Cosmetics contribute to the PFAS load at wastewater treatment plants in California

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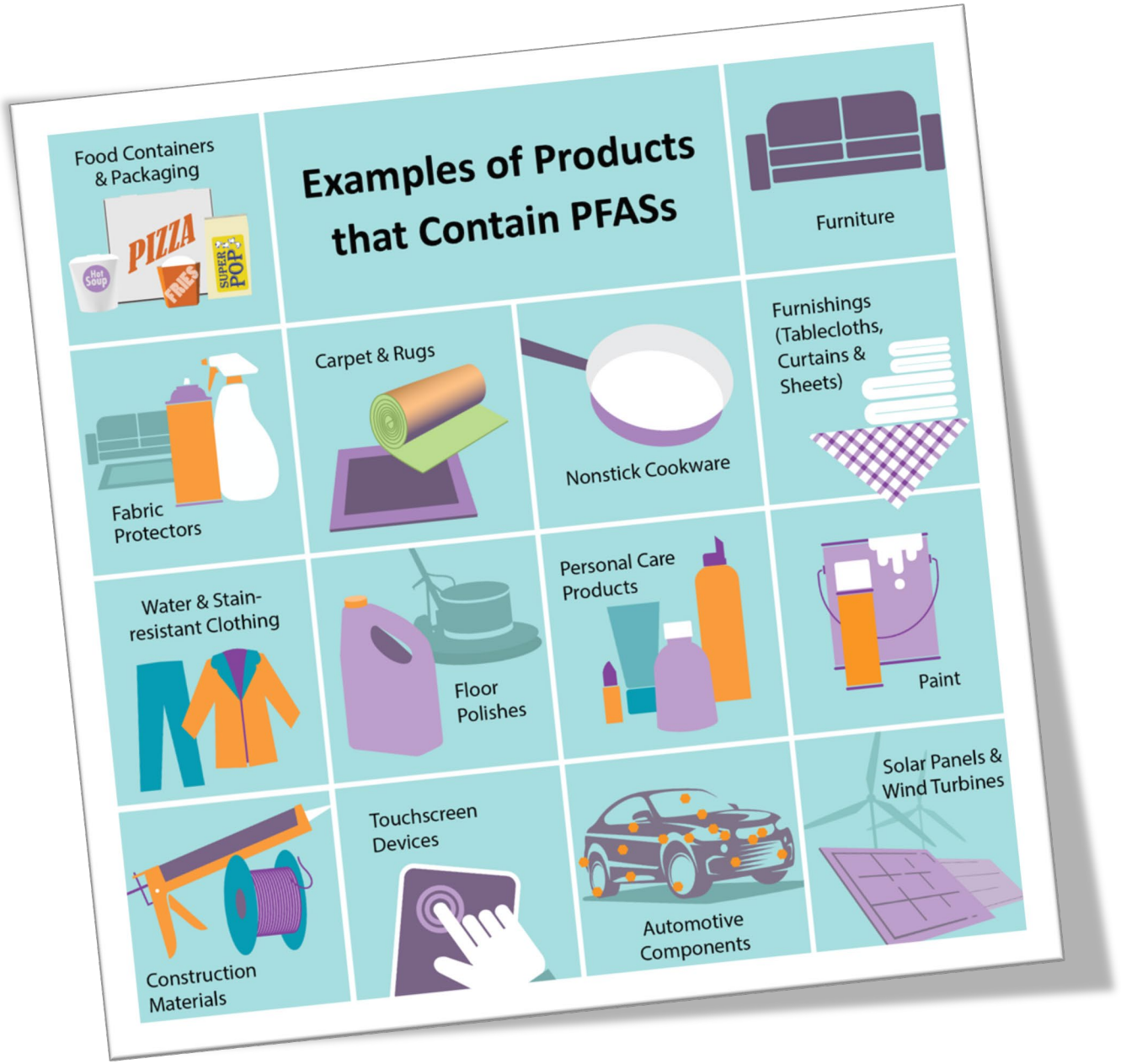
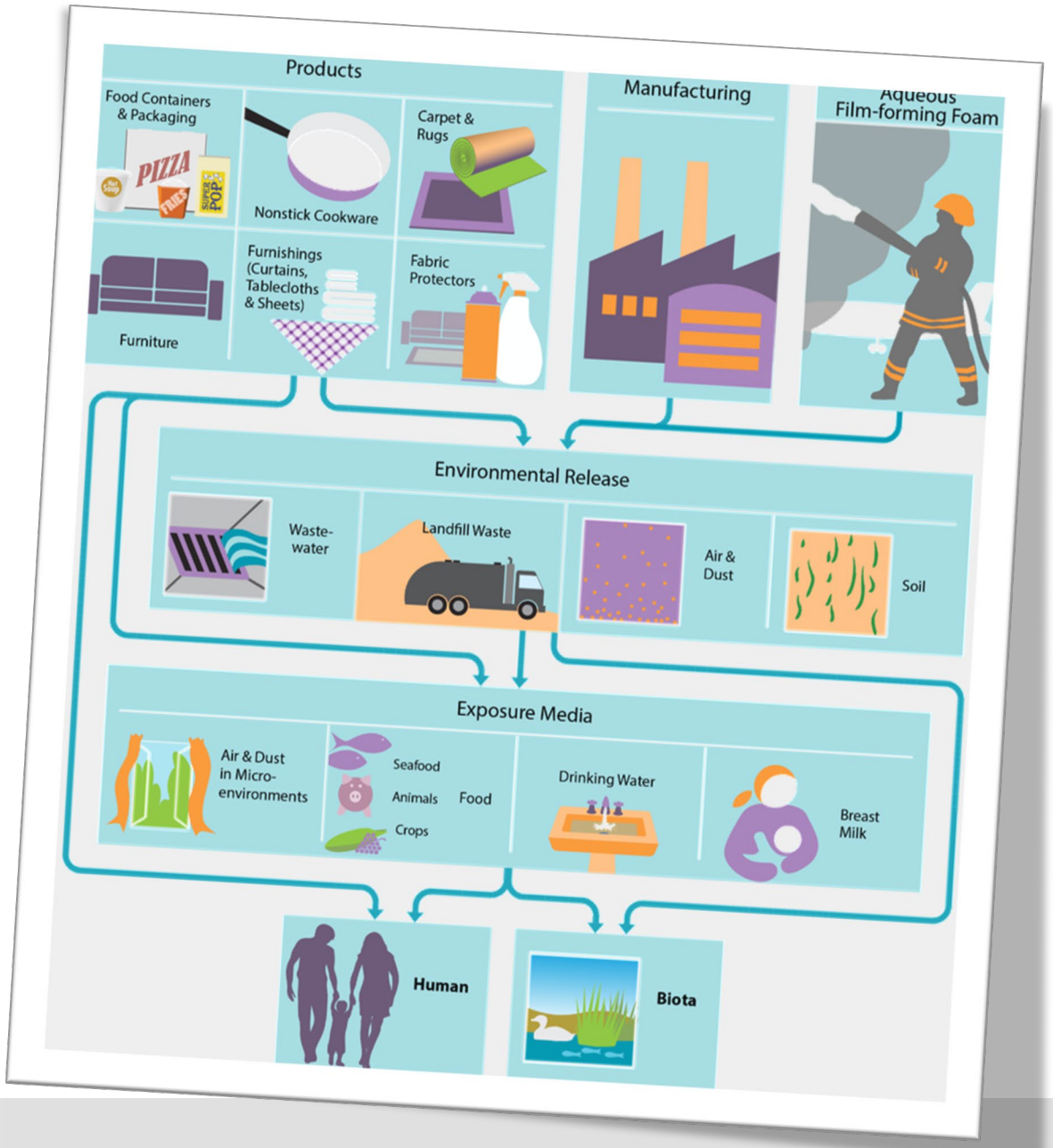
Per- and polyfluoroalkyl substances (PFASs) are virtually everywhere…



