



GREEN SCIENCE
POLICY INSTITUTE

The Chemical Class Concept Catching On: Healthier Products, People, Planet

Arlene Blum PhD

Founder, Green Science Policy Institute

Research Associate in Chemistry, UC Berkeley

February 7, 2020



GREEN SCIENCE POLICY INSTITUTE

Building Research & Information (2021) 48(8): 738-753

Building insulation: Building codes

Fire Science & Technology

Novel and High Volume Use Flame Retardants in US Couches

Heather M. Thomas F.,¹ Nicholas Sclafani,² Department of Architecture

Environmental Letters

Fluorinated Poly- and Perfluoroalkyl Substances (PFASs) in U.S. Fast Food Packaging

Laurel A. Margaret,¹ Silvest Spina,² Green Science & Technology Institute, Department of Environmental Science and Technology, University of California at Berkeley

Detection of Poly- and Perfluoroalkyl Substances (PFASs) in U.S. Drinking Water Linked to Industrial Sites, Military Fire Training Areas, and Wastewater Treatment Plants

Xindi C. Hu,^{1,2,3} David Q. Andrews,⁴ Andrew B. Lindstrom,⁵ Thomas A. Bruton,⁶ Laurel A. Schaidler,⁷ Philippe Grandjean,⁸ Rainer Lohmann,⁹ Courtney C. Carignan,¹⁰ Arlene Blum,¹¹ Simona A. Balan,¹² Christopher P. Higgins,¹³ and Elsie M. Sunderland^{1,14}

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Supporting Information

ABSTRACT: Drinking water contamination with poly- and perfluoroalkyl substances (PFASs) poses risks to the developmental, immune, metabolic, and endocrine health of consumers. We present a spatial analysis of 2013–2015 national drinking water PFAS concentrations from the U.S. Environmental Protection Agency's (US EPA) third Unregulated Contaminant Monitoring Rule (UCMR3) program. The number of industrial sites that manufacture or use these compounds, the number of military fire training areas, and the number of wastewater treatment plants are all significant

Hydrological units with detectable PFASs



Education



Retreats

Research

Policy & Purchasing Change

For a Circular Economy, Avoid Hazardous Substances



Minimise



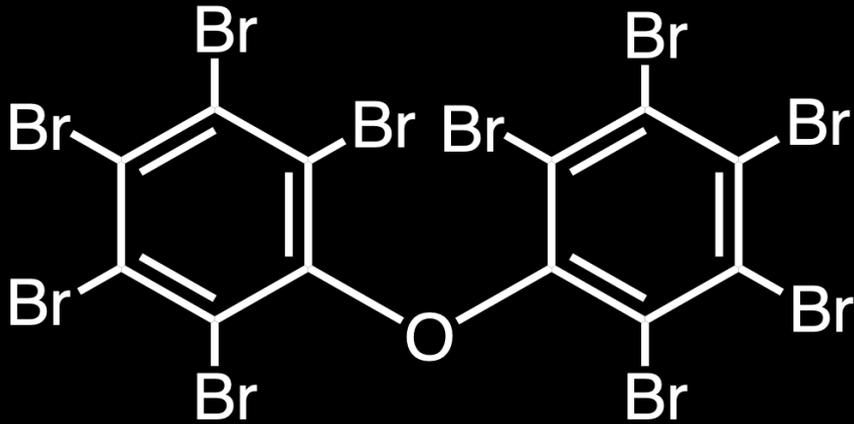
EXTRACTON AND IMPORT OF NATURAL RESOURCES, INCLUDING ENERGY CARRIERS

INCINERATION

LANDFILL

Products with toxics should be land filled or destroyed.

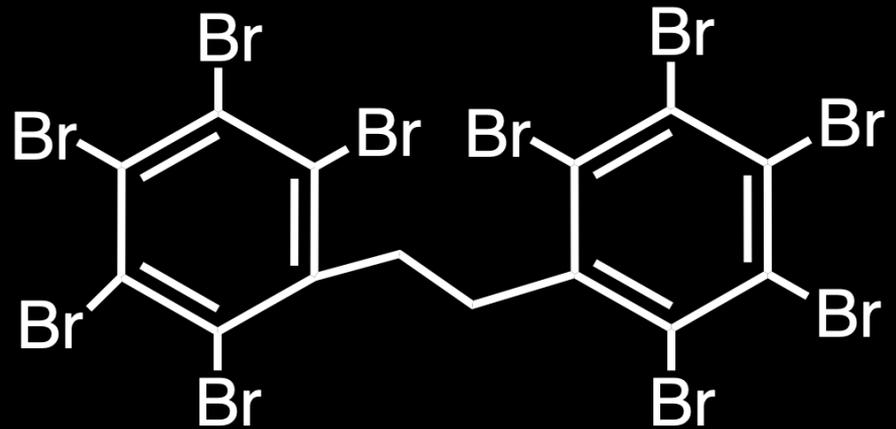
Regrettable Substitution



Decabromodiphenyl
ether

Concerns:

- Persistence
- Bioaccumulation
- Toxicity



Decabromodiphenyl
ethane

Concerns:

- Persistence
- Bioaccumulation
- Toxicity

A large, dense field of multi-colored jelly beans, including red, orange, yellow, green, blue, purple, and pink, filling the entire frame. The text is overlaid on the center of this field.

