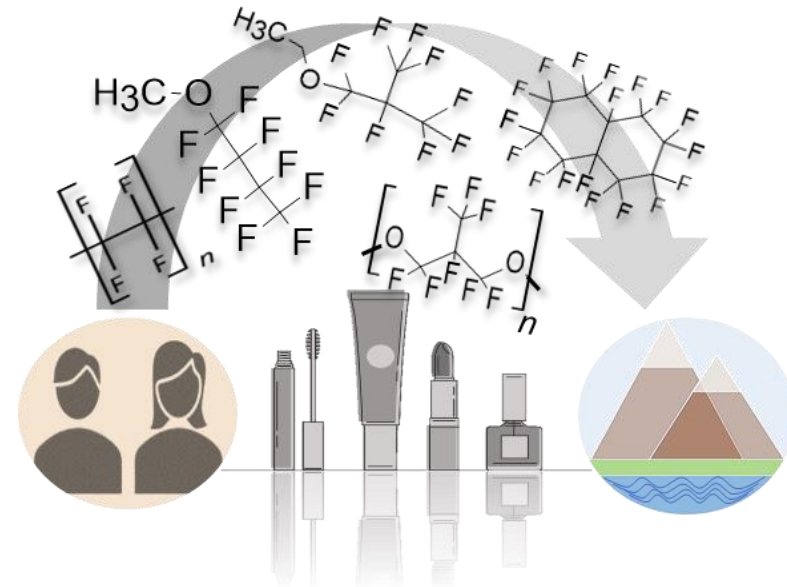


PFAS in cosmetics and personal care products from the European market



Jonathan Benskin

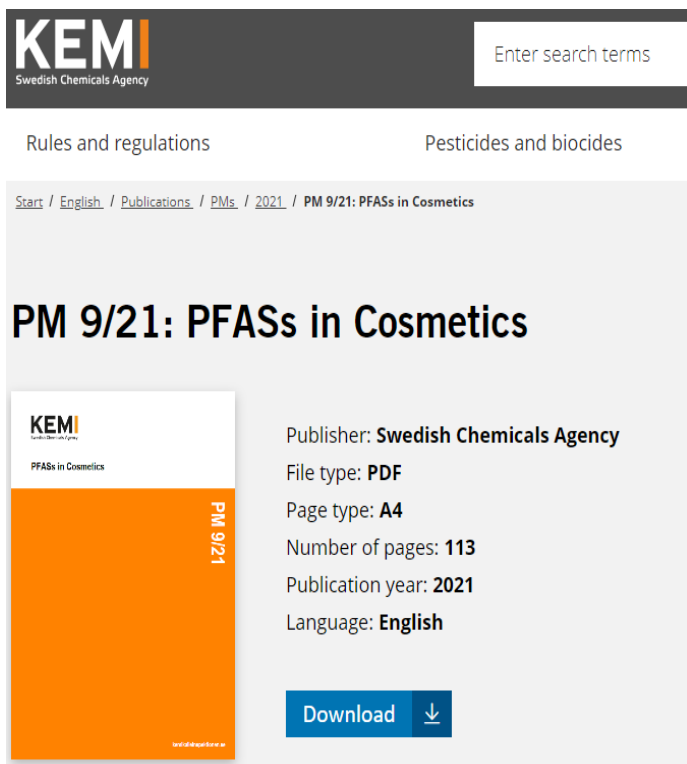
Department of Environmental Science

Jon.Benskin@aces.su.se

Nordic Conference on PFAS Substitution, Sept 2nd 2024

Background

- Work carried out 2020-2023. Report published 2021. Peer reviewed articles published 2022 and 2024.



KEMI
Swedish Chemicals Agency

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PM 9/21: PFASs in Cosmetics

KEMI
PFASs in Cosmetics
PM 9/21

Publisher: **Swedish Chemicals Agency**
File type: **PDF**
Page type: **A4**
Number of pages: **113**
Publication year: **2021**
Language: **English**

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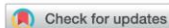
Environmental Science Processes & Impacts



Kerstin Pütz

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Are cosmetics a significant source of PFAS in Europe? product inventories, chemical characterization and emission estimates†

Kerstin Winkens Pütz,^{‡,*a} Shahla Namazkar,[‡] Merle Plassmann^b and Jonathan P. Benskin^{‡,*b}



Shahla Namazkar

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Cite this: *Environ. Sci.: Processes Impacts*, 2024, 26, 259

Characterization and dermal bioaccessibility of residual- and listed PFAS ingredients in cosmetic products†

Shahla Namazkar,^{‡,*a} Oddny Ragnarsdottir,^b Anton Josefsson,^{‡,*a} Felice Branzell,^a Sebastian Abel,^a Mohamed Abou-Elwafa Abdallah,^{‡,*b} Stuart Harrad^{‡,*b} and Jonathan P. Benskin^{‡,*a}

Objectives

Assess the importance of cosmetics from the European market as a source of PFAS to waste streams.

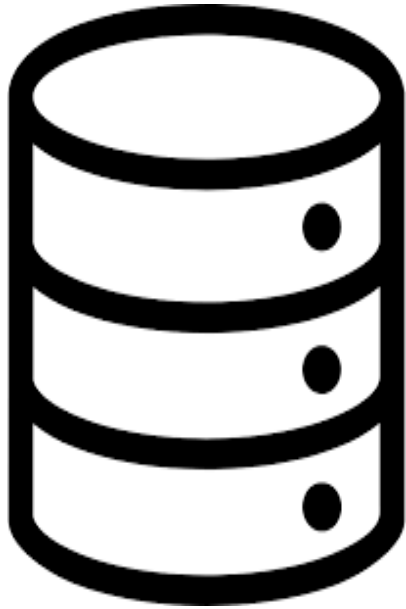
Steps to achieving this aim:

Step 1: Develop an inventory of PFAS in cosmetics using European cosmetic databases.

Step 2: Analyse a selection of cosmetics using a multiple analytical approaches.

Step 3: Estimate annual emission of PFAS into European wastewater and solid waste from cosmetics.

What types of PFAS occur in cosmetics?



