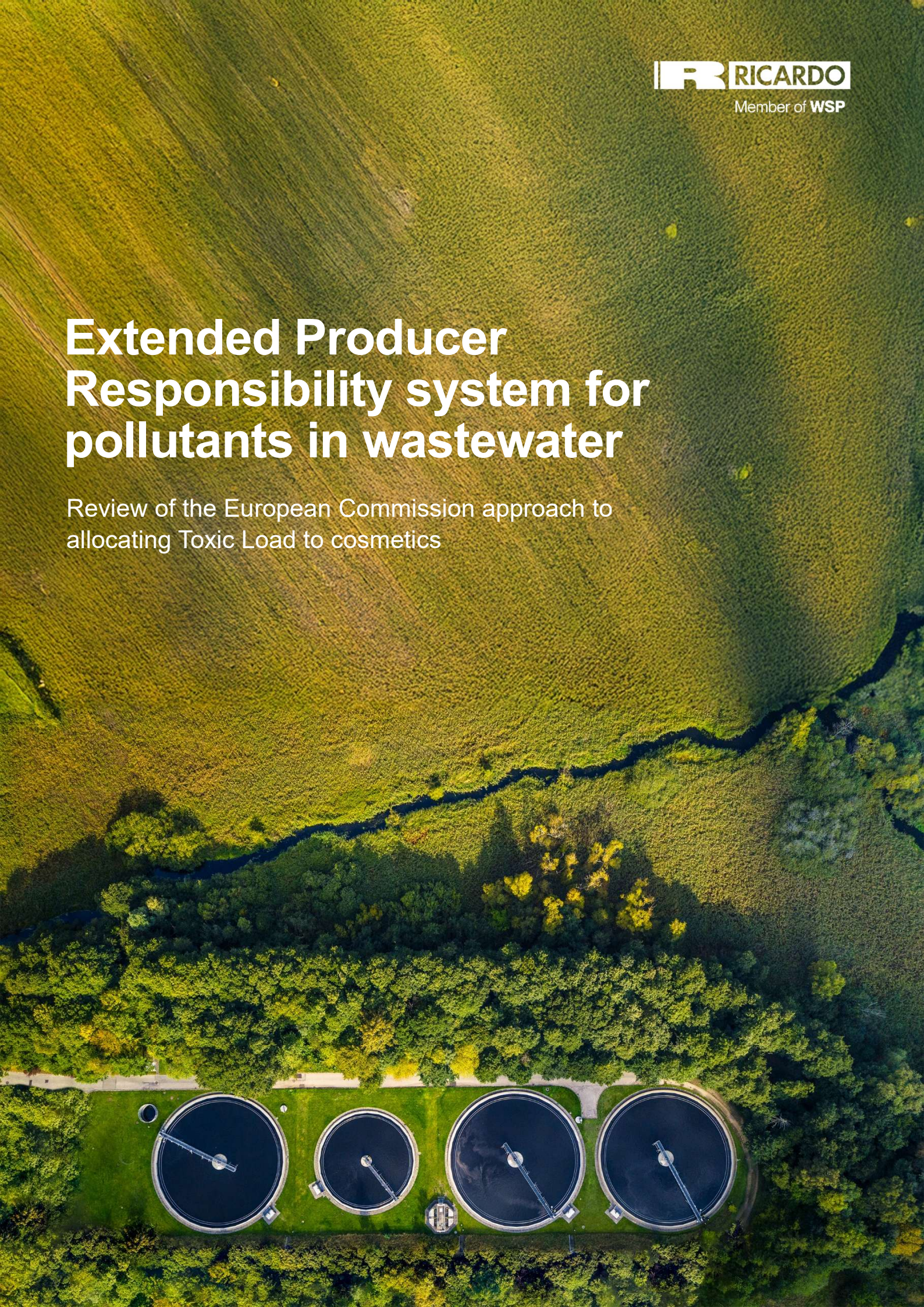


Extended Producer Responsibility system for pollutants in wastewater

Review of the European Commission approach to allocating Toxic Load to cosmetics



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Introduction

Cosmetics Europe has requested Ricardo to validate their methodological approach to the analysis of data they have received from the European Commission following their requests for information in relation to the Extended Producer Responsibility (EPR) feasibility report of the UWWTD to calculate the toxic load which has attributed to cosmetics as a basis for allocating costs under Extended Producer Responsibility (EPR) Schemes in accordance with the recast EU Urban Wastewater Treatment Directive UWWTD, adopted in 2024.

Objective

The aim of this work is to assess substances that were allocated to the cosmetic sector in the Commission Report “Feasibility of an EPR system for micro-pollutants” (070201/2020/837586/SFRA/ENV.C.2) in order to assign a predominant sector in which the substance is being mainly used and is the main responsible of emissions to the environment.

This phase of the project has analysed a total of 23 substances.

Methodology

A total of 119 substances were assigned to the cosmetics sector (named PCP sector in Substances allocation.xlsx). The 23 substances most contributing to the toxic load were selected for the current assessment.

Tier I – Initial evaluation on the 23 substances most contributing to the toxic load

The process involved the following steps:

- 1- Cosmetic ingredient identification: using the Chemical Abstract Service (CAS) registry number provided in the list. CosIng inventory and Cosmole Europe Database were used for cosmetic ingredient screening purposes. The substance regulatory status under the cosmetics regulation, (authorisation, restriction or ban) was confirmed in the EU Cosmetics Regulation (EC) No 1223/2009 and subsequent amendments.
- 2- Identification of potential additional sources of contribution. The following sources were consulted:
 1. the Scientific Committee on Consumer Safety (SCCS),
 2. the Cosmetic Ingredient Review (CIR) Panel,
 3. databases such as PubChem, OECD eChemPortal, ECHA depending on the identified sectors, publicly available market size report summaries and additional limited market literature search for very specific cases

The focus of the search was on EU data coming from publicly available sources. The additional search, when applicable, was limited to collecting the minimum evidence to understand possible substance allocation into one specific sector.

- 3- Substances classification and score. A classification and scoring was carried out based on the overall data according to the following table:

Table 1: Substances classification and score

Substance score	Identified sector	Rationale
1	Cosmetic sector	For substances clearly attributed to the cosmetics sector as the primary source, a contribution value of 1 was assigned
0.5	Multiple sectors	For substances with multiple potential sectors or sources identified but insufficient information to determine the primary contributor, a contribution value of 0.5 was assigned, applying a conservative (worst-case) assumption. Where feasible, the main sector(s) or source(s) were subsequently identified
0	Non-cosmetic sector	Substances clearly identified as non-cosmetic ingredients, or for which other sector(s) or source(s) were determined to be the main contributor, were assigned a contribution value of 0. The main sector or source was identified where possible

4- Data analysis:

1. Calculation of the % Toxic Load PNEC from the Commission Report (column M in the attached excel sheet named Substances allocation_Ricardo review.xlsx)
2. Calculation of the Adjusted % Toxic Load PNEC (column N in the attached excel sheet), derived by applying the assigned Substance score (column P) to the % Toxic Load PNEC from the Commission Report (column M)

The score assigned to each substance is summarized in Appendix I and the references have been compiled in Appendix II of this report.