**EVALUATING TENS OF THOUSANDS OF
INDIVIDUAL CHEMICALS IS UNWORKABLE**



BUT ADDRESSING **SIX GROUPS** OF
CHEMICALS OF CONCERN IS MANAGEABLE



Six Classes Videos

An innovative approach to reducing toxics

1

Highly
Fluorinated

2

Antimicrobials

3

Flame
Retardants

4

Bisphenols
+ Phthalates

5

Some
Solvents

6

Certain Metals



VIEW and SHARE: www.SixClasses.org

Healthier products, healthier people in four minutes!

Is it necessary?

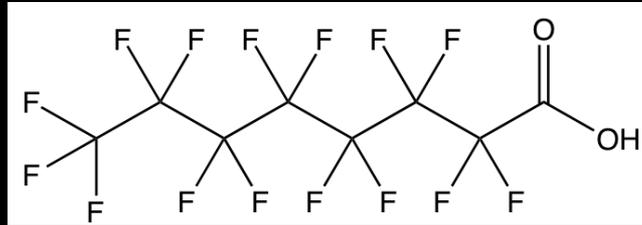
Is it worth it?

Is there a safer alternative?

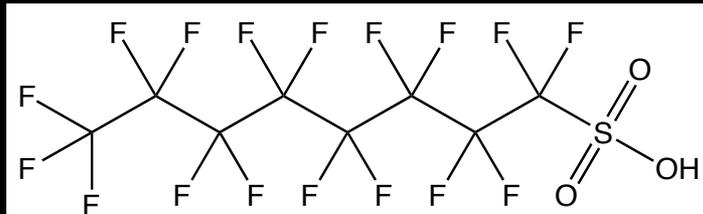
PFAS

(Per- and polyfluoroalkyl substances)

PFOA
(C8)



PFOS
(C8)



Carbon-Fluorine bond strength:

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

Ohio River Valley: West Virginia Manufacturing Plant

- PFOA used to manufacture Teflon
- Releases to water & air
- 70,000 + residents with contaminated drinking water
- C8 Health Study

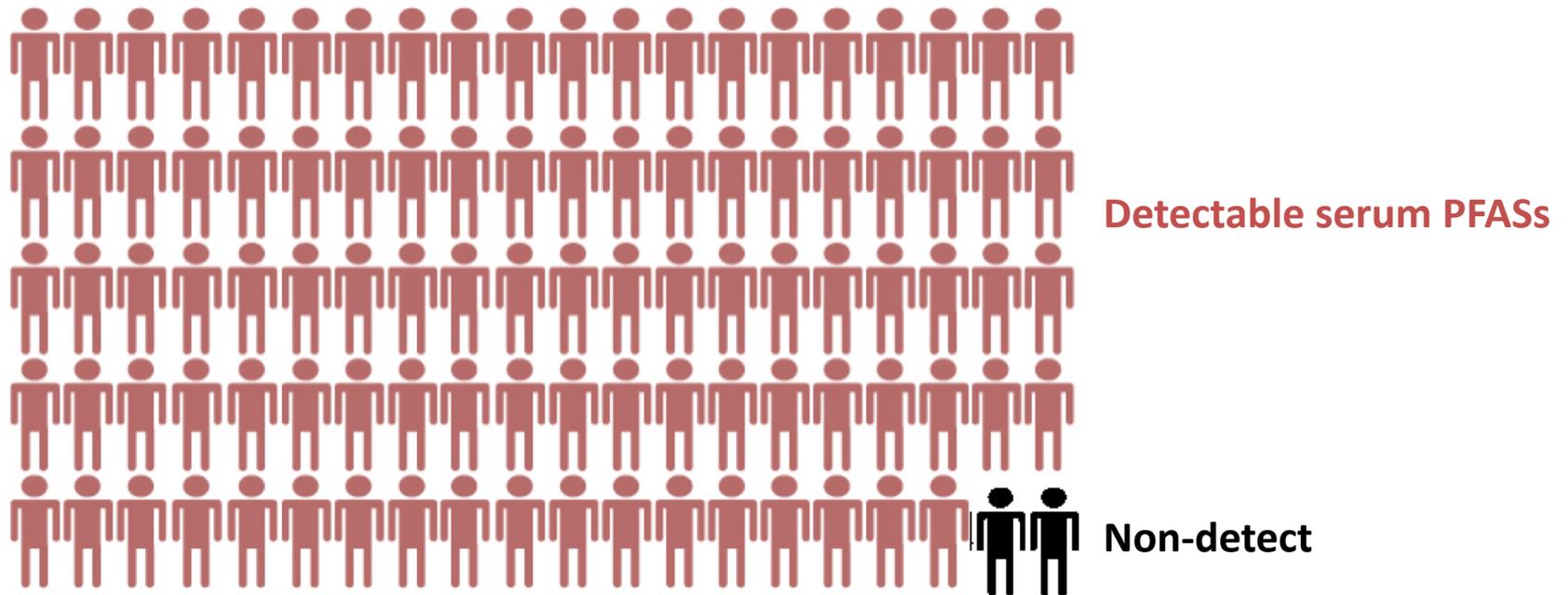


Dark Waters

- The film story of attorney Rob Bilott, who became “DuPonts Worst Nightmare” after uncovering massive PFOA contamination from a DuPont factory



PFAS exposure is a health concern



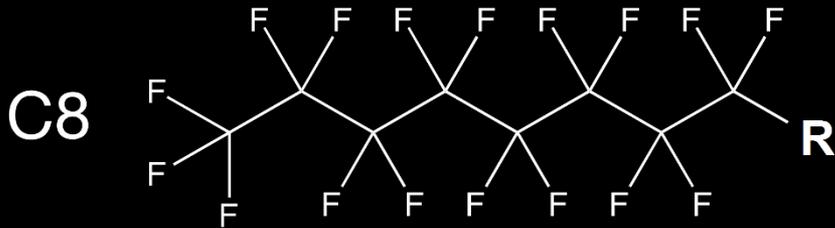
Exposure linked to health risks:

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

Courtesy, Cindy Hu, Harvard University

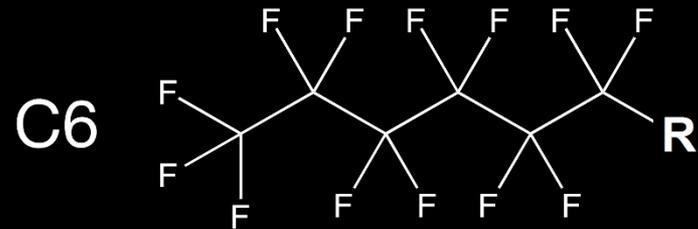
(Ref: Lewis et al., 2015; Grandjean et al., 2012; Braun et al., 2016; Barry et al., 2013)

“Regrettable” Substitution?



Long chain:

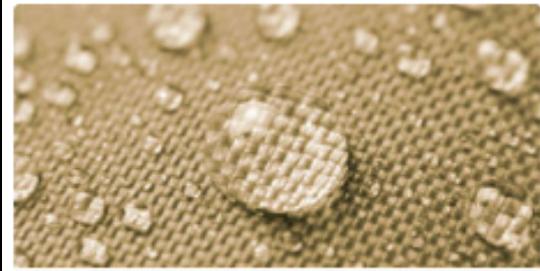
- Extreme persistence
- Bioaccumulation
- Toxicity



Short chain:

- Extreme persistence
- Build-up in plants
- Suspected toxicity
- More mobile
- Clean up more difficult
- Harder to measure & monitor

AGC – THE FIRST COMPANY TO FULLY CONVERT TO PFOA-FREE* WATER AND OIL REPELLENT



AsahiGuard® E Series is a fluorinated water and oil repellent providing sustainable alternatives for many applications, including paper packaging, textiles, apparel, non-wovens, natural and synthetic leathers and home furnishings based on proven AGC C6 chemistry. AsahiGuard E-Series offers high performance



C6 chemistry.



- “C6 polymers are proven safe for their intended use”
- “Evaluated by regulators, showing they are safe and effective”
- “C6 polymers cannot break down to C8”

May 2015 The Madrid Statement on Highly Fluorinated Chemicals

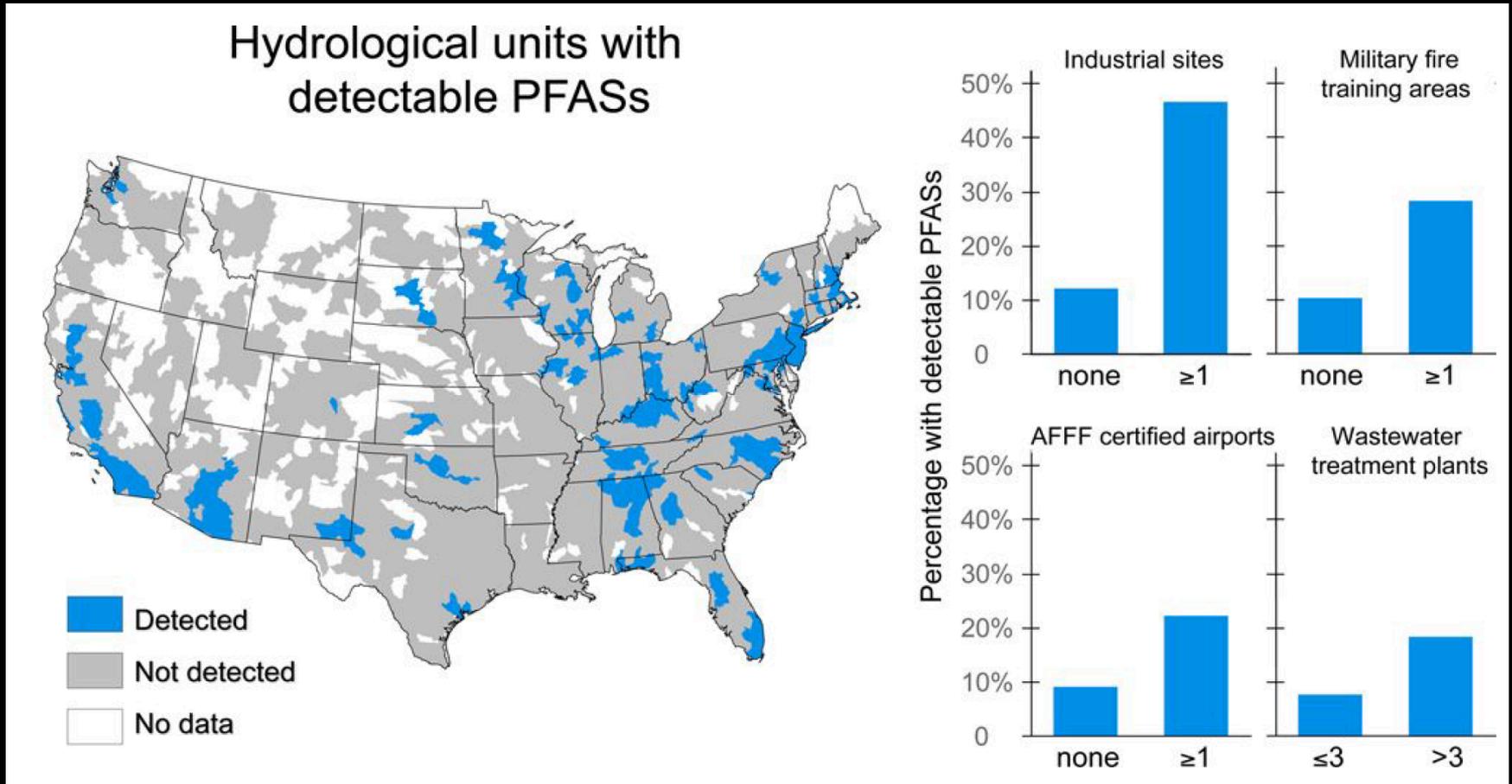


“We call on the international community to cooperate in limiting the production and use of PFASs and in developing safer non-fluorinated alternatives.”