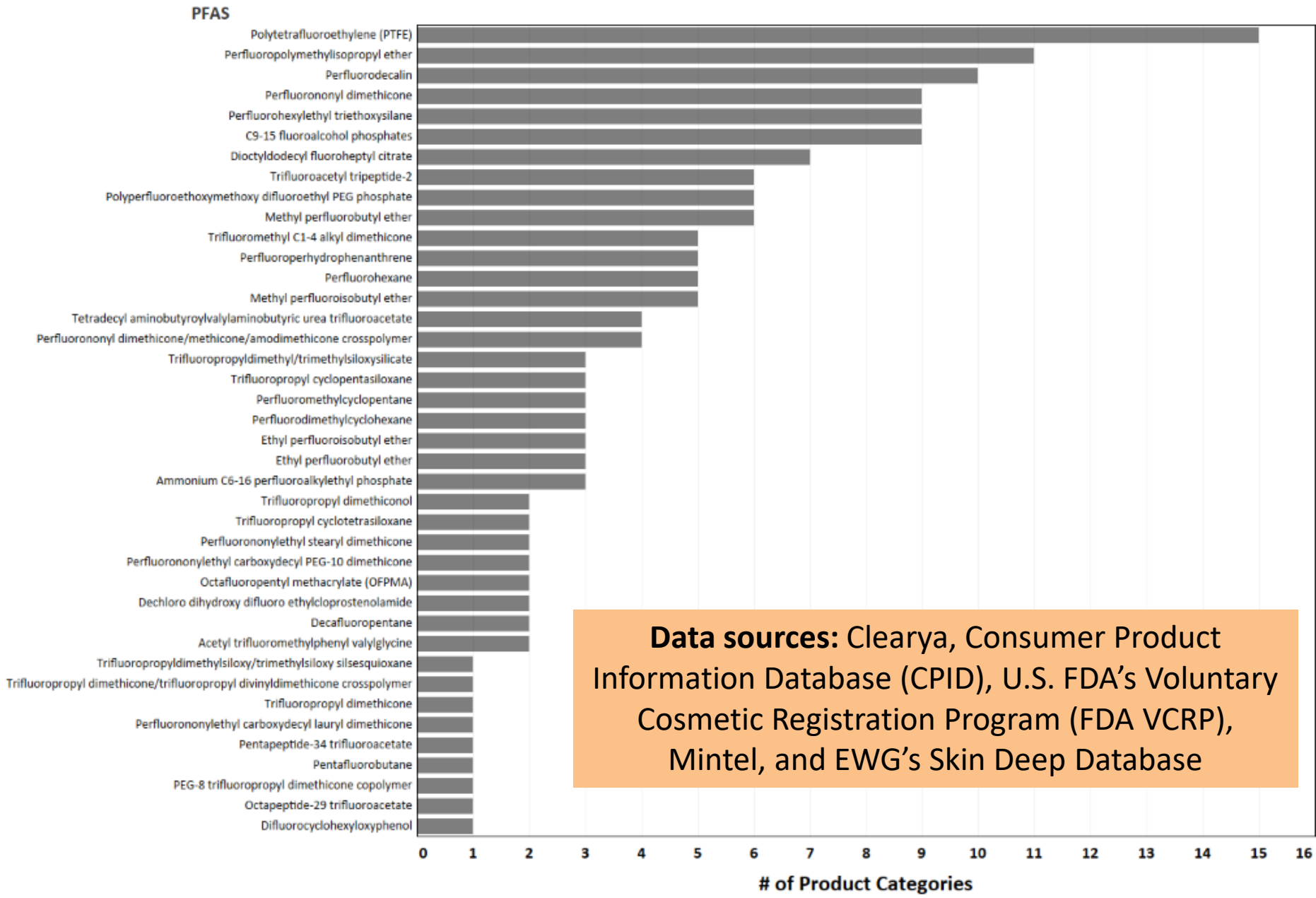
… which means PFAS exposure is highly complex



… 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?

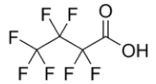
We found 40 distinct PFAS ingredients in 16 cosmetic product subcategories

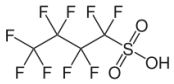


Data sources: Clearya, Consumer Product Information Database (CPID), U.S. FDA's Voluntary Cosmetic Registration Program (FDA VCRP), Mintel, and EWG's Skin Deep Database

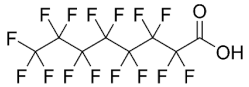
Bălan et al. (in review at *ES&T*)

The PFAS universe


PFBA


PFBS

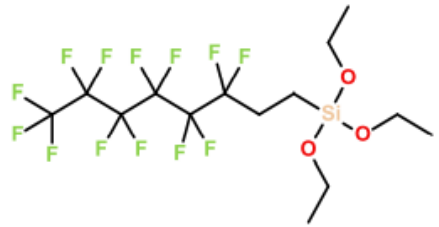

PFHxA

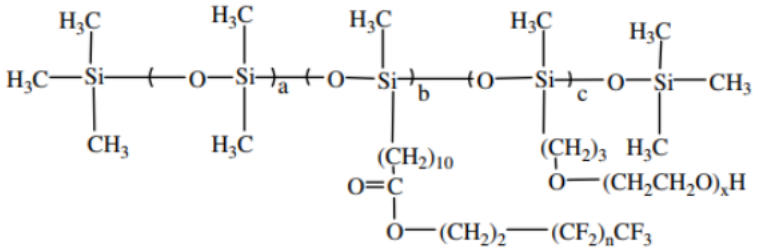

PFOA

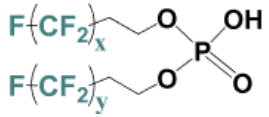

PFNA

Etc.

Perfluoroalkyl acids (PFAAs)


Perfluorooctyl triethoxysilane

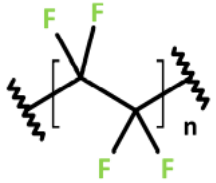

Perfluorononyl ethyl carboxydecyl PEG-10 dimethicone

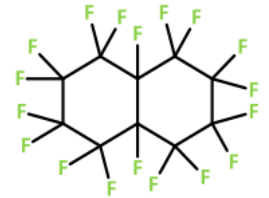

diPAP

Etc.

Perfluoroalkyl acid precursors (pre-PFAAs)

Used in products

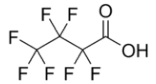

PTFE

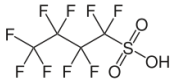

Perfluorodecalin

Etc.

