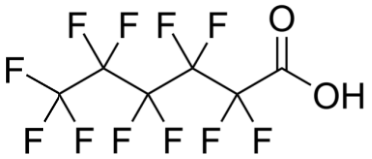
# PFAS in food packaging: Implications for exposure and life cycle considerations





**Laurel Schaider, PhD**
Senior Scientist, Silent Spring Institute

NEWMOA PFAS Conference 2022

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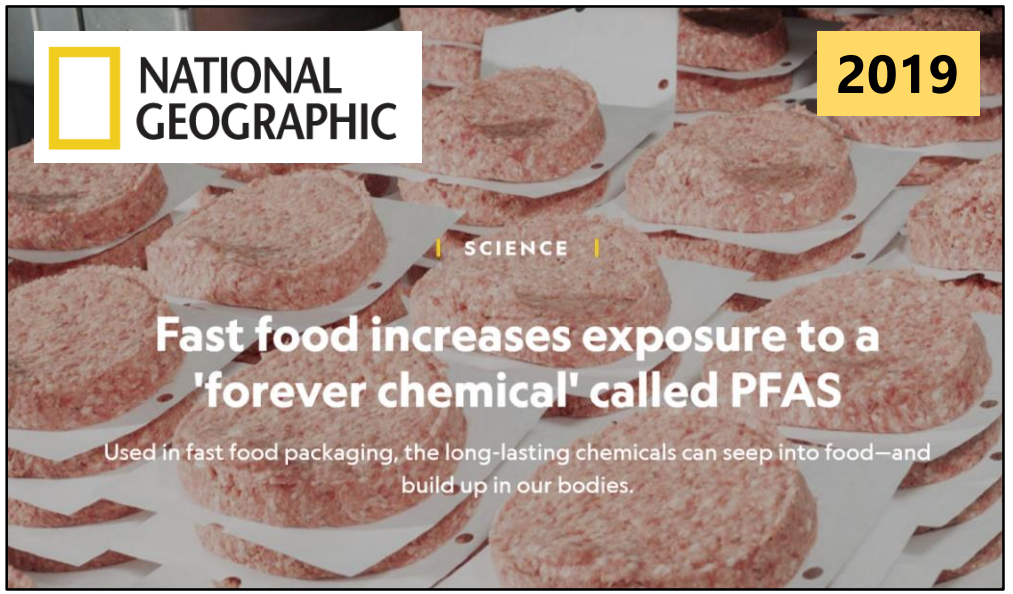
STEEP
Sources, Transport, Exposure & Effects of PFASs
UNIVERSITY OF RHODE ISLAND SUPERFUND RESEARCH PROGRAM

PFAS-REACH
PFAS Research, Education, and Action for Community Health

# Overview

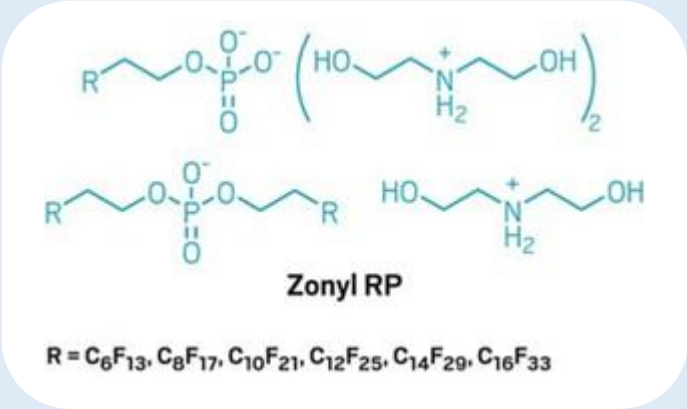
- Uses and prevalence of PFAS in food packaging
- Packaging as a source of exposure
- Life cycle implications
- Regulatory and retailer action

# Silent Spring Institute studies


# Uses of PFAS in food packaging

- US FDA has approved certain PFAS for food contact materials, including paper/paperboard food packaging
- First fluorochemical application for paper food packaging approved in 1967 (Zonyl RP)
- PFAS confer grease, oil, and water resistance and are stable at high temperatures