**CosIng database of
INCI names and uses**



Search of **INCI** names containing
“fluoro”



~170 unique INCI names
containing at least a $-CF_2-$ or $-CF_3$

*Example: “C9–C15 fluoroalcohol
phosphate”*

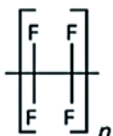
CosIng = European Commission database for information on cosmetic substances and ingredients

INCI = International Nomenclature of Cosmetic Ingredients

Broad diversity of listed PFAS ingredients

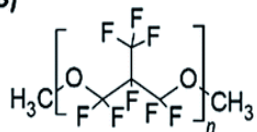
Examples:

(A)



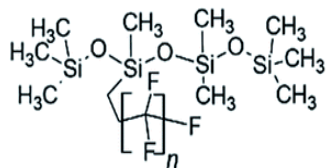
Polytetrafluoroethylene (PTFE)

(B)



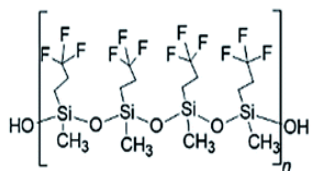
Polyperfluoromethylisopropyl ether

(C)



Perfluorononyl dimethicone

(D)



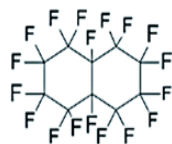
Trifluoropropyl dimethiconol

(G)



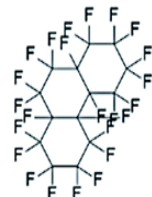
Perfluorohexane

(H)



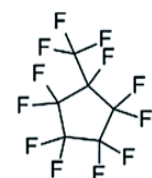
Perfluorodecalin

(I)



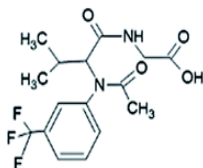
Perfluoroperhydrophenanthrene

(J)



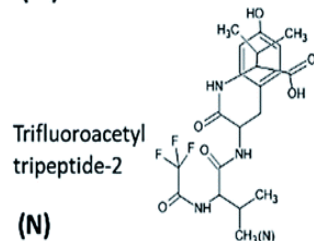
Perfluoromethyl cyclopentane

(L)



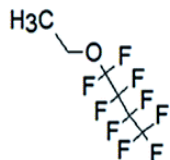
Acetyl trifluoromethylphenyl valylglycine

(M)



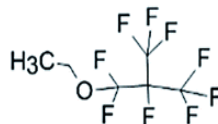
Trifluoroacetyl tripeptide-2

(N)



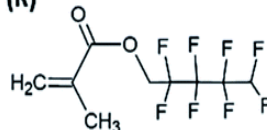
Ethyl perfluorobutyl ether

(O)



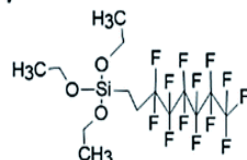
Ethyl perfluoroisobutyl ether

(R)



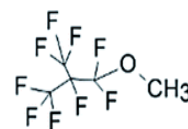
Octafluoropentyl methacrylate

(S)



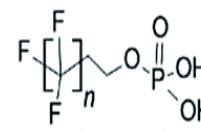
Perfluorooctyl triethoxysilane

(T)



Methyl perfluoroisobutyl ether

(W)



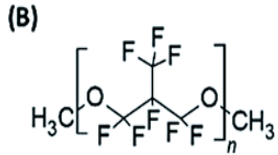
C9-15 Fluoroalcohol phosphate

Broad diversity of listed PFAS ingredients

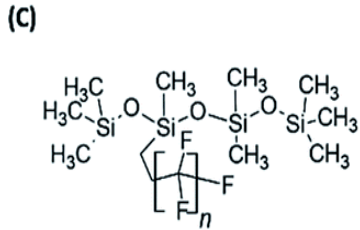
Examples:



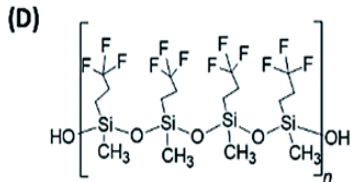
Polytetrafluoroethylene (PTFE)



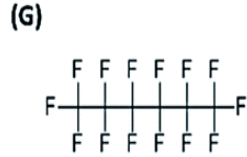
Polyperfluoromethylisopropyl ether



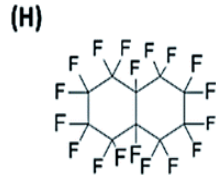
Perfluorononyl dimethicone



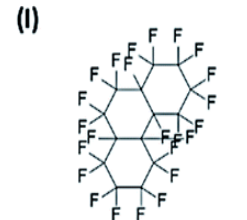
Trifluoropropyl dimethiconol



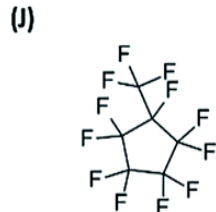
Perfluorohexane



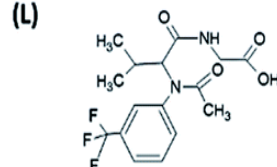
Perfluorodecalin



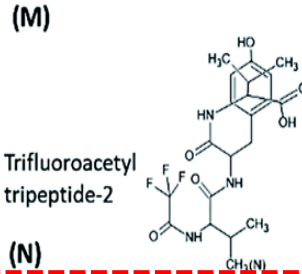
Perfluoroperhydrophenanthrene



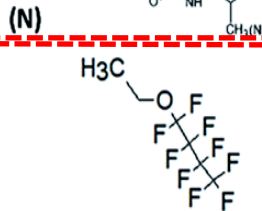
Perfluoromethylcyclopentane



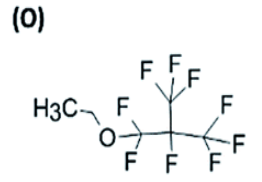
Acetyl trifluoromethylphenyl valylglycine



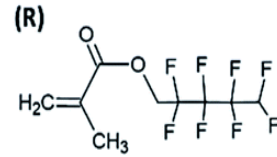
Trifluoroacetyl tripeptide-2



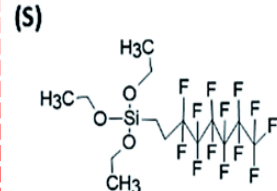
Ethyl perfluorobutyl ether



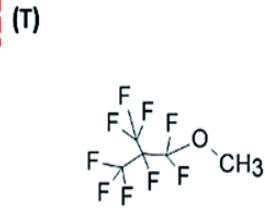
Ethyl perfluoroisobutyl ether



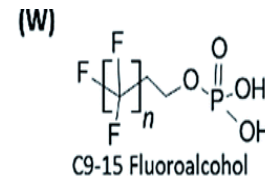
Octafluoropentyl methacrylate



Perfluorooctyl triethoxysilane



Methyl perfluoroisobutyl ether



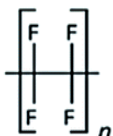
C9-15 Fluoroalcohol phosphate

- Fluorinated polymers
- Volatile aliphatic + cyclic species
- Semi-volatile substances
- Polar substances

Broad diversity of listed PFAS ingredients

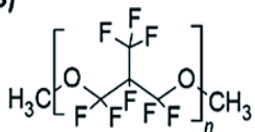
Examples:

(A)



