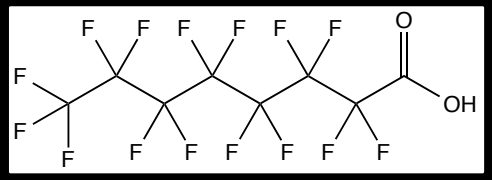
PFASs in Food Contact Materials: Challenges and Opportunities

Tom Bruton, PhD
Green Science Policy Institute

Sept. 21, 2017

PFASs
(Poly- and perfluoroalkyl substances)



Stable

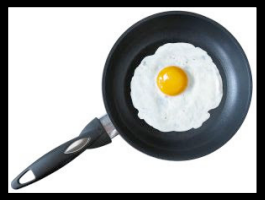
Hydro- & Lipophobic

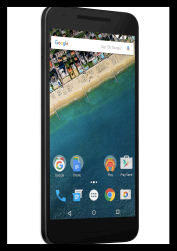
Stain-repellent

Water-repellent

Non-stick

Surface active





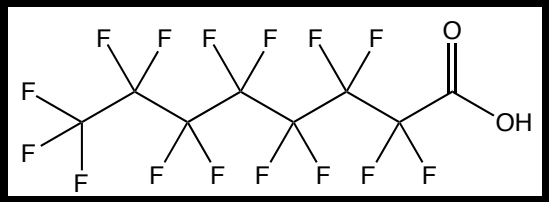
Persistent

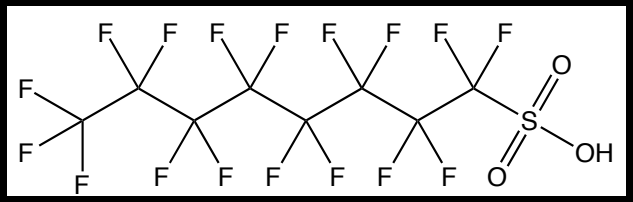
Bioaccumulative (some)

Toxic (some?)

Mobile

PFOA and PFOS

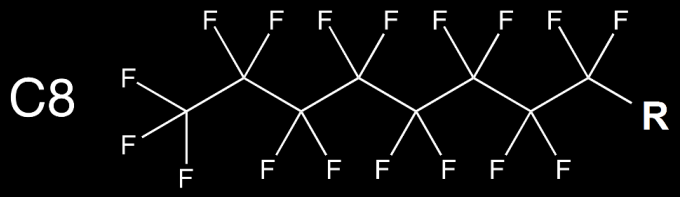




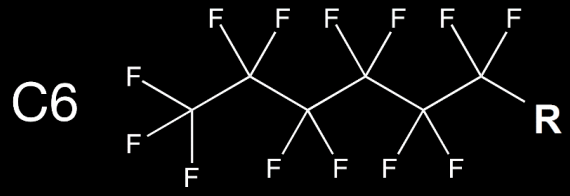
- Persistent
- Bioaccumulative
  - in wildlife, in human serum
- Toxic
  - developmental effects
  - kidney and testicular cancer
  - liver damage
  - immune system effects
  - thyroid effects

- U.S. EPA Lifetime Health Advisory
  - 70 ng/L combined (May 2016)