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cen.acs.org/materials/coatings/PFAS-paper-food-packaging/
www.fda.gov/food/chemical-contaminants-food/authorized-uses-pfas-food-contact-applications

# FDA approval of PFAS in packaging

- 2011 – FDA initiates voluntarily phase-out of long-chain PFAS from food packaging
- 2016 – FDA rescinded approval for three long-chain PFAS used in food packaging in response to petition
- Currently around 50 fluorochemicals approved by FDA to be marketed in US (C&EN 2021)



cen.acs.org/materials/coatings/PFAS-paper-food-packaging/
http://blogs.edf.org/health/2016/02/11/fda-decides-3-pfcs-are-unsafe/
www.fda.gov/food/chemical-contaminants-food/authorized-uses-pfas-food-contact-applications

# Microwave popcorn bags

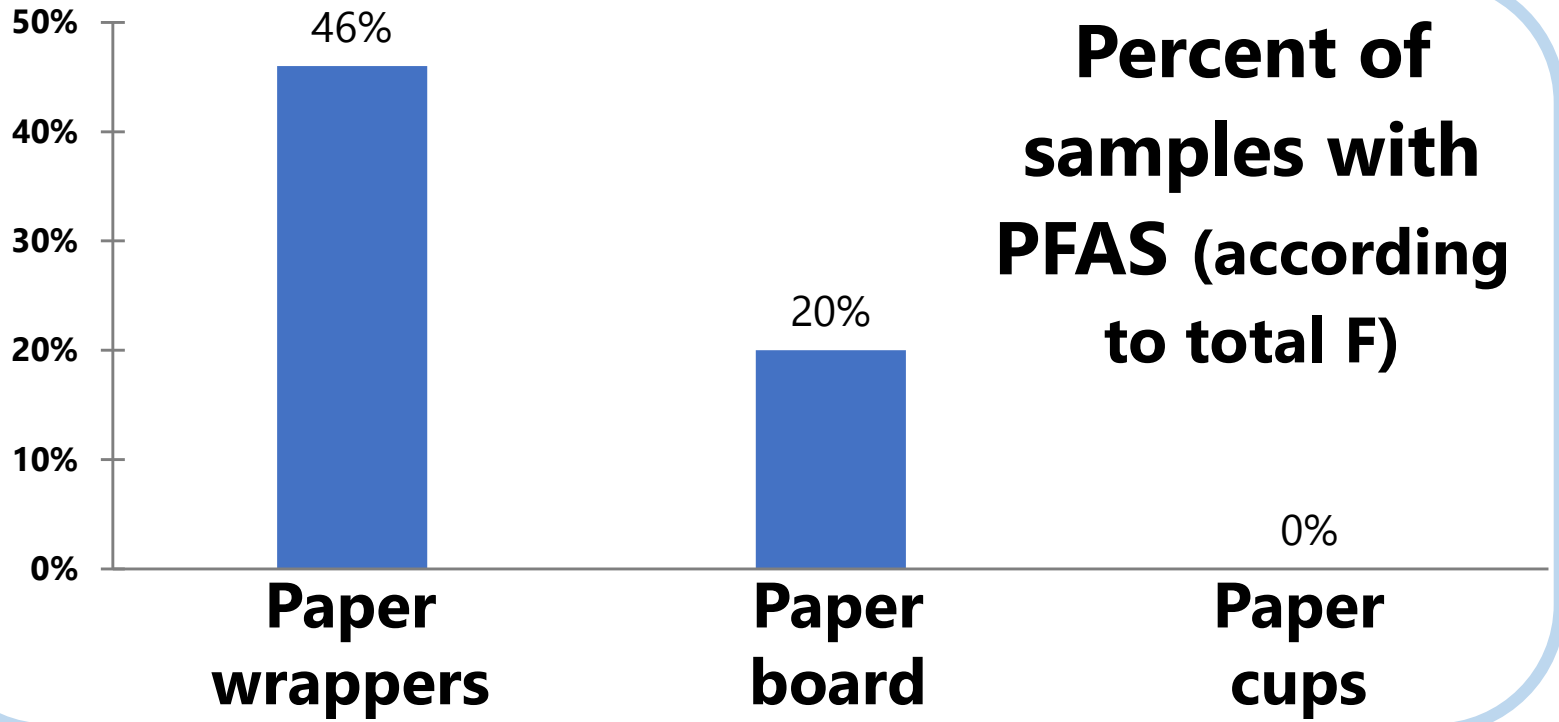

## Center for Environmental Health (2017)

- 100% of 27 microwave popcorn bags were PFAS treated

| BRAND | TYPE |
|---|---|
| Act II | Butter Lovers |
| Act II | Kettle Corn |
| Act II | Buttery Kettle Corn |
| Act II | Movie Theater Butter |
| Act II | Light Butter |
| Act II | Mini Bags Butter |
| Pop Weaver | Kettle Corn |
| Pop Weaver | Extra Butter |
| Pop Weaver | Butter |
| Pop Weaver | Light Butter |
| Orville Redenbacher's | Movie Theater Butter |
| Orville Redenbacher's | Ultimate Butter Pop Up Bowl |
| Clover Valley | Extra Butter Flavor |
| Clover Valley | Kettle Corn |
| Lowrey's | Bacon Curls Microwave Pork Rinds |
| Lowrey's | Bacon Curls Microwave Pork Rinds - Hot & Spicy |
| Pop Secret | Homestyle |
| Pop Secret | Movie Theater Butter |
| Regal Cinemas | Movie Theater Butter Flavor |

https://toxicfreefuture.org/research/pfass-popcorn-bags-pizza-boxes/

# Fast food packaging




- Over 400 samples from 27 fast food chains tested for total fluorine (**2014-2015**)
- 27 PFAS and series of polyfluorinated compounds detected (PFCAs, PFSAs, FTSs, diPAPs, PF polyethers)