Signed by 230 scientists from 40 countries

2015: Environmental Health Perspectives

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



Drinking Water Health Guidelines (parts per trillion)

DuPont PFOA: 5000

DuPont PFOA: 1000

U.S. EPA PFOA: 400
PFOS: 200

U.S. EPA PFOA & PFOS: 70

New Jersey PFOA: 14

New York PFOA: 10
PFOS: 10

1987

1991

2009

May 2016

Nov. 2017

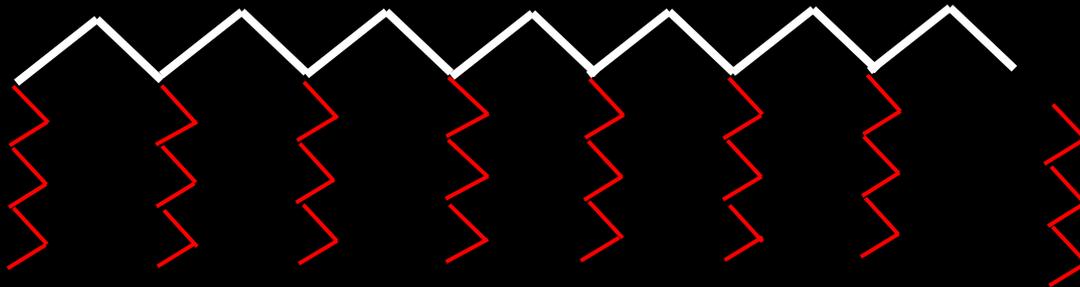
Dec. 2018

Polymer Problems

1. Polymer production (Teflon, Gortex etc.) is a major source of air & water contamination.



2. Side chain polymers can break off and cause harm.



PFAS Polymers Breakdown

ENVIRONMENTAL
Science & Technology

Article

pubs.acs.org/est

Abiotic Hydrolysis of Fluorotelomer-Based Polymers as a Source of Perfluorocarboxylates at the Global Scale

John W. Washington^{*,†} and Thomas M. Jenkins[‡]

[†]USEPA, National Exposure Research Laboratory, 960 College Station Road, Athens, Georgia 30605-2700, United States

[‡]USEPA, Senior Environmental Employment Program, Athens, Georgia 30605-2700, United States

 Supporting Information

Fluoropolymer breakdown leads to PFAS in the environment.

Michigan

- Wolverine treated leather with Scotchguard (PFOS)
 - Leather scrap dumped
 - Sludge applied to fields



- PFOA + PFOS level up to 58,000 ppt
842 times EPA health advisory level!

New Mexico

- Cannon Air Force Base
 - Firefighting foam entered groundwater
 - PFAS migrated from base to dairy wells to cows to milk
 - Farmer: "I can't sell the milk. I can't sell beef. I can't sell the cows. I can't sell crops on my property."
 - PFOS level up to 12,000 ppt
171 times EPA health advisory level!



Maine

- Paper mill sludge led to contamination of
 - Local municipal supply well
 - Milk at dairy
- Maine DEP:
 - All biosolids must now be tested for PFAS prior to use
 - Initial testing: nearly all biosolids exceed state screening levels for PFOS and/or PFOA (5.2 and 2.5 ng/g)



<https://theintercept.com/2019/06/07/pfas-chemicals-maine-sludge/>

See also: Venkatesan and Halden, J. Hazard Mater., 2013

Airway Heights, Washington

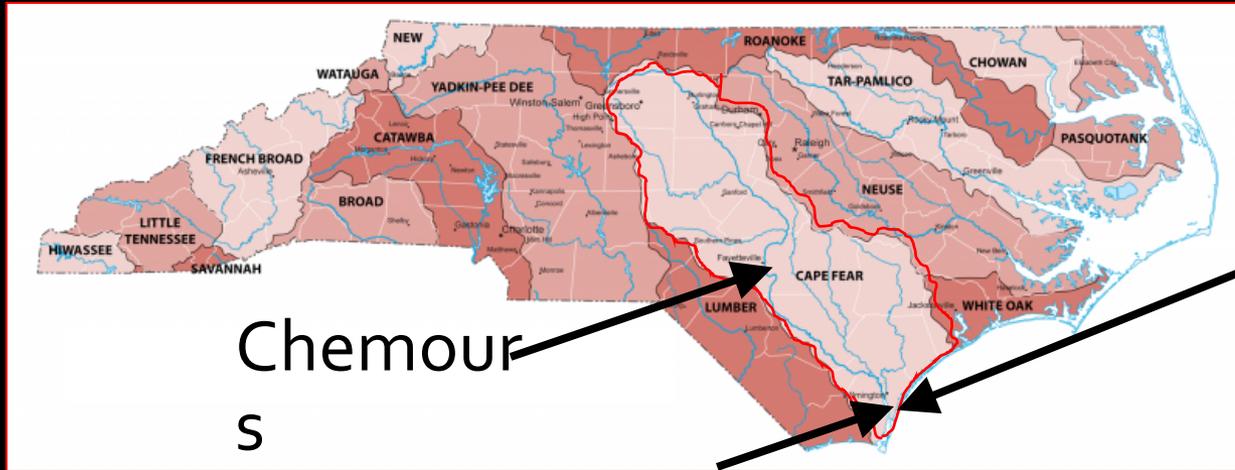
Contamination Levels¹:

- Near Fairchild Air Force Base: **up to 5,700 ppt**
- Levels **up to 80x greater** than the EPA's Health Advisory Level
- Current access to Spokane water
- Some residents being studied for levels of PFAS in their blood and urine beginning October 2019
- Needs a long term plan for clean drinking water



Distribution of bottled water to residents May 2017.