Tier II – Extended assessment for substances over 1% of toxic load

A Tier II assessment was performed on the substances over 1% of toxic load as per European Commission report that were assigned a contribution of 0.5 in the Tier I review (i.e. oleic acid and palmitic acid). This analysis aimed to refine the main source of contribution.

The process involved the following steps:

A. Identification of substances and products that may contribute to oleic acid and palmitic acid presence in urban wastewater

A consistent evidence synthesis approach was applied, beginning with comprehensive literature reviews to identify data on the environmental and consumer sources of oleic acid and palmitic acid in urban wastewater. In addition to the information obtained during the Tier 1 assessment, relevant information and data were searched from peer-reviewed publications (using Web of Science, Scopus, PubMed, ScienceDirect, Google Scholar), grey literature (government and agency reports, technical documents, and environmental monitoring studies), web articles, regulatory outputs, and authoritative databases.

Relevant search terms included, but were not limited to: oleic acid, palmitic acid, olive oil, palm oil, vegetable oils, fatty acid derivatives, surfactants, emollients, wastewater, fatty acids, excretion pathways, consumer intakes, disposal, waste.

The evidence-based approach was designed to integrate:

- Industrial and consumers uses of oleic acid and palmitic acid
- Major substances containing oleic acid and palmitic acid
- Identified substances usage and intake data
- Food, cosmetics and detergent sectors applications
- Disposal and excretion pathways
- Environmental loads

B. Development of scenarios for evaluating substances' contribution to urban wastewater

Contribution scenarios were developed for the two primary sectors responsible for fatty acid release from oils, fats, and surfactants into urban wastewater: the food sector and the cosmetic sector. A targeted literature review was conducted to identify relevant studies and articles providing information that enables the quantification of contributions from key food sector sources, specifically cooking oil disposal and human fat excretion. Relevant search terms included, but were not limited to: cooking oil, frying oil, sink, drain, disposal, human excretion, survey, questionnaire. For the cosmetic sector, the scenario was constructed based on consumer usage patterns and representative frame formula compositions. Potential contributions from cleaning products, considered an additional source of fatty acids in urban wastewater was not analysed as part of this project.

C. Oleic acid and palmitic acid classification and score assignment

A final score was assigned to oleic acid and palmitic acid, based on the findings and according to the classification scheme outlined in Table 1. Where feasible, the final score was assigned to the substances that can be clearly attributed to the food sector or to the cosmetic sector respectively as the main contributor to fatty acids in urban wastewater considering the available data, limitations and uncertainties.

Tier I – Initial evaluation on the 23 substances most contributing to the toxic load

The initial assessment of the 23 PCP substances that most contributed to the toxic load revealed that 18 of them cannot be fully allocated to cosmetics sector as the main contributor to pollution in urban wastewater. It is worth noting that this evaluation was limited by reliance on publicly available market data, which predominantly represent global trends and provide only limited coverage of the European market. The substances allocation scores are presented in Appendix I and the references used in Appendix II.

Following the initial evaluation, a Tier 2 assessment was performed on the substances over 1% of toxic load as per European Commission report that were assigned a contribution of 0.5 in the initial review (oleic acid and palmitic acid) to refine the main source of contribution. The details are included in the following section.

Tier II – Extended assessment for substances over 1% of toxic load

A. Substances that may contribute to oleic acid and palmitic acid presence in urban wastewater

1. Fatty Acids

Fatty acids are major constituents of dietary fats from both plant and animal sources. They are present in wastewater generated by industries such as metal processing, restaurants, slaughterhouses, dairies, poultry processors, edible oil refineries, petrochemical plants, and tanneries¹.

Fatty acids constitute an essential component of the daily diet for mammals, birds, and invertebrates. Limited data exist on the specific quantities of individual vegetable oils consumed in human diets. National dietary surveys commonly estimate total fat intake and broad fatty acid groups (e.g., saturated, polyunsaturated), but do not typically provide detailed breakdowns of specific vegetable oil sources. Additionally, large proportions of dietary fats are consumed indirectly through processed foods or used in cooking, complicating precise consumption assessments². Overall, the Estimated annual consumption is 8466.67 lb, with an average individual intake of 0.007175 mg/kg/day³. Humans typically excrete about 5 g of fat per day on a diet containing 50 g of fat, reflecting roughly 90% digestion efficiency⁴.

Fatty acids and their salts are used in cosmetic sprays and powders, including skin, deodorant, and fragrance products⁵. They are also used in detergents. Eco-friendly cleaning products represent a significant share of the European cleaning market. In Germany, 41% of households exclusively purchase certified eco-friendly cleaners, compared with 27% in France and 19% in Southern Europe. Although this trend does not directly correlate with oleic or palmitic acid use, sustainable cleaning products have exhibited strong growth, up to 22% year-on-year since 2021⁶.

Rapid industrialization and urban growth have led to increased production and discharge of oily wastewater. Fatty substances, including oils and grease (FOG), are generated across the food sector in large quantities. Per-capita FOG consumption exceeds 50 kg/year in developed countries. European households alone generate about 2.5 L of used cooking oil (UCO) per person annually. Inadequate disposal of FOG contributes to sewer blockages and pollution. Annual UCO collection in Europe is estimated between 100,000 and 700,000 tonnes⁷.

¹ Adetunji, A. I., & Olaniran, A. O. (2021). Treatment of industrial oily wastewater by advanced technologies: a review. *Applied Water Science*, 11(6), 98.

² Tennant, D., & Gosling, J. P. (2015). Modelling consumer intakes of vegetable oils and fats. *Food Additives & Contaminants: Part A*, 32(9), 1397-1405.

³ Oleic Acid | C18H34O2 | CID 445639 - PubChem

⁴ Fat Excretion, *Nutrition Reviews*, Volume 13, Issue 7, July 1955, Pages 214–216, <https://doi.org/10.1111/j.1753-4887.1955.tb03488.x>

⁵ Cosmetic Ingredient Review. 2019. Safety Assessment of Fatty Acids & Fatty Acid Salts as Used in Cosmetics

⁶ <https://pmarketresearch.com/hc/sustainable-cleaning-products-market/>

⁷ Wallace, T., Gibbons, D., O'Dwyer, M., & Curran, T. P. (2017). International evolution of fat, oil and grease (FOG) waste management—A review. *Journal of environmental management*, 187, 424-435.