- PFOA among most frequently detected compounds

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*Schaider et al. 2017. ES&T Letters. 4:105-111.*

# Molded fiber packaging

## 2019 testing by *The Counter*

- 100% of "compostable" bowls from 14 NYC restaurants (including Chipotle, Sweetgreen) likely had PFAS based on total fluorine

## 2019 report by Toxic-Free Future and Safer Chemicals, Healthy Families

- 10 of 78 packaging samples at grocery stores tested positive for PFAS
- Samples with PFAS included molded fiber clamshells and plate, coated brown paper carton, and paper for sandwiches and baked goods

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https://toxicfreefuture.org/research/take-out-toxics-pfas-chemicals-in-food-packaging/
https://thecounter.org/pfas-forever-chemicals-sweetgreen-chipotle-compostable-biodegradable-bowls/

# March 2022 Consumer Reports testing

- Screened 118 samples of restaurant and grocery store packaging for organofluorine
- 31% exceeded Danish guideline of 20 ppm
- PFOA most frequently detected compound

Samples with highest total organo-fluorine


www.consumerreports.org/pfas-food-packaging/dangerous-pfas-chemicals-are-in-your-food-packaging-a3786252074/

the ONION®

# Chemicals Found In Fast Food Packaging

**AMERICAN VOICES**
February 1, 2017
VOL 53 ISSUE 04
Opinion

*Researchers have found that one-third of fast food packaging such as burger wrappers contains fluorinated chemicals, grease-repelling compounds that can harm the immune system and are even linked to cancer. What do you think?*

"Anything that touches a Guacamole Bacon Thickburger for long enough is bound to get some chemicals on it."

**Neil Fitch** • LECTURE BOOKER

"Just to be safe, I'll go behind the counter and eat straight off the griddle from now on."

**Paula Werther** • TRUANCY INVESTIGATOR

"This is the wake-up call I needed to stop eating burger wrappers."