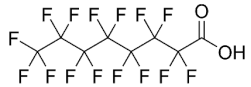
Fluoropolymers and more

What we typically measure


PFBA


PFBS

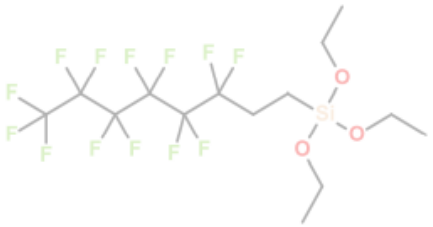

PFHxA

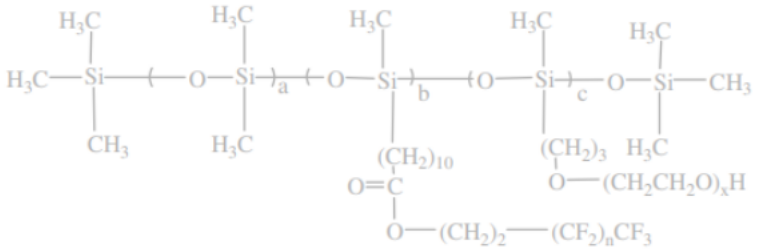

PFOA

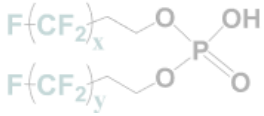

PFNA

Etc.

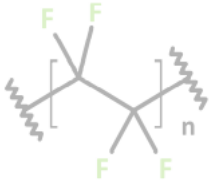
∑ PFAAs, ng/L


Perfluorooctyl triethoxysilane


Perfluorononyl ethyl carboxydecyl PEG-10 dimethicone


diPAP

Etc.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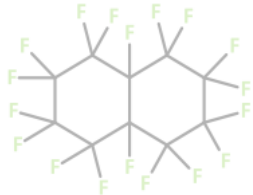
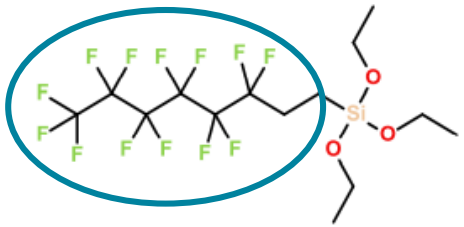

Perfluorodecalin

Etc.

Total Oxidizable Precursor (TOP) assay

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



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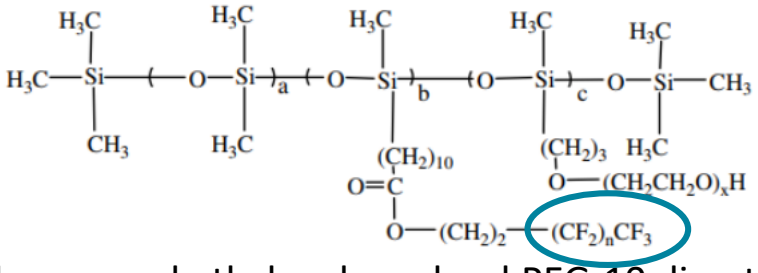
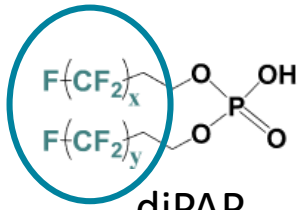


Perfluorononyl ethyl carboxydecyl PEG-10 dimethicone



diPAP

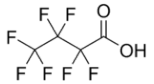
Etc.

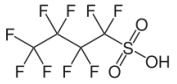
PTFE

Perfluorodecalin

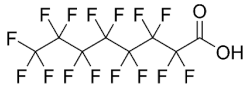
Etc.

Total Oxidizable Precursor (TOP) assay


PFBA

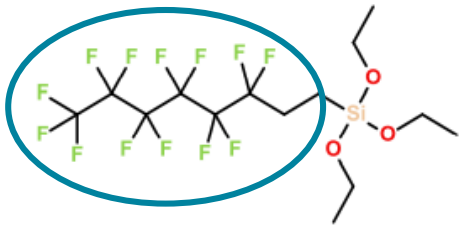

PFBS


PFHxA


PFOA


PFNA

Etc.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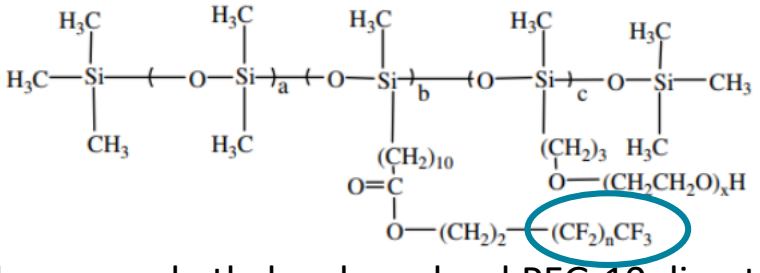
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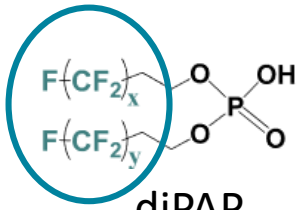
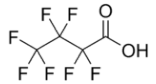

diPAP

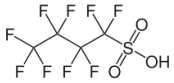
Etc.

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

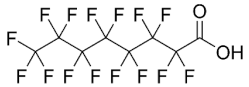
The mass of the fluorinated side-chain groups in cosmetics can be compared to TOP assay data for wastewater

Extractable or Adsorbable Organic Fluorine (EOF or AOF)


PFBA


PFBS


PFHxA


PFOA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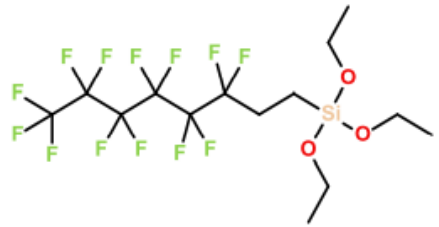
Etc.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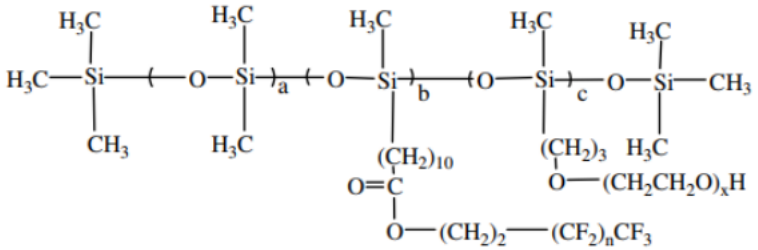
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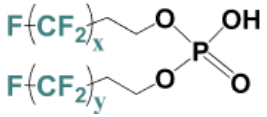
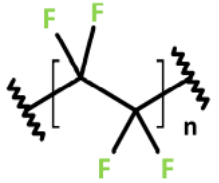
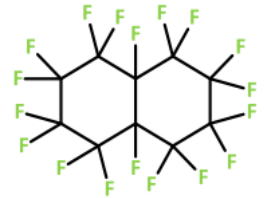

diPAP

Etc.