Fatty acids, including oleic acid and palmitic acid, are integral to human diets, industry, cosmetics, detergents, and numerous manufacturing processes. Their widespread use results in significant environmental release, particularly through oily wastewater and improper disposal of fats and oils.

1. Oleic Acid

Oleic acid is obtained primarily through the hydrolysis and fractionation of animal or vegetable fats and oils. It occurs naturally in various plant and animal essential oils. Oleic acid is widely used in manufacturing soft soaps, oleates, polishing compounds, waterproofing agents, lubricants, ointments, cosmetics, ore flotation materials, surface coatings, and food-grade additives³. Aside from those sources, oleic acid can be released in runoff from its natural sources and in emissions from biomass combustion³.

In Europe, vegetable oils, particularly olive oil, sunflower oil, and canola oil, serve as the primary sources for oleic acid production, with additional contributions from animal fats such as tallow and lard⁸.

Oleic acid is a natural component of many edible oils. The reported oleic acid content percentages per food source are listed in the table below³.

Table 2: Oleic acid content in food

Food Sources	Oleic Acid Content (%)
Peanut oil	36–72
Palm kernel oil	9–16
Coconut oil	6–8
Olive oil	65–85
Corn oil	19–50
Palm oil	38–44
Rapeseed oil	11–60
Soybean oil	20–30
Sunflower oil	14–65
Fish oils (herring, sardine)	8–25
Beef tallow	20–50
Brown rice	37.9–51.6

Olive oil, especially extra virgin, is among the richest natural sources, with oleic acid content reaching up to 80%. Following oral intake, humans excrete less than 10% of consumed oleic acid in faeces⁹.

Oleic acid is used as an ingredient in a wide variety of cosmetic and personal care products. It functions as an emollient, emulsifier, and moisturizer. The reported oleic acid content percentages per cosmetics products are listed in the following table¹⁰.

⁸ Oleic Acid Production in Europe: Sources, Processes, and Industry Overview

⁹ Oleic Acid: Uses, Interactions, Mechanism of Action | DrugBank Online

¹⁰ Oleic Acid in Cosmetics and Personal Care Products - Periodical

Table 3: Oleic acid content in cosmetic products

Cosmetics Products	Oleic Acid Content (%)
Skin care products	1–10
Hair conditioners and masks	10–25
Shampoos	8–15
Lipsticks	5–10
Foundations	1–5
Baby oils and lotions	1–5
Eye makeup	0.1–5
Spray deodorants	≤1.5

Oleic acid acts as a surfactant and emulsifier in cleaning products, improving removal of grease, food residues, grass, and ink¹¹. It is used in bio-based laundry detergents, multipurpose cleaners, stain removers, and eco-friendly cleaning products.

2. Palmitic Acid

Palmitic acid, a saturated fatty acid, is widely distributed in natural fats and oils. It is produced by hydrolysis and fractionation of palm oil, tallow oil, coconut oil, Japan wax, Chinese vegetable tallow, and spermaceti. It is used extensively in soap production, lubricating oils, waterproofing materials, metallic palmitates, and food-grade additives¹².

Palmitic acid is present (44% of content¹³) in palm oil. Palm oil's global significance is partly due to its dual products, crude palm oil (CPO) and crude palm kernel oil (CPKO), used in foods, biofuels, cosmetics, and detergents. Globally, 60–75% of palm oil is used for food, 20–30% for home and personal care, and 5–10% for energy applications¹⁴.

Palmitic acid is found across a wide range of foods¹², including:

- Fruits (banana, papaya, apple, pear, grapes, melon)
- Vegetables and grains (celery, potato, rice, mushrooms, beans)
- Oils (peanut oil, soybean, corn oil)
- Animal fats (beef, pork, lamb—reported but not quantified)
- Seafood (fatty fish, shrimp, crab, clam, scallop—reported but not quantified)

¹¹ Bhadani, A., Iwabata, K., Sakai, K., Koura, S., Sakai, H., & Abe, M. (2017). Sustainable oleic and stearic acid based biodegradable surfactants. *RSC advances*, 7(17), 10433-10442.

¹² Palmitic Acid | C16H32O2 | CID 985 - PubChem

¹³ May, C. Y., & Nesaretnam, K. (2014). Research advancements in palm oil nutrition. *European journal of lipid science and technology*, 116(10), 1301-1315.

¹⁴ Bausano, G., Masiero, M., Migliavacca, M., Pettenella, D., & Rougieux, P. (2023). Food, biofuels or cosmetics? Land-use, deforestation and CO2 emissions embodied in the palm oil consumption of four European countries: a biophysical accounting approach. *Agricultural and Food Economics*, 11(1), 35.

- Dairy: cow's milk fat contains 5.78–29% palmitic acid
- Beverages and spices (beer, rum, whiskey, saffron, ginger, liquorice)

It is also detected in tobacco, tobacco smoke, and smoke substitutes.

Palmitic acid is one of the most widely used fatty acids in cosmetics, with 1532 reported uses in 2016, especially in leave-on skin and eye makeup products. Usage concentrations reach up to 21% in both rinse-off and leave-on preparations⁵.

In detergents, palmitic acid serves as a surfactant and structural builder. Its soap salts provide dense, stable foam and improve the hardness, durability, and integrity of cleansing bars¹⁵. It is commonly used in natural and sustainable cleaning products due to its reliability and favourable environmental profile.

Palmitic acid enters the environment through waste streams associated with soap manufacturing, lubricating oils, waterproofing materials, metal palmitates, and food-grade additive production¹².

B. Development of scenarios for evaluating substances' contribution to urban wastewater

1. Food sector

To estimate the amount of substances contributing to fatty acids presence in urban wastewater that can be attributable to the food sector, two sub-scenarios have been developed.

- Scenario 1 considers the quantity of used cooking oil that, although potentially collected for recycling, is not properly disposed of by consumers through designated collection systems.
- Scenario 2 addresses the fat amount present in urban wastewater as a result of human ingestion and subsequent excretion.

1.1. Cooking oil disposal

Although several reviews address used cooking oil (UCO), collection systems, and its use for energy production (e.g., biodiesel), the available data from different sources are difficult to compare and apply when developing a cooking oil disposal scenario.

Two key references were identified as particularly relevant. The first is the report *Analysis of the Current Development of Household UCO Collection Systems in the EU* published by Greenea in 2016, supported by the European Climate Foundation. This study aimed to estimate the quantities of UCO generated by households and professional sector across EU Member States and to project figures for 2030. Quantitative estimates were based on bottled vegetable oil sales, while actual collection data were obtained from collectors and monitoring organizations. System descriptions relied on interviews, available reports, and direct observations.

