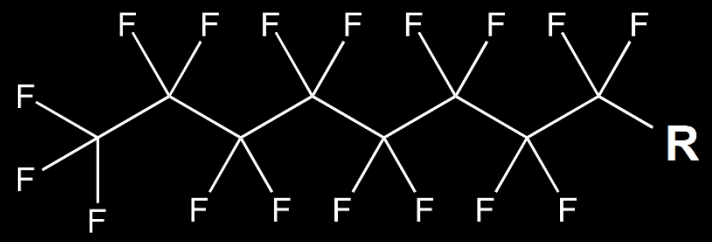
- Leads to oil and water repellency
- "Forever chemicals" -- last for geologic time!

Courtesy: Dr. Jennifer Field

Is C6 an improvement over PFOA and PFOS?

C6 is called the “environmentally friendly” alternative

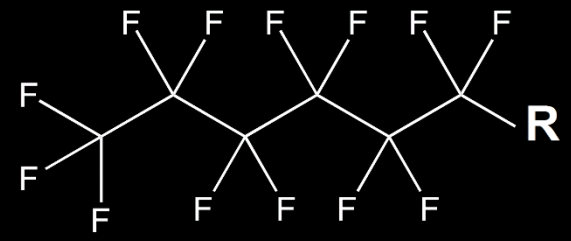
C8



Concerns:

- Extreme persistence
- Bioaccumulation
- Toxicity

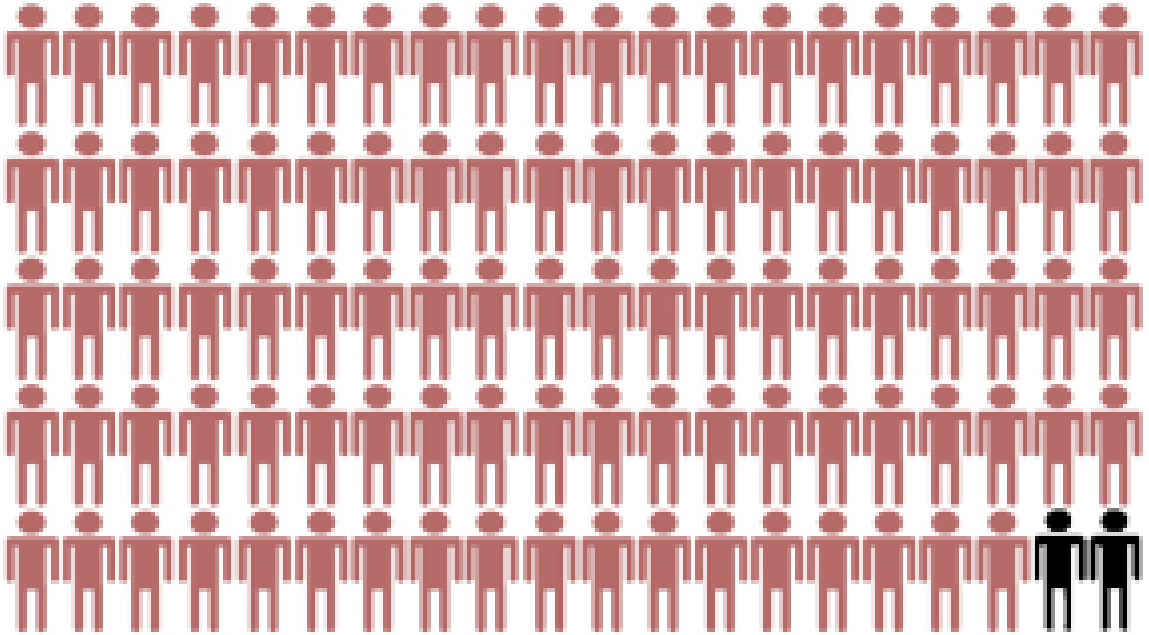
C6



Concerns:

- Extreme persistence
- Bioaccumulation in plants
- Suspected toxicity
- More mobile
- Remediation more difficult

PFAS exposure is a health concern



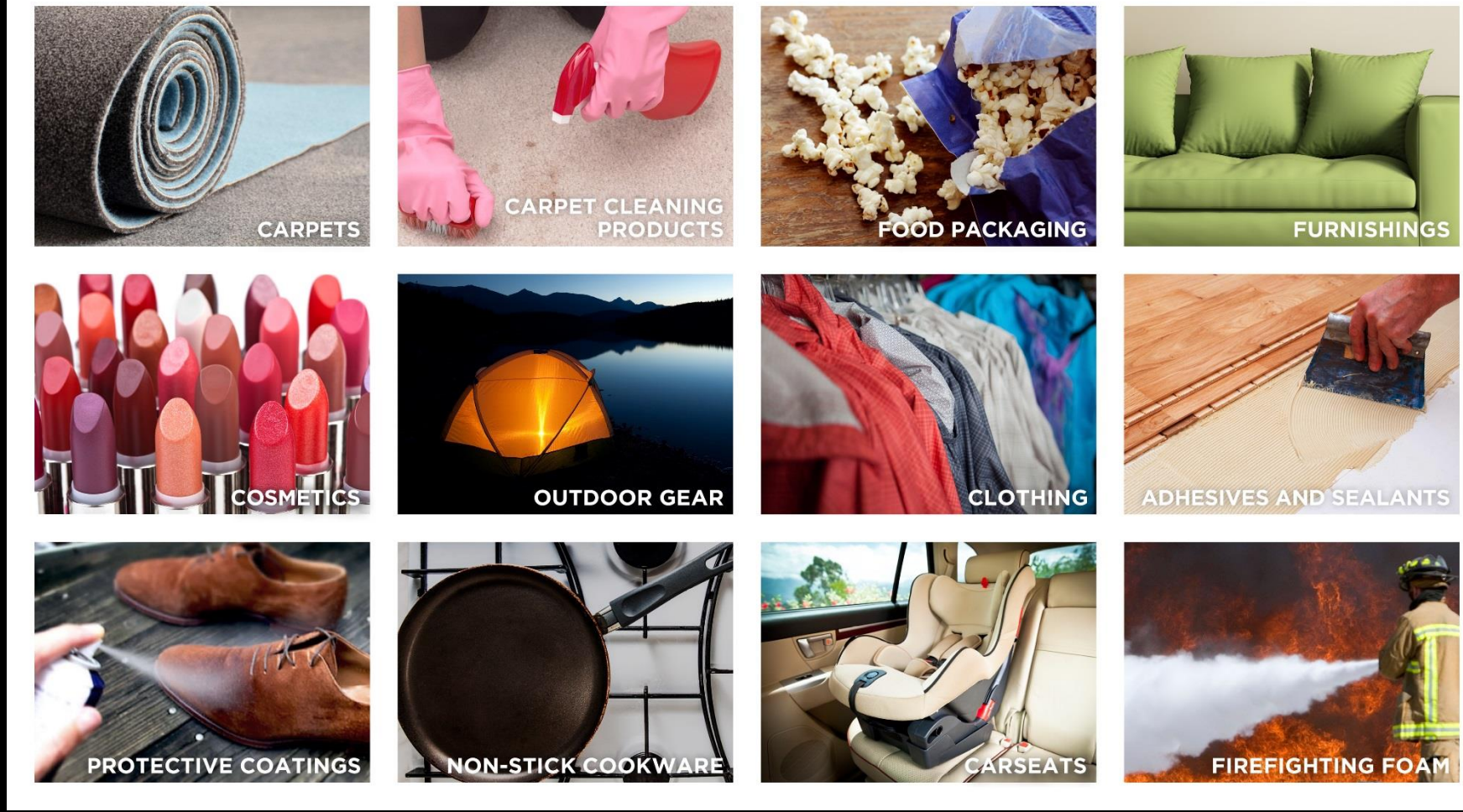
Exposure linked to health risks:

Cancer, elevated cholesterol, obesity, immune suppression, endocrine disruption

(Ref: Lewis et al., 2015; Grandjean et al., 2012; Braun et al., 2016; Barry et al., 2013)

Courtesy, Cindy Hu, Harvard University

Common Uses


CARPETS
CARPET CLEANING PRODUCTS
FOOD PACKAGING
FURNISHINGS
COSMETICS
OUTDOOR GEAR
CLOTHING
ADHESIVES AND SEALANTS
PROTECTIVE COATINGS
NON-STICK COOKWARE
CARSEATS
FIREFIGHTING FOAM

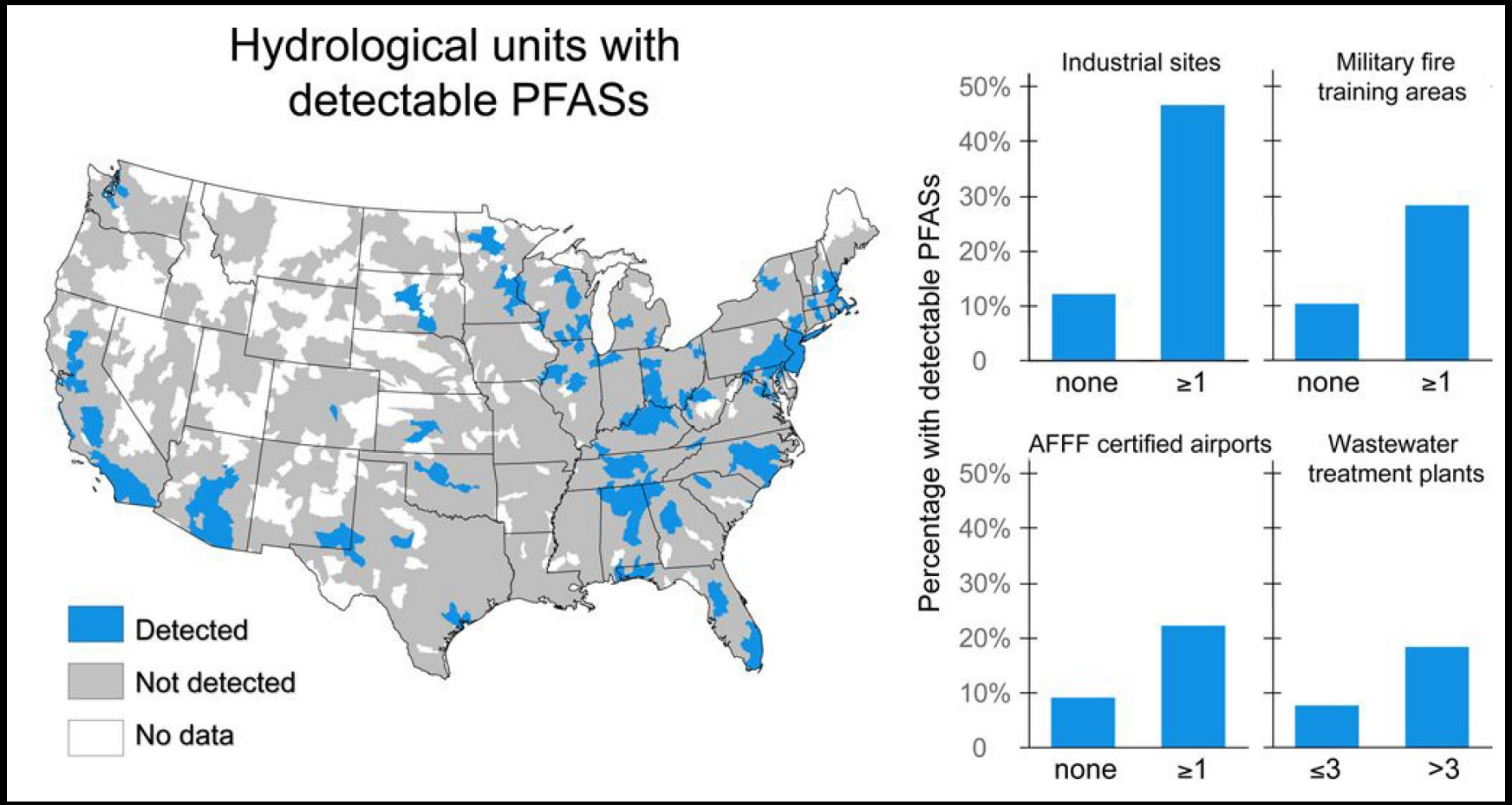
May 2015 The Madrid Statement on Highly Fluorinated Chemicals

"We call on the international community to cooperate in limiting the production and use of PFASs and in developing safer non-fluorinated alternatives."