**Dan Walters** • JUICE BOTTLER

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*https://www.theonion.com/chemicals-found-in-fast-food-packaging-1819563450*

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# PFAS can migrate out of packaging

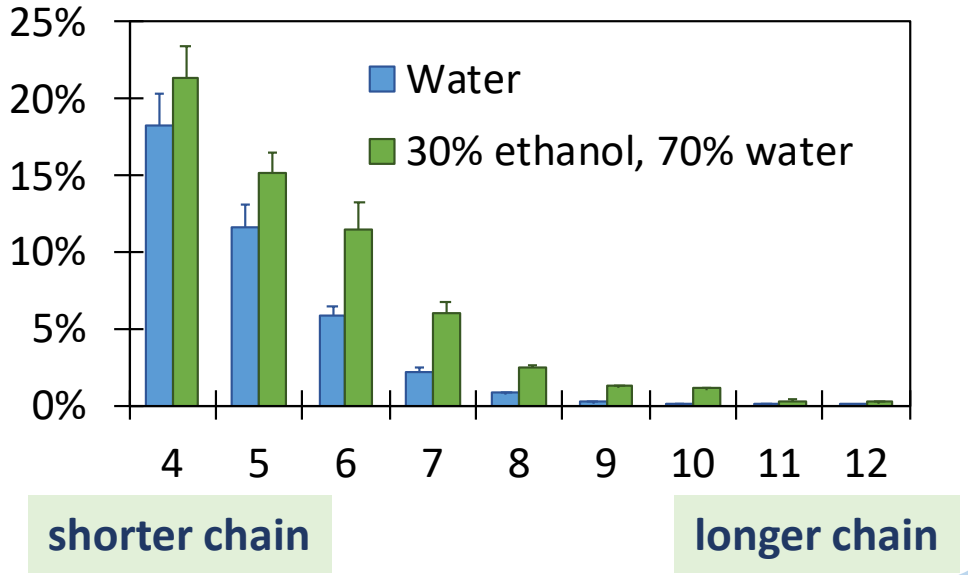
- Factors that increase PFAS migration:
  - Higher temperatures
  - Longer contact times
  - Foods with emulsifiers
  - Lower pH / more acidity
- Some evidence of PFAS migration into popcorn, volatile PFAS also may be inhaled
- Migration varies by compound

*Begley et al. 2008. Food Addit. Contam. 25: 384-390.*
*Sinclair et al. 2007. Environ Sci Technol. 41:1180-1185.*
*Carnero et al. 2021. Foods. 10:1443.*

# Short-chain PFAS more likely to migrate than long-chain PFAS

**Percent of PFCAs that leached out of paper bowls**

*Data from Yuan et al. 2016*




- U.S. food packaging mostly contained short-chain, Chinese packaging more long-chain
- Short-chain PFAS like PFBA more readily leached out than long-chain PFAS like PFOA



Yuan et al. 2016. *Environ Sci Technol.* 50:942-950.

# Silent Spring Institute study of general U.S. population (NHANES 2003-2014)

- Consumption of microwave popcorn linked to higher blood levels of PFOA, PFOS, PFNA, PFDA
- Daily consumption of microwave popcorn led to 63% higher blood level of PFDA

