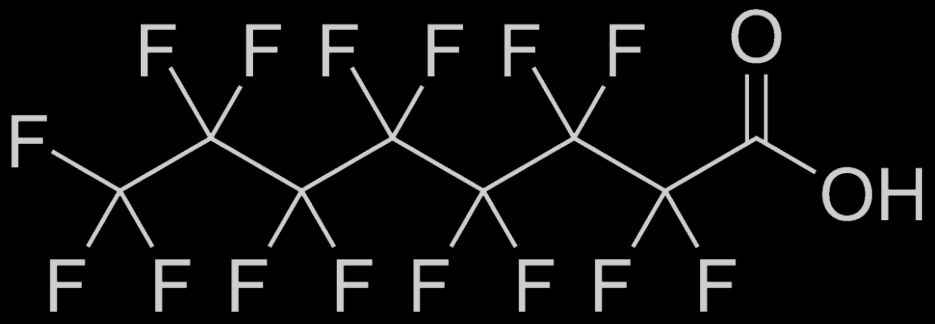
Highly Fluorinated Chemicals (PFASs): Do the Benefits Justify the Harm?

Arlene Blum, Anna Soehl, Green Science Policy Institute
Mark Miller, National Inst. of Environmental Health Sciences
Laurel A. Schaider. Silent Spring Institute

Highly Fluorinated Chemicals

Carbon-Fluorine bond strength:

- Leads to oil and water repellency
- Lasts for geologic time!



Adapted from slide by Dr. Jennifer Field

PFAS timeline

1938	Dr. Roy J. Plunkett accidently discovers Teflon or polytetrafluoroethylene (PTFE)
1945	DuPont registers the Teflon trademark
1951	DuPont begins using PFOA in the manufacture of Teflon in W. Virginia (PFOA is produced by 3M)
1945	DuPont employees express concern about possible toxicity of PFOA
1961	DuPont researchers confirm that PFOA could increase the size of the liver in rats and rabbits
1978	3M and DuPont become aware that PFOA is accumulating in worker's blood and body tissue, causing elevated liver enzymes Rhesus monkeys die after being fed PFOA in a 3M study
1981	3M releases rat study finding birth defects DuPont employee's child born with birth defects
1999	US EPA starts investigating PFASs

Adopted from Morrison, J. C&EN , May 19 2016 ; Lerner S., The Intercept, Oct. 8 2015; Cousins et al. 2016. Env. Int. 94; Graphic: classic film/flickr

November 2014 Helsingør Statement on Poly & Perfluorinated Alkyl Substances

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

In the news

The Opinion Pages | OP-ED COLUMNIST

The New York Times

Chemicals in Your Popcorn?

JUNE 4, 2015

Nicholas Kristof

What do a pizza box, a polar bear and you have in common?

All carry a kind of industrial toxicant called poly- and perfluoroalkyl substances, or PFASs, that do two things: They make life convenient, and they also appear to increase the risk of cancer.

These Chemicals in Pizza Boxes and Carpeting Last Forever

More than 200 scientists around the world document the threats of perfluorinated compounds and call for more government control.

By **Lindsey Konkel**, National Geographic

PUBLISHED MAY 01, 2015

NATIONAL GEOGRAPHIC

The Intercept_

THE TEFLON TOXIN

DuPont and the Chemistry of Deception

Sharon Lerner

Aug. 11 2015, 3:35 p.m.

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The New York Times Magazine

The Lawyer Who Became DuPont's Worst Nightmare

Rob Bilott was a corporate defense attorney for eight years. Then he took on an environmental suit that would upend his entire career — and expose a brazen, decades-long history of chemical pollution.

By NATHANIEL RICH JAN. 6, 2016

November 2015
Highly Fluorinated Chemicals

BIOMONITORING CALIFORNIA

November 2015:

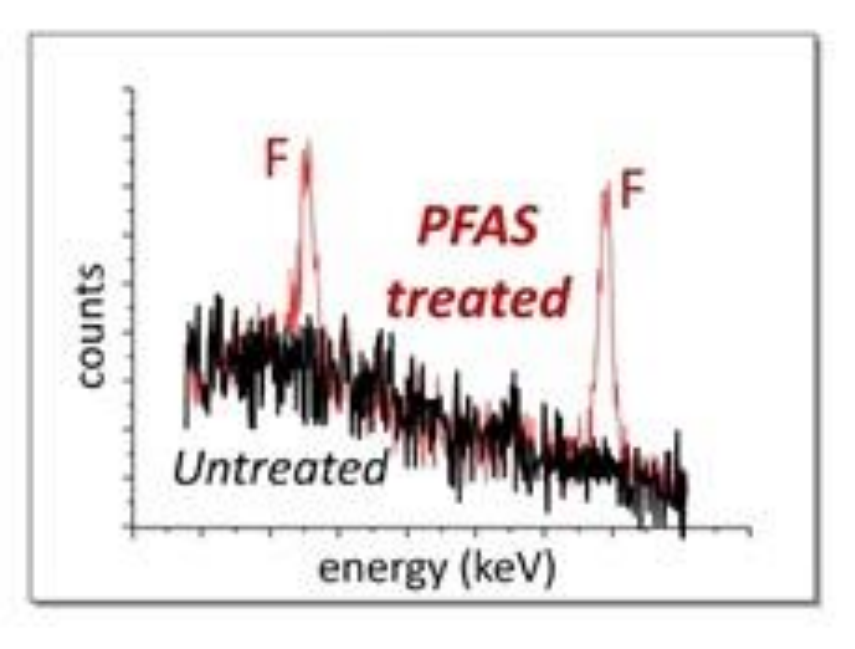
Scientific Guidance Panel votes unanimously to add entire class of Highly Fluorinated Chemicals (PFASs) to priority list of chemicals.

http://biomonitoring.ca.gov/sites/default/files/downloads/SGPMeetingSummaryNovember2015.pdf

The PIGE method

(Particle-Induced Gamma-ray Emission spectroscopy)

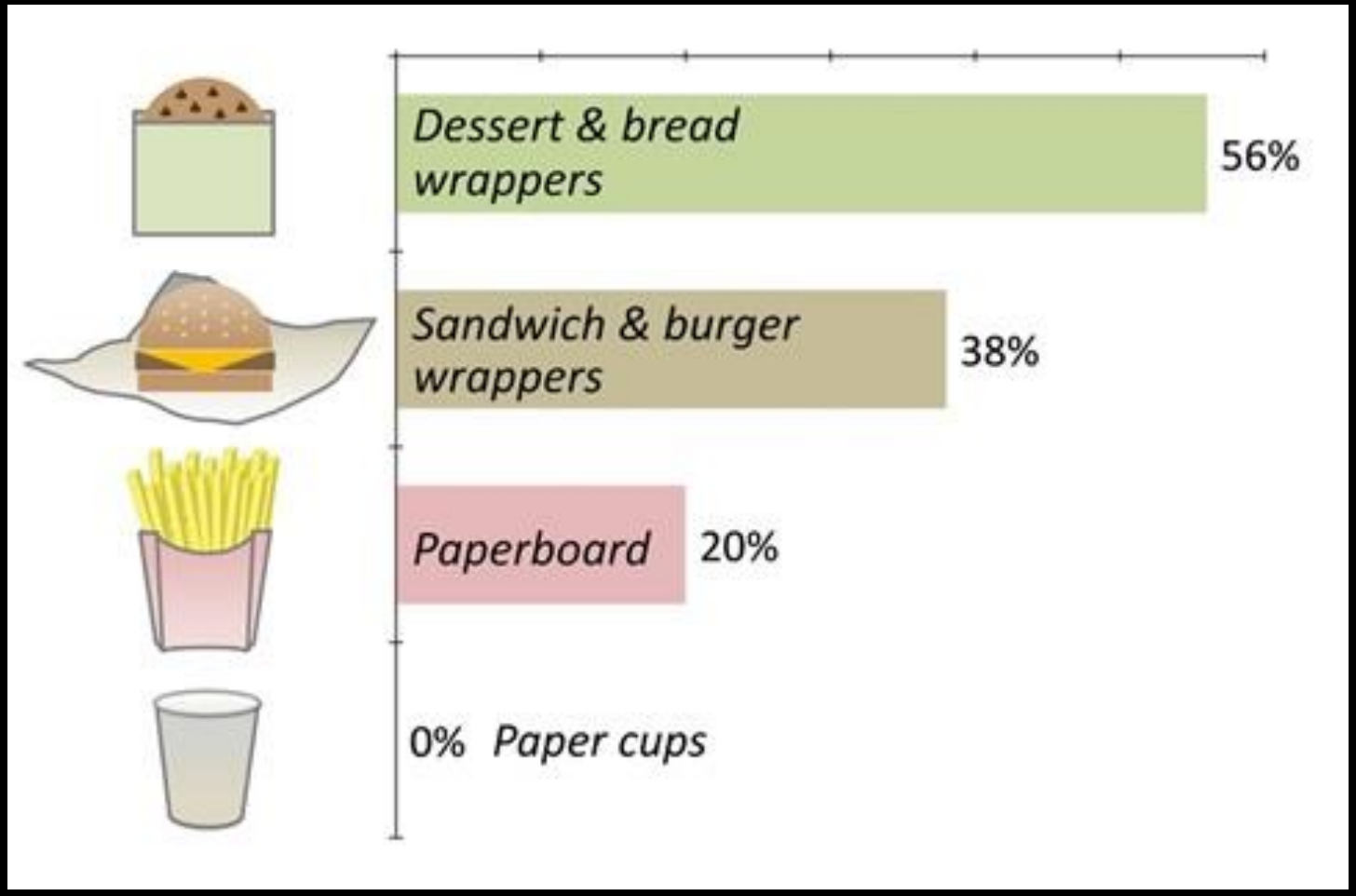
- An inexpensive, non-destructive screening technique
- Measures total fluorine