Signed by 230 scientists from 40 countries

2015: Environmental Health Perspectives

EPA Lifetime Health Advisory Level of 70 ng/L PFOA + PFOS



Hu et al., Environ. Sci. Technol. Lett. 2016

Highly Fluorinated Hush Puppies

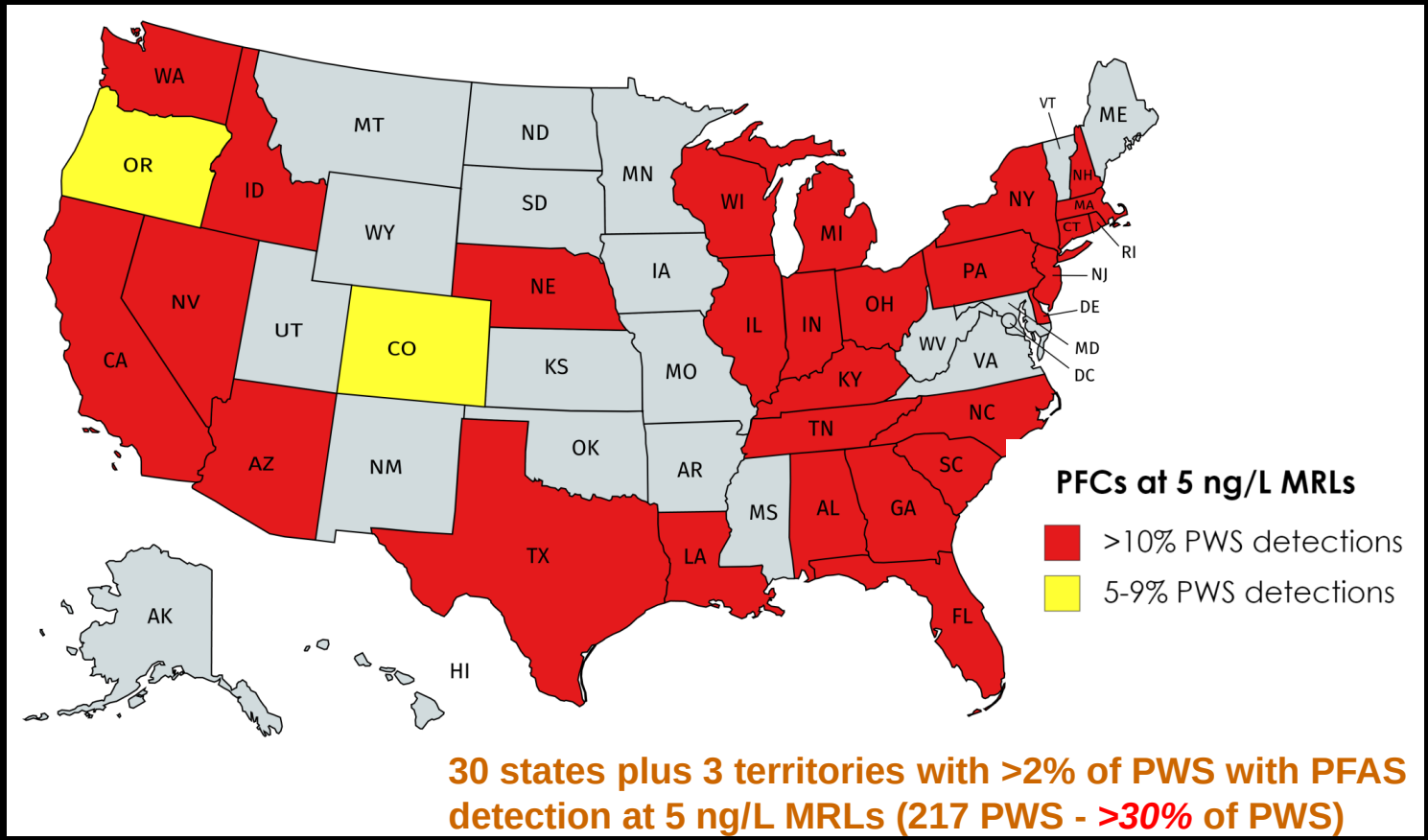
- Wolverine used Scotchguard (PFOS) used for leather treatment 1950s – 2000
  - Leather scrap dumped
  - Sludge applied to fields

- PFOA + PFOS level up to 58,000 ppt

  (842 times EPA health advisory level)

Widespread PFAS occurrence

- Percent of water systems with detectable PFOA:
  - Official EPA estimate: 1%
  - **Estimate from testing lab: up to 24%**



Courtesy of Andy Eaton PhD, Eurofins Eaton Analytical

U. S. PFAS Legal Claims

September 2015: 3,500 personal injury and 37 wrongful death claims in Ohio Valley against DuPont went to trial

(The Teflon Toxin Goes to Court, Sharon Lerner, *The Intercept)*

February 2017: $671 million to settle claims

Minnesota seeks $5 billion for PFAS water pollution

February 2018: 3M, Minnesota settle for $850 million

PFAS are Problematic & Difficult to Remediate

Prevention is Preferable!

CA proposal to list carpets with any PFAS

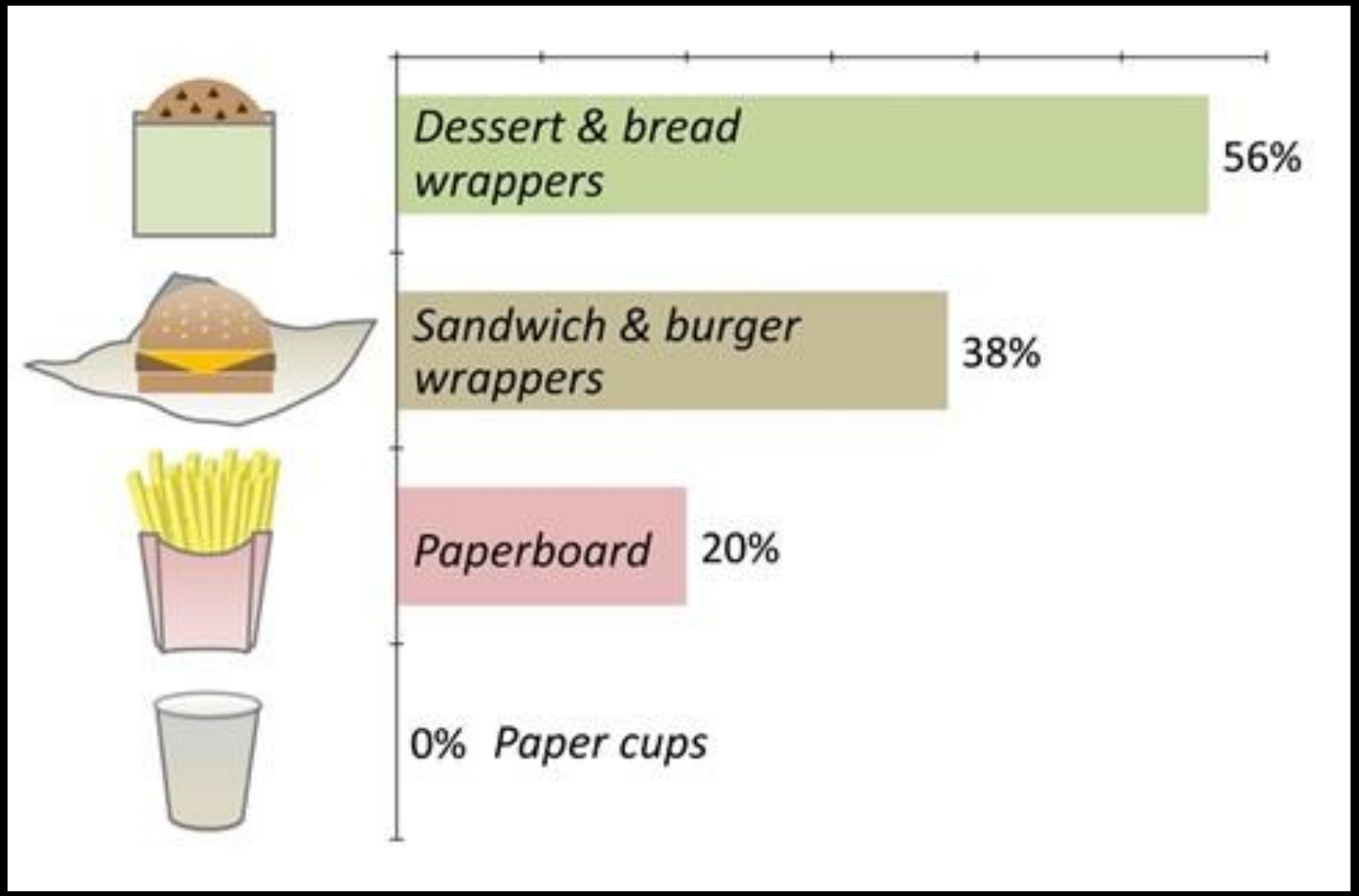
February 15, 2018

SAFER CONSUMER PRODUCTS

The CA Department of Toxic Substances Control is proposing to list carpets & rugs containing any PFAS as priority products for regulation.