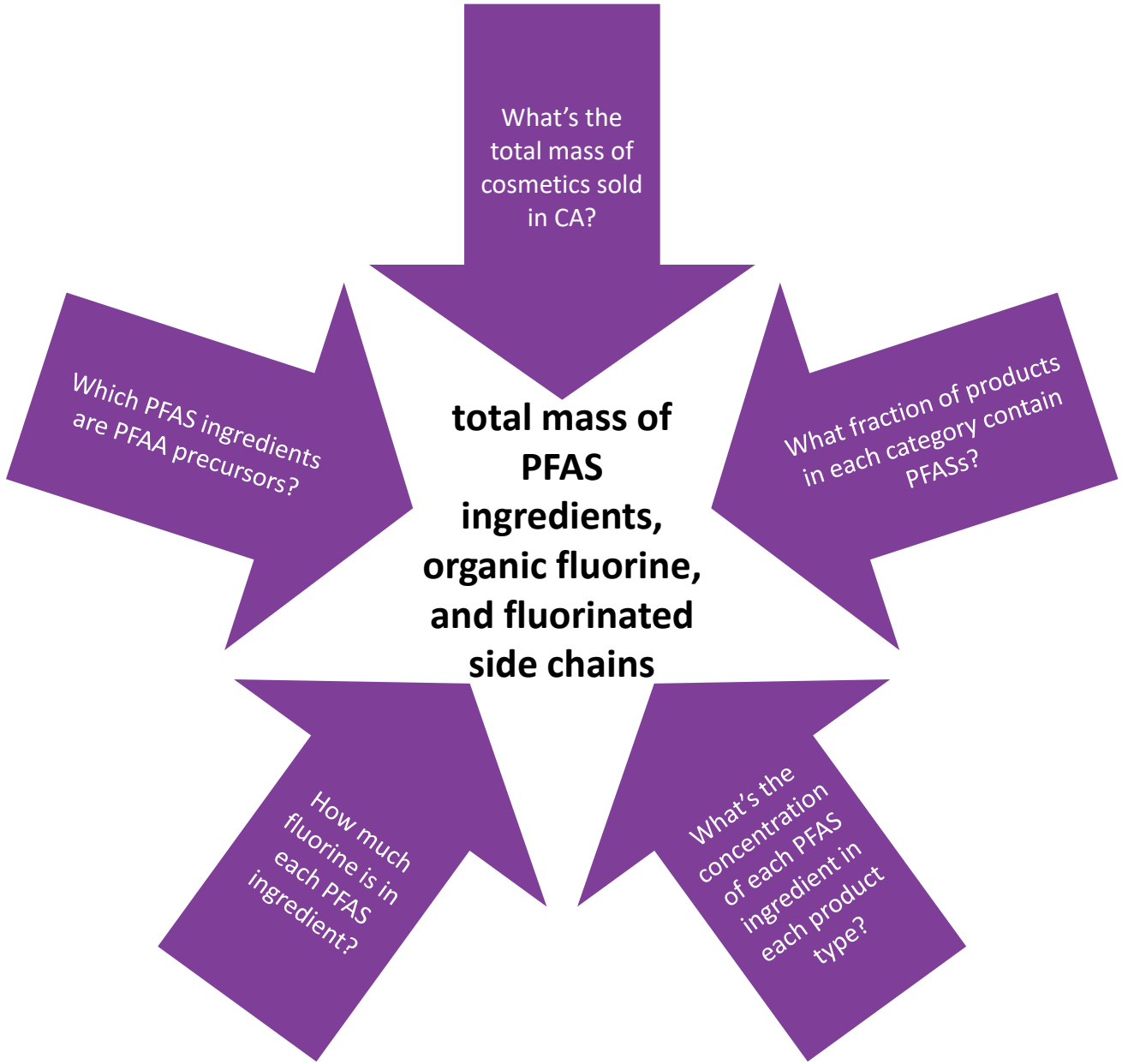

PTFE


Perfluorodecalin

Etc.

