



Cosmetics contribute to the PFAS load at wastewater treatment plants in California's dense urban environments

Logan Hayes, M.S.

Logan.Hayes@dtsc.ca.gov

PFAS: Investigating Inputs to Wastewater Treatment Plants
September 17th, 2024

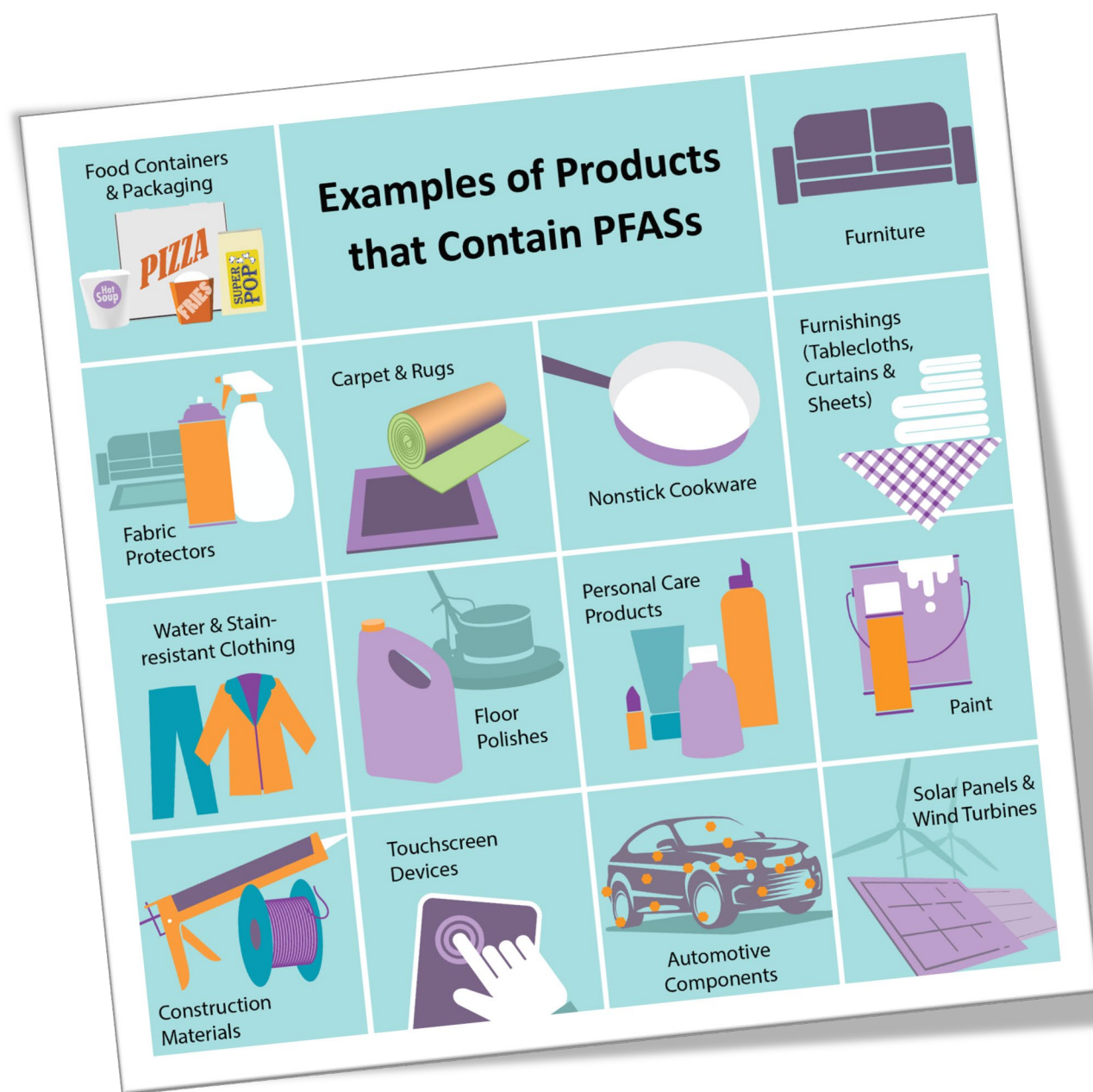


Department of Toxic Substances Control

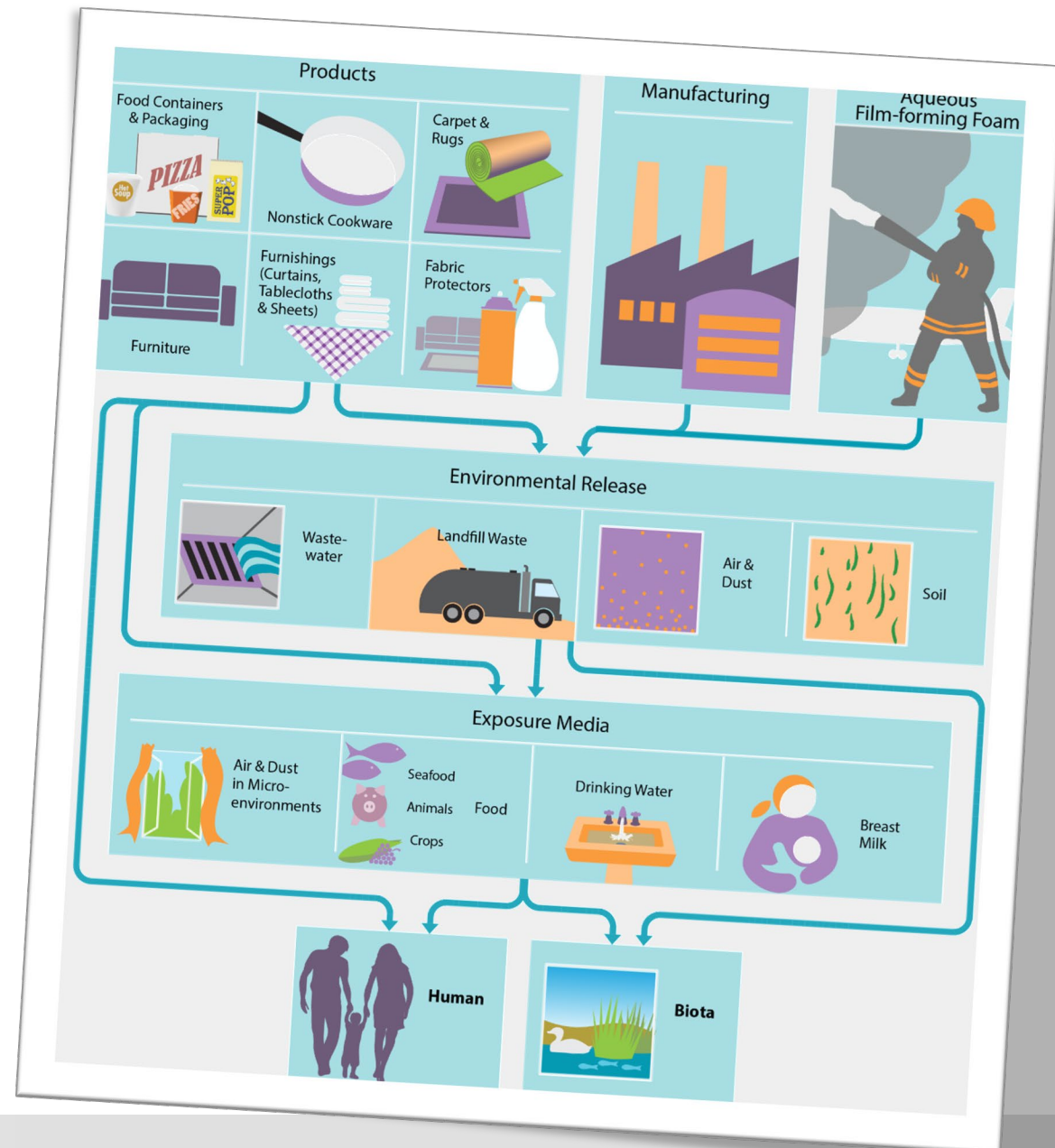


CalEPA

Per- and polyfluoroalkyl substances (PFASs) are virtually everywhere...