The second reference is the review *Quantitative Assessment of the Valorisation of Used Cooking Oils in 23 Countries* by Teixeira et al. (2018). This article provides a global overview of household UCO management, covering regions such as Europe, Canada, Australia, India, China, and Brazil. It examines

¹⁵ Masyithah, Z., Ardiansyah, J., Fauzi, M.I., & Ginting, A. (2023). Study of the surface properties of Alkyl-DEA from palmitic acid for cleaning and cosmetic applications. *ARPN Journal of Engineering and Applied Sciences*. VOL. 18, NO. 19, OCTOBER 2023

vegetable oil consumption, UCO generation, quantities available for recycling, and management practices adopted in the regions included in the review.

Greenea report (2016)¹⁶

When estimating UCO resources from households, dietary habits are a key factor, as they influence per capita vegetable oil consumption and the proportion used for frying versus salads, baking, and other purposes. Countries such as Spain and Belgium, where deep-fried dishes are common, have higher per capita UCO generation.

Although data on vegetable oil sales to individual consumers are available for each Member State, the main challenge lies in determining the percentage of oil that remains and can be collected.

- Household Collection

Based on the French Agency for Ecological Transition (ADEME) calculations, the authors assumed that 30% of all oil used in households can be recycled. Olive oil was excluded from most calculations, as it is rarely used for frying in Europe, except in Spain, Portugal, Italy, and Greece, where both vegetable and olive oil were considered. Adjustments were made for dietary habits:

- Scandinavian countries (Sweden, Denmark, Finland): 25%, due to lower fried food consumption and health-conscious diets.
- Spain, Greece, Belgium, Netherlands: 40%, reflecting higher consumption of deep-fried foods (e.g., French fries in Belgium and the Netherlands).

In the 14 countries with household collection activities, only about 6% of total collected UCO comes from households; at the EU level, this figure is even lower (5.6%).

- Professional Sector Collection

UCO resources from the professional sector include oil generated by:

- Restaurants (fast food, traditional, catering)
- Food-processing industry
- Supermarkets and hypermarkets

Approximately 70% of UCO produced in professional sector can be collected, and current estimates indicate that 84% of collectable UCO from the professional sector is already recovered in the EU.

Based on Greenea's report, an estimated **812,000 tonnes** of UCO could be collected from households. Given the low collection rates and data variability, the total amount is considered potentially available for drain disposal. For the professional sector, 691,000 tonnes of UCO were available for collection, of which 575,600 tonnes were currently collected. The remaining **115,400 tonnes** not collected are considered available for drain disposal. According to Eurostat data, the EU population in 2015 was 443.4 million¹⁷. Based on this figure, the estimated UCO available for drain disposal is **1.83 kg/capita/year from**

¹⁶ Analysis of the current development of household UCO collection systems in the EU. Greenea (2016). Accessed on November 2025 at: https://theicct.org/sites/default/files/publications/Greenea%20Report%20Household%20UCO%20Collection%20in%20the%20EU_ICCT_20160629.pdf

¹⁷ EUROSTAT. EU population at 1 January 2015. <https://ec.europa.eu/eurostat/documents/2995521/6903510/3-10072015-AP-EN.pdf/d2bfb01f-6ac5-4775-8a7e-7b104c1146d0?t=1436453574000>

household sources and **0.26 kg/capita/year** from the professional sector. Of note, data from the United Kingdom was not included in the calculations.

Teixeira et al. review (2018)¹⁸

Over recent decades, vegetable oils have increasingly replaced animal fats in the human diet, driven by greater awareness of the benefits of polyunsaturated fatty acids and lower prices combined with rising purchasing power. Consumption patterns have also shifted in Europe: sunflower oil (about +12 kg/capita/year), rapeseed oil (+10.5 kg), soybean oil (+8.5 kg), olive oil (+2.5 kg), and corn oil (+1 kg) have all increased, while palm and peanut oil consumption has declined by about 2 kg/capita/year.

The European countries included in this review were Belgium, Czech Republic, Germany, Denmark, Spain, France, Greece, Croatia, Hungary, Ireland, Italy, Netherlands, Portugal, and Slovenia. Based on the data collected, the authors estimated an average of 3.89 kg/capita/year of UCO produced and 2.20 kg/capita/year collected, leaving approximately **1.70 kg/capita/year** potentially available for household drain disposal. These findings are consistent with those reported in Greenea's study.

Consumer disposal behaviour

The available data on consumer habits regarding cooking oil disposal in Europe is limited. Findings from four surveys conducted between 2012 and 2025 in Greece, Italy, Portugal, and Spain indicate that the cooking oil disposal systems in these regions are poorly implemented, highlighting a need for enhanced public information and education. Approximately half of the population disposes of cooking oil through the drain (sink or toilet), with percentages ranging from 7% to 56%, depending on the availability of collection systems in their area. Another common disposal method among non-recyclers is discarding oil in the waste bin, reported at 7% to 28%¹⁹.

Although these data reflect practices in specific regions and are not representative of consumer habits across the entire European Union, no additional surveys were identified for other regions. Therefore, under worst-case assumptions, it can be considered that approximately 50% of consumers in Europe dispose cooking oil through the drain.

Following conservative assumptions, data from the Greenea study was selected to develop the cooking oil disposal scenario. Considering a homogeneous usage among consumers and consistent disposal behaviour, it is estimated that 50% of UCO available for disposal is discharged through the drain. This corresponds to **0.92 kg/capita/year (2.52 g/capita/day)** from household sources and **0.13 kg/capita/year (0.36 g/capita/day)** from the professional sector, resulting in a combined total of **2.88 g/capita/day**.

¹⁸ Teixeira, M. R., Nogueira, R., & Nunes, L. M. (2018). Quantitative assessment of the valorisation of used cooking oils in 23 countries. *Waste Management*, 78, 611–620. <https://doi.org/10.1016/J.WASMAN.2018.06.0>

¹⁹ Xirogiannopoulou, A., & Athanasiou, V. (2025). Collection of household used cooking oil in urban areas of Greece: opinions and practices of local inhabitants. *Environmental Research Communications*, 7(2), 025013. <https://doi.org/10.1088/2515-7620/ADB1A4>

1.2. Human excretion

Human subjects typically excrete about 5 g of fat in the faeces per day when they are consuming a diet containing 50 g of fat daily. This reflects that fat is digested to the extent of about 90%. Faecal fat does not simply represent unabsorbed fat, it can have at least five different sources: residual dietary fat, bacteria, epithelial debris, carbohydrates, and secreted fat²⁰.

Normal results for a quantitative faecal fat test are 2 to 7 g/24 h for adults, with fat being less than 20% of the solid stool sample²¹. Results over 7g/24h may be indicative of steatorrhea and suggestive of malabsorption, however a 72-hour quantitative faecal fat result of less than 7 grams of fat per day does not exclude potential steatorrhea or malabsorption. Increased fat in the stool, may occur in the background of bacterial overgrowth, short bowel syndrome, small bowel mucosal diseases such as Crohn disease or celiac disease, or pancreatic exocrine insufficiency²².