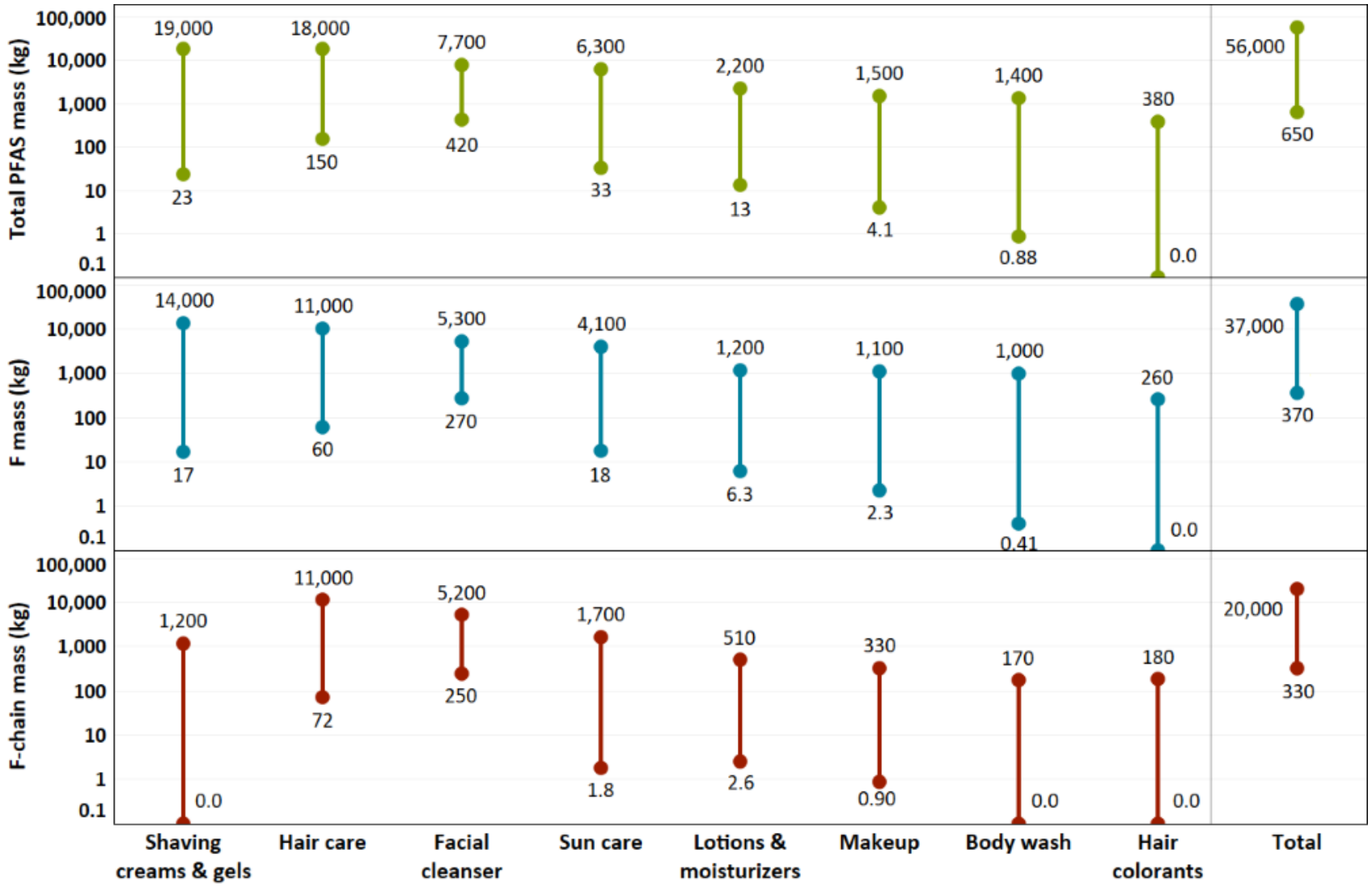
Total organic fluorine

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



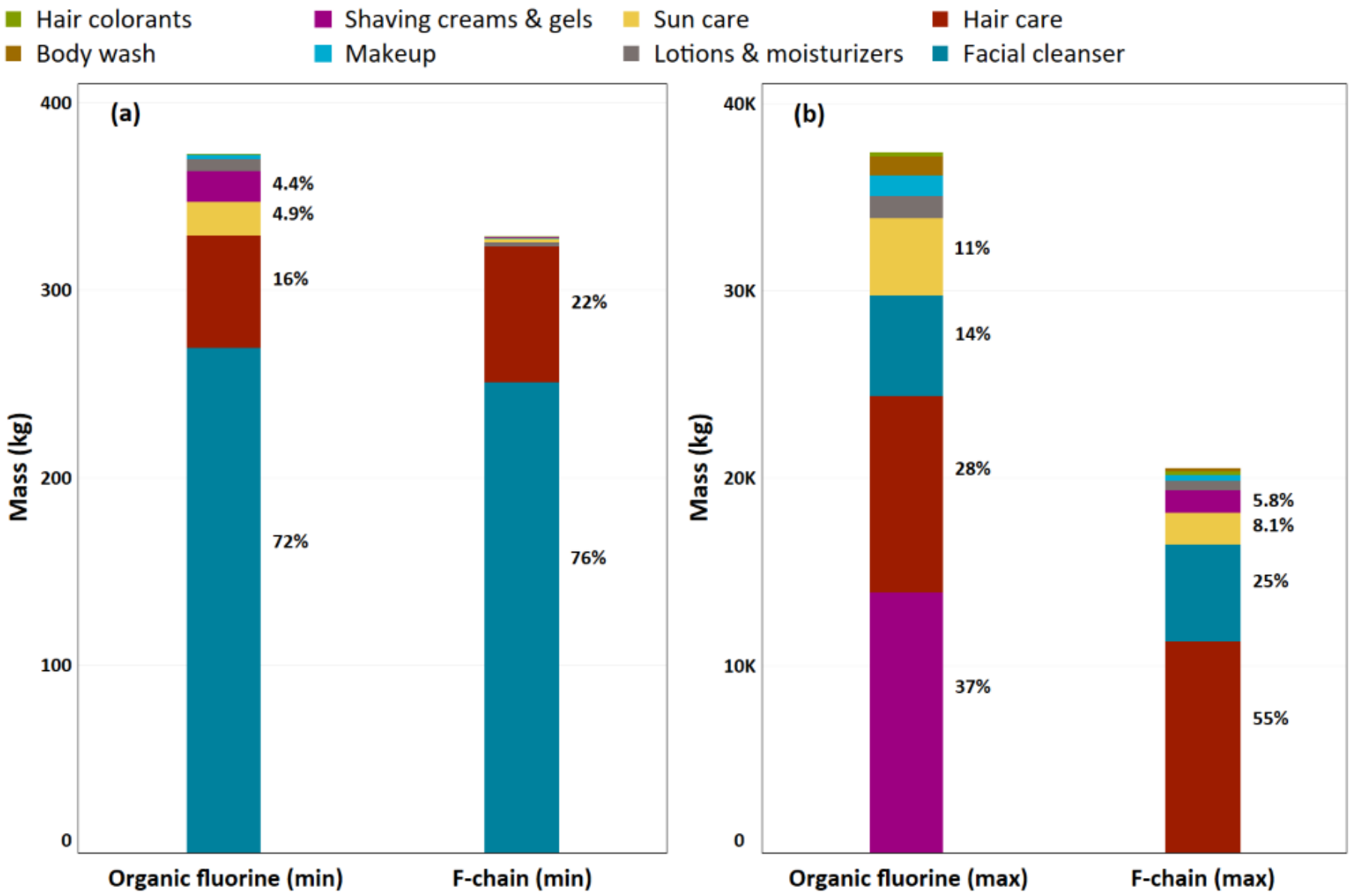
Bălan et al. (in review at *ES&T*)

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. (in review at *ES&T*)

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



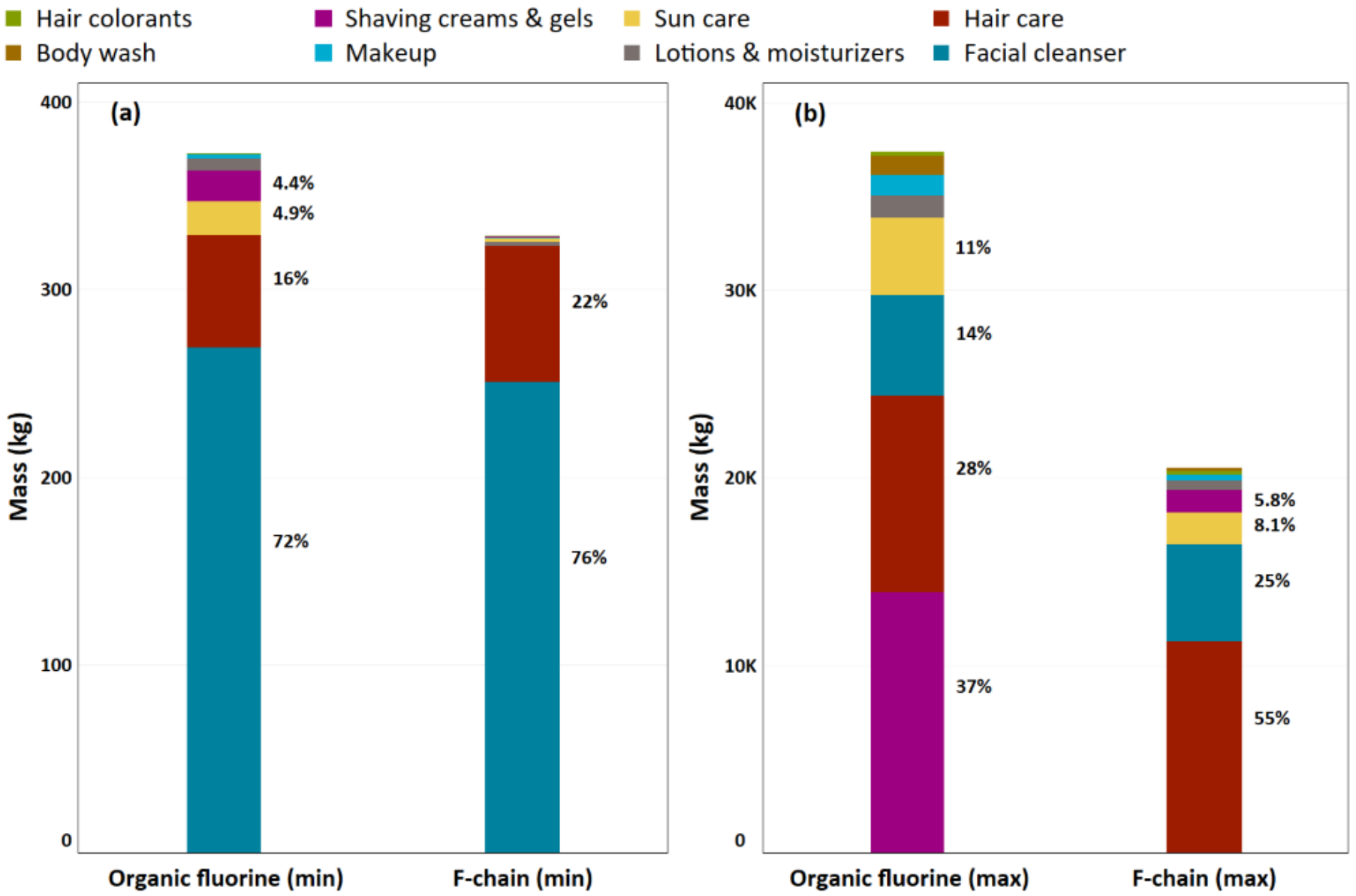
Bălan et al. (in review at *ES&T*)