... which means PFAS exposure is highly complex

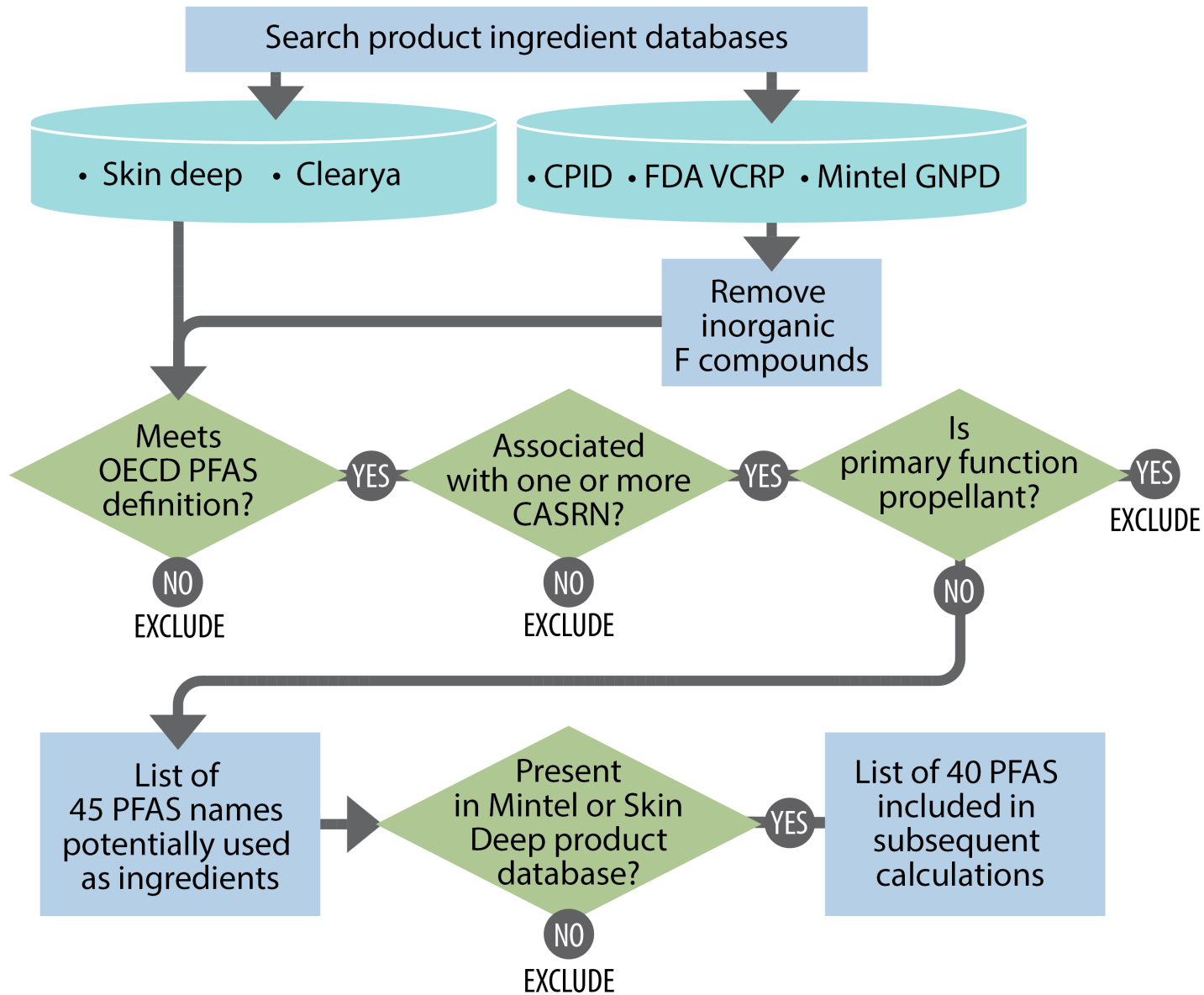




... and it is nearly impossible to identify the source of PFASs to wastewater treatment plants (WWTPs)

How much of the PFAS load measured at WWTPs can be attributed to cosmetics?



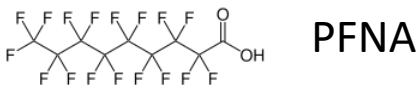
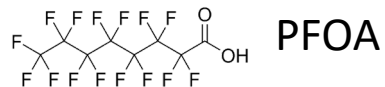
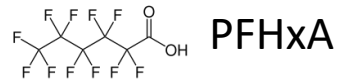
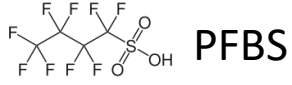
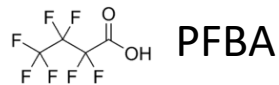


OECD PFAS Definition

- Fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it)

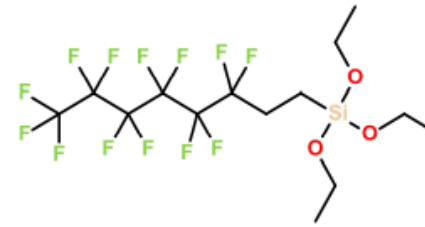


The PFAS universe

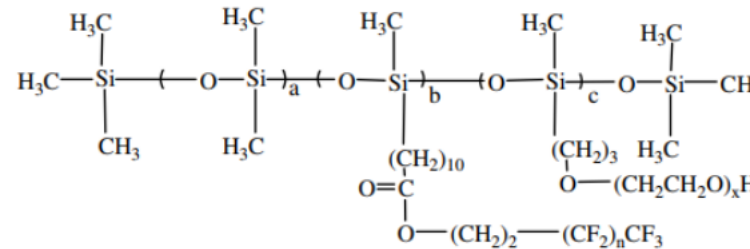


Etc.

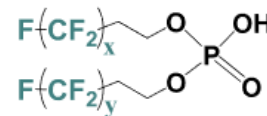
Perfluoroalkyl acids (PFAAs)



Perfluorooctyl triethoxysilane



Perfluorononyl ethyl carboxydecyl PEG-10 dimethicone

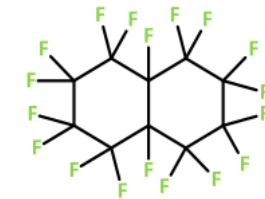
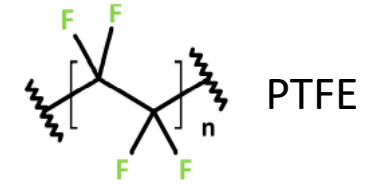


diPAP

Etc.

Perfluoroalkyl acid precursors (pre-PFAAs)

Used in products



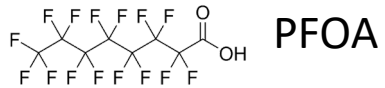
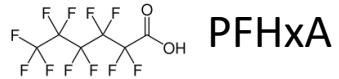
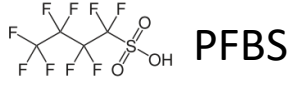
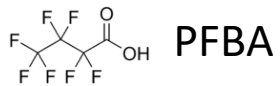
Perfluorodecalin

Etc.

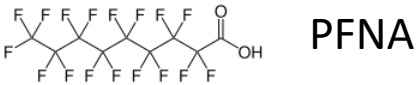
Fluoropolymers and more



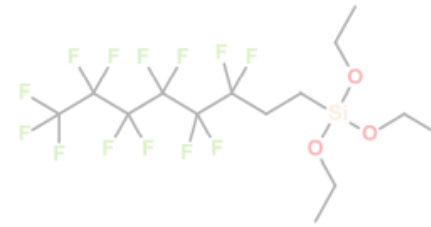
What we typically measure



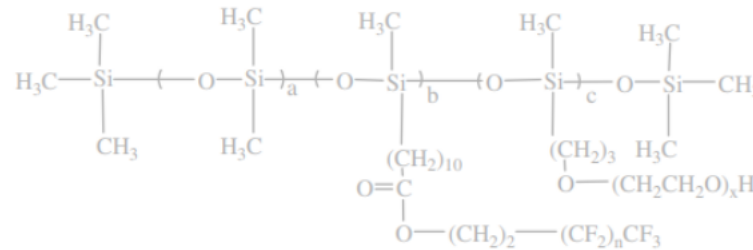
Etc.



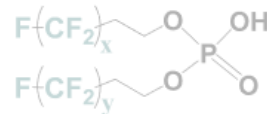
Σ PFAAs, ng/L



Perfluorooctyl triethoxysilane

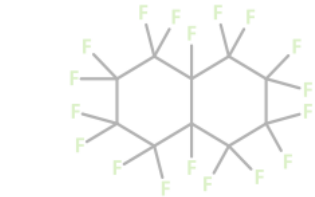
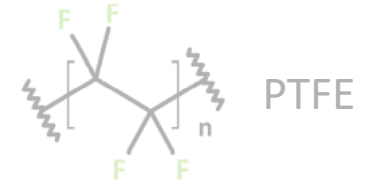


Perfluorononyl ethyl carboxydecyl PEG-10 dimethicone



diPAP

Etc.