Fluorine in U.S. fast food packaging paper

(percent positive; 400 products sampled)



Adopted from Schaider L. 2017 *Fluorinated compounds in U.S. fast food packaging*.

Impact

United States Senate
WASHINGTON, DC 20510

March 9, 2017

Mr. Daniel S. Schwartz
Chief Executive Officer
Restaurant Brands International Inc.
226 Wyecroft Road,
Oakville, Ontario L6K 3X7,
Canada

Dear Mr. Schwartz:

We write to inquire about Burger King's use of potentially harmful fluorinated chemicals in food wrappers, bags, boxes, or other kinds of food packaging. Per and polyfluoroalkyl substances (PFASs) represent a class of chemicals sometimes used in fast food packaging to prevent grease and sauces from seeping through packaging. These chemical compounds have been

New York State purchasing ban on PFAS

single use food containers & packaging

"...products purchased …on State contracts shall not contain perfluorinated chemicals (PFCs)..."

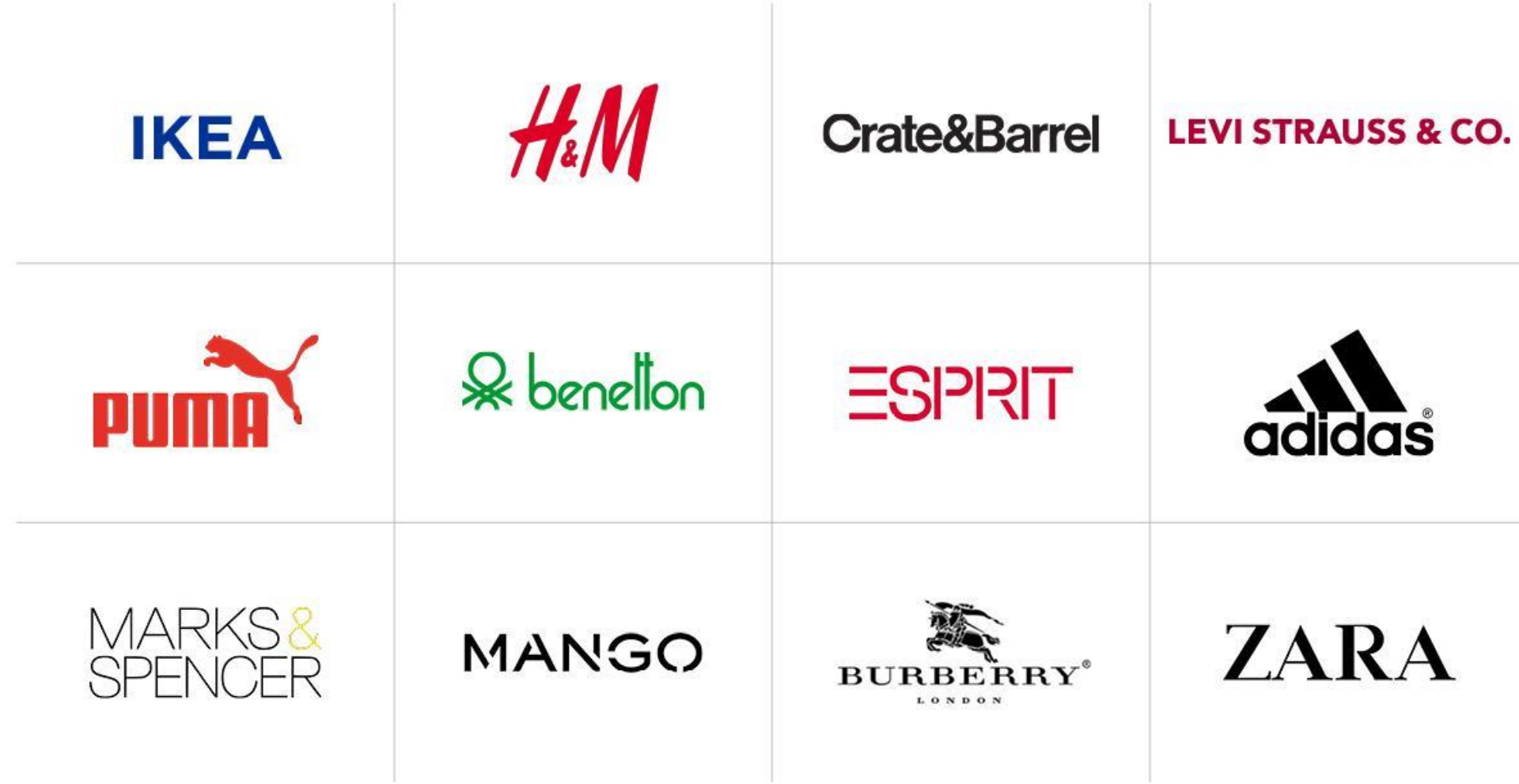
Washington State's Healthy Food Packaging Act
signed March 21, 2018

HB 2658/SB 6396 passes House on a 30-17 vote

Bans paper food packaging containing any PFAS

https://toxicfreefuture.org/key-issues/legislative-priorities-2018/

BRANDS ARE ELIMINATING HIGHLY FLUORINATED CHEMICALS



Sharon Lerner, The Intercept, February 10, 2018

Recommendation

Change the MILSpec to maintain fire safety and permit the use of fluorine-free foams.

- The MILSPEC, a U.S. military specification, followed in Canada requires PFAS in firefighting foam for liquid fuel fires.
- The U.S. FAA requires civilian airports to use foam that meets the MILSPEC, resulting in use of PFAS foams where they may not be needed.
- Safer alternatives are in use worldwide. The MILSPEC should be changed to allow their use in the US and Canada.

AFFF Phase-out in Norway

- 2011: Domestic airports in Norway phase out AFFF and adopt fluorine-free foam
- 2015: Norwegian Defense Force begins adoption of fluorine-free foams

Source: Norwegian Environment Agency

South Australia: AFFF Ban

Jan. 30, 2018

Applies to all fluorinated firefighting foams for all applications

Australia: about 90% of airports are now using fluorine free foams. (They can reach the highest level of performance in ICAO (International Civil Aviation Organization) extinguishment tests.)

Washington State's Ban on PFAS in Firefighting Foam Signed March 27, 2018

(HB 2793/SB 6413)

- Passed the Senate on a vote of 38-9 and the House 72-26 on February 27, 2018
- Bans sale of firefighting foam containing any PFAS beginning July 1,2020
- Bans the use of PFAS-containing foam for training beginning July 1, 2018.
- Requires notification regarding firefighting gear that contains any PFAS

More info https://toxicfreefuture.org/key-issues/legislative-priorities-2018/

TOXIC-FREE FUTURE
SCIENCE • ADVOCACY • RESULTS

In 2012, after extensive testing, Heathrow in the UK switched away from the use of all PFAS. In 2015, a British Airways airbus caught fire and firefighters safely put out the flames with fluorine-free foam.