Makeup accounted for less than 3% of the total fluorine

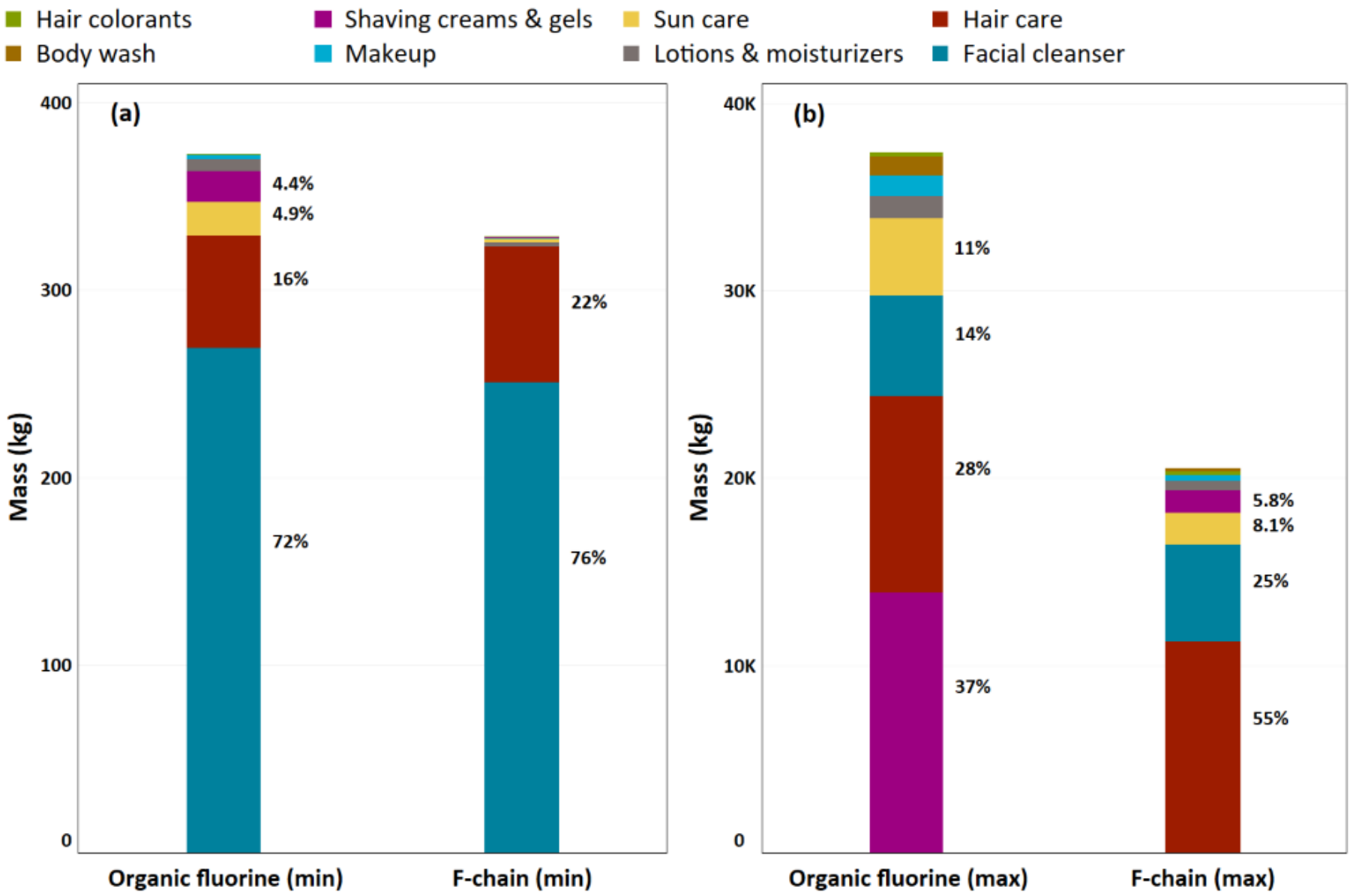
"Makeup" includes:

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

Bălan et al. (in review at *ES&T*)

