



GREEN SCIENCE  
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# Preventing PFAS Pollution

GRAC PFAS Week

Tom Bruton, PhD

Green Science Policy Institute

Apr. 29, 2020



BR1 Building Research & Innovation (2021) 49(6), 738-755

**ENVIRONMENTAL Science & Technology**

**Fluorinated building insulation: a novel and high volume use flame retardants in US Couches**

Heather M. Thomas F., Nicholas S. Department of Fluorinated building insulation: a novel and high volume use flame retardants in US Couches

**ENVIRONMENTAL Science & Technology LETTERS**

**Fluorinated building insulation: a novel and high volume use flame retardants in US Couches**

Laurel A. Margaret

**ENVIRONMENTAL Science & Technology**

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

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**Supporting Information**

**ABSTRACT:** Drinking water contamination with poly- and perfluoroalkyl substances (PFAS) 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



Education

Research

Retreats

**Policy & Purchasing Change**

# GREEN CHEMISTRY

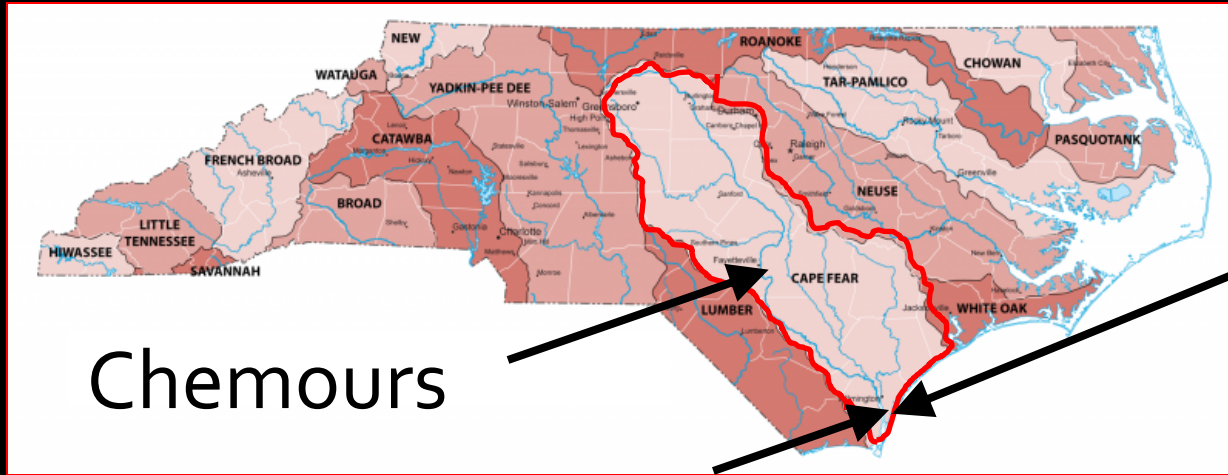
THEORY AND PRACTICE

Paul T. Anastas  
John C. Warner

## Principal 1: Prevention



# Water Treatment Costs: North Carolina



Chemours

Brunswick County:  
reverse osmosis  
filtration:

- \$99M to build
- \$2.9M to operate

Cape Fear Public Utility Authority activated  
carbon filtration:

- \$46M to build
- \$2.7M to operate each year

Wilmington Star News, May 9<sup>th</sup> & 10<sup>th</sup>, 2018



# US Department of Defense Sites

- 651 potential cleanup sites<sup>1</sup>
- 30 year timeline for remediation<sup>1</sup>
- Estimated \$2 billion for PFOA & PFOS alone<sup>2</sup>



1. DoD PFAS Task Force Progress Report, March 2020
2. Dep. Secretary Sullivan, SERDP ESTCP webinar, Sept. 2017

# PFAS: the Cost of Inaction

Estimates for Europe:

- Remediation: 10-20 billion EUR over 20 years
- Health-related costs: 52-85 billion EUR / year



PFAS are Problematic  
& Difficult to Clean Up

Prevention is Preferable!