"zero cleanup costs and zero environmental concerns"

Graeme Day, fire service compliance manager, Heathrow

http://www.bio-ex.com/responsible-commitment/responsible-environmental-commitment

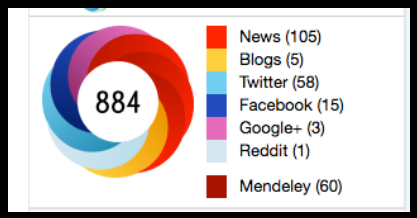
Communications strategy for papers

can increase media coverage, downloads, and impact

Study	Journal	Year	Downloads*	Altmetric Score*
Scientists' letter on PFAS in drinking water	*Env. Health*	2017	2,356	447
Florence Statement on antimicrobials	*EHP*	2017	---	393
Highly fluorinated chemicals in fast food	*ES&T Letters*	2017	10,524	890
Highly fluorinated chemicals in U.S. drinking water	*ES&T Letters*	2016	26,622	1,294
Flame retardants in baby products	*ES&T*	2011	20,672	62

#3 for ES&T Let

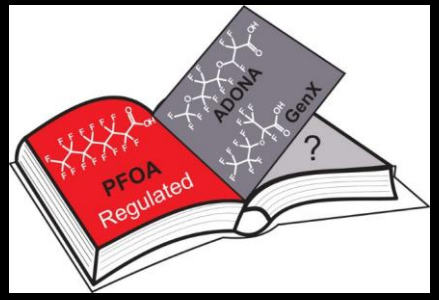
#2 for ES&T Let



* As of Nov. 30, 2017

Green Science Policy Communications Strategy

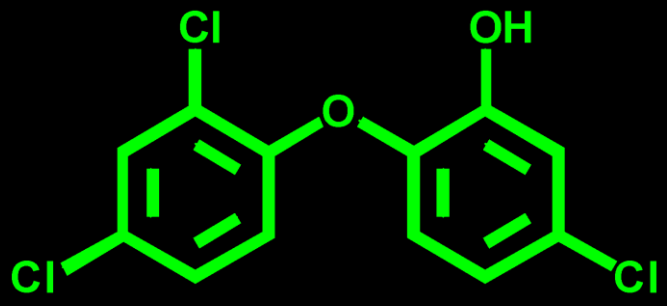
- Select research topic to support policy in public interest.
- Collaborate with authors from multiple institutions.
- After the paper is accepted, select a date for maximum impact for the paper to go on line (2-4 weeks in the future).
- Compose press release in accessible language with a “hook”.
- Query journalists & share release & paper with those who respond.
- Educate journalists on the science & establish relationships.
- Hope it is not a big news day!



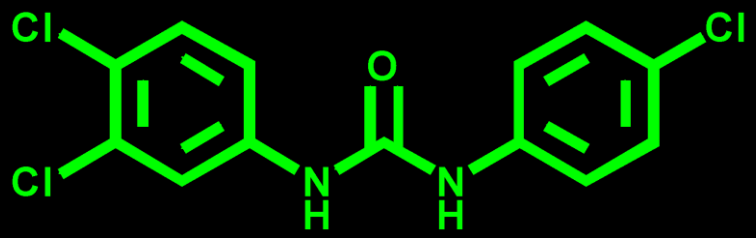
A Never Ending Story of PFASs
Wang, et al. ES&T 2017, © 2017 ACS

Class 2: Antimicrobials

Triclosan

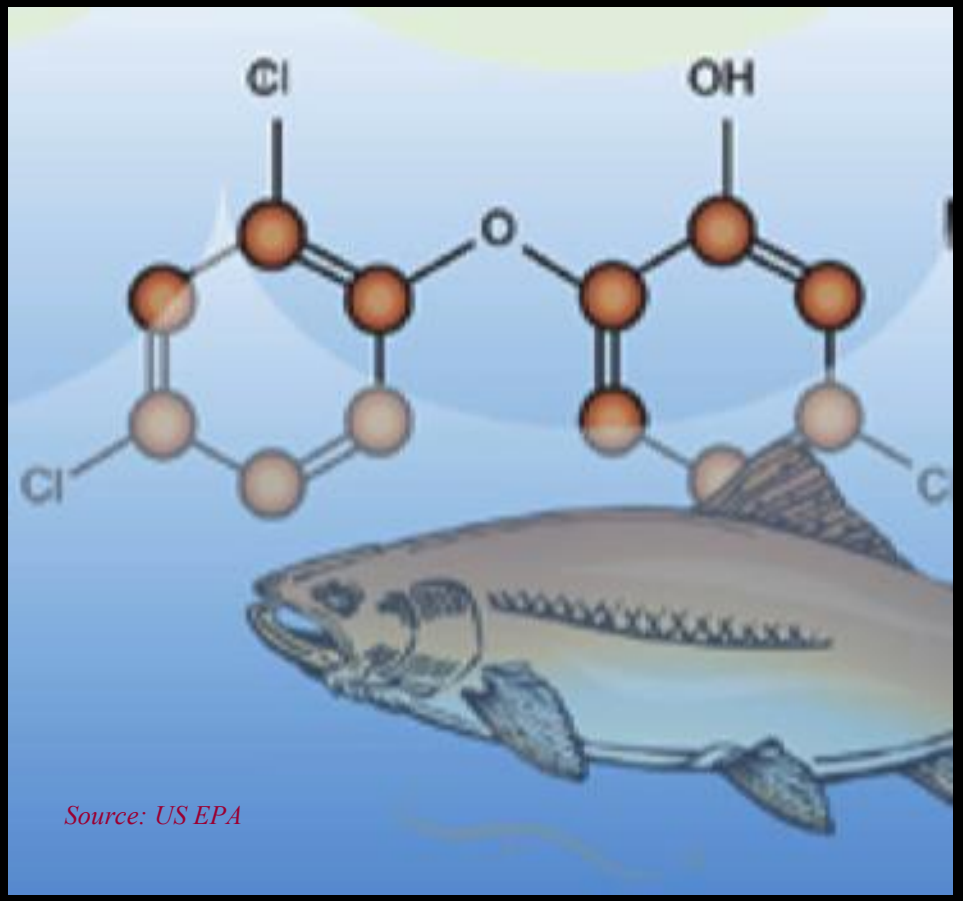


Triclocarban

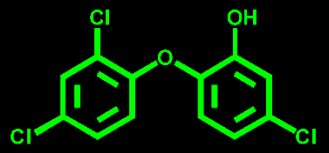


Courtesy: Dr. Gary Ginsberg

5 – 10 Seconds
(ineffective)



Lifetime exposure in aquatic organisms (toxic)



A History of Triclosan in the U.S.

1964 — Patented

1974 — FDA Draft Monograph on lack of efficacy and safety

1984 — First detection in fish

1994 — FDA removes assorted antimicrobials from drug category

2002 — Top ten water contaminant

2007 — Endocrine disruptor; Detectable in 97% of breast milk samples

2010 — NGOs petitions FDA to prohibit triclosan in soaps. NGO sues FDA.

2013 — > 2,000 antimicrobial products.