Industrial Transition

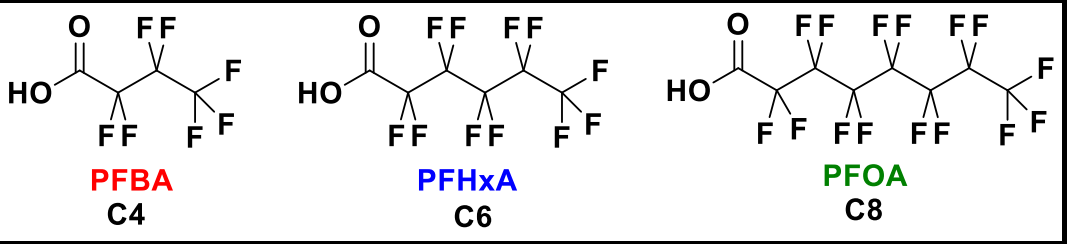


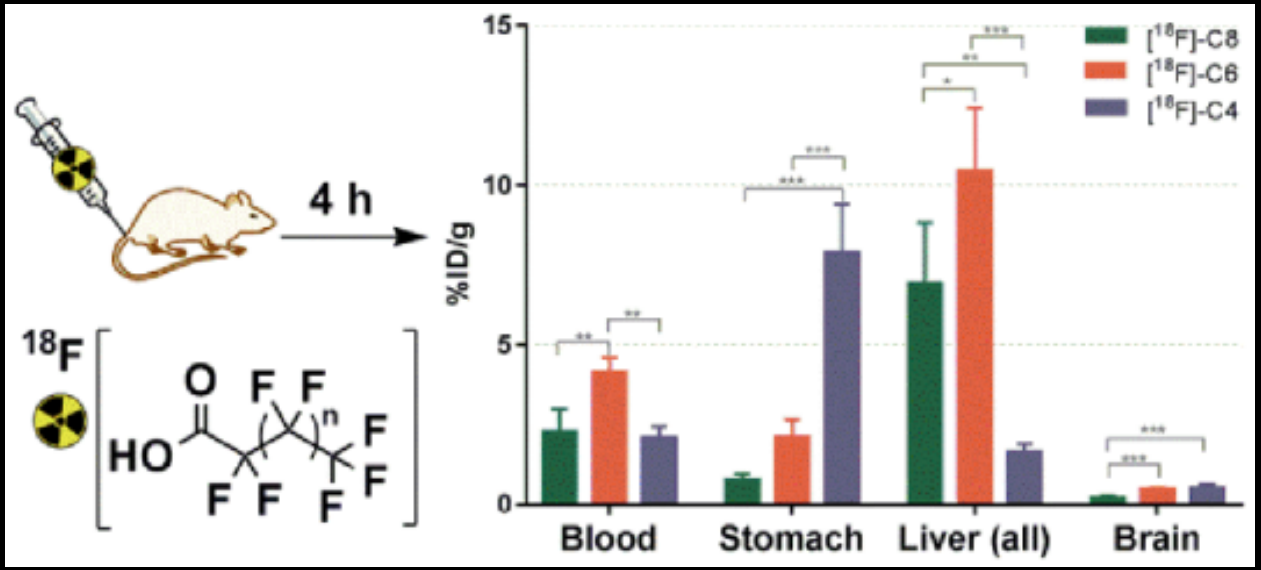
C8 Fluoro-compounds



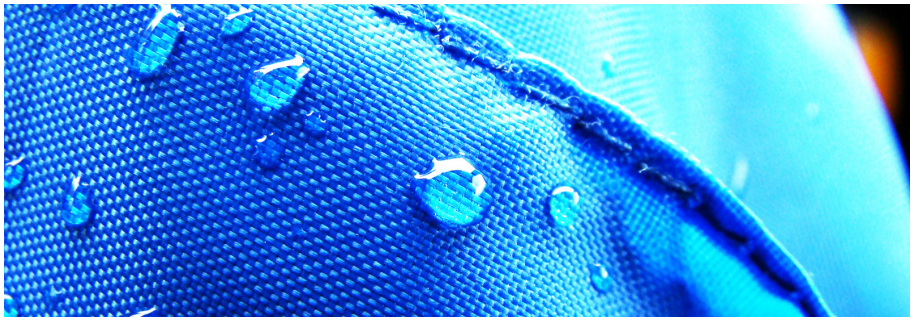
C6 Fluoro-compounds

Shorter chain PFAS at higher levels in some organs





Fluorinated Alternatives?



Fluorinated Alternatives: Myths versus Facts

Long-chain highly fluorinated chemicals — including PFOA, PFOS and other C8 compounds — were used for decades to give water-repellant, stain-resistant, and non-stick properties to furnishings, carpets, outdoor gear and other products. Exposure to PFOA has been linked to kidney and testicular cancer, elevated cholesterol, decreased fertility, thyroid problems and changes in hormone functioning in adults as well as adverse developmental effects and decreased immune response in children[1].

Due to such harmful effects, the long-chain chemicals were recently phased out and replaced by numerous similar compounds, including short-chain molecules called C6 and C4[2]. Industry says these alternatives are safe, sustainable, and well-tested[3]. A look at the facts shows those claims don't stick.

THE BOTTOM LINE

Highly fluorinated chemicals pose a potential risk to human health and the environment, and they should only be used with safeguards when their function is essential.

MYTH: "PFOA-free" means safe.
FACT: Products advertised as "PFOA-free" often contain replacement chemicals made with the same problematic chemical building blocks as PFOA.

Since PFOA has been phased out, numerous related chemicals that are equally persistent and may pose similar health risks have replaced it[4]. To prevent such "regrettable substitutions", the entire class of highly fluorinated chemicals should be avoided.

MYTH: Short-chain fluorinated alternatives like the 6 and 4 carbon-based compounds have been thoroughly tested and are safe.
FACT: Recent studies suggest these alternatives may cause similar health problems as the long chain compounds.