# 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

# 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

# Common Uses



CARPETS



CARPET CLEANING PRODUCTS



FOOD PACKAGING



FURNISHINGS



COSMETICS



OUTDOOR GEAR



CLOTHING



ADHESIVES AND SEALANTS



PROTECTIVE COATINGS



NON-STICK COOKWARE



CARSEATS



FIREFIGHTING FOAM



# Firefighting foam (AFFF)

- Discharge to environment



# Firefighting foam (AFFF)

- Discharge to environment
- Large volumes

Determination of  
Perfluorocarboxylates in  
Groundwater Impacted by  
Fire-Fighting Activity

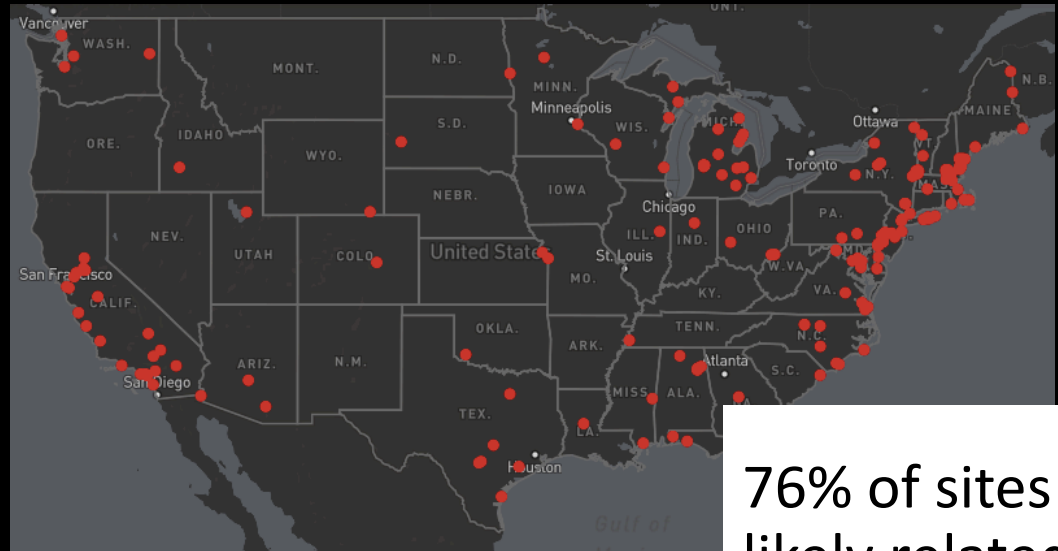
CHERYL A. MOODY AND  
JENNIFER A. FIELD\*

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Oregon State University, Corvallis, Oregon 97331*

- 75-100 L of AFFF used weekly to monthly for 30+ years
- Up to 7 mg/L PFCAs in groundwater 7-10 years after last AFFF use

# Firefighting foam (AFFF)

- Discharge to environment
- Large volumes
- Many sites



76% of sites likely related to firefighting foam use

Source data from:  
SSEHRI PFAS Contamination Site Tracker,  
7.02.2019



# Fluorine-Free Foams

- Contain no PFAS
- Used
  - at airports abroad (Norway, Sweden, UK, Australia, UAE...)
  - by many companies in oil and gas industry
  - increasingly by local fire departments



But...

- Not used by U.S. Military or airports

<https://ipen.org/documents/fluorine-free-firefighting-foams>

# Washington State's Ban on PFAS in Firefighting Foam

(HB 2793/SB 6413)



- Signed into law on March 27, 2018
- Bans sale of firefighting foam containing any PFAS beginning July 1, 2020
- **The states of CT, GA, KY, MA, MN, NY have similar bills this year**

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

# Federal Policy Changes

- 2018: Congress tells Federal Aviation Administration to allow fluorine-free foams by 2021
- 2019: Congress sets timeline for military AFFF phaseout