2016 — FDA determines 19 antimicrobials not safe or effective in consumer soaps

GREEN SCIENCE POLICY INSTITUTE
www.GreenSciencePolicy.org

Env Sci Tech, 2014, 48, 3603 - 3611

The Florence Statement on Triclosan and Triclocarban

Documents the scientific consensus about:

- potential for harm
- recommendations to prevent further harm

Signed by 205 international scientists

2017: *Environmental Health Perspectives*

Alternative Antimicrobials

	Toxic to Aquatic Organisms	Can Persist in the Environment	Can Contribute to Antimicrobial Resistance	Health Risks?
Triclosan & Triclocarban	✓	✓	✓	Hormone disruption Allergy sensitivity Altered microbiome
Quats	✓	✓	✓	Asthma Skin irritation Reproductive toxicant?
Nanosilver	✓	✓	✓	Significant data gaps

Halden *et al.* (2017) In press.
NIH Environmental Management System; Melin *et al.* (2014) *Reprod. Toxicol.*

Class 3 Flame retardants

Updating1970s Flammability Standards

- Children's sleepwear --1976
- Furniture and baby product foam --2014
- Foam building insulation --2019?

Brominated Tris Flame Retardant

Tris (2,3-dibromopropyl) phosphate

- In children's sleepwear 1975 to 1977
- Up to 10% of the weight of fabric
- In children's urine
- Mutagen and possible carcinogen

Science, January 7, 1977

Flame-Retardant Additives as Possible Cancer Hazards

The main flame retardant in children's pajamas is a mutagen and should not be used.

Arlene Blum and Bruce N. Ames

TRIS-Treated Children's Garments Banned

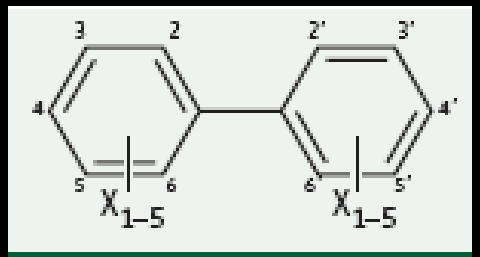
April , 1977

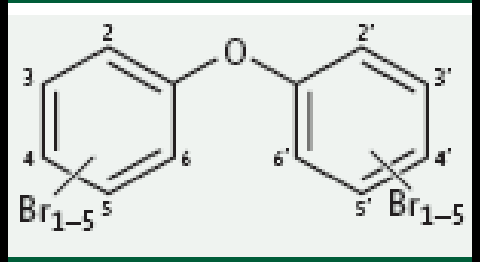
Chlorinated Tris replaced Brominated Tris

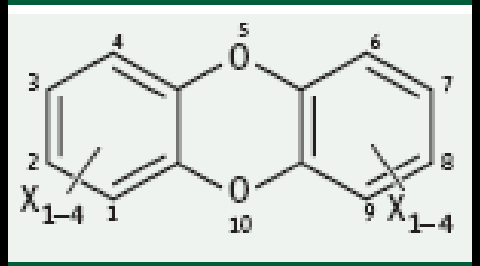
- Removed from pajamas in 1978
- Used in furniture until 2012

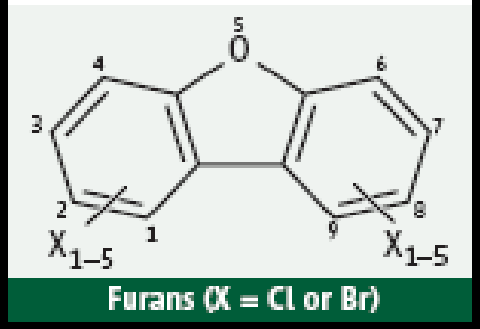
Technical Bulletin 117

- Required furniture foam to withstand a small open flame for 12 seconds
- No significant fire safety benefit (fires start in exterior fabric not filling)









PentaBDE Flame Retardant

Used from 1975 to 2004 to meet TB117.

98% of use in furniture and vehicle foam in US and Canada in 2003

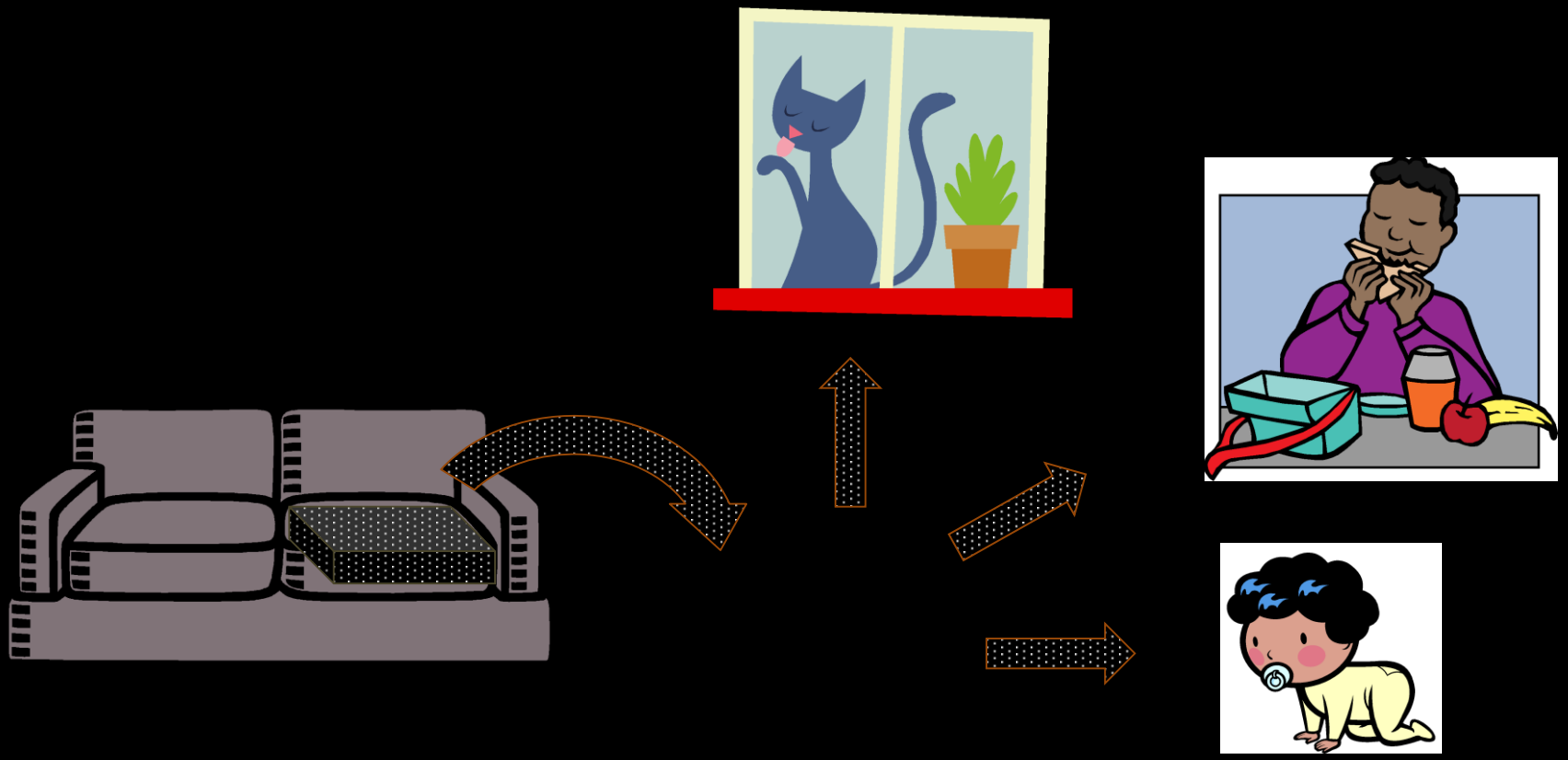
Furniture foam flame retardant (PentaBDE) associations with human health problems