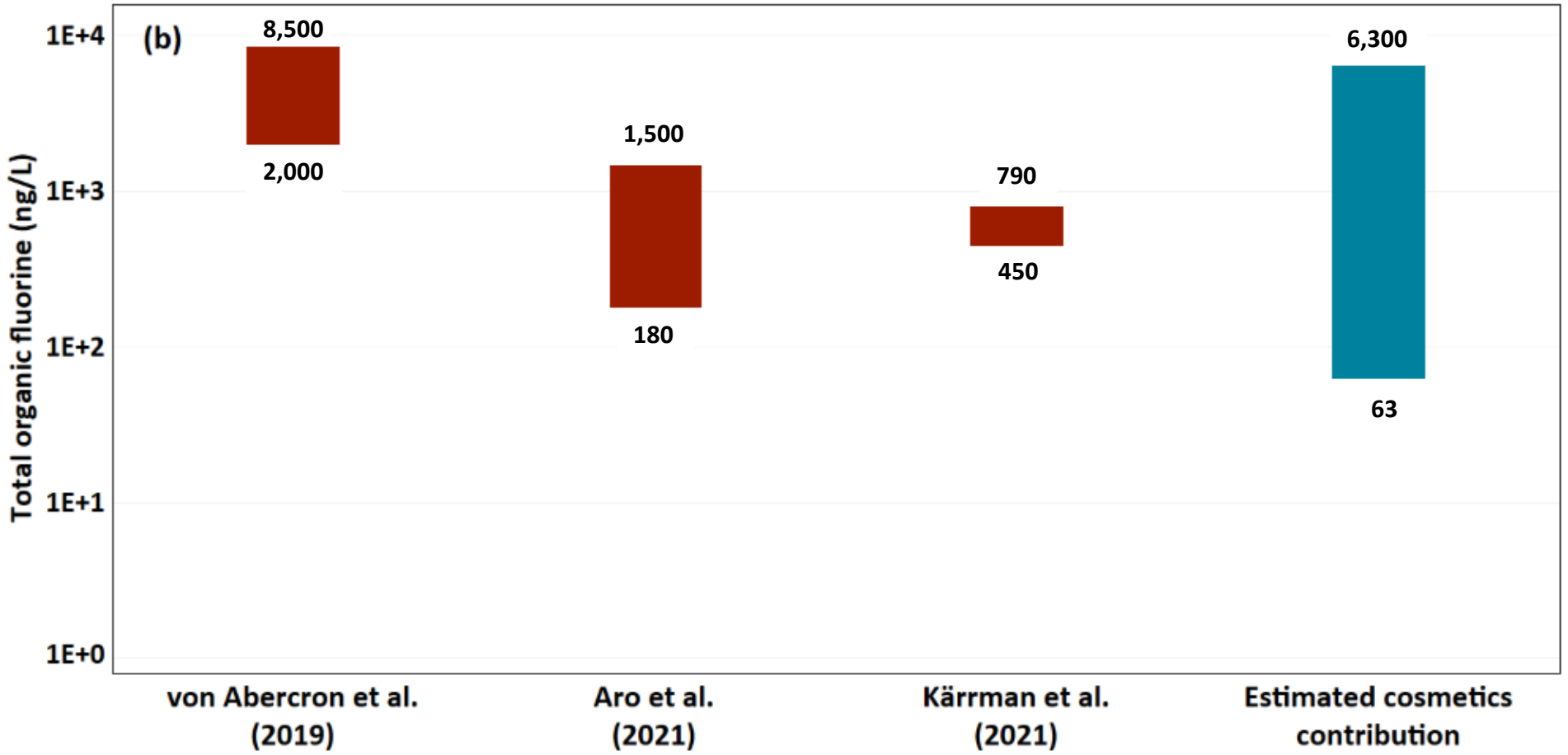


Hair care products and facial cleansers contribute over 80% of the PFAA precursors (makeup contributes less than 1.6%)



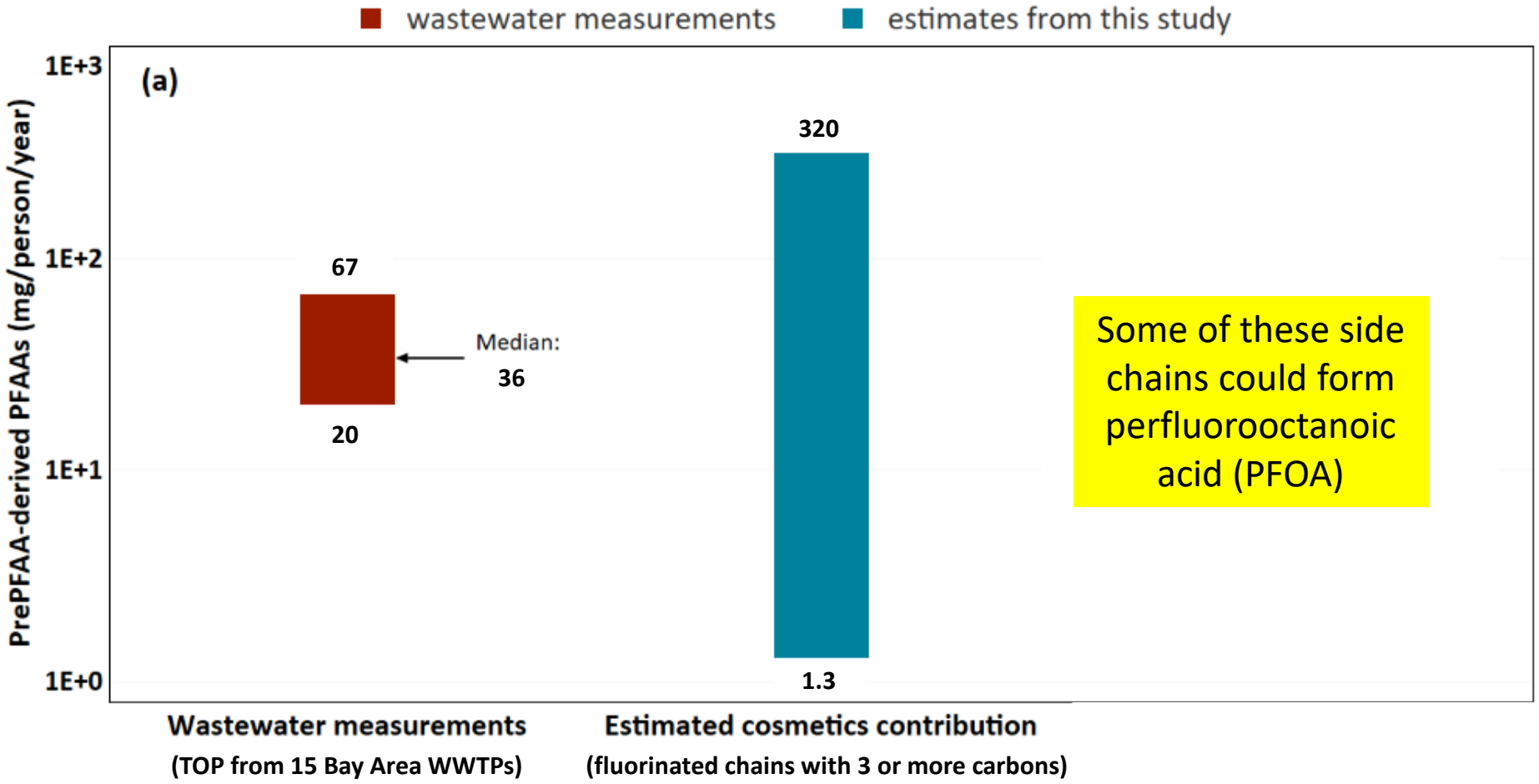
Bălan et al. (in review at *ES&T*)