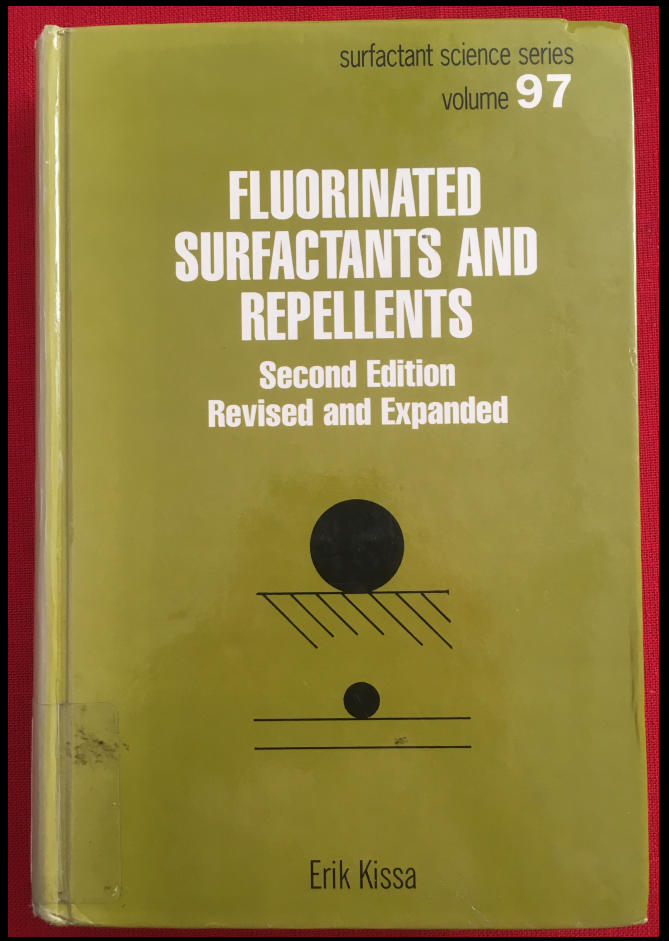
Green Science Policy Institute www.GreenSciencePolicy.org + 1 (510) 898-1739 Info@GreenSciencePolicy.org

www.greensciencepolicy.org/highly-fluorinated-chemicals/

Food contact uses

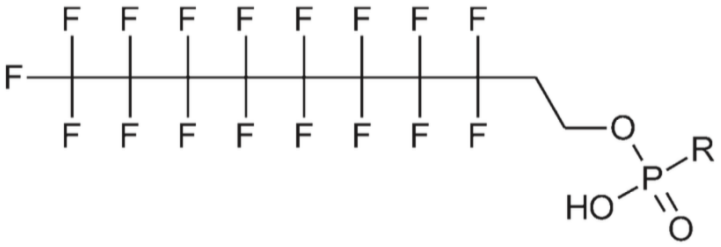
Used as oil, grease, and solvent repellents

- Liner board: meat
- Folding cartons: snack foods, carryout fast food, cake mixes, margarine, candy, bakery products, and pet foods
- Multiwall bags: snack foods, cake mixes, pet food
- Flexible packaging: carryout fast food, candy wrap
- Support cards: candy and bakery products



Monomers vs. Polymers

Monomeric fluorinated surfactants (with cationic retention aids)



Fluorotelomer phosphate esters
(ex. if R= OH then 8:2 monoPAP
if R= 8:2 FTO ester then 8:2 diPAP)

Lindstrom, et al. *ES&T*, 2011

Polymeric fluorochemicals

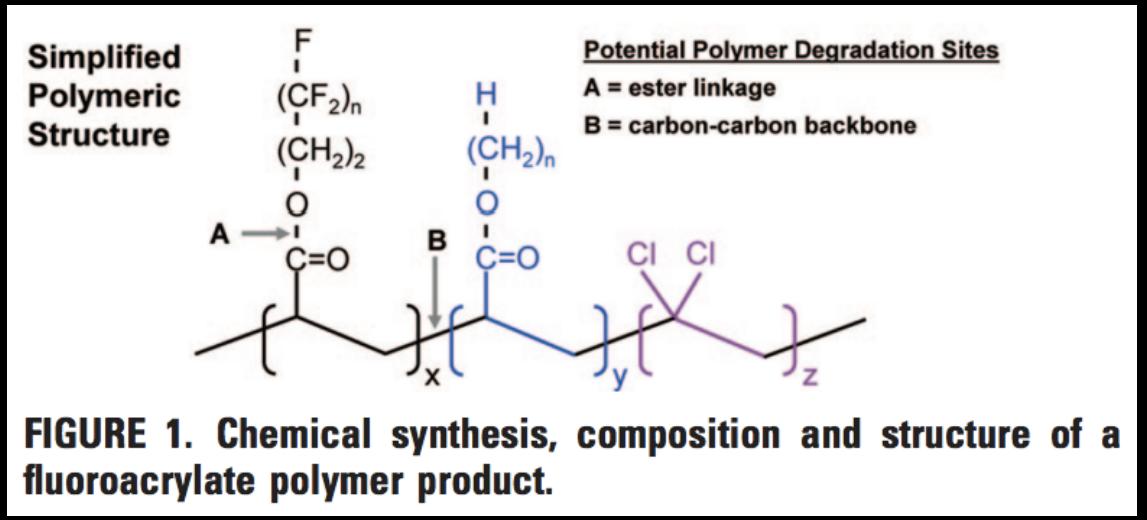


FIGURE 1. Chemical synthesis, composition and structure of a fluoroacrylate polymer product.