Increased time to pregnancy
Altered thyroid hormone
Thyroid disease in women

Impaired attention
Poorer coordination
Lower IQ
Developmental toxicity
Baby boys' genital problems
Lower birth weight
Delayed puberty in girls
Earlier puberty in boys

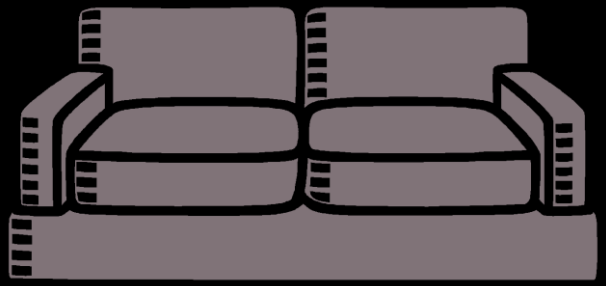
Main et al. 2007; Goodyer et al 2017; Eskenazi et al., 2010, 2011, 2012; Herbstman et al. 2010; Makey et al. 2016; Windham et al. 2015; Harley et al. 2017; Allen et al. 2016

From Products to People



TB117 Fire Safety Benefit?

TB117 foam



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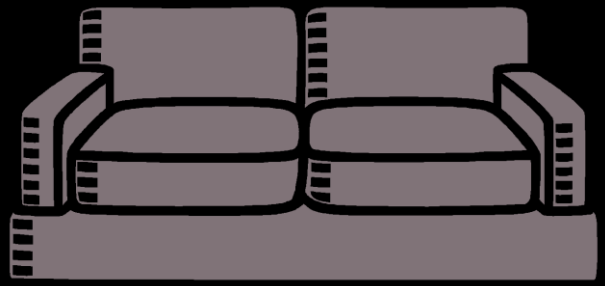
Non - TB117 foam



"No significant, consistent difference…"

Babrauskas et al. 2011; Talley 1995; Mehta (CPSC) 2012

Flame retardants increase smoke toxicity more than they reduce fire growth

Flame retardants delay, but don't prevent ignition

Then, flame retardants can increase….

- Soot and Smoke
- Carbon Monoxide and Hydrogen Cyanide
- Dioxins and Furans

Hull 2017; Bocchini 2009; Mennear 1994

Increased fire safety without flame retardants

Assembly Bill 706, Senate Bill 772, Senate Bill 1291, Senate Bill147

Paid for by Californians for Fire Safety:

- Albemarle
- Chemtura
- Israel Chemicals LTD (ICL)

San Antonio Statement on Brominated and Chlorinated Flame Retardants

- Signed by over 200 scientist's from 30 countries
- Documents health and environmental harm and lack of proven fire safety benefit

2010: Environmental Health Perspectives

BIFMA INTERNATIONAL

Elimination of Fire Retardant Chemicals in Office Furniture

"Given the increasing body of evidence that indicates the persistence, bio-accumulation and potential health aspects of many fire retardants, we believe the risks associated with the use of these chemicals is greater than the hazard associated with the fire risk from furniture without fire retardants."

- From the position paper

Business and Institutional Furniture Manufacturer's Association. (BIFMA)

Pulitzer Prize

Finalist

Goldsmith Prize

Investigative Reporting

Environmental Journalists Society

Environmental Reporting

Gerald Loeb Award

Business and Financial Journalism

National Press Club

Consumer Award

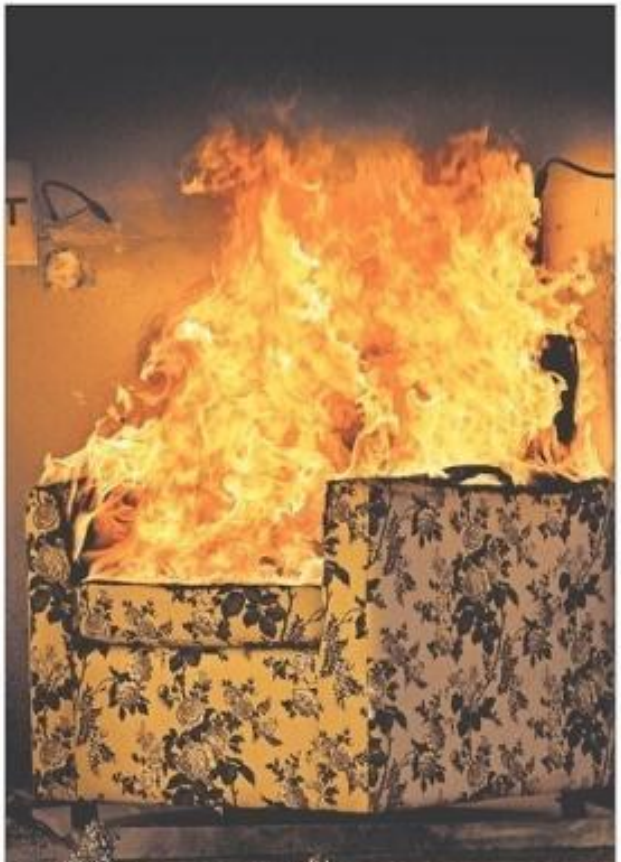
Chicago Tribune

QUESTIONS? CALL 1-800-TRIBUNE | SUNDAY, MAY 6, 2012 | BREAKING NEWS AT CHICAGOTRIBUNE.COM

TRIBUNE WATCHDOG

Playing with fire

A deceptive campaign by industry brought toxic flame retardants into our homes and into our bodies. And the chemicals don't even work as promised.



BY PATRICIA CALLAHAN AND SAM ROE
Tribune reporters

Dr. David Heimbach knows how to tell a story.

Before California lawmakers last year, the noted burn surgeon drew gasps from the crowd as he described a 7-week-old baby girl who was burned in a fire started by a candle while she lay on a pillow that lacked flame retardant chemicals.

"Now this is a tiny little person, no bigger than my Italian greyhound at home," said Heimbach, gesturing to approximate the baby's size. "Half of her body was severely burned. She ultimately died after about three weeks of pain and misery in the hospital."

Heimbach's passionate testimony about the baby's death made the long-term health concerns about flame retardants voiced by doctors, environmentalists and even firefighters sound abstract and petty.

But there was a problem with his testimony. It wasn't true. Records show there was no dangerous pillow or candle fire. The baby he described didn't exist.

Neither did the 9-week-old patient who Heimbach told California legislators died in a candle fire in 2009. Nor did the 6-week-old patient who he told Alaska lawmakers was fatally burned in her crib in 2010.

Heimbach is not just a prominent burn doctor. He is a star witness for the manufacturers of flame retardants.

His testimony, the Tribune found, is part of a decades-long campaign of deception that has loaded the furniture and electronics in American homes with pounds of toxic chemicals linked to cancer, neurological deficits, developmental problems and impaired fertility.