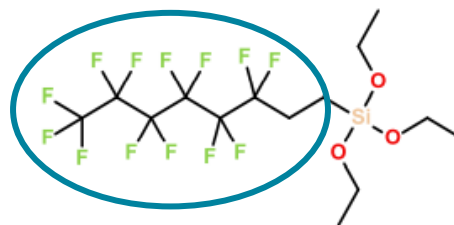
Perfluorodecalin

Etc.

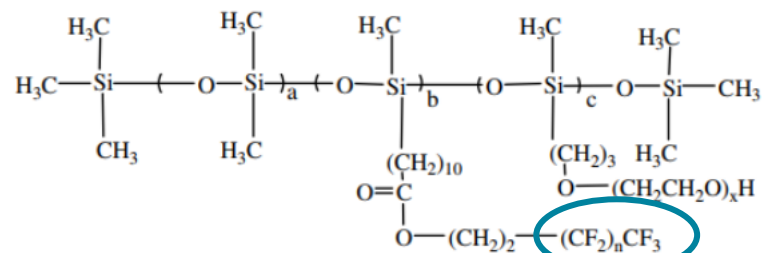


Total Oxidizable Precursor (TOP) assay

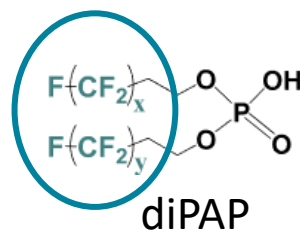
- Oxidative reaction cleaves perfluoroalkyl group from non-fluorinated portion of molecule
- Perfluoroalkyl groups transformed to PFAAs



Perfluorooctyl triethoxysilane

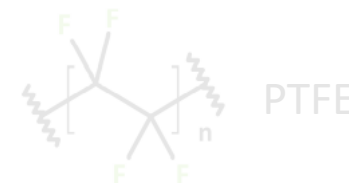


Perfluorononyl ethyl carboxydecyl PEG-10 dimethicone

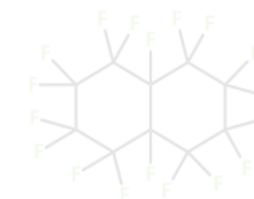


diPAP

Etc.



PTFE

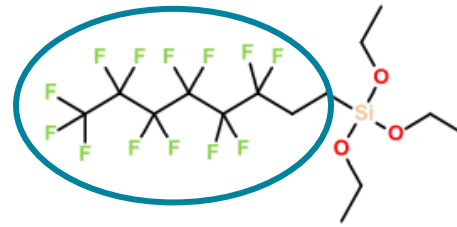


Perfluorodecalin

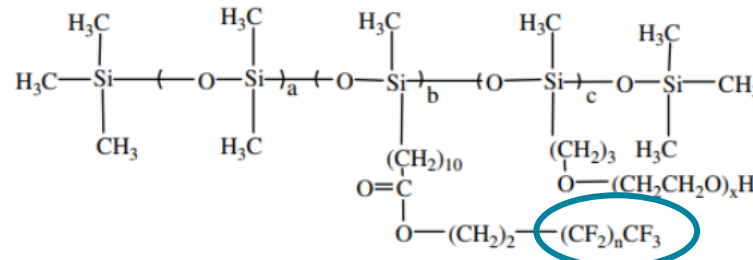
Etc.



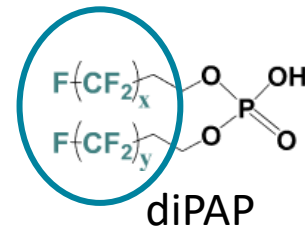
Total Oxidizable Precursor (TOP) assay



Perfluorooctyl triethoxysilane

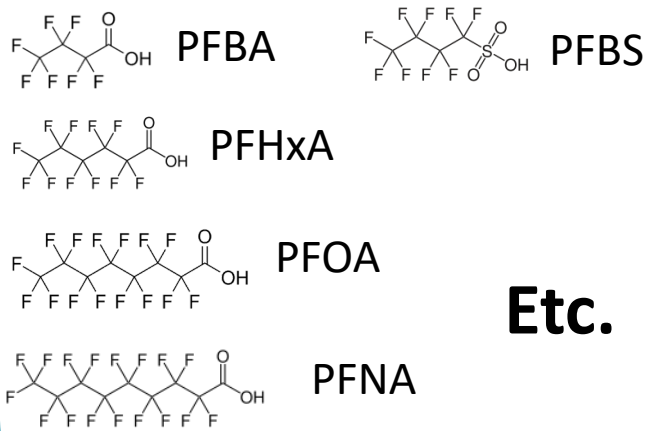


Perfluorononyl ethyl carboxydecyl PEG-10 dimethicone



diPAP

Etc.



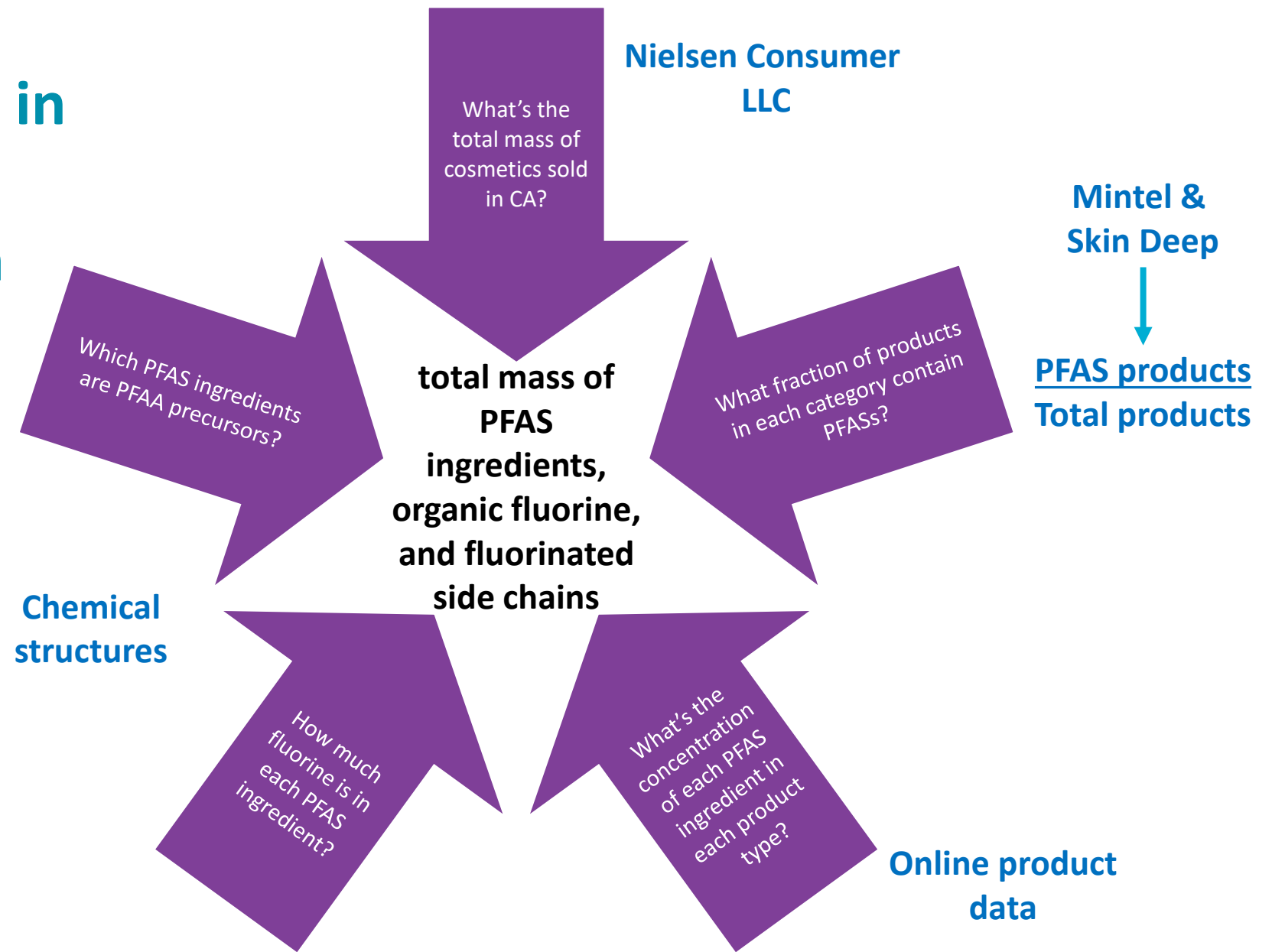
Etc.

$$\sum \text{PFAAs}_{\text{post reaction}} - \sum \text{PFAAs}_{\text{pre reaction}} = \sum \text{pre-PFAAs}$$

The mass of the fluorinated side-chain groups in cosmetics can be compared to TOP assay data for wastewater



For cosmetics sold in California during a one-year period in 2019-2020, we calculated the...