Water Treatment Costs: North Carolina



Brunswick County:
reverse osmosis
filtration for 25,000
customers:
-\$99M to build
-\$2.9M to operate

Cape Fear Public Utility Authority activated
carbon filtration plant:

-\$46M to build

-\$2.7M to operate each year

Wilmington Star News,
May 9th and 10th, 2018

PFAS are Problematic
& Difficult to Clean Up

Prevention is Preferable!

Recommendation:

Only use PFAS in products
when essential.

From Surfer Shorts to Surgical Drapes: The concept of essential use



Ian Cousins, Gretta Goldenman, et al., June 17, 2019

Category	Definition	PFAS examples
1	Uses that are not essential for health and safety, and the functioning of society. The use of substances is driven by market opportunity.	Dental floss, water repellent surfer shorts, ski waxes
2	Uses regarded as essential by society because they perform important functions, but where alternatives have now been developed that have equivalent functionality.	Most uses of AFFFs, certain water-resistant textiles
3	Uses considered essential for health or safety or for important purposes <i>and</i> for which alternatives are not yet established. There should be a constant search for alternatives to move these uses into Category 2	Certain medical devices, occupational protective clothing

2020 National Defense Authorization Act

- Require military to phase PFAS out of firefighting foams
- USGS nationwide water sampling
- Require reporting from PFAS manufacturers
- Authorize Air Force to compensate for contaminated agricultural lands
- Prohibit fluorinated packaging in meals ready to eat
- Continue funding health studies in impacted communities



NDAA – What's not there?

- EPA regulation of:
 - Drinking water under Safe Drinking Water Act
 - Water emissions under Clean Water Act
 - Contaminated sites under CERCLA (hazardous substances designation)



RCRA Petition for PFAS regulation

Filed on 1/15/20 by UC Berkeley Law on behalf of:



Benefits:

1. Ensure safe management of PFAS wastes
2. Automatic CERCLA listing to speed site clean-ups

Europe to adopt total PFAS drinking water standard

- 2020: group standard for 20 PFAS
- Next 3 years: develop analytical method for total fluorine
- Testing to begin in 2021-2022



PFAS Phase-out Gaining Traction in Europe

- Proposal from Sweden, Netherlands, Germany, Denmark:
- Take action “on the EU-level to phase out PFASs at the latest by 2025, to be in effect by 2030.”
- “A broad restriction under REACH covering all PFAS would be the preferred option.”



Moving away from PFAS in food packaging

Jan. 10, 2020:
Taco Bell phasing
out PFAS



MEDIA RELEASE / JANUARY 10, 2020

Taco Bell to phase out toxic chemicals in food packaging

Fast-food chain will ban PFAS, phthalates, and BPA by 2025; public health advocates urge the

<https://saferchemicals.org/2020/01/10/taco-bell-to-phase-out-toxic-chemicals-in-food-packaging/>

Denmark bans all PFAS in paper and paperboard food packaging

- “I do not want to accept the risk of harmful [PFAS] migrating from the packaging and into our food. These substances represent such a health problem that we can no longer wait for the EU.”

- Danish Food Minister Mogens Jensen



• <https://www.cnn.com/2019/09/04/health/denmark-pfas-food-packaging-ban-intl/index.html>

PFAS and Carpet

- PFAS-treated carpet linked to high PFAS blood levels

Exceptionally High Serum Concentrations of Perfluorohexanesulfonate in a Canadian Family are Linked to Home Carpet Treatment Applications

Sanjay Beesoon,[†] Stephen J. Genuis,[‡] Jonathan P. Benskin,^{†,§} and Jonathan W. Martin^{*,†}

[†]Division of Analytical and Environmental Toxicology, Department of Laboratory Medicine and Pathology, University of Alberta, Edmonton, AB, Canada

[‡]Department of Medicine, University of Alberta, Edmonton, AB, Canada

S Supporting Information

Moving away from PFAS in carpet

- Major manufacturers phasing out PFAS
 - 2014 – Interface
 - 2017 – Tarkett
 - 2019 – Engineered Floors
 - 2019 – Shaw

Home Depot plans to phase out selling rugs and carpets containing PFAS

By VIRGINIA GORDAN • SEP 17, 2019

 Share  Tweet  Email



CREDIT ANDREI / ADOBE STOCK

The Home Depot announced Tuesday that it will stop buying from its suppliers any rugs and carpets that contain [PFAS chemicals](#).

"Excluding PFAS from the carpets and rugs we sell is another example of our shared commitment to building a better future for our customers and the planet,"

Ron Jarvis, The Home Depot's vice president for environmental innovation, said in a written statement.

Michigan Radio, Sept. 17, 2019

BRANDS ARE ELIMINATING HIGHLY FLUORINATED CHEMICALS

IKEA

H&M

Crate&Barrel

LEVI STRAUSS & CO.