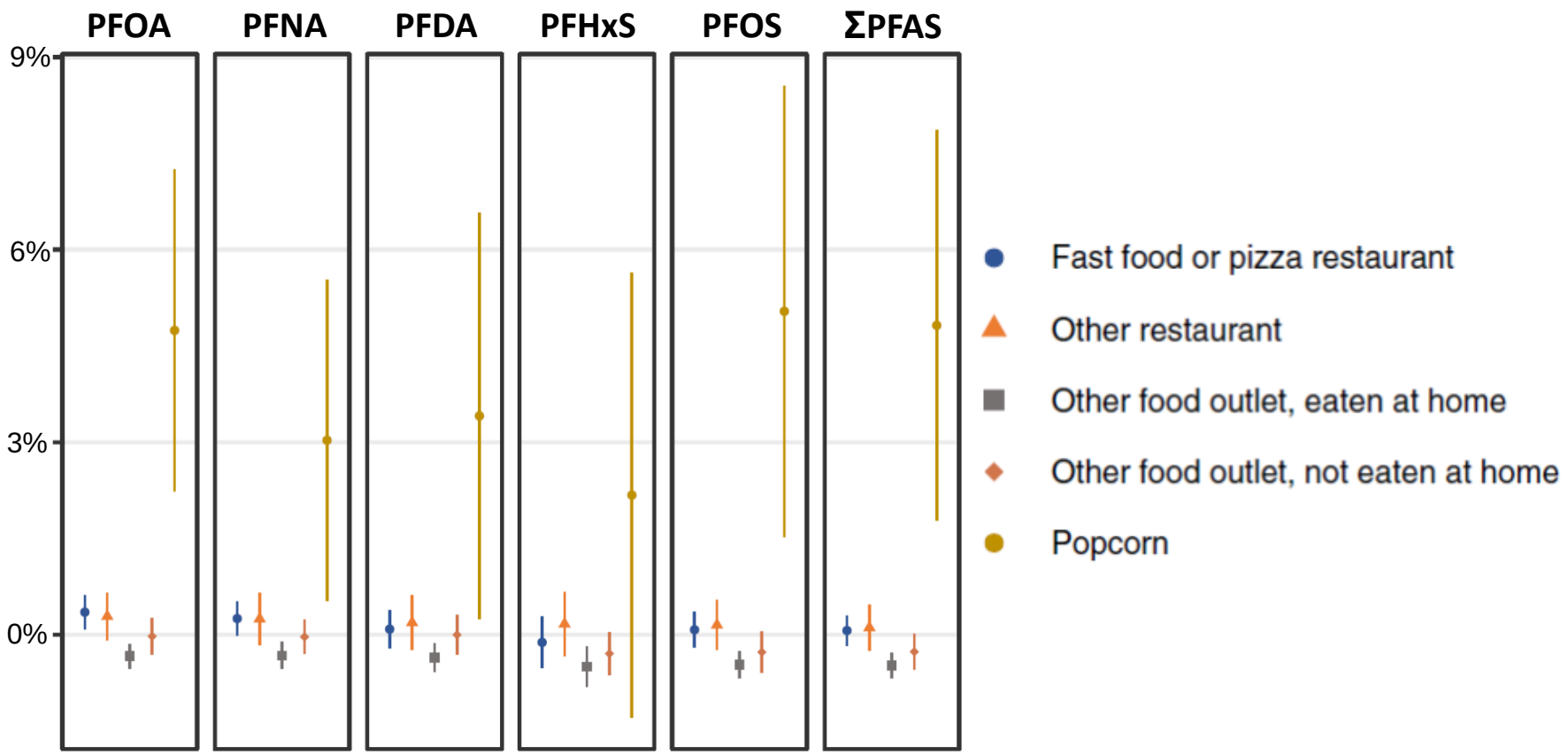
- Eating more meals at home was linked to lower blood levels of 5 PFAS (PFOA, PFOS, PFNA, PFDA, PFHxS)
- Restaurant food may have higher PFAS from packaging, and people may eat higher PFAS foods out of the home



Susmann et al. 2019. *Environ Health Perspect*. 127(10):107003.

# Silent Spring Institute study of general U.S. population (NHANES 2003-2014)

Percent increase in PFAS in blood serum per 100 calories in last 24 hours

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Susmann et al. 2019. *EHP.* 127(10):107003.

# Behaviors linked to PFAS exposure

- Boronow (2019, California)
  - Consuming higher levels of prepared food in cardboard packaging associated with 90-124% higher PFOA, PFNA, PFDA, and PFOS in African American women only
  - Higher PFAS levels in blood also associated with PFAS-contaminated water, stain-resistant carpets and furniture, and flossing with Oral-B Glide floss



Boronow et al. 2019. *JESEE*. 29:206-217

# Dietary links to PFAS exposures

- Halldorsson (2008, Denmark)
  - PFAS in blood associated with consumption of snacks, including popcorn linked to higher PFAS exposures
- Wu (2015, California)
  - PFAS in blood associated with consumption of microwave popcorn
- Other studies have not addressed whether consumption of fast food or restaurant food is linked to higher PFAS



Halldorsson et al. 2008. *Environ Sci Technol.* 42: 8971-8977.
Wu et al. 2015. *Environ Res.* 136: 264-273.