Russell, et al. *ES&T*, 2008

PFAS in food contact materials

Application methods:

- Add to pulp slurry (1.0-1.5% dry weight basis)
- apply to paper surface
- included in pigmented coatings

Transfer to food

- Food is major source of human PFAS exposure
- Unclear what portion is from food itself vs. packaging

Table 6. Estimate of Adult (Mass, 60 kg) Exposure to Perfluorinated Carboxylates and PFOS

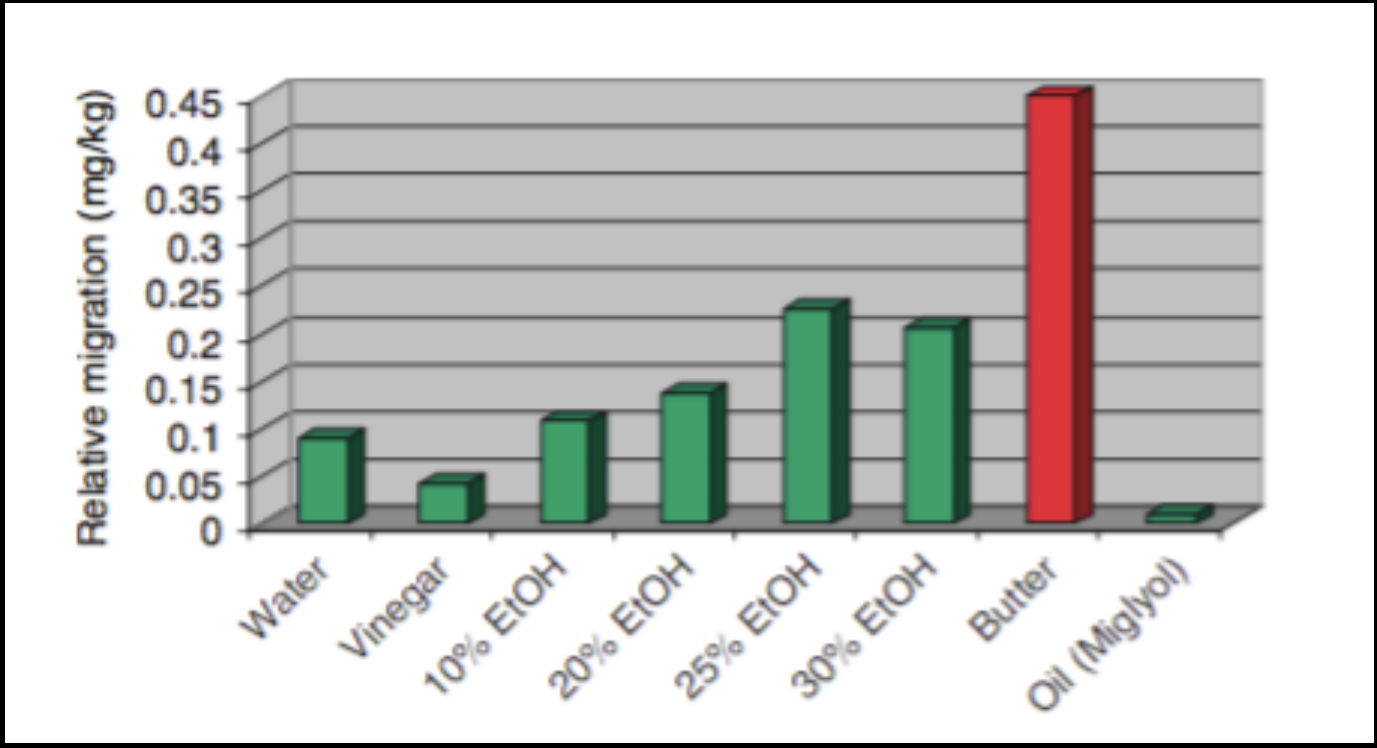
source of PFAs	estimated daily intake (ng/day)	notes
food	250	mean female and male (≥ 12 years old) dietary intake of SPFAs for 2004 Canadian TDS data
water	0.3	calculated from PFOA tap water concentrations for Calgary and Vancouver, Canada
dust	28	calculated from mean PFOS and PFOA dust concentrations from homes in Ottawa, Canada
solution-treated carpeting	120	reasonable maximum aggregate adult exposure to PFOA
treated apparel	12	reasonable maximum aggregate adult exposure to PFOA
air		negligible due to low vapor pressures of perfluorinated carboxylates and PFOS
total intake from all sources	410	