PUMA

benetton

ESPRIT

adidas

MARKS &
SPENCER

MANGO

BURBERRY[®]
LONDON

ZARA

San Francisco City Carpet Regulation

(courtesy Jen Jackson)



NO
PFAS
Flame Retardants
Antimicrobials
(among other sustainability provisions)

Moving away from PFAS



CARPETS



CARPET CLEANING PRODUCTS



FOOD PACKAGING



FURNISHINGS



COSMETICS



OUTDOOR GEAR



CLOTHING



ADHESIVES AND SEALANTS



PROTECTIVE COATINGS



NON-STICK COOKWARE



CARSEATS



FIREFIGHTING FOAM



PFAS Central: sharing notable news, scientific papers & events



NEWS

PFAS Chemicals to be Banned in Firefighting Foam Used on Military Bases

U.S. Senator Kirsten Gillibrand today announced that a provision she cosponsored to prohibit the Department of Defense from procuring firefighting foam that contains per- and polyfluoroalkyl substances (PFAS) passed the Senate Armed Services Committee as part of the annual National Defense Authorization Act (NDAA).

[LEARN MORE](#)



SCIENCE

Larval amphibians rapidly bioaccumulate poly- and perfluoroalkyl substances.

Toxic frogs lead to bioaccumulation in predator species.

[LEARN MORE](#)



POLICY

The Cost of Inaction: A socioeconomic analysis of environmental and health impacts linked to exposure to PFAS

A recent Nordic Council study, The Cost of Inaction: A socioeconomic analysis of environmental and health impacts linked to exposure to PFAS, estimates the very high cost of harm to human health and the environment from PFAS exposure in Europe.

[LEARN MORE](#)

Although useful, PFAS or highly fluorinated chemicals are associated with serious health harm and can remain in the environment forever.

[LEARN MORE](#)

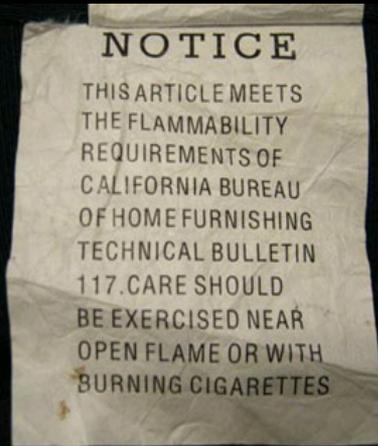
Class 3 Flame retardants

Updating 1970s Flammability Standards

- Children's sleepwear --1976
- Furniture and baby product foam --2014
- Foam building insulation
- Electronics cases

Flammability Standards Drive FR Use:

Technical Bulletin 117



Furniture foam to withstand a small open flame for 12 seconds

- Smolder vs. open flame fires—6:1 death ratio
- Slow response in ionizing smoke detectors

ASTM E84

All insulation must pass Steiner tunnel test



- Behind thermal barrier?
- Beneath a concrete foundation?

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



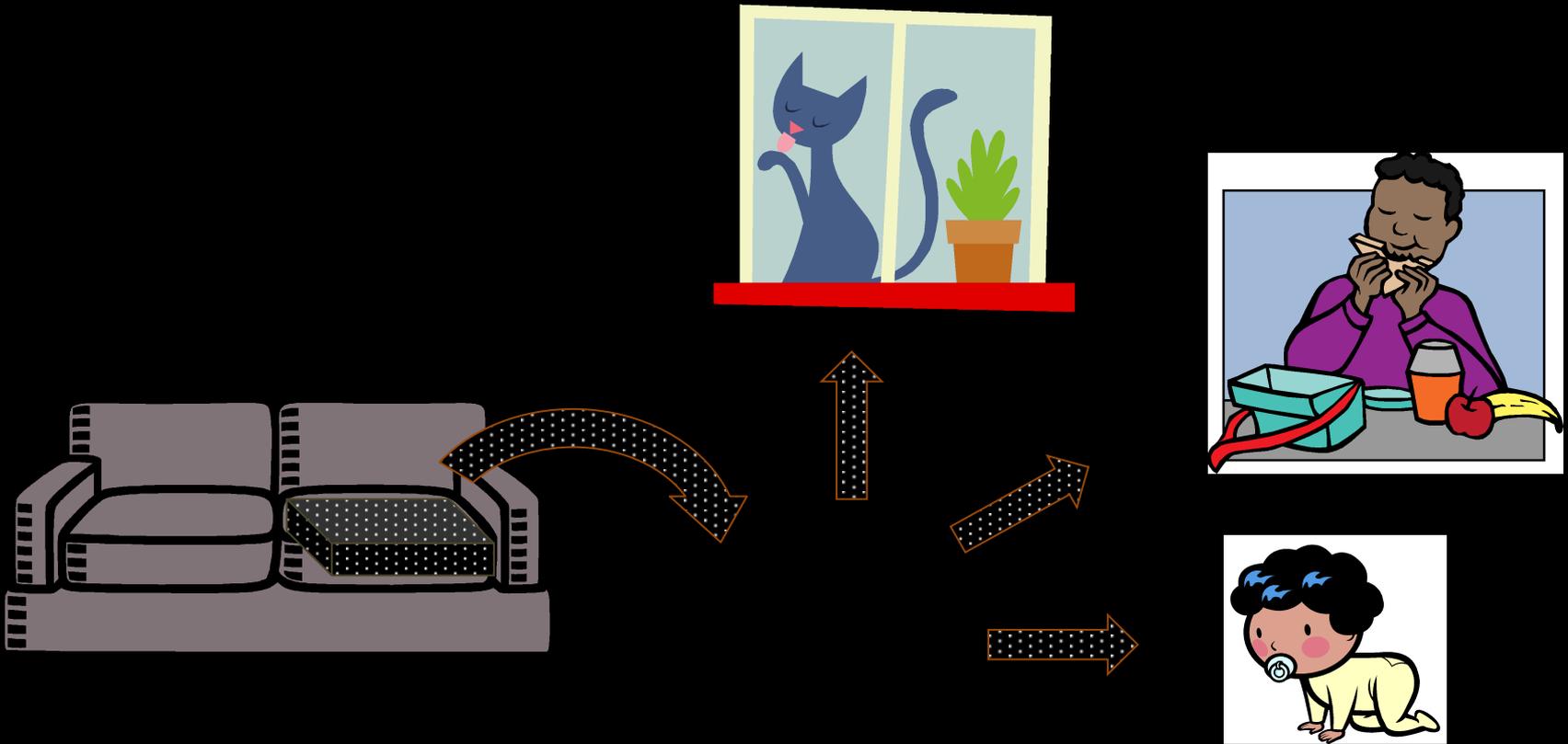
Increased time to pregnancy
Altered thyroid hormone
Thyroid disease in women