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



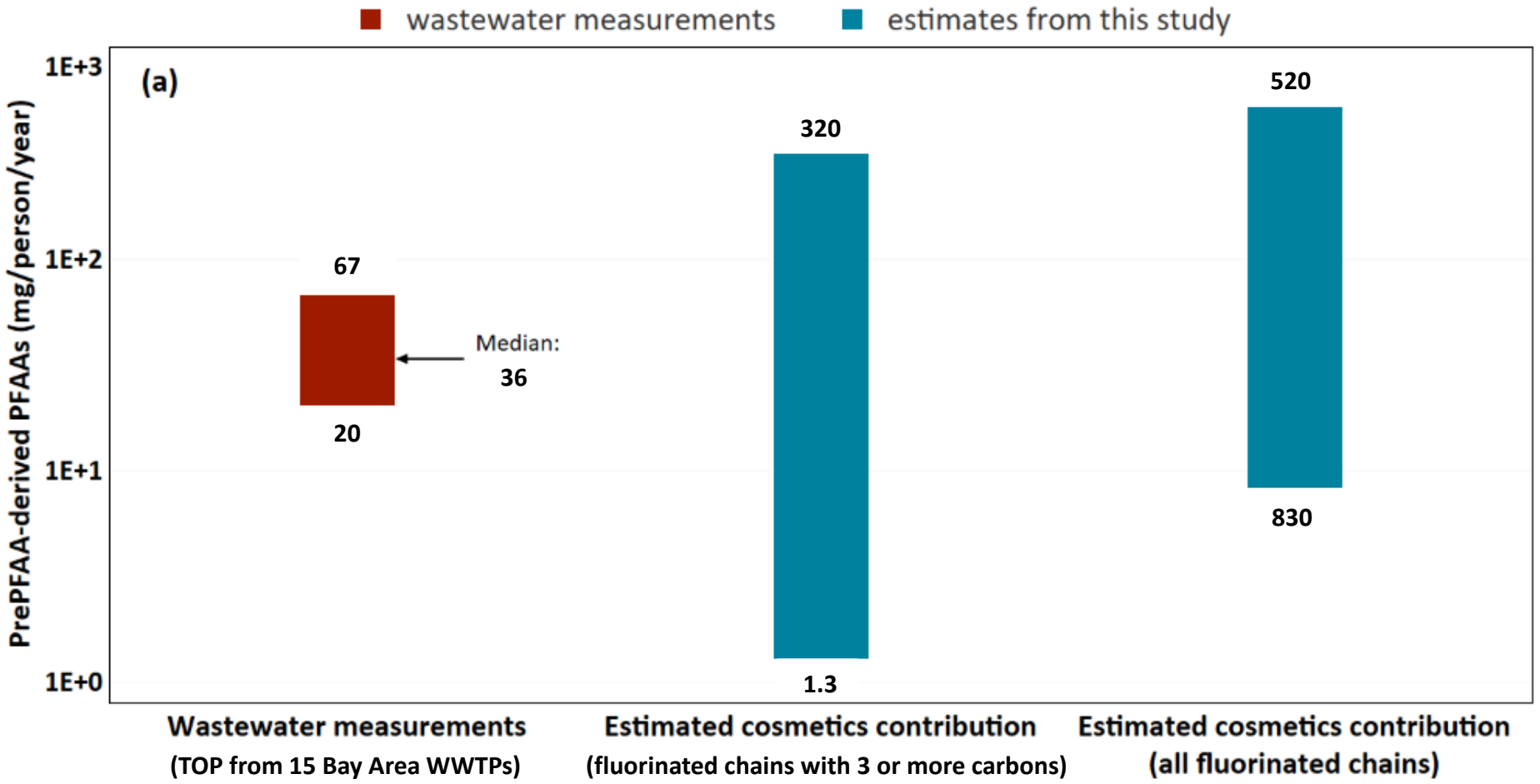
Bălan et al. (in review at *ES&T*)

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

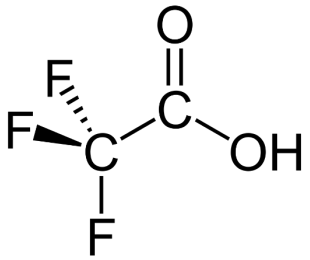


Bălan et al. (in review at *ES&T*)

… plus 280 to 8,000 kg/yr ultra-short chains (one or two carbons)



Some of this will convert to trifluoroacetic acid (TFA)

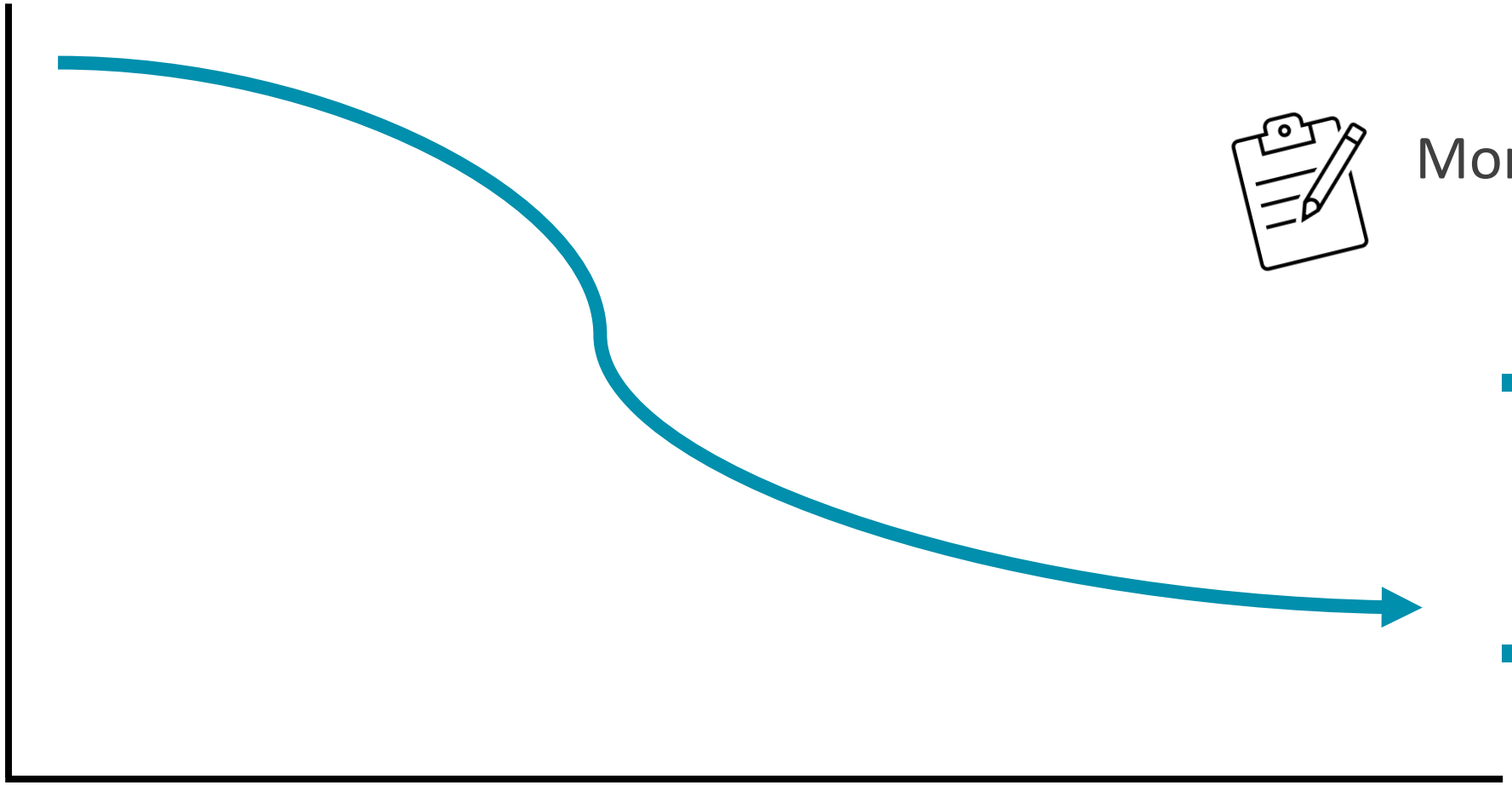


Bălan et al. (in review at *ES&T*)

It takes a village

- Co-authors:
  - Tom Bruton
  - Kyle Harris
  - Logan Hayes
  - 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

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: simona.balan@dtsc.ca.gov

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

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