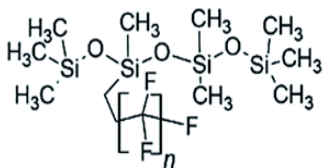
Polytetrafluoroethylene (PTFE)

(B)



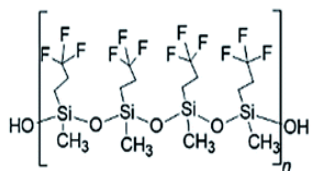
Polyperfluoromethylisopropyl ether

(C)



Perfluorononyl dimethicone

(D)



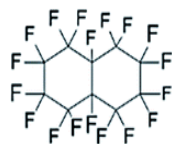
Trifluoropropyl dimethiconol

(G)



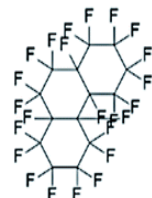
Perfluorohexane

(H)



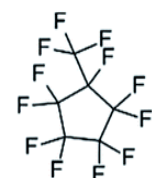
Perfluorodecalin

(I)



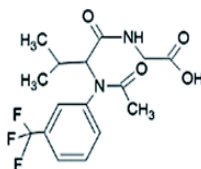
Perfluoroperhydrophenanthrene

(J)



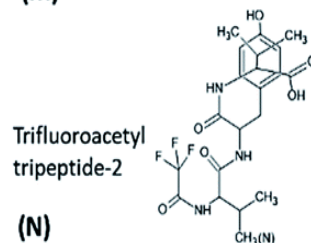
Perfluoromethylcyclopentane

(L)



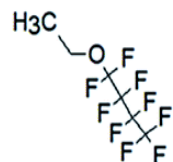
Acetyl trifluoromethylphenyl valylglycine

(M)



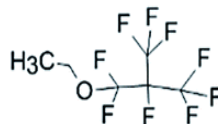
Trifluoroacetyl tripeptide-2

(N)



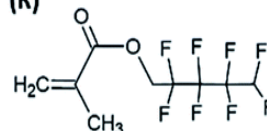
Ethyl perfluorobutyl ether

(O)



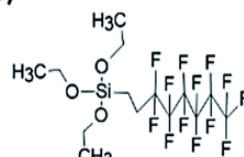
Ethyl perfluoroisobutyl ether

(R)



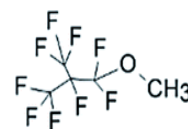
Octafluoropentyl methacrylate

(S)



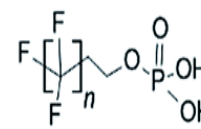
Perfluorooctyl triethoxysilane

(T)



Methyl perfluoroisobutyl ether

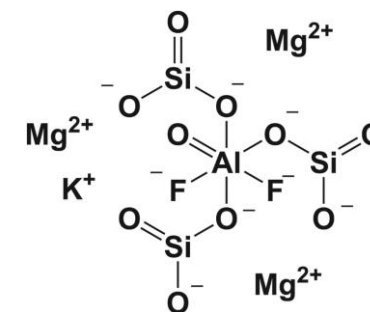
(W)



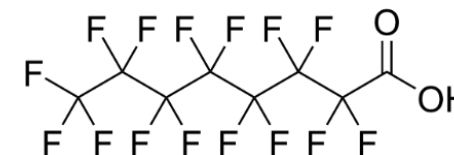
C9-15 Fluoroalcohol phosphate

Also...

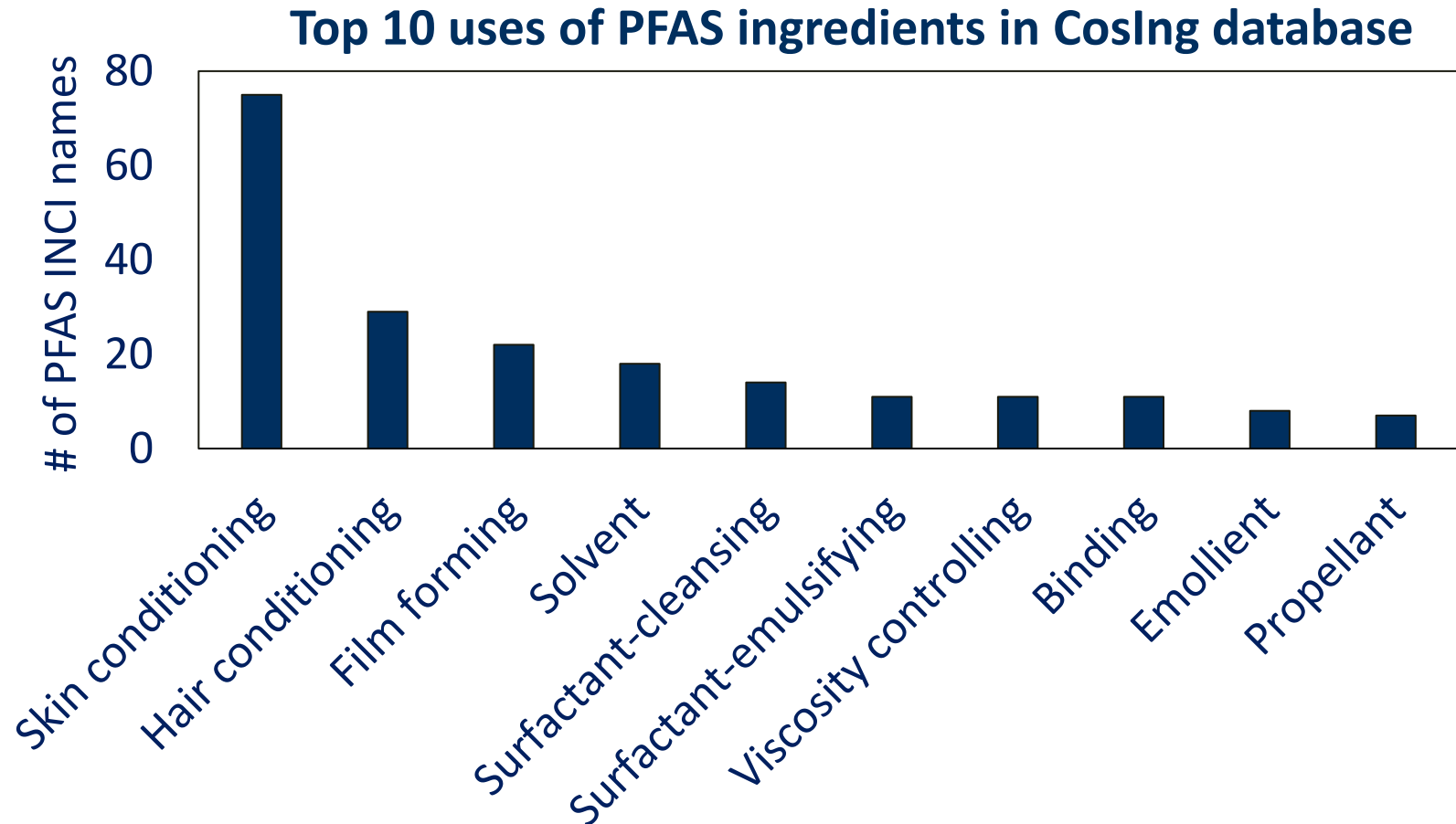
Inorganic fluorine (synthetic mica)