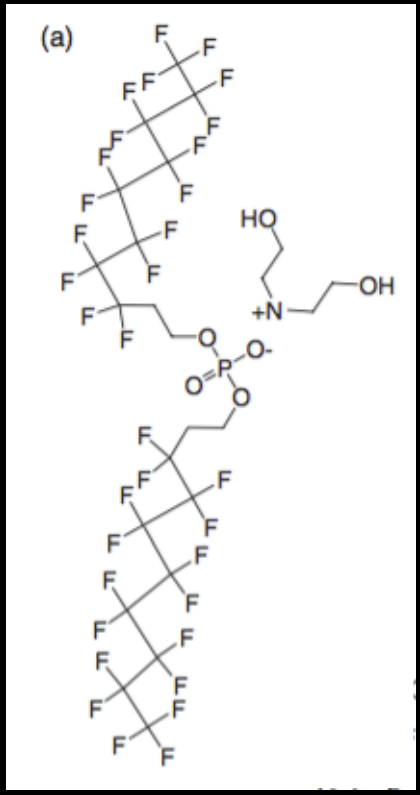
Tittlemeir, et al. *J. Agric. Food Chem.*, 2007

Transfer to food

Extent of migration from FCM to food depends on:

- Type of food (fat- vs. water-based)



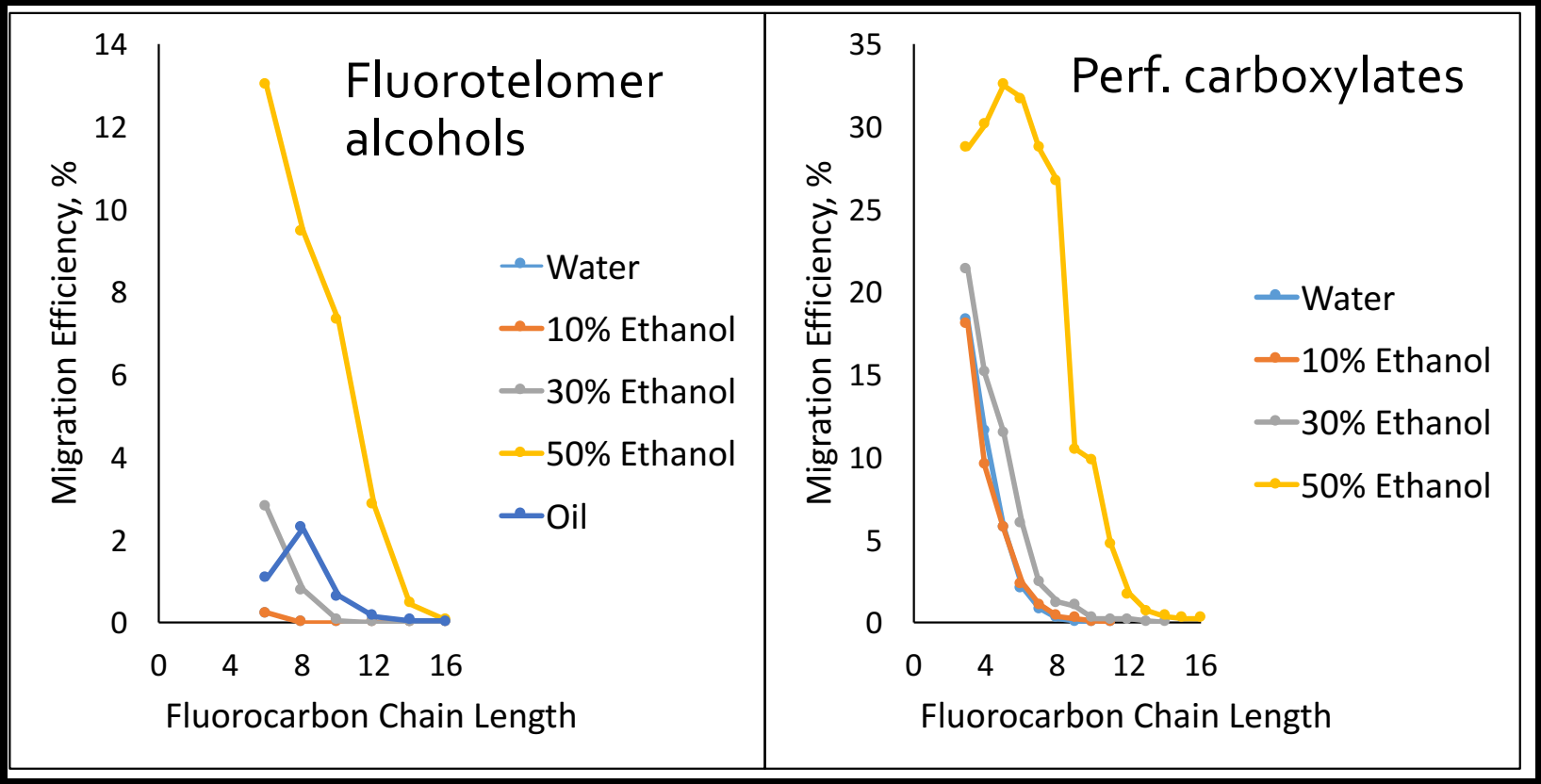


Begley, et al. *Food Add. Cont. A, 2008*

Transfer to food

Extent of migration from FCM to food depends on:

- Amount, type, and **chain-length** of PFAS



Modified from Yuan, et al. *ES&T*, 2015

Transfer to food

Extent of migration from FCM to food depends on:

- Amount, type, and chain-length of PFAS
- Type of food (fat- vs. water-based)
- Temperature
- Contact time

Transfer to compost

?