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

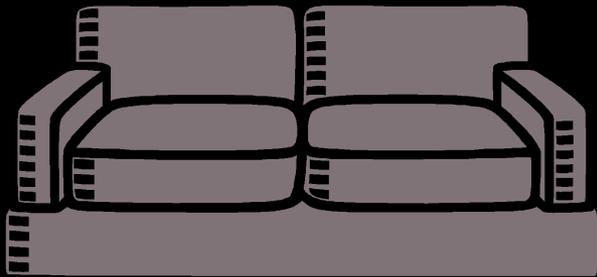
*Main et al. 2007; Goodyer et al 2017;
Eskenazi et al., 2010, 2011, 2012; Herbstman et
al. 2010; Makey et al. 2016; Windham et al.
2015; Harley et al. 2017; Allen et al. 2016*

From Products to People



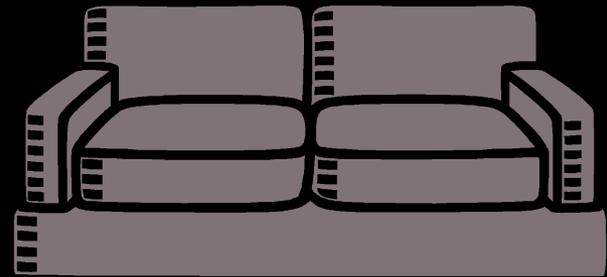
TB117 Fire Safety Benefit?

TB117 foam



~

Non - TB117 foam



“No significant, consistent difference...”

Increased fire safety without flame retardants



Assembly Bill 706, Senate Bill 772, Senate Bill 1291, Senate Bill 147

A DEADLY MISTAKE

Help stop the bill that will ban material used to make flame resistant products.

CALL YOUR STATE SENATOR TODAY AND TELL THEM TO
VOTE NO ON AB 706

Call State Senator
Tom Torlakson
at **916-651-4007** and tell him to
VOTE NO on AB 706.

Presorted Standard
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Permit #275

P-15 P25 *****ECRLOT**C018

Richmond, CA 94804-5339

**DON'T LET THE SACRAMENTO POLITICIANS BAN THE USE OF
PROVEN FLAME RETARDANTS-IT COULD BE A DEADLY MISTAKE**

Paid for by Californians for Fire Safety:

- Albemarle
- Chemtura
- Israel Chemicals LTD (ICL)



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



Pulitzer Prize

Finalist

Goldsmith Prize

Investigative Reporting

Environmental

Journalists Society

Environmental Reporting

Gerald Loeb Award

Business and Financial Journalism

National Press Club

Consumer Award

California TB117-2013

REQUIREMENTS FOR CALIFORNIA BUREAU OF FIRE PREVENTION, HOME APPLIANCES AND ELECTRICAL DIVISION, 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

CONTAIN NO ADDED FLAME RETARDANT CHEMICALS

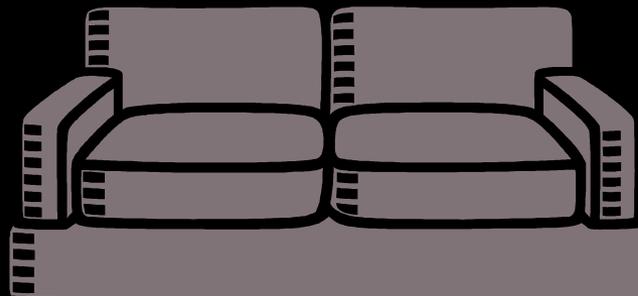
THE STATE OF CALIFORNIA HAS UPDATED THE FLAMMABILITY STANDARD AND DETERMINED THAT THE FIRE SAFETY REQUIREMENTS FOR THIS PRODUCT CAN BE MET WITHOUT ADDING FLAME RETARDANT CHEMICALS. THE STATE HAS IDENTIFIED MANY FLAME RETARDANT CHEMICALS AS BEING KNOWN TO, OR STRONGLY SUSPECTED OF, ADVERSELY IMPACTING HUMAN HEALTH OR DEVELOPMENT.

California Bans Flame Retardants in furniture, children's products & mattress foam

Signed September 30, 2018

“Toxic flame retardant chemicals have put consumers, children, and firefighters at risk for decades. Today we say no more.”