Unlisted residuals (from prior literature)



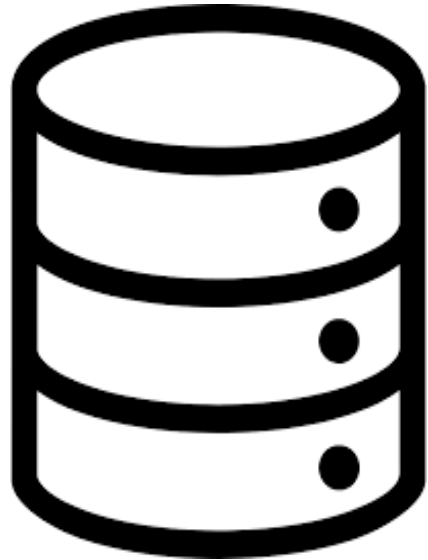
Wide diversity of PFAS functions in cosmetics



Are there alternatives to PFAS in cosmetics?

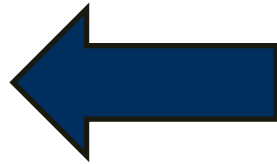
YES! According to a producer (interview), PFAS can be exchanged for other substances, but reformulation may be required

Which specific products contain PFAS?



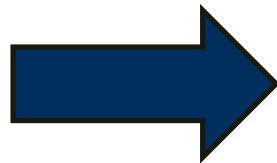
CosmEthics database

121 246 products



170 PFAS INCIs from CosIng

Example: "C9–C15 fluoroalcohol phosphate"



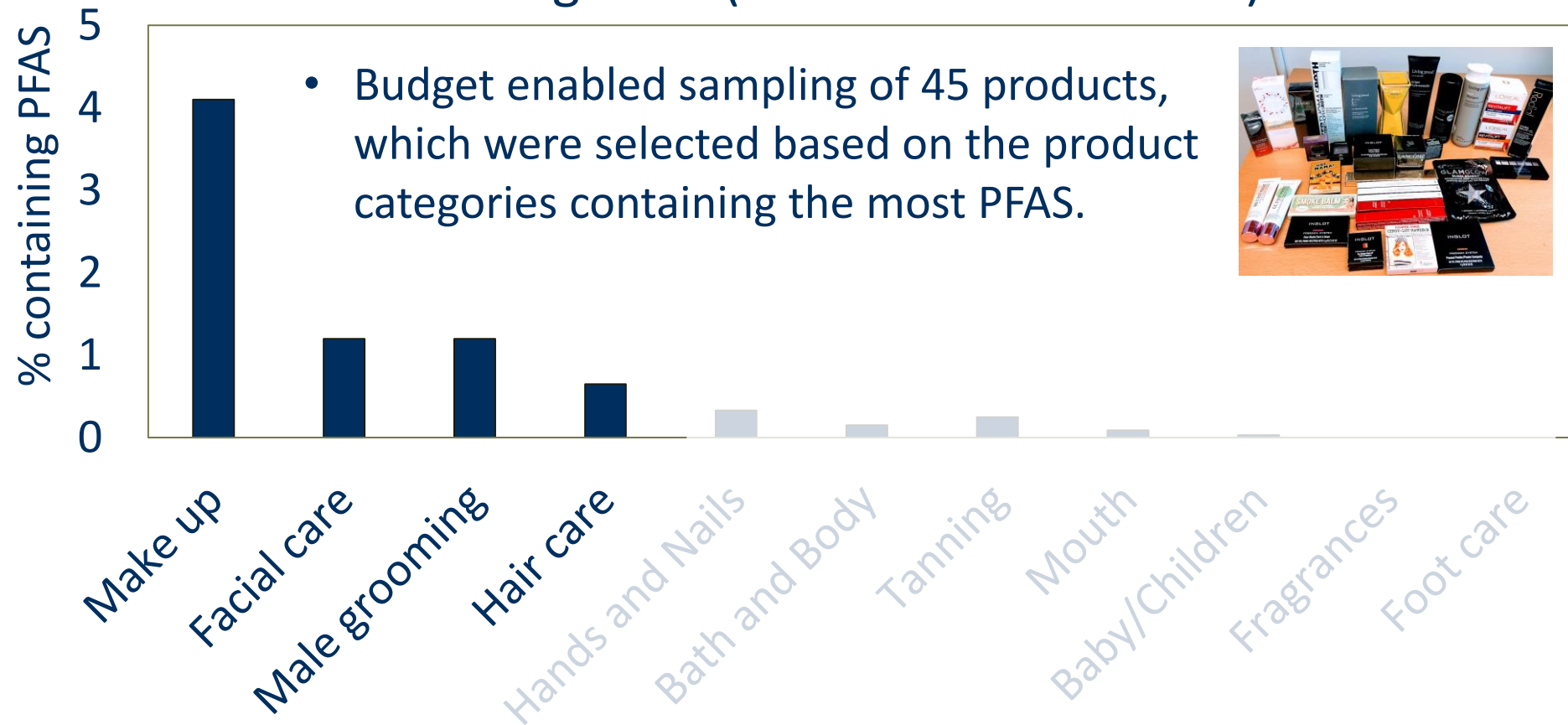
1658 products containing a PFAS INCI
(1.4% of all products in database)

*Example: "Clinique Super balanced makeup" contains
C9–C15 fluoroalcohol phosphate*