Poll Question

- **The PFAS we can quantify with available analytical methods are the same PFAS typically used in cosmetics:**
 - True
 - False



Poll Question

- **The PFAS we can quantify with available analytical methods are the same PFAS typically used in cosmetics:**
 - True
 - False

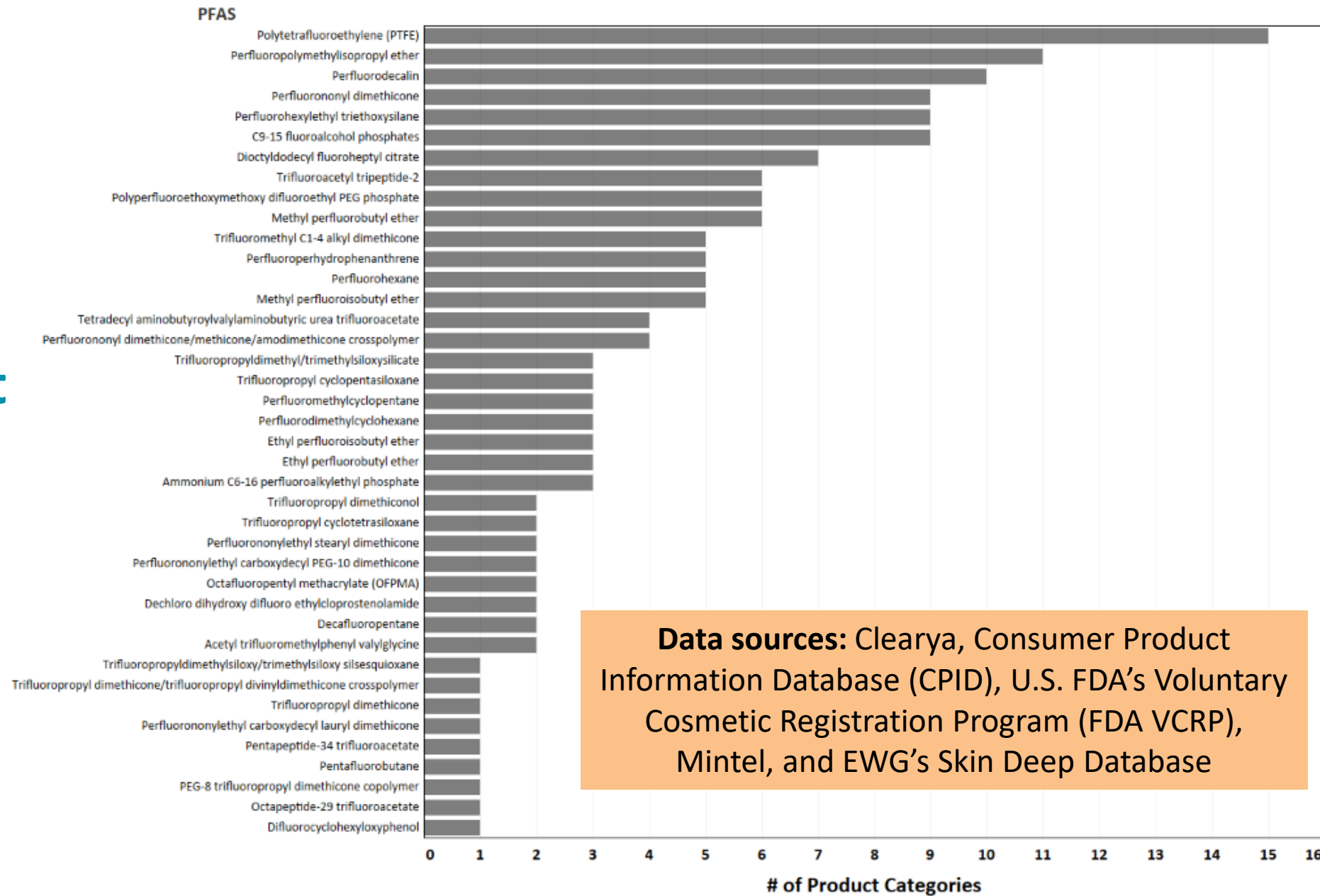


Prevalence of PFAS in California cosmetics is low (<3%)

product subcategory	total no. of products found		total product mass sold in one year in California (kg)	no. of distinct PFASs found	PFAS prevalence in product (%)	average PFAS concentration in product (%)	total PFAS mass from product (kg/year)	contribution to $\sum M_{PFAS}$ (%)
	in Mintel	in Skin Deep						
makeup								
blush	6330	1545	$9.98-10.1 \times 10^3$	4	0.39-1.44	0.09-30.00	4.00×10^{-2} to 4.36×10	0.01-0.08
mascara	5338	1089	$9.04-12.1 \times 10^4$	4	0.55-1.59	0.10-30.00	4.80×10^{-1} to 5.76×10^2	0.07-1.03
bronzer and highlighter	1842	1794	$1.35-1.44 \times 10^4$	4	1.56-2.39	0.10-30.00	2.10×10^{-1} to 1.03×10^2	0.03-0.18
eye brow	3224	1323	$9.23-9.48 \times 10^3$	5	0.60-0.71	0.08-22.75	4.00×10^{-2} to 1.54×10	0.01-0.03
eye liner	7781	1931	$1.22-1.26 \times 10^4$	5	1.52-1.86	0.01-2.61	2.00×10^{-2} to 6.15×10^0	0.00-0.01
eye shadow	21 336	3651	$2.55-2.69 \times 10^4$	9	1.73-2.26	0.09-26.78	3.90×10^{-1} to 1.62×10^2	0.06-0.29
face powder	4509	799	$5.44-5.56 \times 10^4$	5	1.13-1.55	0.08-30.00	4.70×10^{-1} to 2.59×10^2	0.07-0.46
foundation and concealer	26 829	7763	$2.24-2.69 \times 10^5$	17	0.52-1.47	0.18-8.11	2.13×10^0 to 3.20×10^2	0.33-0.57
lip cosmetics	60 485	8291	$6.46-7.4 \times 10^4$	17	0.22-0.46	0.20-8.67	2.90×10^{-1} to 2.94×10	0.04-0.05
hair colorants	3760	977	$2.46-22.8 \times 10^5$	2	0.00-0.13	0.00-12.60	0.00×10^0 to 3.82×10^2	0.00-0.68
hair care products	30 671	10 361	$5.72-7.22 \times 10^7$	17	0.13-0.52	0.21-4.77	1.54×10^2 to 1.79×10^4	23.69-32.06
facial cleansers	6806	4691	$5.58-6.46 \times 10^6$	13	0.71-1.45	1.07-8.27	4.21×10^2 to 7.75×10^3	13.84-64.90
lotions and moisturizers	62 465	11 718	$2.21-2.54 \times 10^6$	34	0.71-1.16	0.08-7.40	1.30×10 to 2.17×10^3	2.00-3.88
shaving creams and gels	2510	485	$3.00-3.03 \times 10^6$	8	2.39-2.68	0.03-22.89	2.32×10 to 1.86×10^4	3.58-33.17
sun care products	4723	1693	$2.27-2.35 \times 10^6$	16	0.57-2.60	0.25-10.29	3.29×10 to 6.29×10^3	5.07-11.23
body washes	12 430	1586	$2.72-3.13 \times 10^7$	2	0.02-0.06	0.02-6.88	8.80×10^{-1} to 1.36×10^3	0.14-2.42