A study was conducted to determine whether diarrhoea increases faecal fat excretion²³. Faecal fat output was measured during three consecutive days in 18 normal subjects and in normal subjects in whom diarrhoea was purposefully induced (29 subjects from mild to moderate and 19 severely induced diarrhoea). The mean faecal fat excretion in normal subjects following a normal diet was 3.4 g/day, being the upper limit of normal 6.4 g/day. From the subjects with induced osmolar or secretory diarrhoea, 21% of subjects with mild to moderate and 58% of subjects with severe diarrhoea had faecal fat excretion above the upper limit of normal, with values as high as 13.6 g/day.

Considering the differences among the identified sources, the upper limit of **6.4 g/capita/day** for faecal fat excretion reported for healthy subjects in the study is regarded as a reasonable estimate for the worst-case human excretion scenario.

2. Cosmetic sector

The cosmetic contribution scenario was designed selecting a total of 13 cosmetic products that were considered representative and widely used within the consumers. The products included are:

- Rinse-off products:
 - Shampoo
 - Conditioner
 - Shower gel
 - Face cleanser, make up remover
 - Hand soap (liquid)
 - Hand soap (solid bar)
 - Toothpaste
- Leave-on products:
 - Hair styling
 - Face cream
 - Body lotion

²⁰ Fat Excretion, *Nutrition Reviews*, Volume 13, Issue 7, July 1955, Pages 214–216, <https://doi.org/10.1111/j.1753-4887.1955.tb03488.x>

²¹ Fecal fat. University of Rochester Medical Center, https://www.urmc.rochester.edu/encyclopedia/content?contenttypeid=167&contentid=fecal_fat

²² 72 Hour Quantitative Fecal Fat: Optimal Testing Recommendations, Association for Diagnostics & Laboratory Medicine, <https://myadlm.org/advocacy-and-outreach/optimal-testing-guide-to-lab-test-utilization/a-f/72-hour-quantitative-fecal-fat>

²³ Fine KD, Fordtran JS. The effect of diarrhoea on faecal fat excretion. *Gastroenterology*. 1992 Jun;102(6):1936-9. [https://doi.org/10.1016/0016-5085\(92\)90316-q](https://doi.org/10.1016/0016-5085(92)90316-q)

- Hand cream
- Face Makeup (liquid foundation)
- Deodorant (non-spray)

The estimated daily amount applied values were taken from the SCCS Notes of Guidance 12th Revision (2023)²⁴ which are conservative values, in most cases the 90th Percentile (P90) derived from consumer use studies. For hand soap, RIVM Cosmetics Fact Sheet (2006)²⁵ was used to calculate the estimated daily amount applied. The retention factors and absorption default values stated in the SCCS Notes of Guidance were used to calculate the water discharge factor.

Frame formulations from Cosmetic Products Notification Portal (CPNP) were used to understand the raw amount of cosmetic ingredients, i.e. emollients, surfactants, and the data from the RIVM report was used for verification. Anionic surfactants were excluded since they are mostly derived from lauric acid (i.e. sodium lauryl sulfate). The frame formulations contain the typically maximum % of substances for each category. Adjustment factors were applied to the frame formulations to narrow the presence of ingredients with fatty acid release potential and exclude other ingredients belonging to the same category such as waxes or mineral oil. The ingredient categories selected and adjustment factors are indicated in the following table:

Table 4: Adjustment factors assigned for each ingredient category

Ingredient category	Adjustment factor
Soaps	1
Amphoteric and non-ionic surfactants, emulsifying agents	0.3
Oils, waxes and fats	0.3
Oils	0.5
Emollients	0.3

For products with more than one frame formulation, two most representative formulations were selected, and their average value was used. This was the case of:

- shower gel and face cleanser: foaming skin cleanser, and foaming skin cleanser with high level of oils and/or humectants
- face cream, body cream and hand cream: skincare cream, lotion or gel, and skincare cream, lotion or gel with high level of fatty compounds.
- Deodorants (non-spray): roll-on and stick without antiperspirant salts

²⁴ Scientific Committee on Consumer Safety (SCCS). The SCCS Notes of Guidance for the testing of cosmetic ingredients and their safety evaluation. 12th revision, (2023)

²⁵ RIVM report 320104001/2006, Cosmetics Fact Sheet (2006)

Furthermore, representative values for three product categories were derived from published data, specifically the mean fatty acid concentrations reported for solid and liquid hand soaps in one study²⁶, and the mean cocamidopropyl betaine concentration in toothpaste from another study²⁷.

Based on the conservative assumptions outlined above, the worst-case calculated quantity of substances contributing to fatty acid load in wastewater from cosmetics was estimated at **9.22 g/capita/day**. The calculations can be found in Appendix III.

C. Oleic acid and palmitic acid classification and score assignment

The publicly available data on the presence and quantities of fatty acids, and more specifically oleic acid and palmitic acid is limited and are very different amongst the sources of contribution considered. These challenges led to the scenarios designed that consider substances contributing to fatty acid load as a measure of potential fatty acid presence in urban wastewater. Conservative assumptions and worst-case approaches were considered for both food and cosmetics sector.

The calculated amount of cooking oil released to urban wastewater correspond to 2.52 g/capita/day from household sources and 0.36 g/capita/day from the professional sector, resulting in a combined total of 2.88 g/capita/day. The EU Member states make efforts on cooking oil disposal education and collection methods therefore the quantities of used cooking oil disposed through the drain could be reduced nowadays. A consumer disposal through the drain of 50% was considered based on surveys only from Greece, Italy, Portugal, and Spain. The cooking oil coming from professional sector is highly regulated. Overall, the amount of cooking oil currently released through the drain may be less than the estimated value, or more, depending on the region. Regarding human excretion, the upper limit of 6.4 g/capita/day for faecal fat excretion reported for healthy subjects in a study was selected as worst case. Combined, this gives to **a total of 9.28 g/capita/day of substances contributing to fatty acid load in wastewater coming from the food sector.**

The cosmetic usage and release scenario was built considering 13 cosmetic products widely used by the consumers. The estimated daily amount applied values are conservative, in most cases the 90th Percentile (P90) derived from consumer use studies, and the frame formulations contain the typically maximum % of substances for each category. Adjustment factors were applied and average fatty acid concentrations from a study were incorporated for solid and liquid hand soap to narrow the scenario while keeping it conservative. As a result, **a total of 9.22 g/capita/day of substances contributing to fatty acid load in wastewater were calculated coming from the cosmetic sector.**

Considering the available data and the current scenarios proposed, the main contribution of oleic acid and palmitic acid to urban wastewater cannot be clearly attributed to the food sector or to the cosmetic sector. As a result, a final score of 0 or 1 cannot be applied and **the initial score of 0.5 seems to be the most appropriate value to represent multiple sectors contribution.**

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Conclusions

This study analysed the 23 substances identified as the primary contributors to the toxic load from the cosmetic sector, as reported in the Commission document Feasibility of an EPR System for Micro-Pollutants (070201/2020/837586/SFRA/ENV.C.2), following a two-tiered approach.