What portion of food contact material actually contains PFASs?

Environmental Science & Technology Letters

Letter

pubs.acs.org/journal/estlcu

Fluorinated Compounds in U.S. Fast Food Packaging

Laurel A. Schaider,[*,†] Simona A. Balan,[‡] Arlene Blum,[§,∥] David Q. Andrews,[⊥] Mark J. Strynar,[#] Margaret E. Dickinson,[▽] David M. Lunderberg,[▽] Johnsie R. Lang,[○] and Graham F. Peaslee[@]

[†]Silent Spring Institute, Newton, Massachusetts 02460, United States

[‡]California Department of Toxic Substances Control, Sacramento, California 95814, United States

[§]Green Science Policy Institute, Berkeley, California 94709, United States

[∥]Department of Chemistry, University of California at Berkeley, Berkeley, California 94720, United States

[⊥]Environmental Working Group, Washington, D.C. 20009, United States

[#]National Exposure Research Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, United States

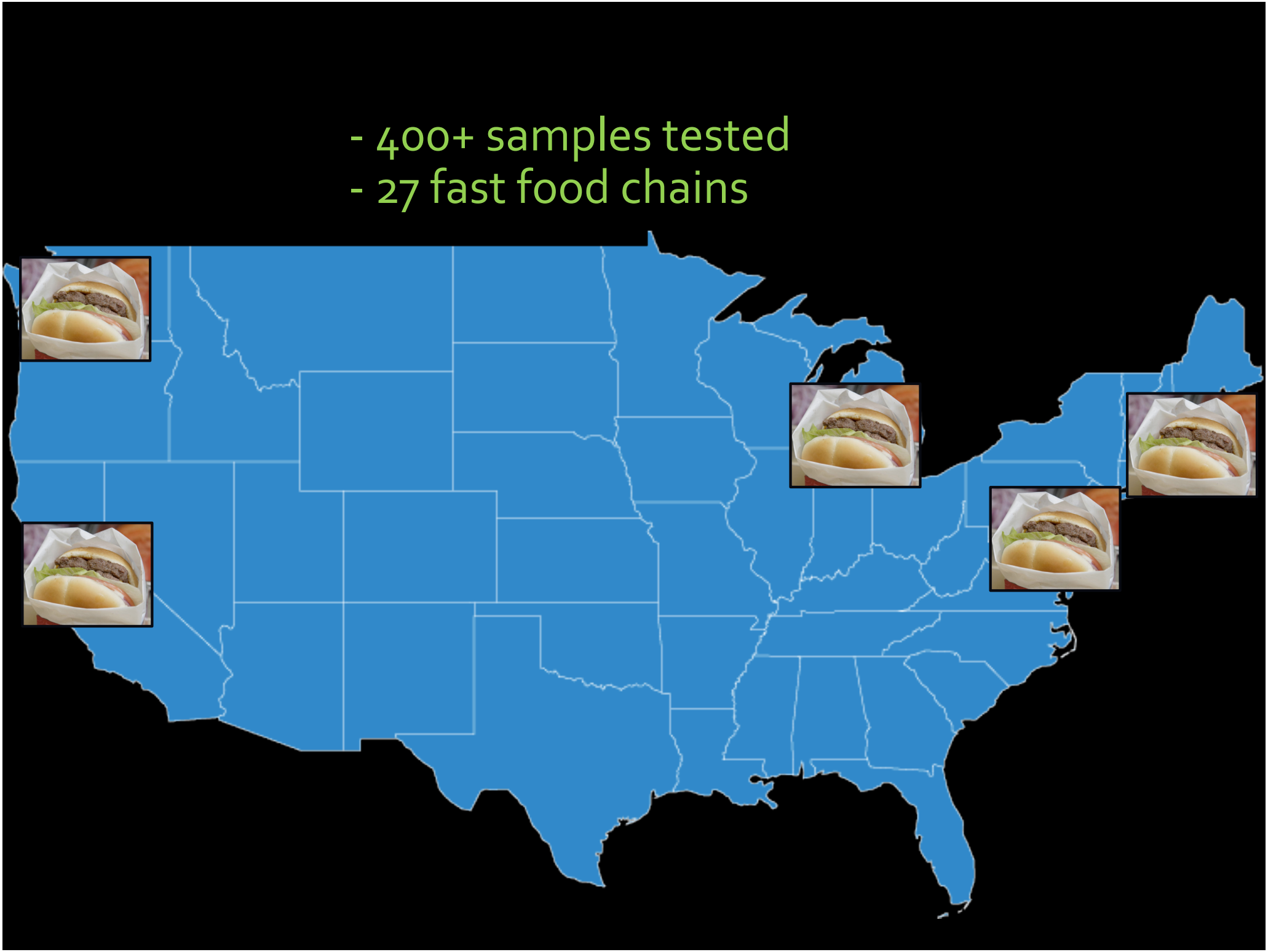
[▽]Chemistry Department, Hope College, Holland, Michigan 49423, United States