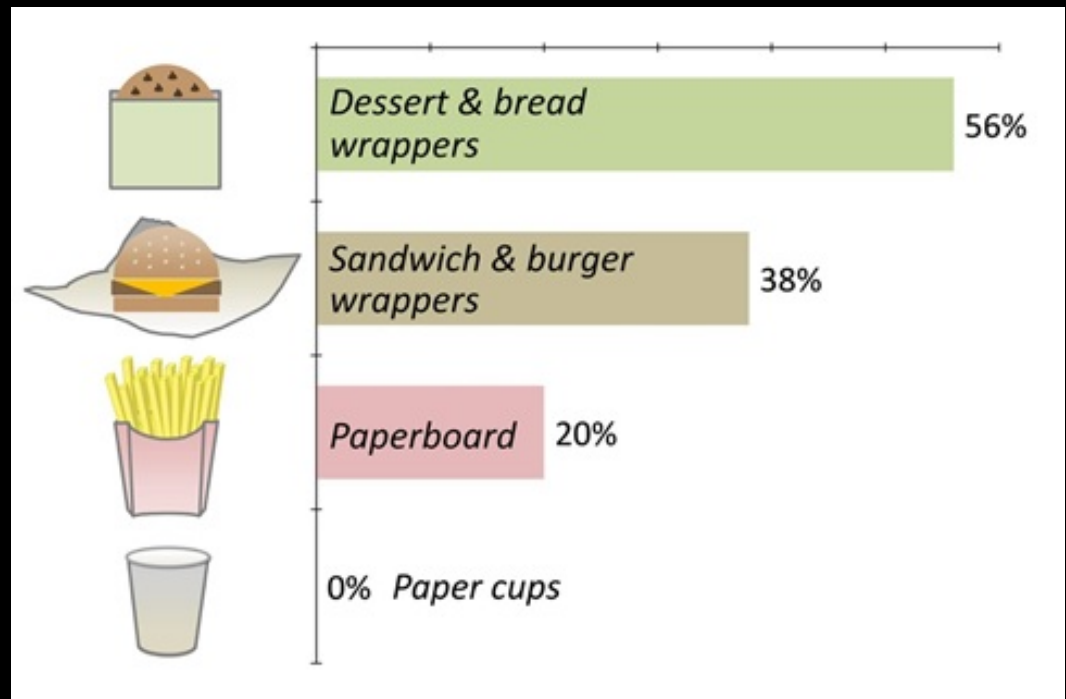


# Food Packaging



Molded fiber

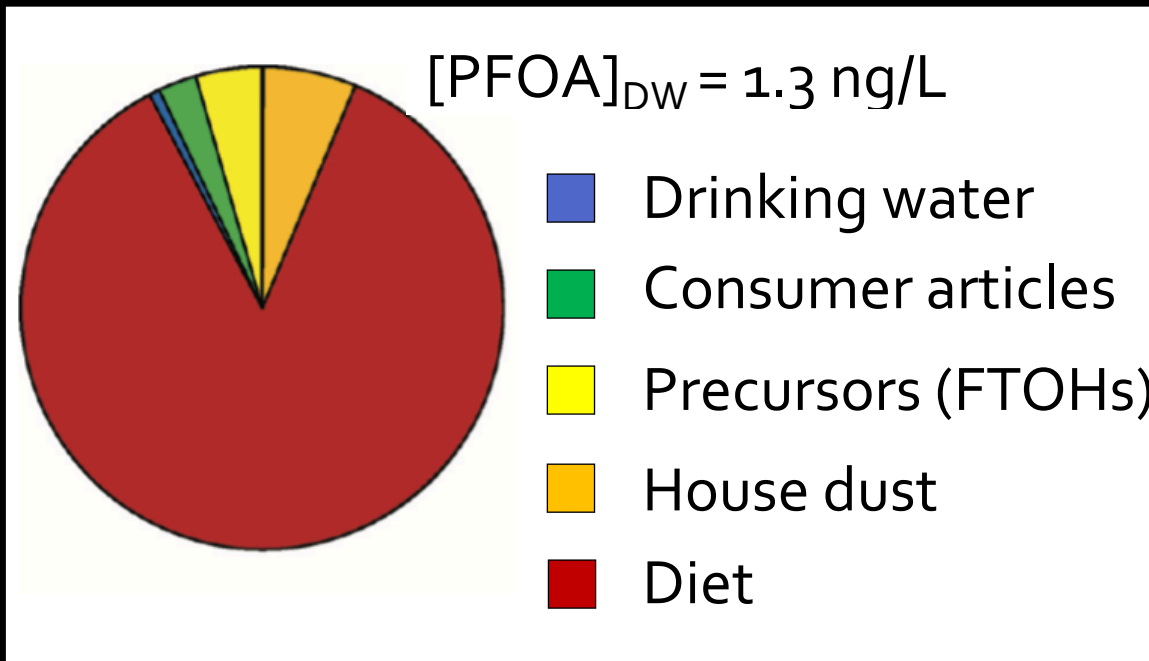
Fluorine in U.S. fast food packaging paper  
(percent positive; 400 products sampled)



Schaider, et al., *Environ. Sci. Technol. Lett.* 2016.