Tier I addressed the evaluation of the 23 substances using the Chemical Abstract Service (CAS) registry number provided in the Commission's list using publicly available databases such as CosIng, Cosmole, PubChem, OECD eChemPortal, ECHA depending on the identified sectors as well as publicly available market size report summaries and additional limited market literature search for very specific cases. The evaluation was limited by reliance on publicly available market data, which predominantly represent global trends and provide only limited coverage of the European market. The substance scoring system applied in this assessment distinguishes chemicals between those clearly attributable to the cosmetics sector (score 1), those with multiple potential contributing sectors (score 0.5), and those primarily linked to non-cosmetic sources (score 0). Tier I assigned a score to each substance based on the available information, resulting in 8 substances scored as 0, 10 substances as 0.5, and 5 substances as 1. This outcome indicates that several substances may have been incorrectly allocated to the cosmetics sector as the primary source in the Commission's Feasibility study. Furthermore, for substances assigned a score of 0.5, the available evidence does not allow the cosmetics sector to be identified as the main contributor, and therefore the cosmetics sector should not be presented as the primary source without further assessment.

A Tier II assessment was performed on the substances over 1% of toxic load as per European Commission report that were assigned a contribution of 0.5 in the Tier I review (i.e. oleic acid and palmitic acid) with the aim of refining the main source of contribution. The process involved the identification of substances and products that may contribute to oleic acid and palmitic acid presence in urban wastewater and the development of scenarios for evaluating substances' contribution to urban wastewater from food and cosmetics sector. The study showed that publicly available data on the presence and quantities of fatty acids, and more specifically oleic acid and palmitic acid is limited and differ significantly amongst the sources of contribution considered. For this reason, instead of considering fatty acids measurements we considered substances known to contribute to fatty acid load, such as cooking oil, excreted fat, and cosmetic ingredients as a measure of potential fatty acid presence in urban wastewater.

Within the scope of this study, conservative assumptions and worst-case approaches were applied for both food and cosmetics sectors to enable the development of disposal scenarios and allow comparability across sectors. For cooking oil, households were identified as the main contributors, with the professional sector playing a secondary role. Due to low collection rates and high data variability amongst the countries included in the study, the total estimated amount of oil that could be collected from households was considered potentially disposed to the drain. The limited data available on consumer disposal behaviour resulted in an overestimation, assuming that 50% of the population disposes of oil through the drain. For contributions via food consumption, given the variability among the few available data sources the upper limit value from a study involving 18 subjects was selected as the worst-case estimate for human fat excretion. Further studies would be needed to better understand current oil consumption, cooking and dietary habits, disposal behaviours and excretion patterns to build more representative scenarios for fatty acids in the food sector. For the cosmetic sector, the estimated daily amount values were based on 90th percentile (P90) data from consumer use studies for most product categories. Frame formulations were used to estimate the typical ingredient concentrations for each cosmetic product type. Although average cosmetic use values from the consumer use studies would likely be more representative for the cosmetic sector, the use of worst-case estimates ensures methodological alignment across sectors. As more robust and reliable data become available, future assessments will be able to incorporate more realistic values

for all sectors to increase certainty. As a result, it was concluded that the presence of oleic acid and palmitic acid in urban wastewater cannot be clearly attributed to either the food sector or the cosmetic sector.

Based on the findings from the Tier II assessment, additional work is recommended to further refine the usage/disposal scenarios in order to reduce uncertainty and to better clarify the main sector contributing to oleic acid and palmitic acid release to urban wastewater. The detailed data on fatty acid sources obtained in this assessment also suggest that myristic acid could be included to capture all potential contributors, thereby enabling a more robust final classification and scoring. Future work may include:

- Evaluation of additional factors not previously considered for both food and cosmetic sectors
- Assessment of usage scenarios for detergents sector
- Adjustment of contributions based on oleic and palmitic acid content in individual substances

Finally, the assessment of the 23 PCP substances that most contributed to the toxic load revealed that 18 of them cannot be fully allocated to the cosmetics sector as the main contributor to pollution in urban wastewater. Using the substance score as adjustment factor to the toxic load results in 22.014% reduction on the overall toxic load assigned to cosmetic sector. This reduction would bring the overall contribution of the cosmetic sector according to the Commission report to a 4.29%. The substances allocation scores are presented in Appendix I.

Overall, the current assessment demonstrates that the contribution of the cosmetics sector to the toxic load in urban wastewater has been substantially overestimated in the original Commission report. The re-evaluation of sectoral attribution, supported by a structured scoring system and refined scenario analysis, shows that most substances cannot be reliably assigned to cosmetics as the primary source. In particular, the fatty acids driving the reported toxic load cannot be conclusively linked to any single sector. These findings highlight that several substances were likely misallocated in the original assessment and underscore the need for more robust, sector-specific data to support accurate pollutant source attribution.

Moreover, despite the efforts to identify the main sector contributing to a substance release in urban wastewater, in some cases the data may reveal that the main contribution is similar between two or more sectors. In those cases, it would be recommended to share the responsibility of the contribution amongst the two sectors involved. Further guidance on sector specific data and cut off values for the substance allocation process would be needed for a more transparent and proportionate assignment of the contribution to the toxic load.

Appendix I: Summary of substance score

CAS number	Substance name	Substance score	Reasoning	% Toxic Load PNEC (from the Commission Report)	Adjusted % of Toxic Load PNEC (applying substance score)	% Change
52645-53-1	Permethrin	0	Permethrin is not used as a cosmetic ingredient. The identified uses of permethrin are as insecticide, wood preservative and medicinal product for human and veterinary use. The available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	16.42	0.00	-16.42
112-80-1	Oleanolic acid	0.5	Oleic acid is used as a cosmetic ingredient. Other identified sources of oleic acid include food, either present in certain foodstuffs or used as a food additive. The available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	3.85	1.92	-1.92
57-10-3	Hexadecanoic acid	0.5	Hexadecanoic acid, also known as palmitic acid, is used as a cosmetic ingredient. Other identified sources of palmitic acid include food, either present in certain foodstuffs or used as a food additive, and cleaning products. The available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	2.36	1.18	-1.18