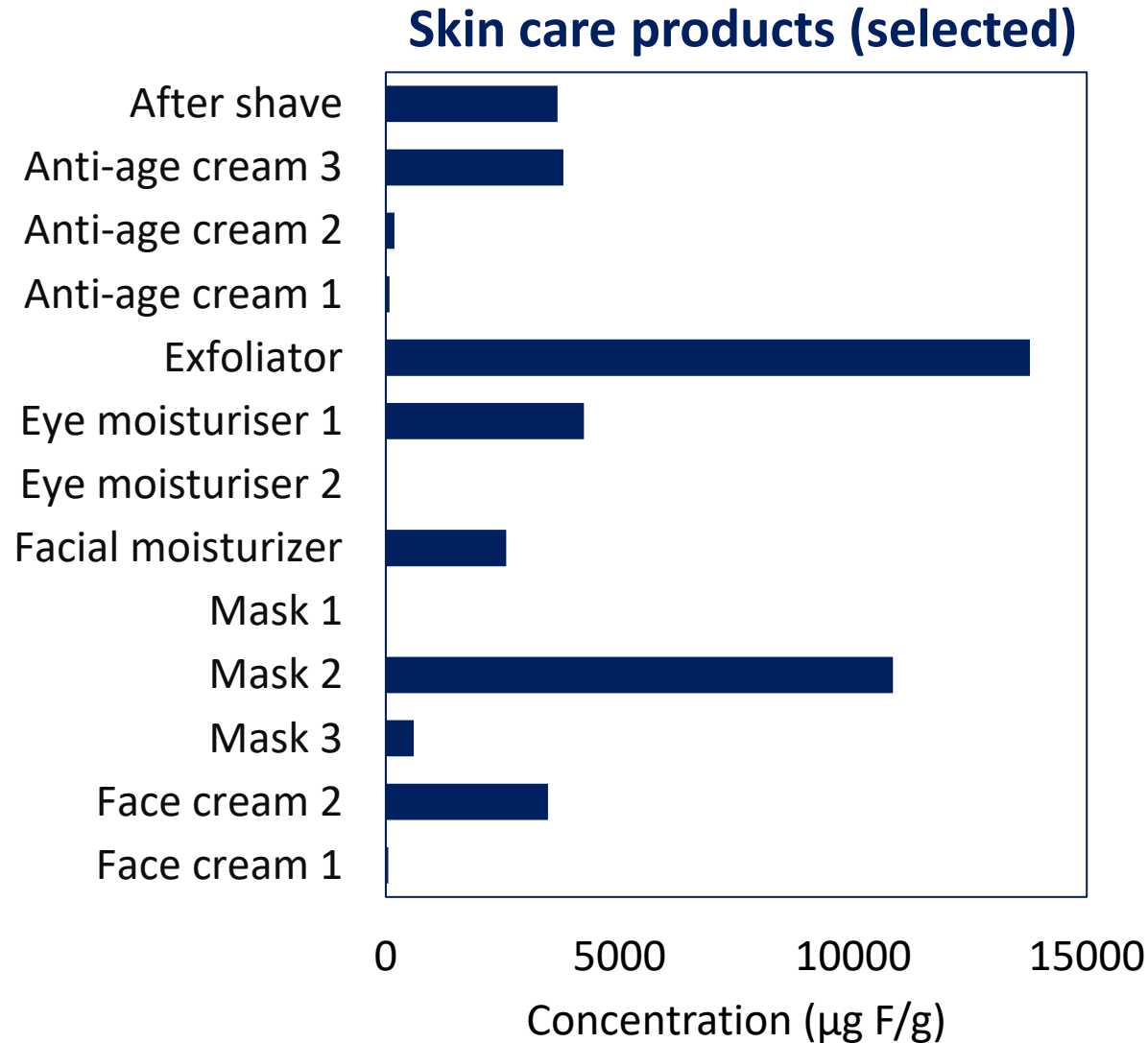
Rank	PFAS INCI Name	# of products in CosmEthics
1	PTFE	541
2	Perfluorooctyl triethoxysilane	232
3	C9-15 fluoroalcohol phosphate	208

Categorization of products containing PFAS

Percentage of individual product categories containing PFAS (CosmEthics database)