The tactics started with Big Tobacco, which wanted to shift focus away from cigarettes as the cause of fire deaths, and continued as chemical companies worked to preserve a lucrative market for their products, according to a Tribune review of thousands of government, scientific and internal industry

stoked the public's fear of fire and helped organize and steer an association of top fire officials that spent more than a decade campaigning for their cause.

Today, scientists know that some flame retardants escape from household products and settle in dust. That's why toddlers, who play on the floor and put things in their mouths, generally have far higher levels of these chemicals in their bodies than their parents.

Blood levels of certain widely used flame retardants doubled in adults every two to five years between 1970 and 2004. More recent studies show levels haven't declined in the U.S. even though some of the chemicals have been pulled from the market. A typical American baby is born with the highest recorded concentrations of flame retardants among infants in the world.

People might be willing to accept the health risks if the

California Flammability Standards TB117-2013

Mandatory January 1, 2015

Flame retardants not needed, but can still be used

Product Labels Required

TB133 being revoked in California due to lack of need and potential for harm

NOTICE

THIS ARTICLE MEETS THE FLAMMABILITY REQUIREMENTS OF CALIFORNIA BUREAU OF ELECTRONIC AND APPLIANCE REPAIR, HOME FURNISHINGS AND THERMAL INSULATION TECHNICAL BULLETIN 117-2013. CARE SHOULD BE EXERCISED NEAR OPEN FLAME OR WITH BURNING CIGARETTES.

The upholstery materials in this product:
____contain added flame retardant chemicals
__X__contain NO added flame retardant chemicals

The State of California has updated the flammability standard and determined the fire safety requirements for this product can be met without adding flame retardant chemicals. The State has identified many flame retardant chemicals as being known to, or strongly suspected of, adversely impacting human health or development.

www.bearhfti.ca.gov/about_us/sb_1019_faq.pdf

Proposed Canadian open flame standard
CAN/ULC-S131-YY

Standard method of tests for fire growth flammability of upholstered furniture

Under Underwriters Laboratory

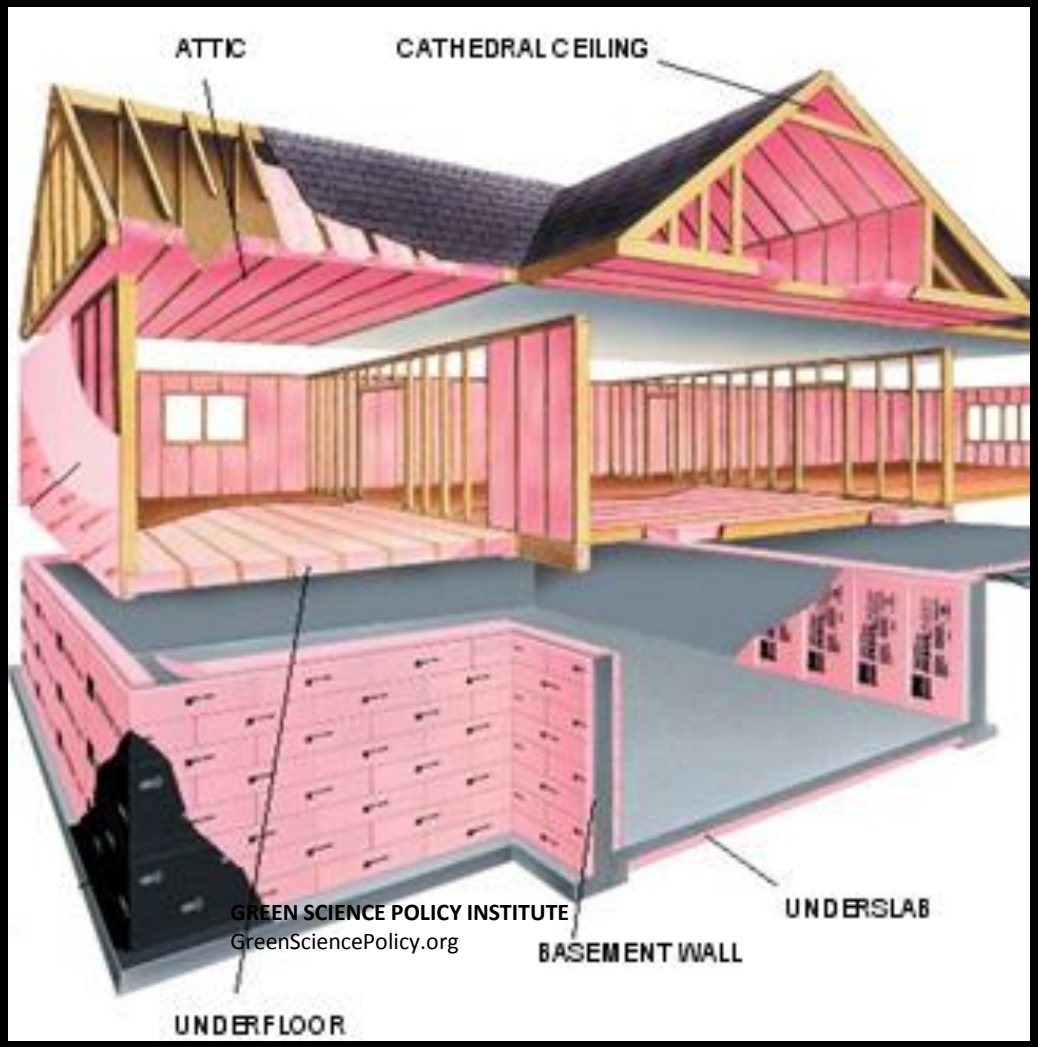
NFPA 277 would reintroduce an open-flame standard in residential upholstered furniture

- A new furniture flammability test is not needed.
- NFPA 277 would not significantly improve fire safety, but would harm human health and ecosystems.
- NFPA process lacked transparency & was industry dominated.

GREEN SCIENCE POLICY INSTITUTE
GreenSciencePolicy.org

If passed, NFPA 277 could bring toxic & unneeded flame retardants back into US, Canadian furniture!

Plastic foam insulations
(polystyrene, polyurethane, polyiso, etc.)



Used increasingly for energy efficiency

Can be used:

- inside walls
- below grade
- attics, etc.

Building codes drive use of FRs in insulation

BRI Building Research & Information (2012) 40(6), 738–755

Routledge Taylor & Francis Group

INFORMATION PAPER

Flame retardants in building insulation: a case for re-evaluating building codes

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Assembly Bill 127 (2013):
Safer Building Insulation

- State fire marshal may propose updates that:
  - Maintain overall fire safety
  - Provide flexibility in meeting fire safety standards with or without chemical flame retardants

- Implementation:
  - Working Group (ended summer 2015)
  - Testing & analysis at Oklahoma State University

http://osfm.fire.ca.gov/codedevelopment/wgfsbim.php

Oklahoma State University Study

Commissioned by California OSFM following AB 127 Working Group.

Key Findings

- Comparable ignition and heat release rates between foam plastic insulation with and without flame retardants and other combustible construction materials .
- When installed below grade, no risk of fire spread to the structure from insulation without flame retardants.

California codes can be safely updated to allow below-grade use of insulation without flame retardants.

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