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# Food packaging is a non-essential use that contributes to PFAS pollution

Environmental Science
Processes & Impacts

ROYAL SOCIETY OF CHEMISTRY

CRITICAL REVIEW

View Article Online
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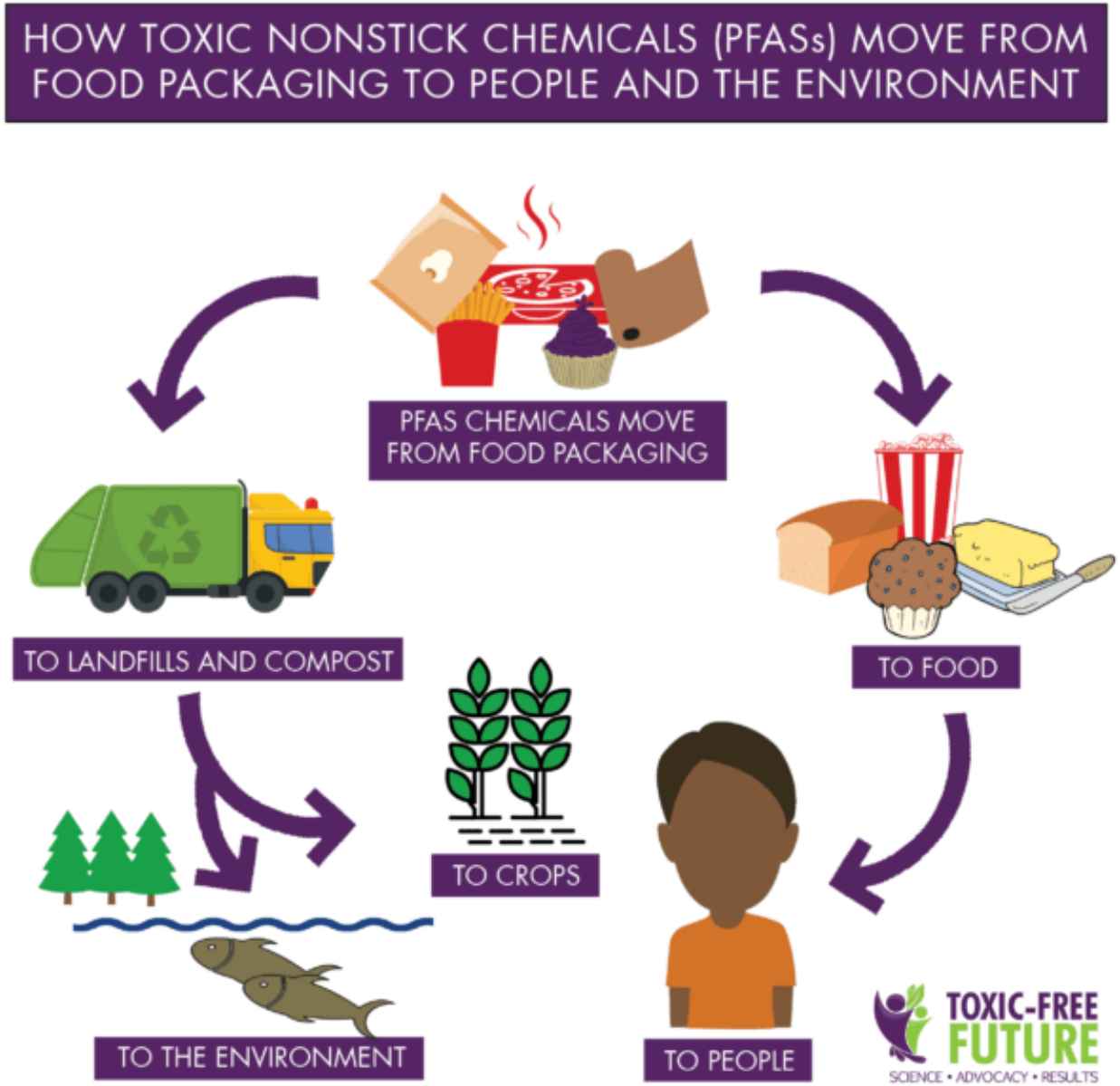
Cite this: *Environ. Sci.: Processes Impacts*, 2019, **21**, 1803