CAS number	Substance name	Substance score	Reasoning	% Toxic Load PNEC (from the Commission Report)	Adjusted % of Toxic Load PNEC (applying substance score)	% Change
544-63-8	Tetradecanoic acid	0	Tetradecanoic acid, also known as myristic acid, is used as a cosmetic ingredient. Other identified sources of myristic acid include food, either in certain foodstuffs or used as a food additive. The available data suggest that Food sector may be the main sector contributing to pollution in urban wastewater.	1.72	0.00	-1.72
112-18-5	N,N-Dimethyldodecylamine	0.5	N,N-Dimethyldodecylamine, also known as Dimethyl Lauramine, is used as a cosmetic ingredient. Other identified sources of N,N-Dimethyldodecylamine include detergents and industrial applications (asphalt emulsifier, metal corrosion inhibitor). The limited available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	0.92	0.46	-0.46
3380-34-5	Triclosan	1	Triclosan is used as a cosmetic ingredient. Other identified sources of Triclosan include detergents, treated textiles and plastics intended for food contact materials. Although the use of Triclosan has been reduced due to regulatory restriction in 2024, the overall data suggest that Cosmetic sector may be the main contributor to pollution in urban wastewater.	0.41	0.41	0.00

CAS number	Substance name	Substance score	Reasoning	% Toxic Load PNEC (from the Commission Report)	Adjusted % of Toxic Load PNEC (applying substance score)	% Change
27176-93-8	Nonylphenoldiethoxylate	0.5	Nonylphenoldiethoxylate, also known as Nonoxynol-2, cannot be used at technically effective concentrations in cosmetic products due to REACH restrictions, which limits Nonylphenol and Nonylphenol ethoxylates to concentrations <0.1%, while effective cosmetic use historically required levels >10%. This is further supported by the absence of this substance in the 1380 formulations collected in 2023 from more than 40 cosmetic companies by Cosmetics Europe.	0.21	0.00	-0.21
5466-77-3	2EthylHexyl4-methoxycinnamate	1	Ethylhexyl methoxycinnamate, also known as Octinoxate, is used as a cosmetic ingredient. Other identified sources of ethylhexyl methoxycinnamate include pharmaceutical products. The available data suggest that Cosmetic sector may be the main sector contributing to pollution in urban wastewater.	0.18	0.18	0.00
120-40-1	Lauryl diethanolamide	0.5	Lauryl diethanolamide, also known as Lauramide DEA, is used as a cosmetic ingredient. Other identified sources of Lauryl diethanolamide include household/ industrial cleaning products and treated textiles. The available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	0.18	0.09	-0.09

CAS number	Substance name	Substance score	Reasoning	% Toxic Load PNEC (from the Commission Report)	Adjusted % of Toxic Load PNEC (applying substance score)	% Change
47221-31-8	Dodecylbenzene sulfonic acid	0	Dodecylbenzene sulfonic acid is used as a cosmetic ingredient. Other identified sources of Dodecylbenzene sulfonic acid include detergents and household cleaning products. The available data suggest that Detergents sector may be the main sector contributing to pollution in urban wastewater.	0.05	0.00	-0.05
128-37-0	butylhydroxytoluene (BHT)	0	Butylhydroxytoluene is used as a cosmetic ingredient. Other identified sources of Butylhydroxytoluene include food, pharmaceutical products and plastics. The available data suggest that Food sector may be the main sector contributing to pollution in urban wastewater.	0.04	0.00	-0.04
120-72-9	Indole	0.5	Indole is used as a cosmetic ingredient. Other identified sources of indole include food, either used as a flavour or as a result of Tryptophane metabolism by the gut bacteria. The available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	0.02	0.01	-0.01
112-75-4	N,N-Dimethyltetradecyl amine	0.5	N,N-Dimethyltetradecylamine, also known as Dimethyl myristamine, is used as a cosmetic ingredient. Other identified sources of N,N-Dimethyltetradecylamine are industrial (corrosion inhibitor, intermediate substance, and surfactant). The limited available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	0.02	0.01	-0.01

CAS number	Substance name	Substance score	Reasoning	% Toxic Load PNEC (from the Commission Report)	Adjusted % of Toxic Load PNEC (applying substance score)	% Change
94-62-2	Piperine	0.5	Piperine is used as a cosmetic ingredient. Other identified sources of piperine include food, either present in spices or used as a food additive. The available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	0.01	0.01	-0.01
91-44-1	7-Diethylamino-4-methylcoumarin	0.5	7-Diethylamino-4-methylcoumarin, also known as Diethylaminomethylcoumarin, is used as a cosmetic ingredient. Other identified sources of Diethylaminomethylcoumarin include detergents and industrial applications (treated textiles, coatings). The limited available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	0.01	0.00	0.00
101-20-2	Triclocarban	1	Triclocarban is used as a cosmetic ingredient. Other identified sources of Triclocarban include cleaning products. The available data suggest that Cosmetic sector may be the main sector contributing to pollution in urban wastewater.	0.01	0.01	0.00
4065-45-6	Benzophenone-4	1	Benzophenone-4, also known as Sulisobenzone, is used as a cosmetic ingredient. Other identified sources of Benzophenone-4 include industrial applications (treated textiles, coatings). The available data suggest that Cosmetic sector may be the main sector contributing to pollution in urban wastewater.	0.01	0.01	0.00

CAS number	Substance name	Substance score	Reasoning	% Toxic Load PNEC (from the Commission Report)	Adjusted % of Toxic Load PNEC (applying substance score)	% Change
1222-05-5	Galaxolide	0.5	Galaxolide, also known as Hexamethylindanopyran, is used as a cosmetic ingredient. Other identified sources of Galaxolide include household cleaning products. The available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	0.01	0.00	0.00
38083-17-9	climbazole	1	Climbazole is used as a cosmetic ingredient. No other sources of Climbazole were identified in Europe. The available data suggest that Cosmetic sector may be the main sector contributing to pollution in urban wastewater.	0.00	0.00	0.00
58-55-9	Theophylline	0	The use of Theophylline is banned in cosmetic products as per Commission Regulation (EU) 2023/1490 of 19 July 2023 amending Regulation (EC) No 1223/2009. The available data suggest that Pharmaceutical sector may be the main sector contributing to pollution in urban wastewater.	0.00	0.00	0.00
121-00-6	2-tert-butyl-4-methoxyfenol	0	2-tert-butyl-4-methoxyfenol, also known as 2-tert-butylhydroquinone methyl ether, is used as a cosmetic ingredient. Other identified sources of 2-tert-butyl-4-methoxyfenol include food and pharmaceutical products. The available data suggest that Food sector may be the main sector contributing to pollution in urban wastewater.	0.00	0.00	0.00

CAS number	Substance name	Substance score	Reasoning	% Toxic Load PNEC (from the Commission Report)	Adjusted % of Toxic Load PNEC (applying substance score)	% Change
626-93-7	2-hexanol	0.5	2-hexanol is used as a cosmetic ingredient. Other identified sources of 2-hexanol include food and pharmaceutical products. The available data do not allow to conclude on the main sector contributing to pollution in urban wastewater.	0.00	0.00	0.00
446-72-0	Genistein	0	Genistein is used as a cosmetic ingredient. Other identified sources of Genistein include food, either present in certain foodstuffs or used as a dietary supplement. The available data suggest that Food sector may be the main sector contributing to pollution in urban wastewater.	0.00	0.00	0.00