[○]Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee 37831, United States

[@]Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556, United States

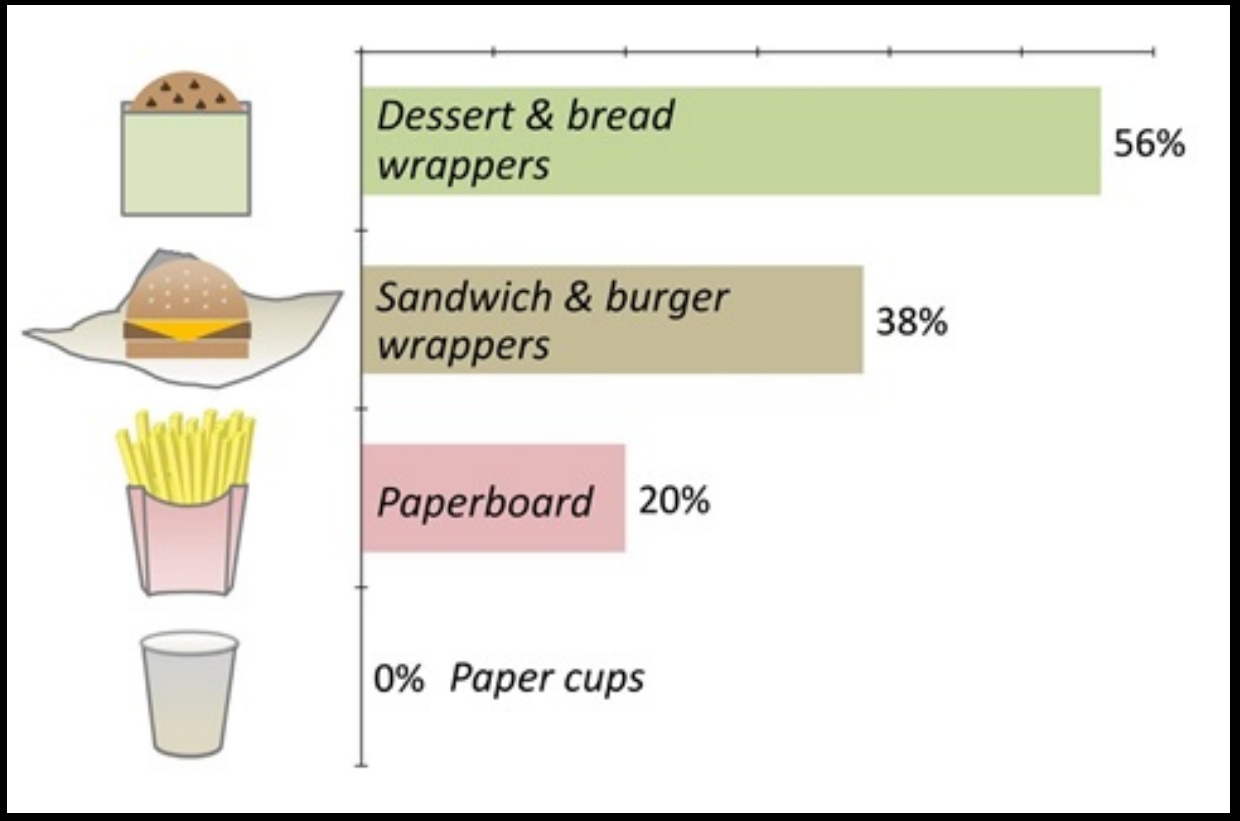
Supporting Information

- 400+ samples tested
- 27 fast food chains



Fluorine in U.S. fast food packaging paper

(percent positive; 400 products sampled)