**The concept of essential use for determining when uses of PFASs can be phased out**

Ian T. Cousins, †*[a] Gretta Goldenman,[b] Dorte Herzke,[c] Rainer Lohmann, [d] Mark Miller,[e] Carla A. Ng, [f] Sharyle Patton,[g] Martin Scheringer, [h] Xenia Trier,[i] Lena Vierke,[j] Zhanyun Wang [k] and Jamie C. DeWitt[l]

"…non-fluorinated alternatives have been historically available for all applications of paper-and-board food packaging and the use of fluorinated protective coatings has never been essential."

# Food packaging is a non-essential use that contributes to PFAS pollution




https://www.healthytomorrow.org/campaigns/pfas-in-food-packaging/

# Concerns about compost and PFAS in packaging

## Biodegradable Products Institute standard for compostability (2020)

"Products may no longer be claimed as BPI Certified, whether on the product itself, or on a product's packaging or marketing materials, unless it meets all conditions of the rule, including **no intentionally added fluorinated chemicals** (as demonstrated in Safety Data Sheets) and a test report showing **less than 100 ppm total fluorine.**"

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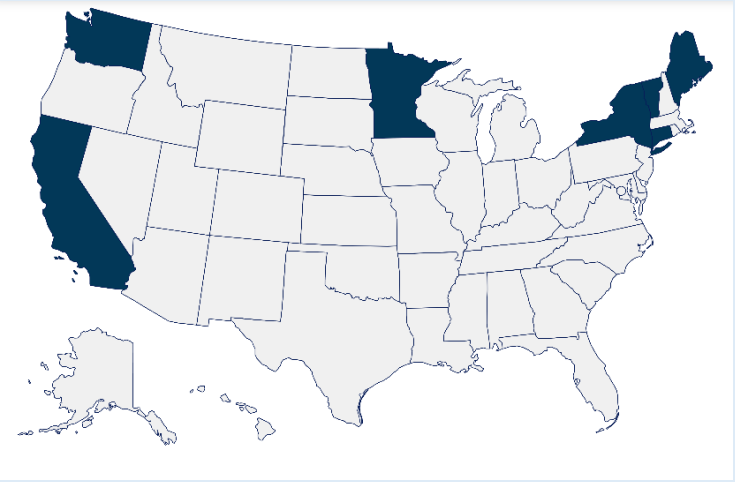
# State regulatory restrictions on PFAS

- 7 states with bans on PFAS in packaging
  - WA (2018)
  - ME (2019)
  - NY (2020)
  - VT (2021)
  - MN (2021)
  - CT (2021)
  - CA (2021)



- Other states with proposed legislation, including Mass.
- Safer States tracks state-level policies:
  www.saferstates.com/toxic-chemicals/pfas/

# New York becomes third state to ban PFAS chemicals in food packaging

By News Desk on December 5, 2020

New York Gov. Andrew Cuomo has signed legislation that will help protect consumers from the harmful effects of a dangerous class of chemicals linked to serious health problems, according to Consumer Reports.

https://www.foodsafetynews.com/2020/12/new-york-becomes-third-state-to-ban-pfas-chemicals-in-food-packaging/

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## The New York State Senate

JUSTIFICATION:

The chemicals PFOA and PFOS have come under scrutiny in New York over the last several years due to water contamination cases. While existing federal and state efforts to regulate PFOA and PFOS are critical, there is a troubling gap in these efforts. PFOA and PFOS are part of a class of man-made chemicals called PFAS, or perfluoroalkyl and polyfluoroalkyl chemicals. Regulations on PFOA and PFOS do not address less common chemicals in the PFAS family that could pose similar and unknown human health impacts, not to mention the potential for new PFAS chemicals to be developed in the future. This bill ban PFAS chemicals in food packaging containers used in New York. Chemicals that are similar in chemical makeup to chemicals we know to be harmful should not be automatically approved for use, because it is likely they also lead to harmful health impacts. Rather, we should utilize a precautionary principle and prohibit the use of all PFAS chemicals in food packaging.