Adopted from: Schaider L. 2016 et al (submitted).
Fluorinated compounds in U.S. fast food packaging.

Fluorine in U.S. fast food packaging paper

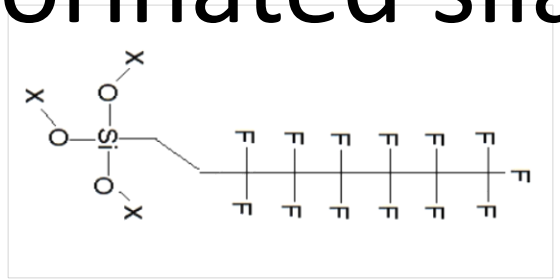
(percent positive; 400 products sampled)



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

Fluorinated silanes and siloxanes

X = alkyl



(3,3,4,4,5,5,6,6,7,7,8,8,8-tridecafluorooctyl)trialkoxysilane (TDFAs)
belongs to group of polyfluorooctyl trialkoxysilanes

- Polyfluorinated siloxanes $C_6F_{13}CH_2CH_2Si(OCH_3)_3$
- Widely used
  - textiles (cotton), antifouling, stone, cellulose, personal care products
- Acute respiratory toxicity for humans and mice
- REACH restriction (Annex XVII) prepared by the Danish EPA

Contact:

Toke Winther: towin@mst.dk

Zhanyun Wang : zhanyun.wang@chem.ethz.ch

(standards can be shared)

[2] Nørgaard *et al.* (2010)

[1] Wang et al., 2013. Environ Int. 60, 242-248.