# Food packaging: Human exposure

- PFAS can migrate from food contact material to food<sup>1-2</sup>
- Diet is important component of exposure<sup>3</sup>



1. Begley, et al., *Food Add. Cont. A*. 2008.

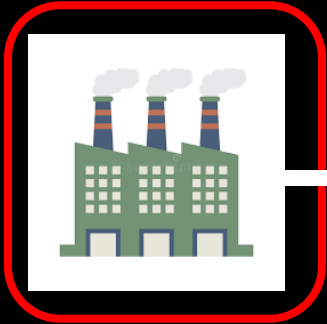
2. Yuan et al., *Environ. Sci. Technol.* 2016.

3. Vestergren & Cousins, *Environ. Sci. Technol.* 2009.



# Life Cycle Impacts

PFAS  
manufacturing



Paper mill



PFAS into  
food

Landfill



Compost



Recycle



# Microwave Popcorn Bags

- High PFAS concentrations <sup>1-4</sup>
- Coop Denmark - halted popcorn sales in 2015 due to PFAS
- RESULT: PFAS-free popcorn bags



1. Zabaleta, et al., *Talanta*. 2016.
2. Zafeiraki, et al., *Chemosphere*. 2014.
3. Dolman and Pelzing. *Chrom. B*. 2011.
4. Begley, et al. *Food Add. and Cont.* 2005.

# Moving away from PFAS in food packaging

## Whole Foods Ditches Packaging Containing PFAS Chemicals

12/11/2018

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



MEDIA RELEASE / MARCH 6, 2020

## Sweetgreen to phase out toxic PFAS in food packaging

## Chemours asks US FDA to pull food contact approvals for PFASs

FDA reviewing all authorised uses of chemicals in food applications

16 August 2019 / Food & drink, Food contact, PFAS, United States

# Food Packaging: Policy & Regulation

## Bans:

- 2018 - Washington state
- 2019 – Maine
- 2019 – Denmark
- 2020 – San Francisco
- 2020 – CA DTSC possible priority product
- 2020 – US Congress: no PFAS in military meals-ready-to-eat (MREs)



# Carpet:

A significant exposure in indoor environments



- For infants, toddlers & children, hand-to-mouth transfer from carpet contributes 40-60% of total PFOA and PFOS uptake<sup>1</sup>.
- After-market treatment linked to high PFAS levels in blood<sup>14</sup>

1. Trudel et al., *Risk Anal.* 2008.

2. Beeson et al., *Environ. Sci. Technol.* 2012.



# Carpet:

## Release of PFAS to the environment

- Contamination of water supplies downstream of manufacturing sites<sup>1</sup>
- Long-term emissions from landfills (municipal solid waste and construction & demolition)<sup>2</sup>
- Runoff from artificial turf<sup>3</sup>

1. "Second Alabama City Sues North Georgia Carpet Manufacturers..."  
Chattanooga Times Free Press, 2017.

2. Solo-Gabriele et al. 2020

3. "Toxic PFAS Chemicals Found in Artificial Turf. *The Intercept*, 2019.

# Carpet industry phasing out PFAS

- Demand from large purchasers
- Potential CA regulation
- Potential liability




- Major manufacturers decide to stop using PFAS



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

By VIRGINIA GORDAN • SEP 17, 2019

[Share](#) [Tweet](#) [Email](#)



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

# Moving away from PFAS



CARPETS



CARPET CLEANING PRODUCTS



FOOD PACKAGING



FURNISHINGS



COSMETICS



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CLOTHING



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FIREFIGHTING FOAM

# 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.”





# Thank you!

**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](#)

To learn more:  
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[tom@GreenSciencePolicy.org](mailto:tom@GreenSciencePolicy.org)

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