...

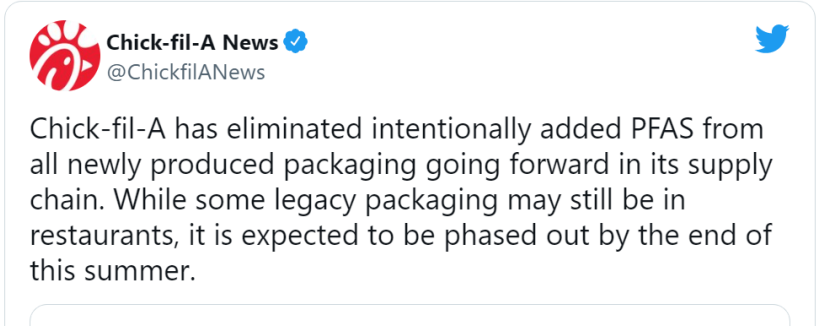
Food packaging is a key place to look for PFAS chemicals, as they often include non-stick components to repel grease. PFAS chemicals in food packaging can enter a human's bloodstream by leaching into food that is consumed, as well as find its way into the environment through disposal.

https://www.nysenate.gov/legislation/bills/2019/s8817

A study published in February 2017 (Silent Spring Institute et. al., Environ. Sci. Technol. Lett., 2017, 4 (3), pp 105-111) looked at 400 samples of food packaging from fast food restaurants in the United States. It found that PFAS chemicals were found in 46% of food contact papers and 20% of paperboard samples, including a breakdown of 56% of dessert and bread wrappers, 38% of sandwich and burger wrappers, and 20% of paperboard.

# Retailers eliminating PFAS in packaging

- Fast food chains have committed to eliminate PFAS
  - Cava, Chipotle, Freshii, McDonald's, Panera Bread, Sweetgreen, Taco Bell, Wendy's
- New commitments in March 2022





MEDIA RELEASE / MARCH 24, 2022

**Burger King announces global ban of toxic "forever chemicals" in food packaging**

Restaurant Brands International commits to eliminating PFAS in food packaging by 2025 in all stores worldwide including Burger King, Tim Hortons, and Popeyes

MEDIA RELEASE / MARCH 31, 2022

**Starbucks announces ban of toxic "forever chemicals" in its food packaging**

Starbucks commits to eliminating PFAS from all U.S. packaging by the end of 2022, and international packaging in 2023

# Recent FDA action

- New evidence by FDA scientists on toxicity and biopersistence of 6:2 FTOH for use in paper/board packaging
- July 2020 – FDA announcing voluntary agreement with 3 manufacturers to phase out products based on 6:2 FTOH in food packaging

PA Rice et al. 2019. Food Chem Toxicol. 138:111210.

www.fda.gov/food/cfsan-constituent-updates/fda-announces-voluntary-phase-out-industry-certain-pfas-used-food-packaging

# Emerging concerns about PFAS in plastics

- EPA testing found PFAS in plastics used for pesticides based on findings of PEER (Public Employees for Environ. Responsibility)
- Fluorination of plastics likely source of PFAS in bottles
- August 2021 – FDA issued new guidance on fluorinated polyethylene to avoid PFAS

https://www.fda.gov/media/151326/download

E&E NEWS | GREENWIRE

**FDA raises alarm over PFAS-tainted food containers**

By Ariel Wittenberg, E.A. Crunden | 08/06/2021 12:32 PM EST

# Challenges & emerging concerns

- Enforcement of regulations and verification of PFAS levels
- Analytical methods
- How to distinguish intentional vs nonintentional PFAS additions
  - Danish Veterinary and Food Administration introduced indicator value of 20 µg/g organic F in paper for intentional addition of PFAS to paper and board
- Avoiding regrettable substitutions – How do we know alternatives are safer?



www.foedevarestyrelsen.dk/english/SiteCollectionDocuments/Kemi%20og%20foedevarekvalitet/UK-Fact-sheet-fluorinated-substances.pdf

# Thank you!

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**URI STEEP:** web.uri.edu/steep

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