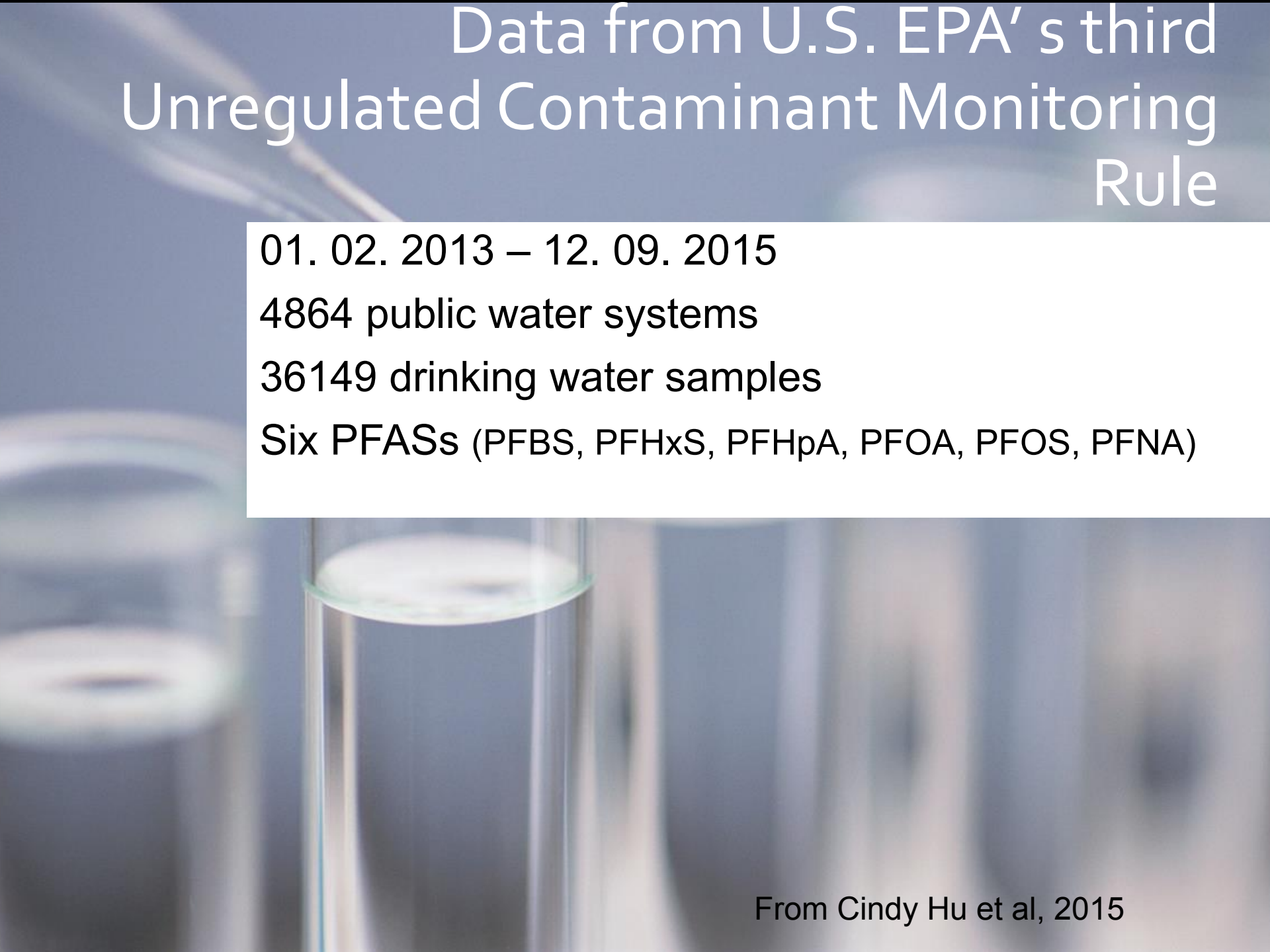
Data from U.S. EPA' s third Unregulated Contaminant Monitoring Rule