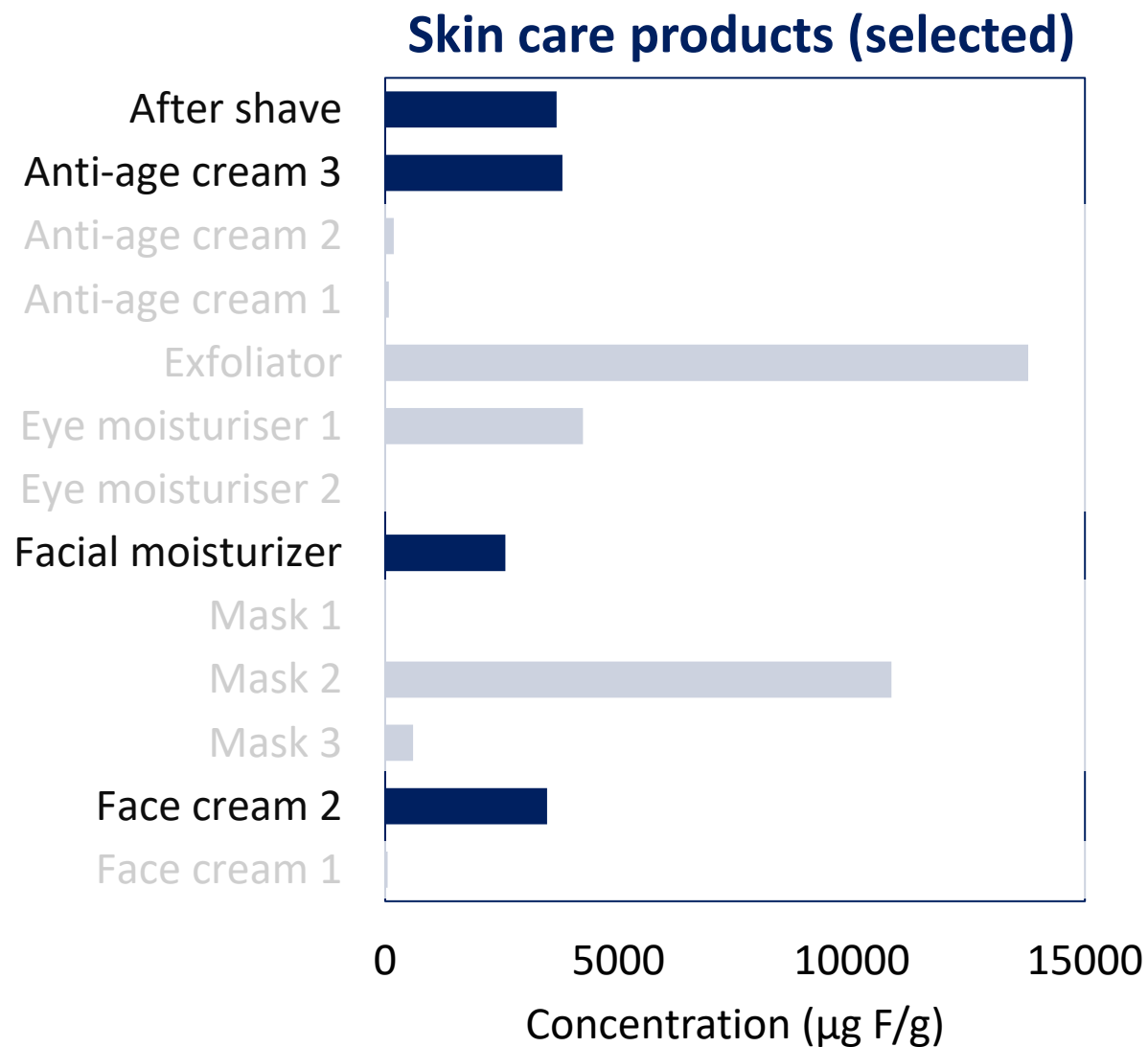


Results: Total fluorine (TF) in cosmetic products



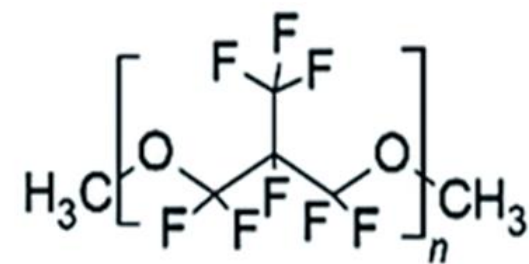
- TF concentrations ranged from <LOD – 13.8 mg F/g in products listing PFAS as an ingredient.
- Considerable **variability** in TF across all product types.
- Exfoliator and Mask 2 contained the highest TF amongst all products.

Interpreting TF data for cosmetic products



Products containing “polyperfluoromethyl isopropyl ether”

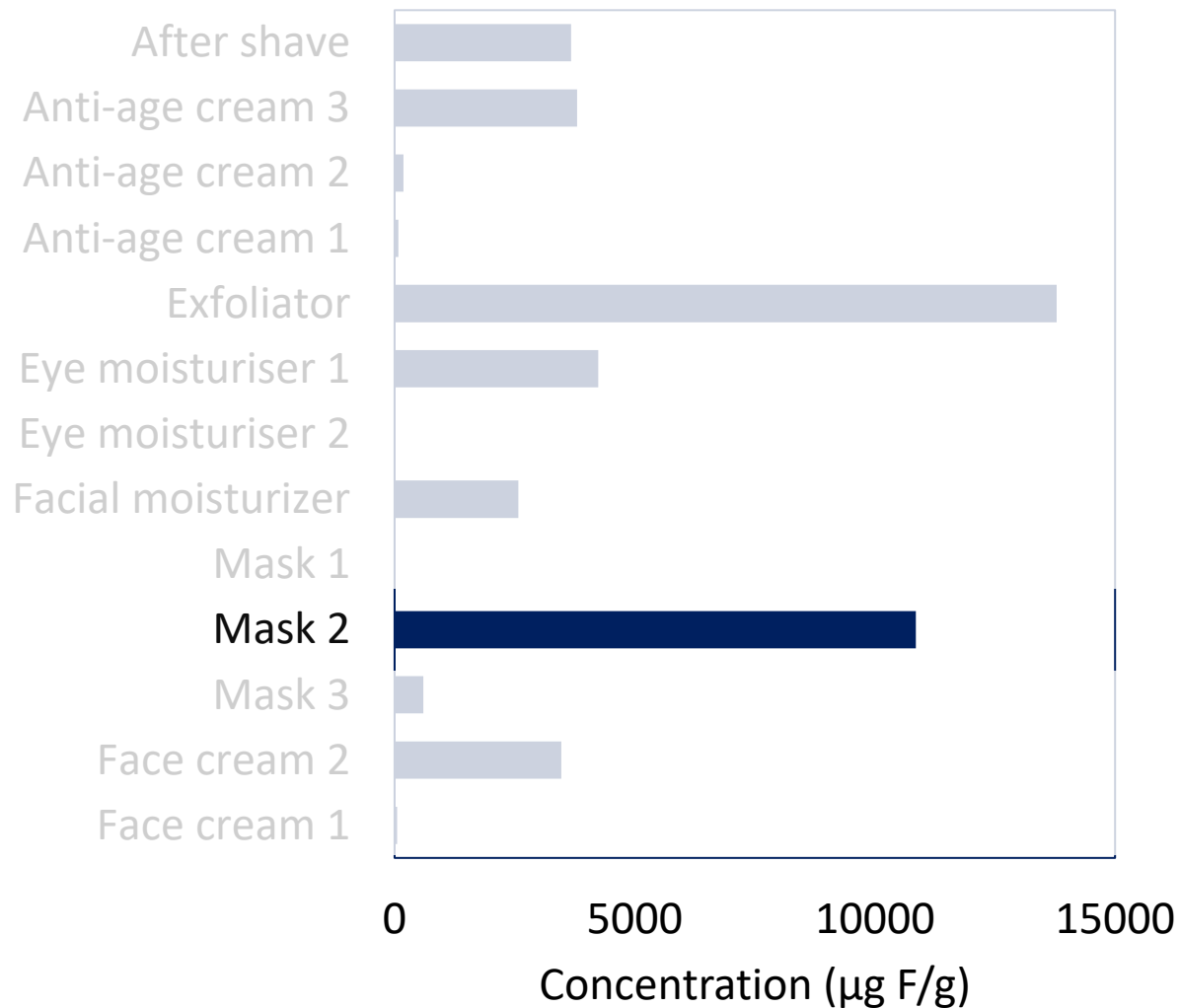
- No inorganic fluorine ingredients.
- Single INCI name
- INCI is a single substance
- **Conclusion:** TF represents concentration of listed ingredient.



Polyperfluoromethylisopropyl ether

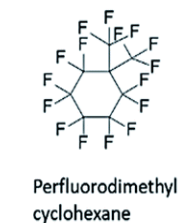
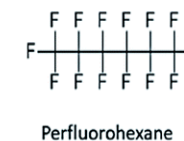
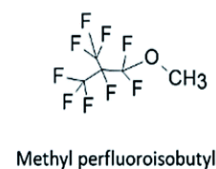
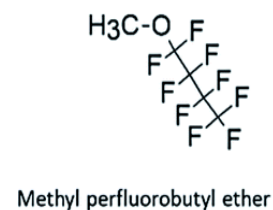
Interpreting TF data for cosmetic products

Skin care products (selected)