We found 40 distinct PFAS ingredients in 16 cosmetic product subcategories

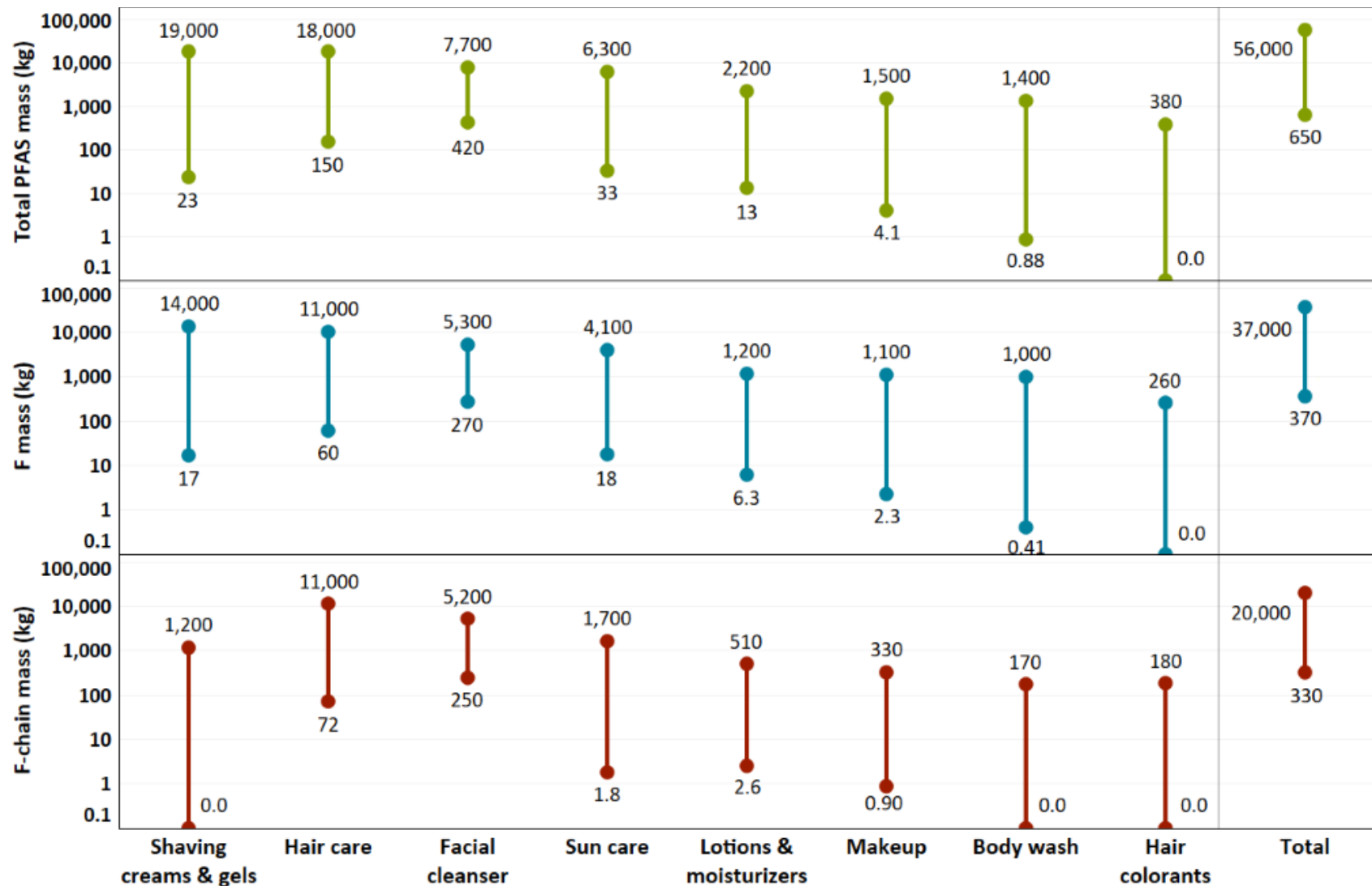


Data sources: Clearya, Consumer Product Information Database (CPID), U.S. FDA's Voluntary Cosmetic Registration Program (FDA VCRP), Mintel, and EWG's Skin Deep Database

Bălan et al. (2024)



Cosmetics sold in California during a one-year period contain 650 to 56,000 kg PFASs, including 330 to 20,000 kg fluorinated side chains

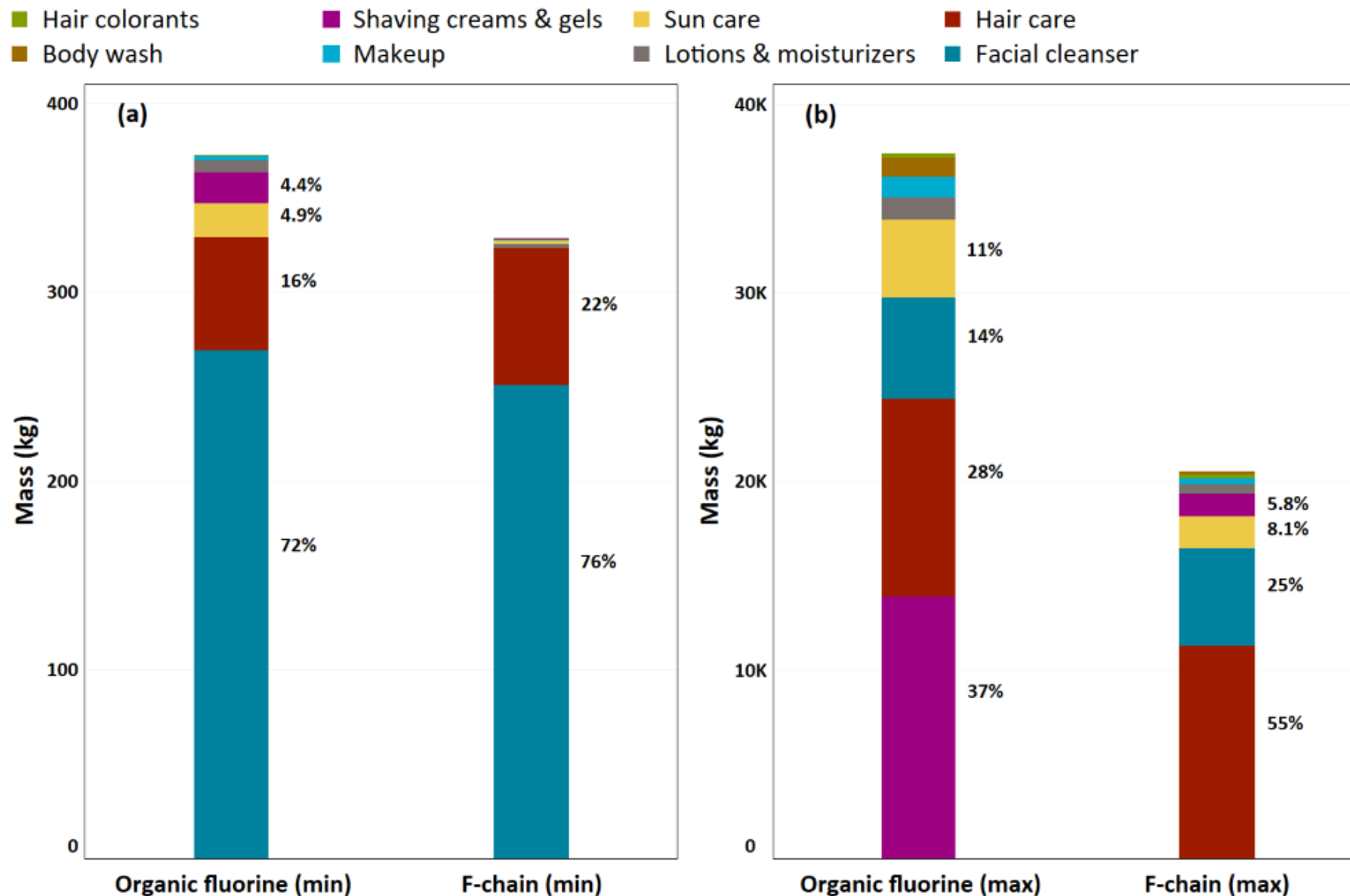


Bălan et al. (2024)



Shaving creams and gels, hair care, facial cleansers, and sun care accounted for >90% of the total organic fluorine in cosmetics

Bălan et al. (2024)