-AB 2998, Sponsor: Assemblyman Bloom



PETITION: U.S. Consumer Product Safety Commission

Products with the **class** of Organohalogen Flame Retardants

GRANTED --2017

Declare as “banned hazardous substances”:

- Children’s products
- Residential furniture
- Mattresses & mattress pads
- Plastic electronics enclosures

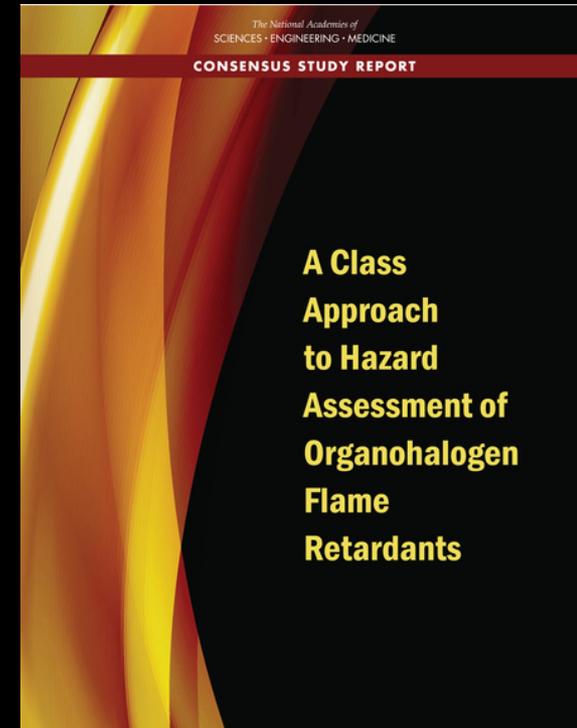


containing additive, non-polymeric organohalogen FRs

PETITION: U.S. Consumer Product Safety Commission

UPDATE: May 15, 2019

- National Academy of Science advisory Committee to Develop Scoping Plan Report
- OFRs can be divided into 14 subclasses subclasses for hazard assessment

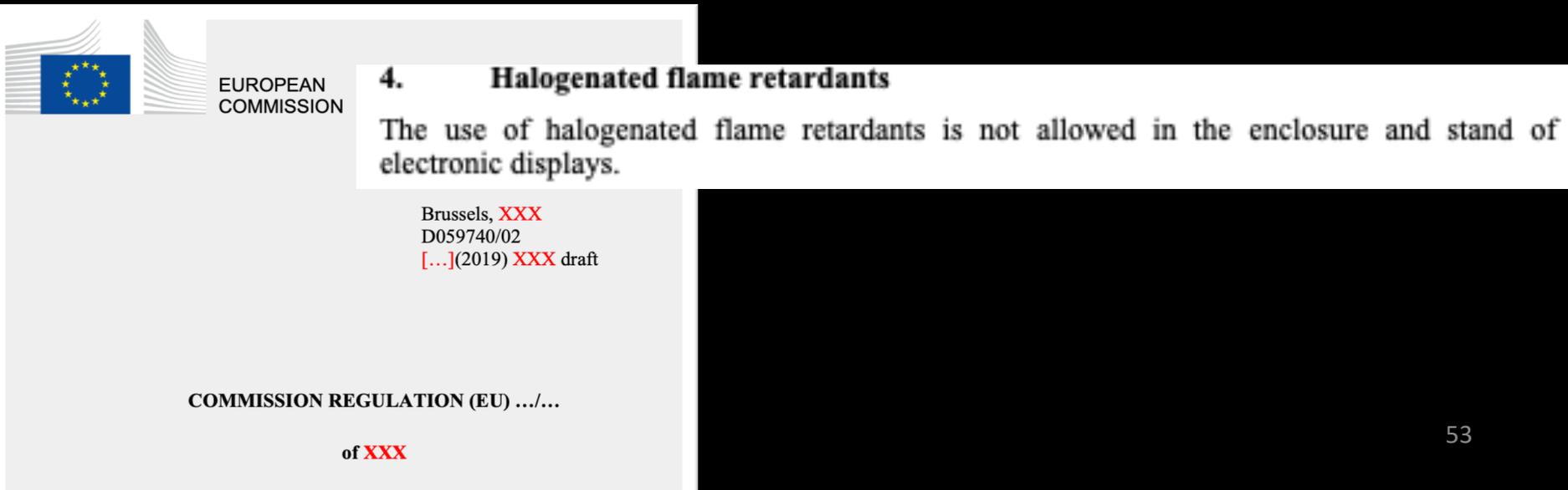


“Although the challenges to a class approach might appear daunting, the alternative—individual assessments of hundreds of chemicals—is unrealistic. **The only possible practical approach for a set of chemicals as large as the OFRs is a class approach.**”

EU Ban on Flame Retardants in Electronics Cases

Ecodesign directive bans the **class** of organohalogen flame retardants

- In cases and stands of electronic displays and TVs
- Unanimously approved by 24 member states
- Effective March 2020
- Motivation: plastic recycling in the Circular Economy



California Hall of Fame



Robert Redford, Fernando Valenzuela, Ann Gust Brown, Jerry Brown, Arlene Blum, Thomas Keller, Ed Lee's daughter, Belva Davis, & Joan Baez.

Six Classes Videos

1

Highly
Fluorinated



2

Antimicrobials



3

Flame
Retardants



4

Bisphenols
+ Phthalates



5

Some
Solvents



6

Certain Metals



www.SixClasses.org



For monthly e-newsletters,
give Arlene your card or
sign our mailing list

**This talk will be
under Past Events at
www.GreenSciencePolicy.org**

By limiting use of the Six Classes

We can have a healthier world.

**For more information:
GreenSciencePolicy.org**