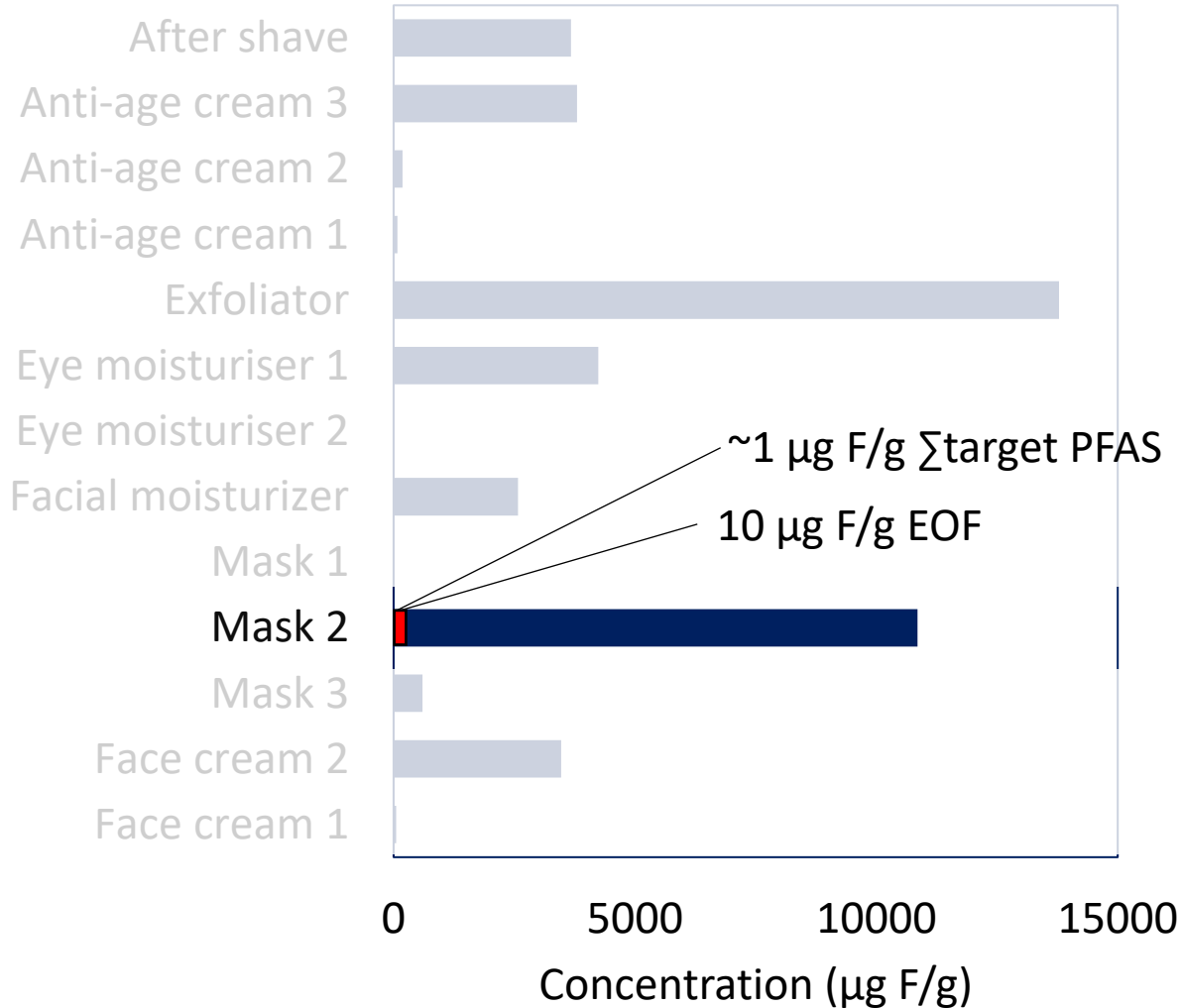
“Mask 2”

- Inorganic fluorine ingredient.
- Multiple PFAS ingredients.
- **Conclusion:** TF is likely an overestimate of total PFAS concentration. Concentration of individual substances unclear.



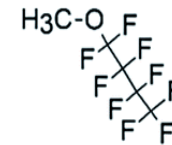
TF vs extractable organic fluorine (EOF) + target PFAS

Skin care products (selected)

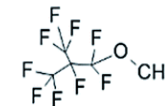


“Mask 2”

- EOF and Σ target PFAS \ll TF.
- EOF removes inorganic fluorine but likely also some PFAS.
- Targeted analysis captures low level residuals missed by TF or EOF but misses listed ingredients.



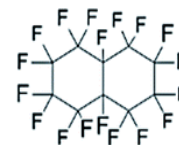
Methyl perfluorobutyl ether



Methyl perfluoroisobutyl



Perfluorohexane



Perfluorodecalin

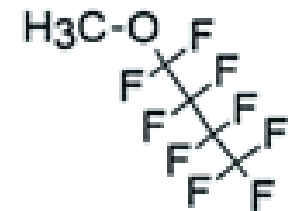
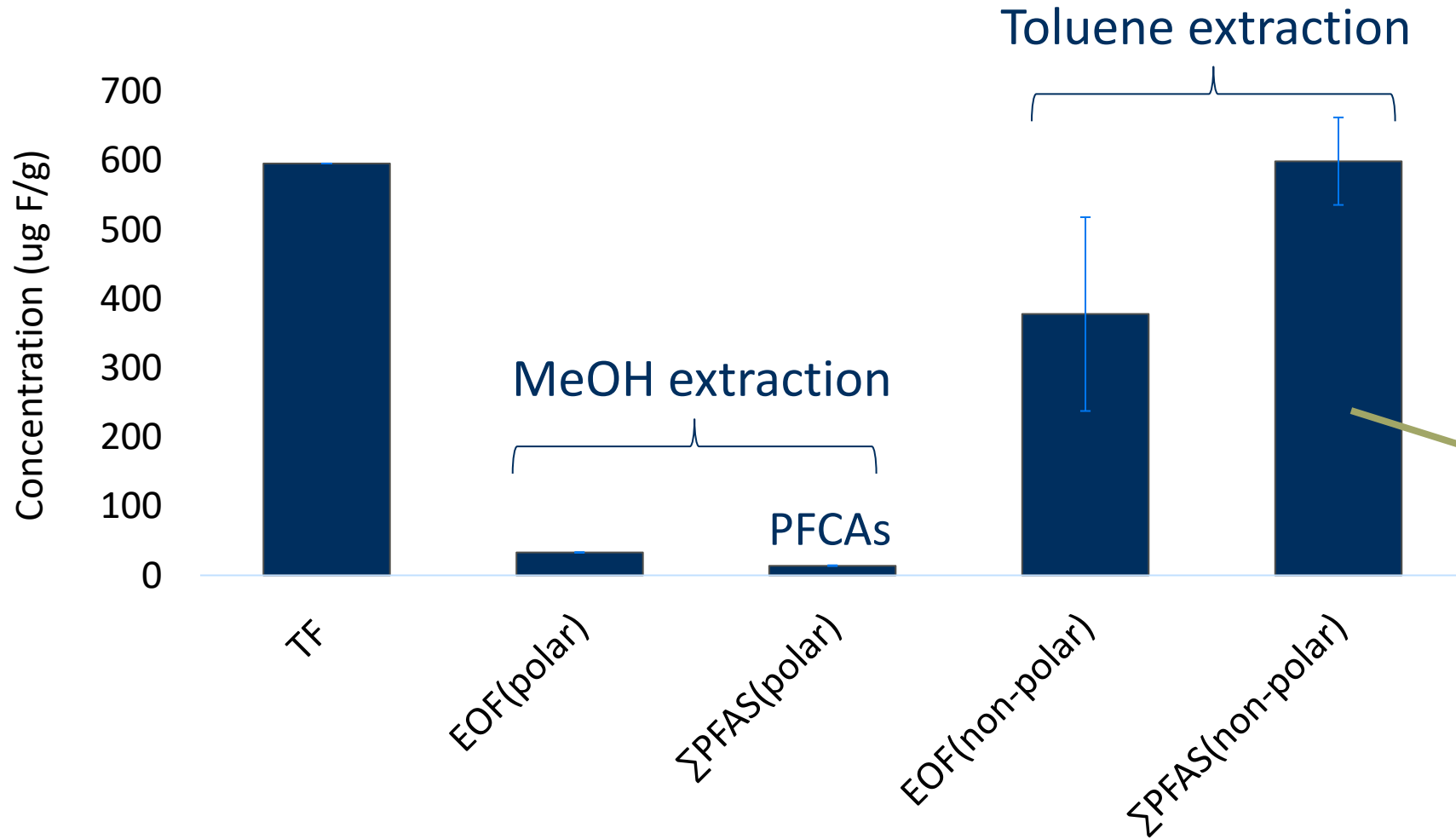