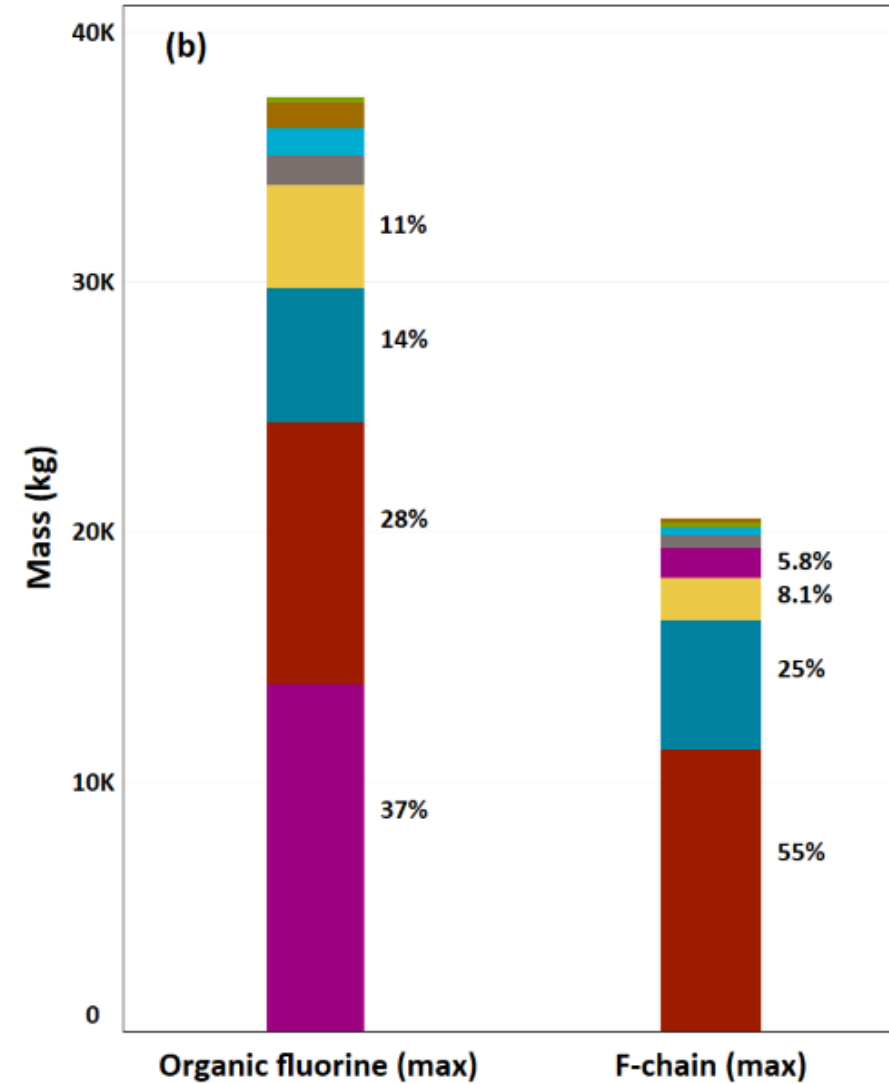
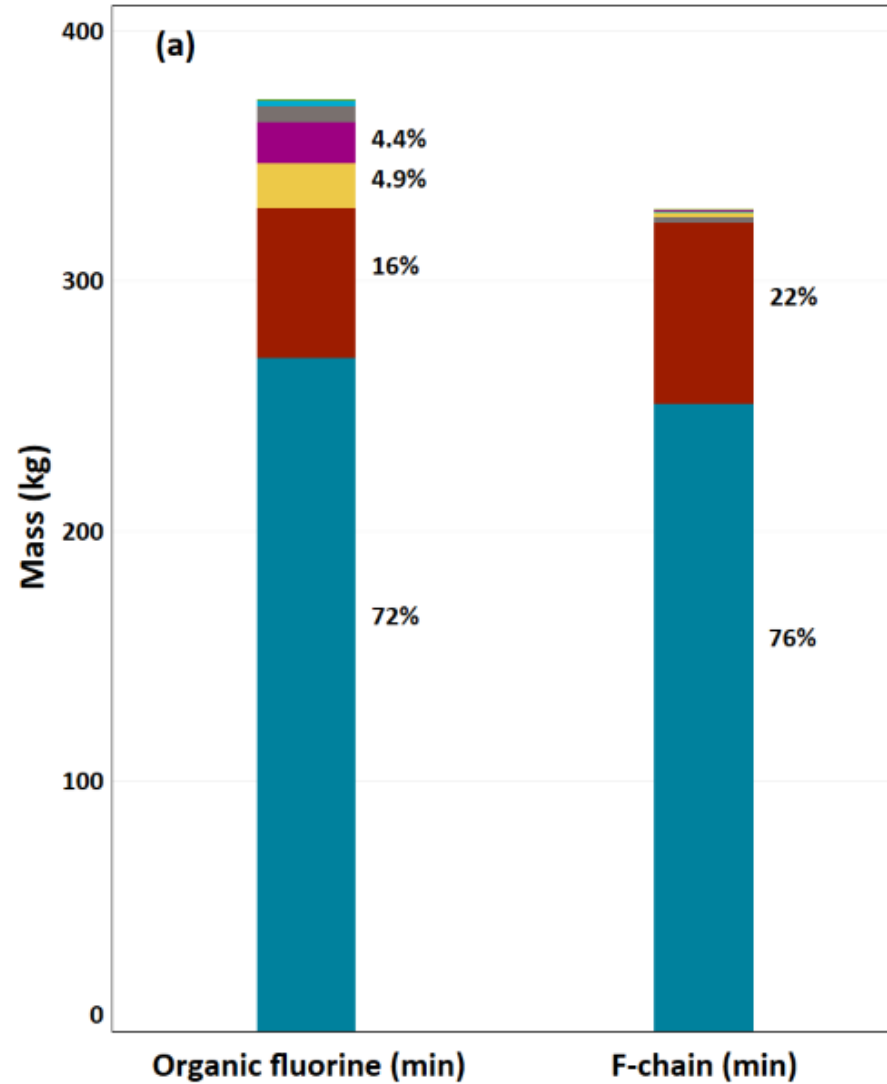
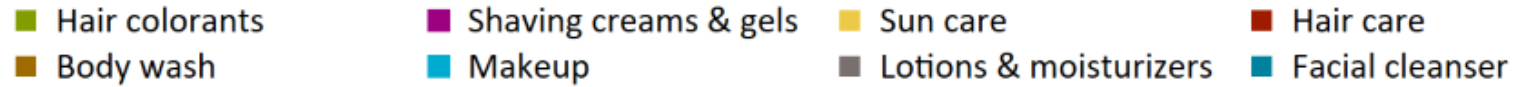


Makeup accounted for less than 3% of the total fluorine

“Makeup” includes:

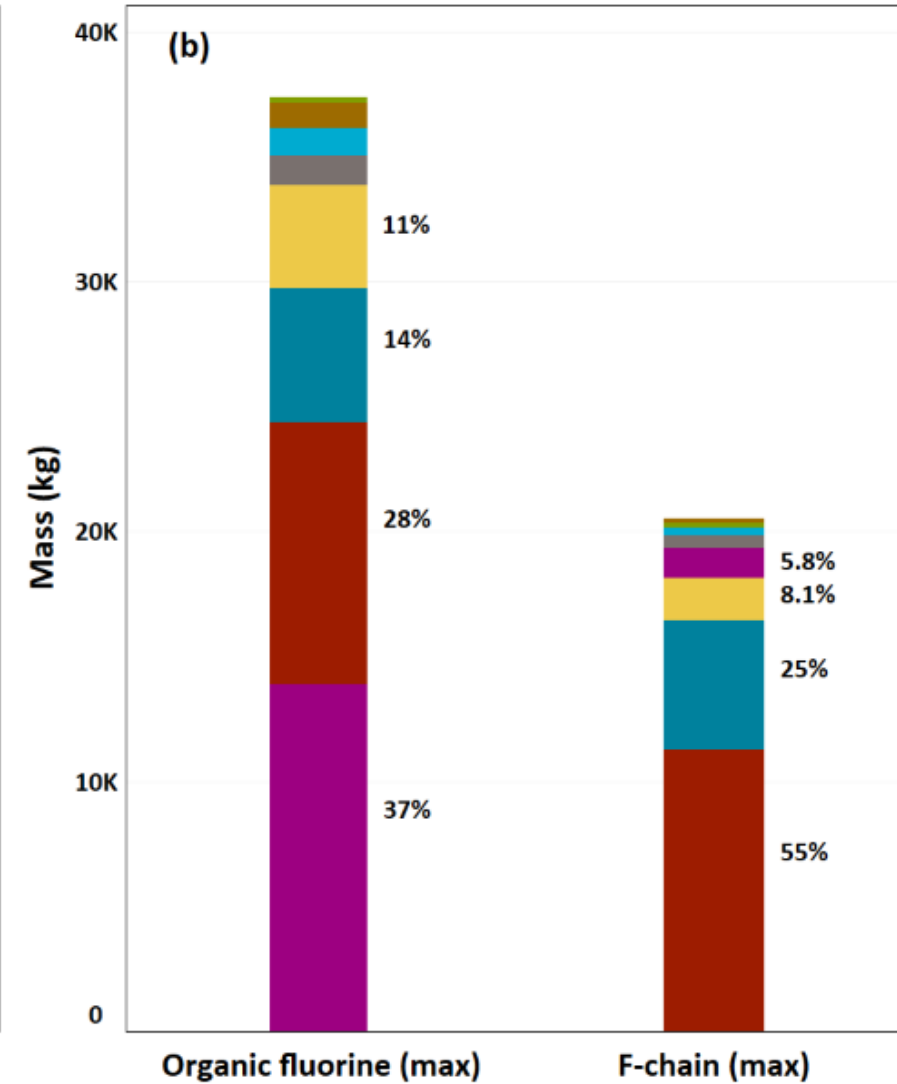
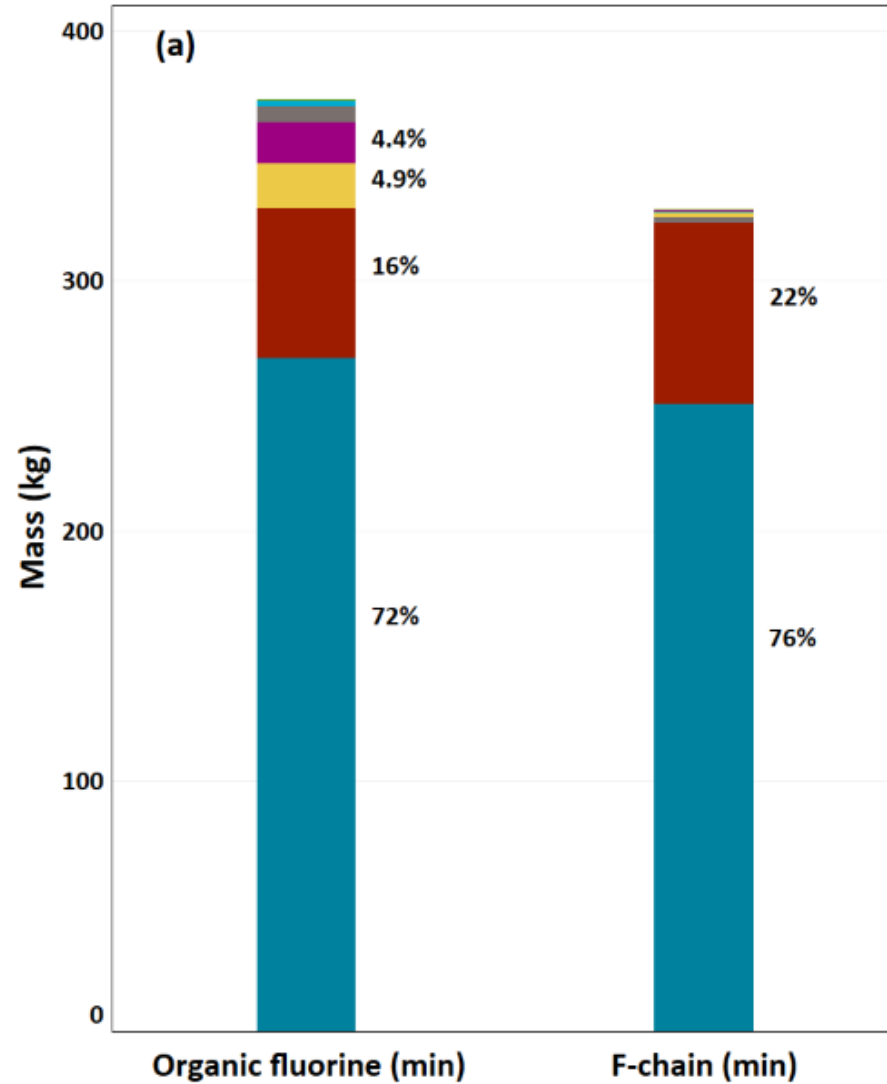
- blush
- bronzer and highlighter
- eye brow
- eye liner
- eye shadow
- face powder
- foundation and concealer
- lip cosmetics
- mascara

Bălan et al. (2024)



Hair care products and facial cleansers contribute over 80% of the PFAA precursors (makeup contributes less than 1.6%)

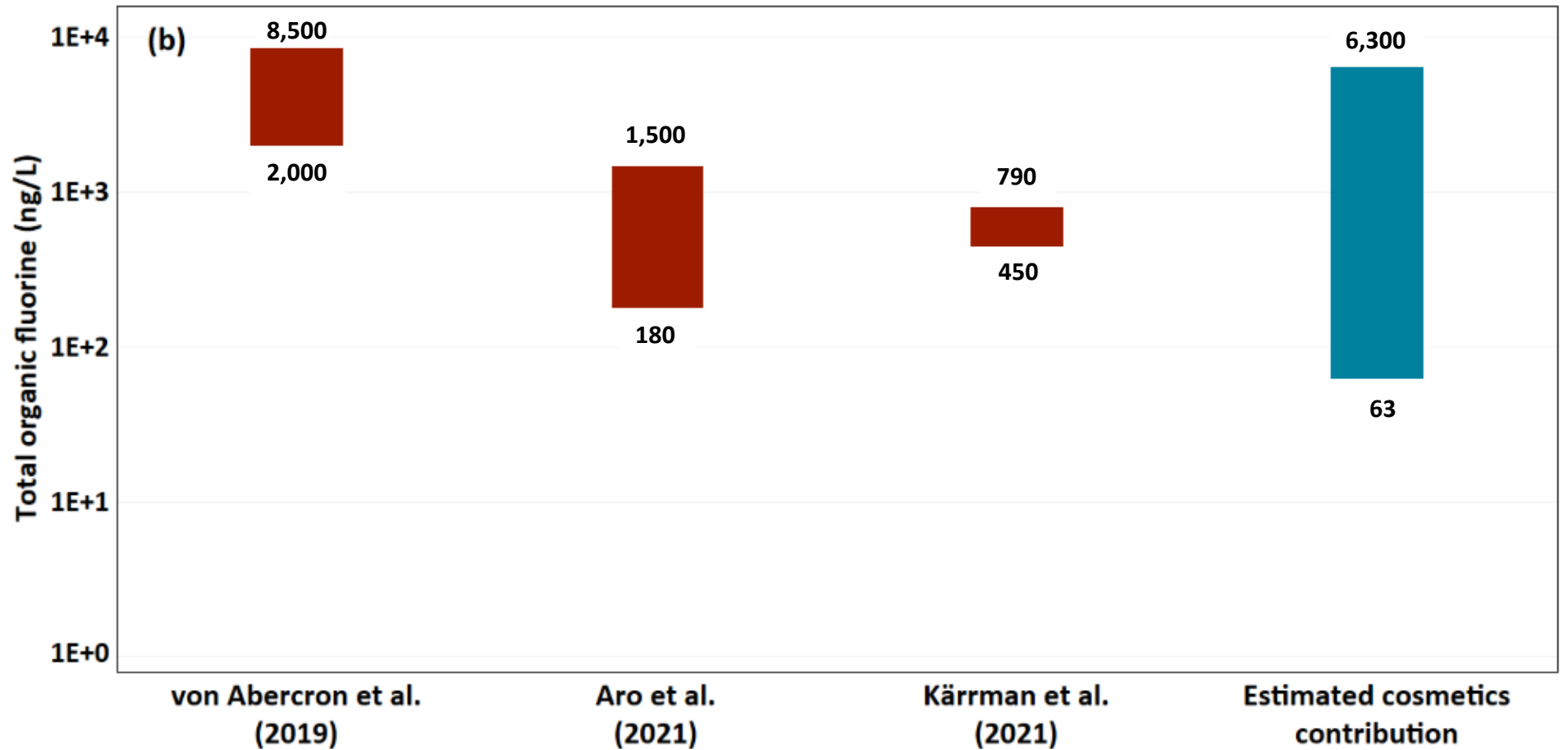
- Hair colorants
- Shaving creams & gels
- Sun care
- Hair care
- Body wash
- Makeup
- Lotions & moisturizers
- Facial cleanser



Bălan et al. (2024)