Appendix II: Market data references

General references

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Appendix III: Cosmetic substances release scenario

Product Category	Product Type	Estimated Daily Amount Applied (g/person/day) (1, 2) *	Retention Factor (rinse/off) or Absorption (leave/on) (1)	Water Discharge Factor	Cosmetic Ingredients with Fatty Acid Release Potential (%) - RIVM (2)	Cosmetic Ingredients with Fatty Acid Release Potential (%) - Frame Formulation	Potential Fatty Acid Source (%)**	Substances Contributing to Fatty Acid Load in Wastewater (g/person/day)
Shampoo	Rinse-off	10.46	0.01	0.99	5 % betaines (surfactant, foaming agent; also coconut oil-diethanolamide and lauric acid diethanolamide) 2 % quaternary ammonium compounds (conditioner; also betaines)	20% amphoteric surfactants, betaine derivatives 15% Non-ionic surfactants, fatty alkanolamide (3)	10.50	1.09
Conditioner	Rinse-off	3.92	0.01	0.99	Quaternary ammonium compounds (quats) are often used as conditioners. Other substances that are used are silicones, fatty acid-protein compounds, panthenol and betaine compounds.	20% oils waxes and fats 15% amphoteric surfactants, betaine derivatives (betaines) 5% emollients, humectants (4)	12.00	0.47
Shower gel	Rinse-off	18.67	0.01	0.99	18% surfactants and lipids	30% oils, waxes and fats 20% amphoteric surfactants, non-ionic surfactants (5) 50% oils, waxes and fats 20% Non-ionic surfactants, amphoteric surfactants (6)	18.00	3.33
Face cleanser, make up remover	Rinse-off	5.00	0.01	0.99	3-63 % lipids (lotions contain no lipids) 1-15 % surface-active agents In addition to the above-mentioned ingredients, foam contains approximately 6 % alkali and 33 % higher fatty acids.	30% oils, waxes and fats 20% amphoteric surfactants, non-ionic surfactants (5) 50% oils, waxes and fats 20% Non-ionic surfactants, amphoteric surfactants (6)	18.00	0.89

Product Category	Product Type	Estimated Daily Amount Applied (g/person/day) (1, 2) *	Retention Factor (rinse/off) or Absorption (leave/on) (1)	Water Discharge Factor	Cosmetic Ingredients with Fatty Acid Release Potential (%) - RIVM (2)	Cosmetic Ingredients with Fatty Acid Release Potential (%) - Frame Formulation	Potential Fatty Acid Source (%)**	Substances Contributing to Fatty Acid Load in Wastewater (g/person/day)
Hand soap (liquid)	Rinse-off	2.50	0.01	0.99	15 % surface-active agent (cleaning) 1 % surface-active agent (foaming agent) 2 % lipids: to 'put back' the oils	40% anionic and amphoteric surfactants 20% soaps (sodium, potassium or triethanolamine) 20% emollients (7)	10.92	0.27
Hand soap (solid bar)	Rinse-off	2.00	0.01	0.99	85-95 % sodium salt from fatty acids	Total Fatty Acid content (8) 99% Soap, saponified vegetable oil, tallow fatty acids 10% emollients, humectants 5% amphoteric, anionic surfactants, cocamidopropyl betaine 5% oils, vegetable oil, mineral oil (9)	76.07	1.51
Hair styling	Leave-on	4.00	0.10	0.90	4.5 % oils (hair styling mousse)	Total Fatty Acid content (8) 5% oils, vegetable oil, mineral oil, long chain alcohols (10)	2.50	0.09
Face cream	Leave-on	1.54	0.50	0.50	10-80 % lipids 2-5 % surface-active agent (emulsifier)	30% Oils waxes and fats 5% emulsifying agents (11) 95% Oils waxes and fats 15% emulsifying agents (12)	21.75	0.17
Body lotion	Leave-on	7.82	0.50	0.50	10-80 % lipids 2-5 % surface-active agent (emulsifier)	30% Oils waxes and fats 5% emulsifying agents (11) 95% Oils waxes and fats 15% emulsifying agents (12)	21.75	0.85

Product Category	Product Type	Estimated Daily Amount Applied (g/person/day) (1, 2) *	Retention Factor (rinse/off) or Absorption (leave/on) (1)	Water Discharge Factor	Cosmetic Ingredients with Fatty Acid Release Potential (%) - RIVM (2)	Cosmetic Ingredients with Fatty Acid Release Potential (%) - Frame Formulation	Potential Fatty Acid Source (%)**	Substances Contributing to Fatty Acid Load in Wastewater (g/person/day)
Hand cream	Leave-on	2.16	0.50	0.50	10-80 % lipids 2-5 % surface-active agent (emulsifier)	30% Oils waxes and fats 5% emulsifying agents (11) 95% Oils waxes and fats 15% emulsifying agents (12)	21.75	0.23
Face Makeup (liquid foundation)	Leave-on	0.51	0.50	0.50	15-50 % Oil (water/oil emulsion) 10-30 % Oil (oil/water emulsion)	40% oils, vegetable oil, mineral oil 5% anionic surfactants, amphoteric surfactants, non-ionic surfactants 30% emollients, propylene glycol, lanolin (13)	30.50	0.08
Deodorant (non-spray)	Leave-on	1.50	0.50	0.50	5% Lipids, 8% surface active agent (stick) 5-15 % Lipids and 2-5 % surface active agent (roll-on)	30% oils and waxes 25%Thickeners, emollients, emulsifying agents (14) 45% oils and waxes 30% emollients 25% soaps, emulsifying agents (15)	27.63	0.21
Toothpaste	Rinse-off	2.75	0.05	0.95	The general composition of toothpaste is: - fine abrasive - cleaning agent: lauryl ether sulphate, alkylpolyglycoethers, alcohol ethoxy/propoxylates - fluoride (maximum 0.15 %): the fluoride-level in children's toothpaste: maximum 0.038 %	6% anionic surfactants (16) Cocamidopropyl betaine used in toothpaste (17)	1.80	0.05
TOTAL		62.83						9.22

- * Values according to the SCCS Notes of Guidance 12th Revision (2023). For hand soap, RIVM Cosmetics Fact Sheet (2006) was used to calculate the estimated daily amount applied.
- ** Frame formulations were used for the calculations, and data from the RIVM report was used for verification. Adjustment factors were applied as follows: 1 for soaps, 0.5 for oils, 0.3 for oils waxes and fats, 0.3 for surfactants, and 0.3 for emollients. For products with more than one frame formulation, the two most representative formulations were selected, and their average value was used.

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