Perfluoroperhydrophenanthrene



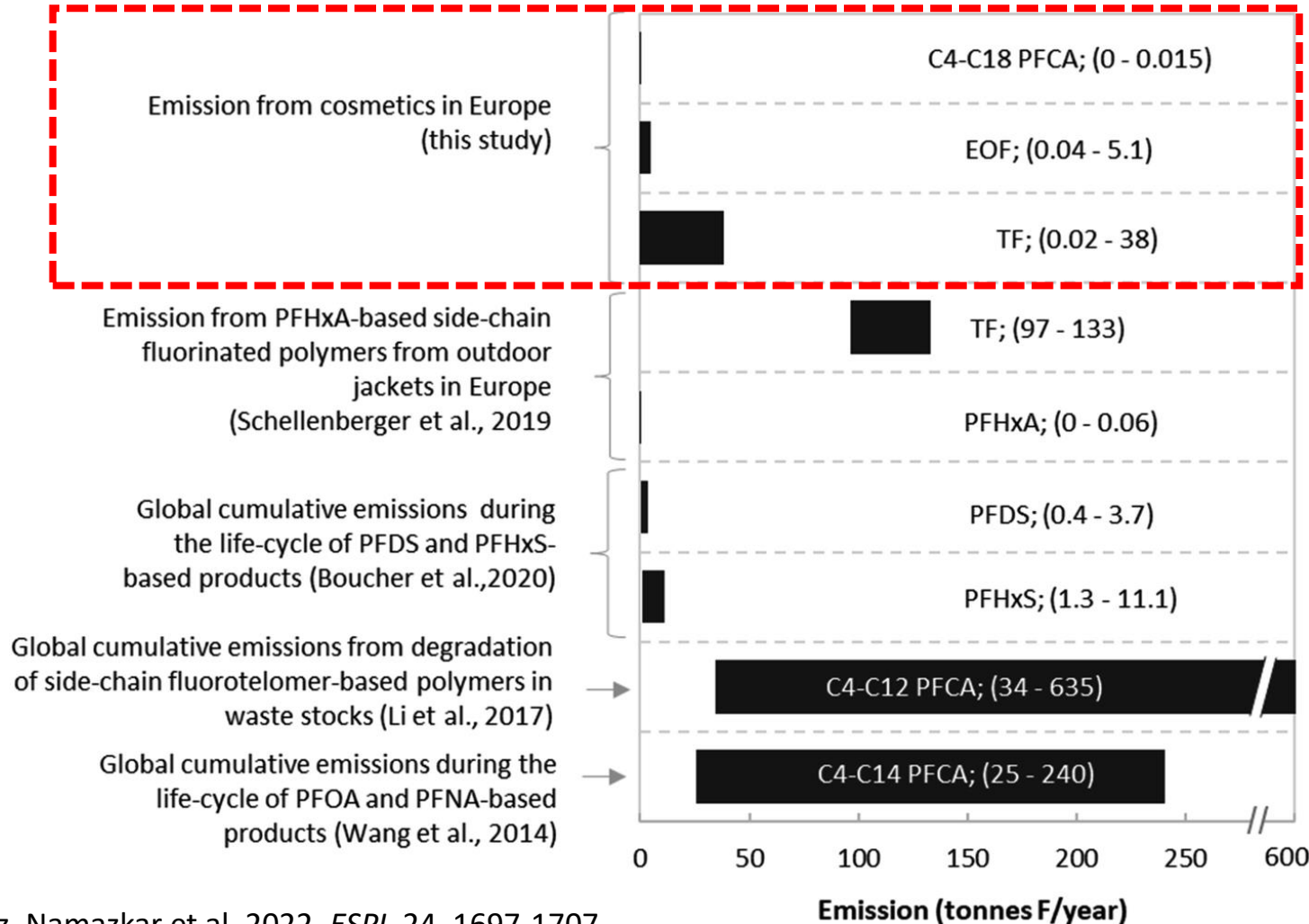
Perfluorodimethyl cyclohexane

Aligning extraction procedures with listed ingredients



Listed ingredient: Methyl perfluorobutyl ether

PFAS emission estimates to wastewater and solid waste



- Emission of PFAS from cosmetics lower than from performance outdoor jackets and comparable to PFDS and PFHxS-based products.

Take home messages from analysis of cosmetic products

- Combining total fluorine with targeted analyses is key to obtain upper and lower bounds estimates of PFAS in consumer products.
- Inorganic fluorine is prevalent and may confound total fluorine data.
- Extraction can remove inorganic fluorine but may also remove some PFAS.

Acknowledgements



FORMAS 

The word "FORMAS" is written in a large, black, sans-serif font. To its right is a graphic consisting of six colored dots (yellow, red, blue, green, yellow, and blue) arranged in a 2x3 grid.

Thanks for listening!

KEMI
Swedish Chemicals Agency

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Are cosmetics a significant source of PFAS in Europe? product inventories, chemical characterization and emission estimates†

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Characterization and dermal bioaccessibility of residual- and listed PFAS ingredients in cosmetic products†

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