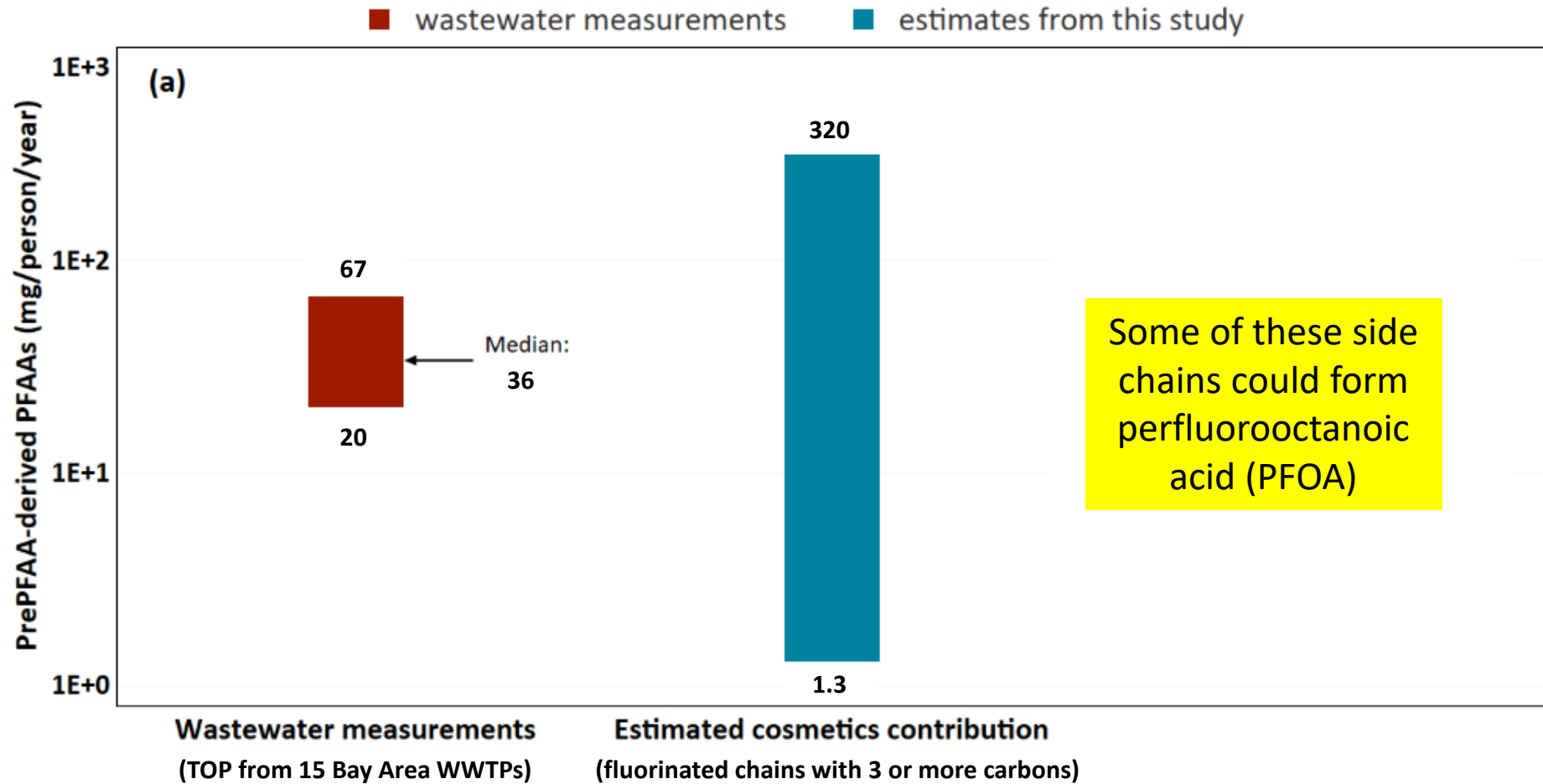
Cosmetics can explain some of the total organic fluorine measured at WWTPs



Bälan et al. (2024)



Cosmetics contribute at least 4% of the precursor-derived PFAAs measured at WWTPs in the SF Bay Area



Bălan et al. (2024)



...Takeaways

- cosmetics sold in California during a one-year period cumulatively contain 650 to 56,000 kg total PFASs, 370 to 37,000 kg organic fluorine, and 330 to 20,000 kg of fluorinated side chains associated with PFAA precursors
- our estimates suggest that cosmetics may account for at least 4% of the precursor-derived PFAAs measured in wastewater
- over 90% of the PFAS mass came from shaving creams and gels, hair care, facial cleansers, sun care, and lotions and moisturizers
- the sum of all nine makeup subcategories accounted for less than 3%



It takes a village

■ Co-authors:

- Simona Bălan
- Tom Bruton
- Kyle Harris
- Chris Leonetti
- Vivek Mathrani
- Abigail Noble
- Diana Phelps

■ Other SCP staff:

- Elena Galkina
- Dave Grealish
- Tiglath Moradkhan
- Nancy Ostrom
- Anne Cooper Doherty

■ Collaborators

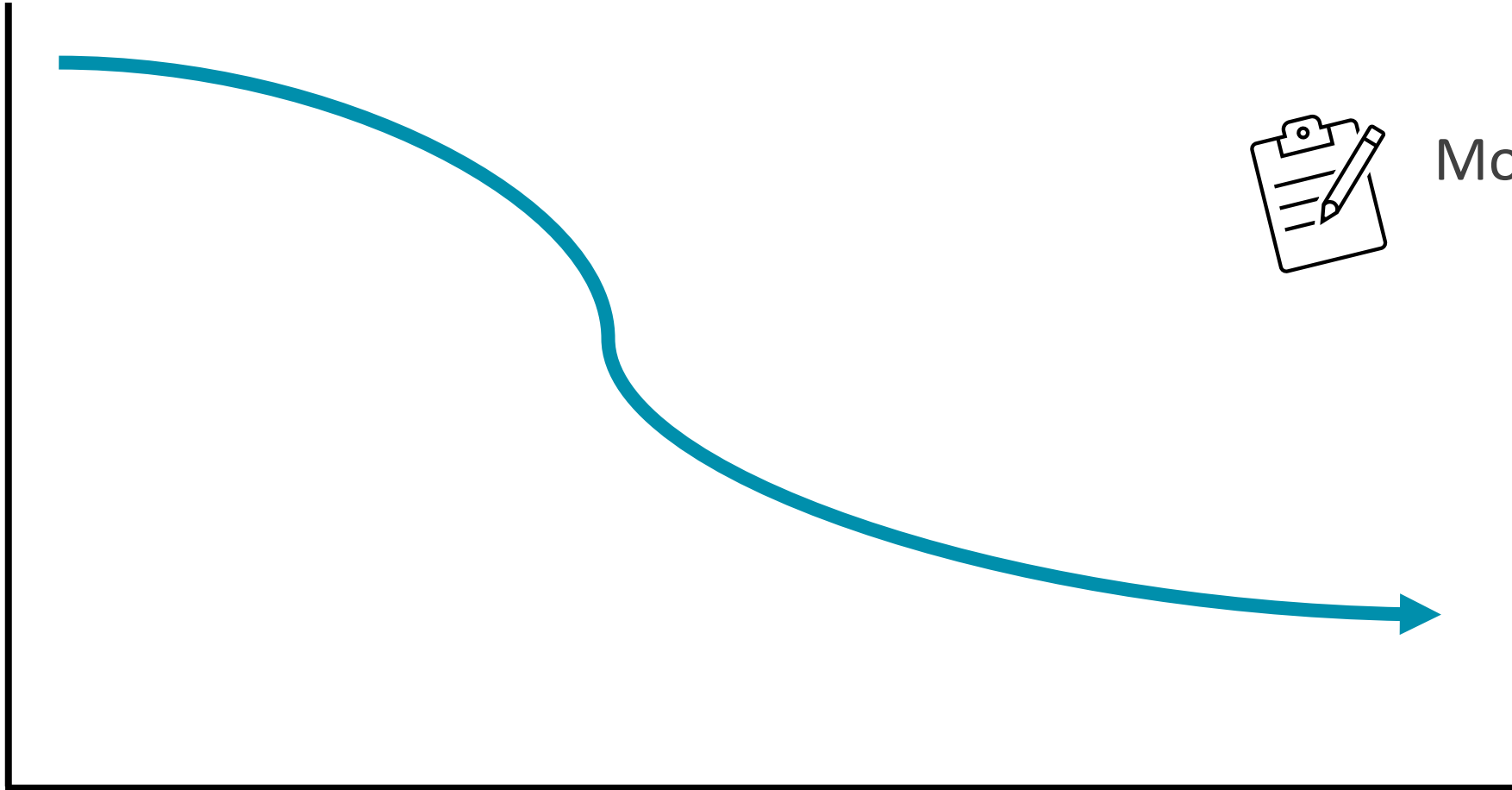
- Amit Rosner (Clearya)
- Michelle Herrmann (U.S. FDA)
- David Andrews (EWG)
- SFEI team

[The Total Mass of Per- and Polyfluoroalkyl Substances \(PFASs\) in California Cosmetics](#)

Bălan et al., 2024, Environmental Science and Technology



Will the PFAS levels go down due to AB 2771?



Monitor again in 2025!

- Cosmetics containing intentionally-added PFASs banned in CA as of January 1, 2025
- ... but so are textiles (AB 1817)



Let's stay in touch!

Contact me: Logan.Hayes@dtsc.ca.gov

SCP home page: <https://dtsc.ca.gov/scp>

Work with us: <https://dtsc.ca.gov/scp/safer-consumer-products-career>



Safer Consumer Products

We are working toward safer California households, workplaces, and products.