01. 02. 2013 – 12. 09. 2015

4864 public water systems

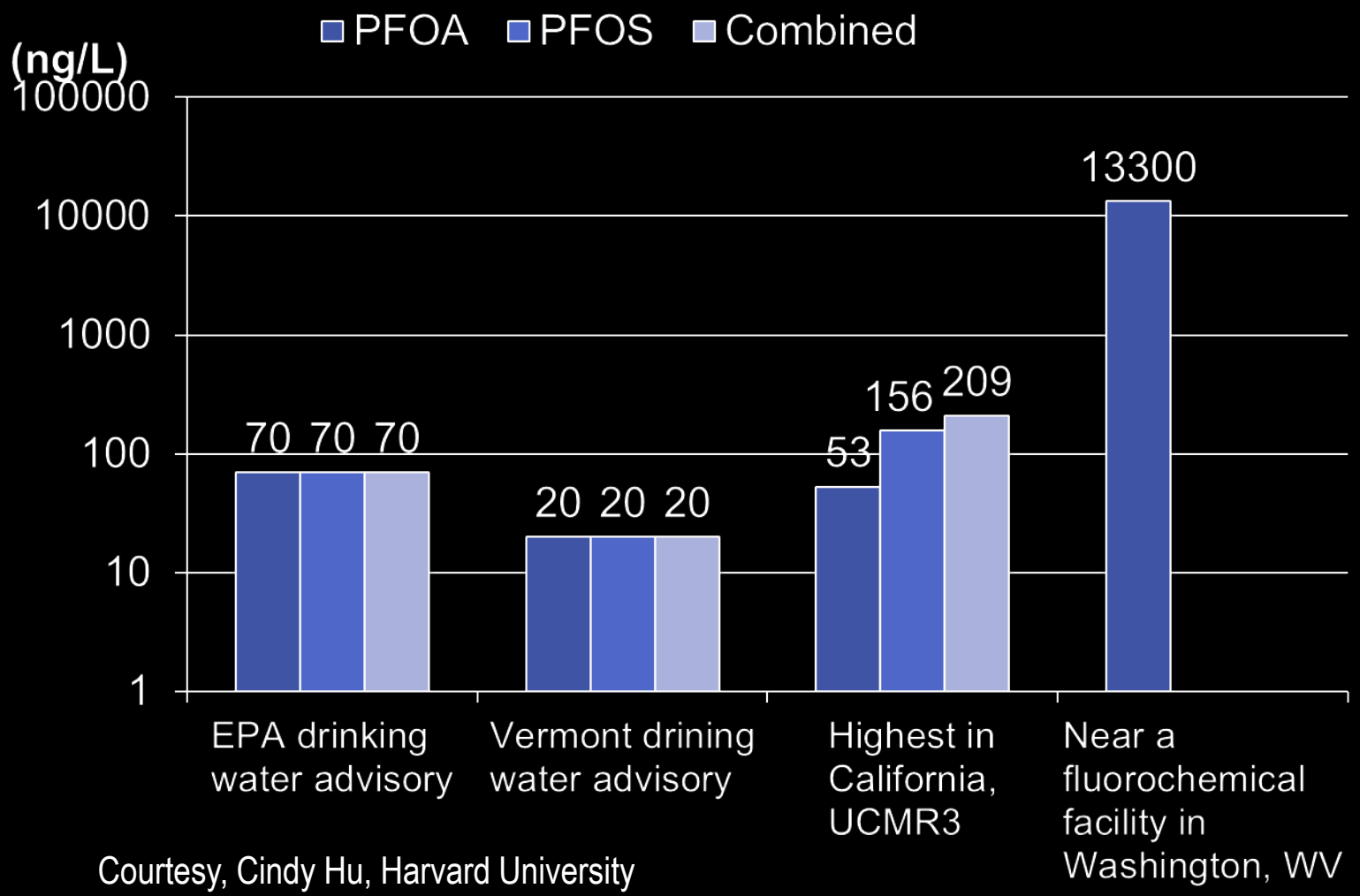
36149 drinking water samples

Six PFASs (PFBS, PFHxS, PFHpA, PFOA, PFOS, PFNA)



From Cindy Hu et al, 2015

Drinking Water Levels



Courtesy, Cindy Hu, Harvard University

EPA Drinking Water Health Advisory Levels

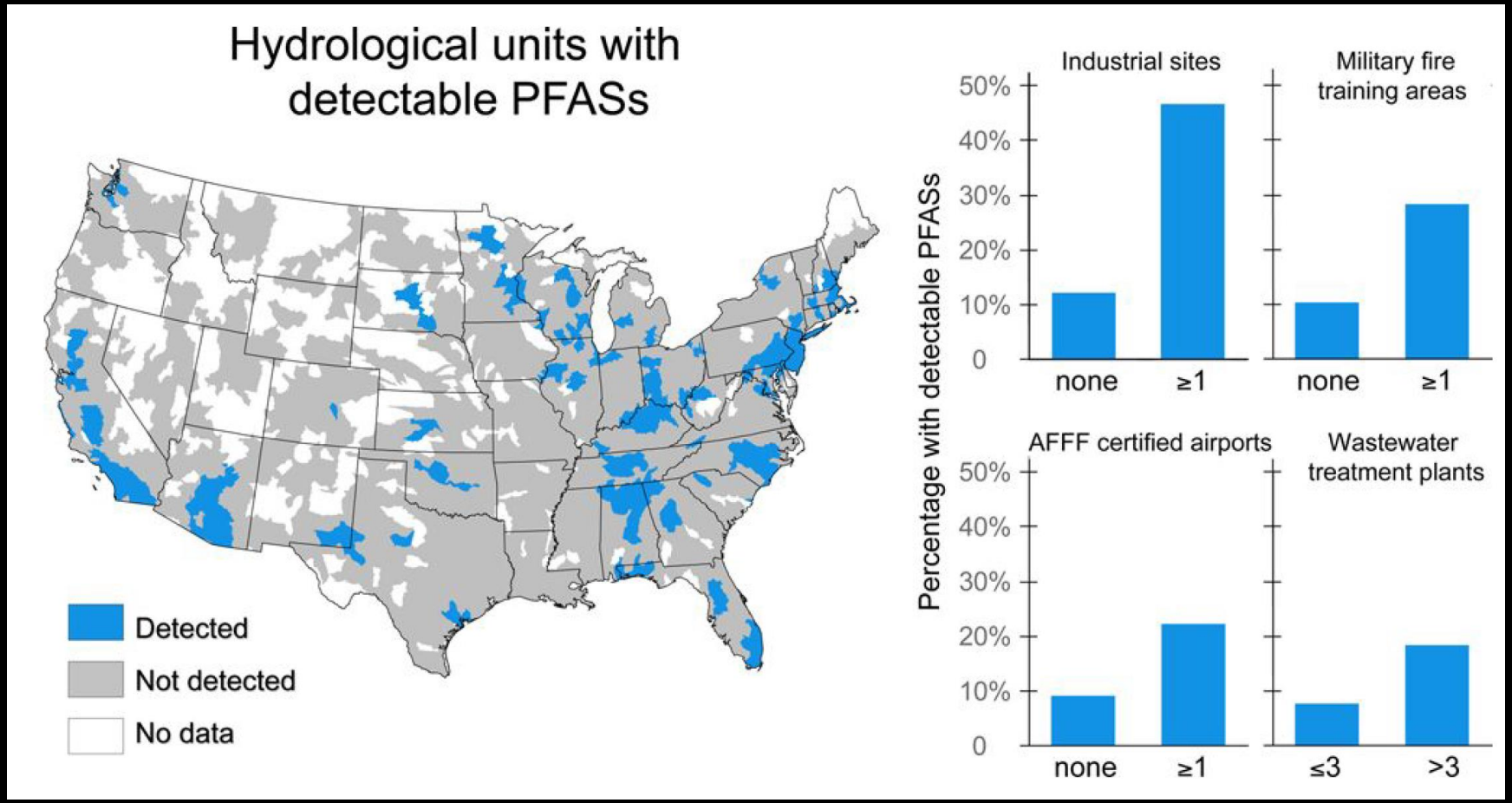
January 2009:

Provisional level of 400 ppt for PFOA and 200 ppt for PFOS

May 2016:

Lifetime level of 70 ppt for PFOA and PFOS – individually or combined

Watersheds with point sources have higher detection frequencies for PFASs



Courtesy, Cindy Hu, Harvard University

Air Force to stop using AFFF foam in training exercises

- Drinking water of six million Americans contaminated with PFAS
- AFFF firefighting foams used in training are a major contributor
- Air Force, on 19 August 2016, said:
  - "will stop using foam in training exercises"
  - "will replace all C8 foam with C6 by the end of this year"

Are short chain safer than long?

- Industry Knowledge Foundation: "…short chain fluorinated chemicals have a favorable environmental, health and safety profile, rapid bioelimination and are not bioaccumulative… they are safe for workers, consumers and the environment …"

- DuPont filed 16 reports to the EPA between April 2006 and January 2013 citing similar adverse health effects in animal studies from short chain exposure as found from long including cancer of the liver, pancreas, and testicles as well as kidney disease, liver degeneration, and uterine polyps. (Sharon Lerner, *The Intercept*)

AsahiGuard E-Series offers high performance properties with improved environmental and biological profiles.

Products are PFOA-free

What is C6?

- C6 fluorinated polymers are proven safe for their intended use.
- C6 fluorinated polymers cannot break down to form PFOA or PFOS.

http://www.agcce.com/asahiguard-e-series/

BRANDS ARE ELIMINATING HIGHLY FLUORINATED CHEMICALS

adidas	ESPRIT	Crate&Barrel	H&M
LEVI STRAUSS & CO.	MARKS & SPENCER	benetton	BURBERRY LONDON
IKEA	MANGO	PUMA	ZARA

source: http://www.greenpeace.org/international/en/campaigns/detox/fashion/detox-catwalk

Policy or Purchasing?

- Large purchasers
- Manufacturers of consumer products
- Retailers
- Designers and specifiers
- Consumers

The Challenge

Can the use of the Highly Fluorinated Chemicals and other Classes of Concern in consumer products be

reduced by 50% in five years?

"Tackling Toxics" in *Science*

Scientists can:

- Develop safer chemistries
- Evaluate impacts across lifecycle
- Translate research to catalyze action among users and regulators
- Contribute to policy recommendations
- Collaborate on scientific consensus statements

Purchasers can ask:

"Do we need this chemical, given the potential for harm?"

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For monthly e-newsletters
www.greensciencepolicy.org
Questions:
Arlene@arleneblum.com

WITH THANKS TO:

The Green Science Policy Institute Team:

Avery Lindeman
Sara Petty
Caroline Clarke
Veronica Chin
Zoe Laventhol
Eileen Kramer
Anna Soehl
Gretta Goldenman

By reducing use of Chemical Classes of Concern

We can have a healthier world.

For more information
Google: Green Science Policy
www.greensciencepolicy.org