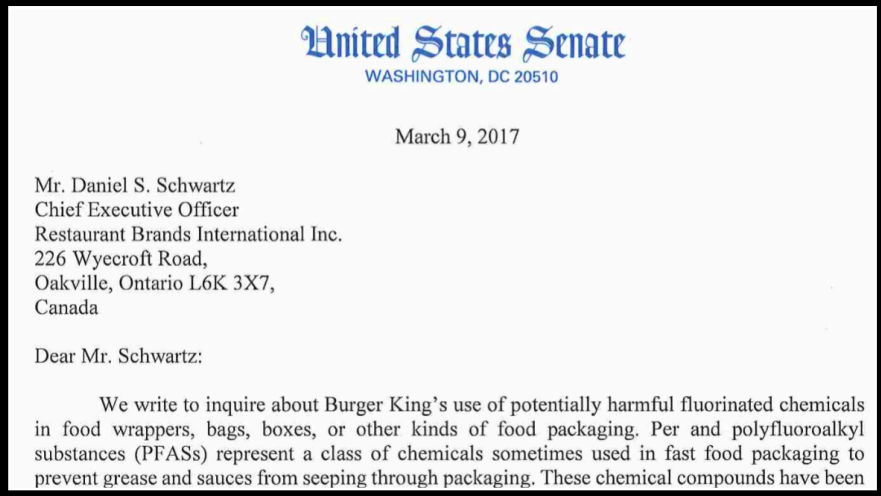


Adopted from Schaider L. 2016 Fluorinated compounds in U.S. fast food packaging.

Should these products be considered compostable?

Impacts

- ~10,000 views
- Media coverage
- Letter from US Senators



United States Senate
WASHINGTON, DC 20510

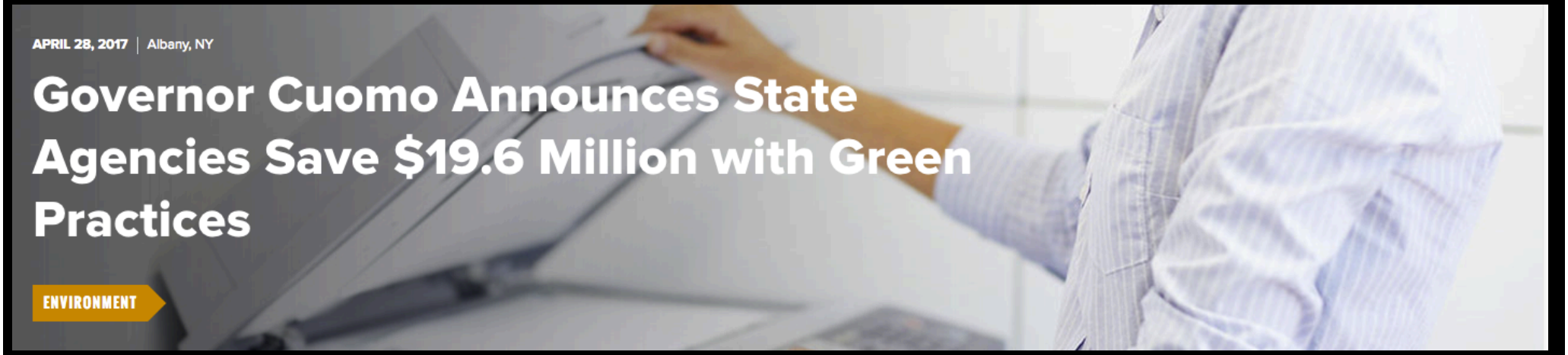
March 9, 2017

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

Policy: New York



- New York state's new purchasing requirements for single use food containers and packaging:
  - "...products purchased …on State contracts shall not contain perfluorinated chemicals (PFCs)..."

Policy: Proposed State Legislation on Food Packaging

- California Assembly Bill 958 (Ting)
  - "A food provider shall not serve, offer for sale, or offer for promotional purposes prepared food in, on, or with fast food packaging that contains PFAS."
- Vermont
- Washington
- Indiana

Purchasing: Microwave Popcorn Bags in Denmark

- PFAS coating used to increase resistance of paper to hot butter
- Higher PFAS concentrations than other food packaging materials[1-4]
- Coop Denmark - halted popcorn sales in 2015 over PFAS concerns
- RESULT: innovative PFAS-free packaging

1. Zabaleta, I., et al. Talanta. 152, 353-363. (2016)
2. Zafeiraki, E., et al. Chemosphere. 94, 169-176. (2014)
3. Dolman, S. and Pelzing, B. J. Chrom. B. 879:22, 2043-2050. (2011)
4. Begley, T. H., et al. Food Add. and Cont. 22:10, 1023-1031. (2005)

Opportunity:

- PLA-coated paper products
- Clay-coated paper products
- Products made entirely of PLA or other bio-based resins
- Untreated
- Wax-coated
- What else?

Conclusion

- Fluorinated grease proofing chemicals can be useful, but have health and environmental impacts
- Before using a chemical in the Six Classes, ask: "Is it really needed?"

Six Classes Videos

An innovative approach to reducing toxics

1	2	3	4	5	6
Highly Fluorinated	Antimicrobials	Flame Retardants	Bisphenols + Phthalates	Some Solvents	Certain Metals






VIEW and SHARE: www.SixClasses.org

Healthier products, healthier people in four minutes!


WITH THANKS TO:
Laurel Schaider
Graham Peaslee
Alicia Culver
Arlene Blum
The Green Science Policy Institute Team