

**Universidade de Lisboa
Faculdade de Farmácia**



**Water Sustainability
– A Waterless Life Cycle for Cosmetic Products**

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Monografia orientada pela Professora Doutora Joana Marques Marto, Professora
Auxiliar da Faculdade de Farmácia da Universidade de Lisboa

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**Trabalho Final de Mestrado Integrado em Ciências Farmacêuticas apresentada
à Universidade de Lisboa através da Faculdade de Farmácia**

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Abstract

Water is Earth's most precious natural resource, vital for all known forms of life and the lifeblood of our societies and economies. We are so used to seeing water come out of our taps at any time that we do not realize water scarcity is already affecting every continent, and its position as an undervalued and overused resource is shifting. With freshwater becoming rare due to limited supplies allied to climate change, pollution and soaring demand for water from expanding population, urbanization and economic development, cosmetic companies and consumers are increasingly concerned about the environmental impact of their everyday beauty and personal care products.

The Cosmetic Industry has deeply relied on water as a key element of formulation and manufacture of cosmetic products, being one of the most used ingredients, constantly needed to grow raw materials, heating and cooling processes, equipment cleaning, and producing packaging, leading to very high water consumption and having a significant impact in pollution, at all stages of the cosmetic product life cycle. To save water and to limit their dependence on it, companies must embrace a waterless life cycle for their cosmetic products, reducing water whenever possible. Some brands are already making efforts in this direction by developing waterless, fast rinse-off and non-rinse formulas, finding alternative water sources, optimizing manufacturing processes and adopting circular water management in their facilities, implementing biodegradable, recyclable and reusable packaging, and adapting their transport practices while educating consumers on how to responsibly use and dispose of the products. Besides all the benefits to the planet, waterless products offer many advantages to consumers as they tend to be more concentrated, richer, lighter, economical and lasting longer.

To evaluate the product's impact, set improvement goals and report progress to society, contributing to business transparency and informed consumption choices by consumers, it is important to define sustainability metrics based on water footprint assessment and achieve proper certification. Although there is still a long way to go, through collective actions and collaboration between businesses, governments, regulators and communities it will be possible to improve water management at a global level and safeguard water resources for everyone.

Keywords: water; waterless; cosmetics; cosmetic product life cycle; sustainability

Resumo

A água é o recurso natural mais precioso da Terra, essencial para todas as formas de vida conhecidas e a força vital das sociedades e economia. Apesar de cerca de 70% do planeta ser coberto por água e o conhecermos como planeta azul, menos de 3% corresponde a água doce e uma percentagem ainda menor está acessível aos biliões de organismos que dependem de água para sobreviver. Estamos tão habituados a ver a água correr das torneiras a qualquer momento que nem nos apercebemos de que a sua escassez já está a atingir todos os continentes, prevendo-se que afete 2/3 da população mundial em 2025, segundo a Organização das Nações Unidas. A visão da água como recurso subvalorizado e sobreutilizado está a mudar e, à medida que a água potável se vai esgotando devido à reduzida disponibilidade aliada às alterações climáticas, poluição e crescente procura resultante do aumento da população, urbanização e desenvolvimento económico, as empresas de cosméticos e os consumidores estão cada vez mais preocupados com o impacto ambiental dos seus produtos de beleza e cuidado pessoal.

Não há dúvida de que os cosméticos têm um papel importante na vida de qualquer um, fazendo parte de todas as rotinas diárias, não só como produtos de beleza para efeitos decorativos, mas principalmente para cuidados de higiene e saúde da pele, contribuindo para melhorar a aparência, autoestima e bem-estar. Mas tal como noutros setores, a Indústria Cosmética tem usado a água como elemento-chave da formulação e fabrico de produtos cosméticos, sendo dos ingredientes mais utilizados e constantemente necessário para o cultivo de matérias-primas, processos de aquecimento e arrefecimento, limpeza de equipamentos e produção de embalagens, provocando impactos consideráveis no consumo e poluição da água em todas as fases do ciclo de vida do produto.

De forma a poupar água, limitar a sua dependência deste recurso natural e produzir cosméticos mais sustentáveis, as empresas devem promover um ciclo de vida *waterless* para os seus produtos, reduzindo a água sempre que possível. Algumas marcas já começam a investir neste sentido, através do desenvolvimento de fórmulas contendo pouca ou nenhuma água, de enxaguamento rápido ou não requerendo enxaguamento, encontrando fontes de água alternativas e recuperando água da chuva, otimizando processos de fabrico e adotando gestão circular da água nas instalações, implementando embalagens biodegradáveis, recicláveis e reutilizáveis, e adaptando as práticas de distribuição, ao mesmo tempo que instruem os consumidores sobre como utilizar e eliminar os produtos de forma responsável. O controlo de qualidade ao longo de todo o processo e o tratamento adequado das águas residuais são também essenciais para reduzir a poluição e permitir a reciclagem e reutilização da água de forma segura. Para além de todos os benefícios para o planeta, os produtos

waterless oferecem muitas vantagens aos consumidores, uma vez que tendem a ser mais concentrados, mais ricos, leves, duradouros e económicos, surgindo como uma das mais recentes tendências de cosmética em crescimento nos dias de hoje.

Para avaliar o impacto dos produtos, definir metas de melhoria e reportar progressos, contribuindo para a transparência das empresas e escolhas informadas do consumidor, é importante definir medidas de sustentabilidade baseadas na avaliação da pegada hídrica considerando todo o ciclo de vida do produto, e obter uma certificação adequada. Embora ainda haja um longo caminho a percorrer e a mudança para uma cosmética *waterless* mais sustentável e ecológica possa ser desafiante a vários níveis, através de ações coletivas e de colaboração entre empresas, governos, reguladores e comunidades, será possível melhorar a gestão da água a nível global e salvaguardar os recursos hídricos para todos.

Esta dissertação tem como objetivo desvendar o papel da Indústria Cosmética na escassez de água e discutir estratégias a aplicar em cada fase do ciclo de vida do produto cosmético - desde a sua formulação, extração de matérias-primas, produção, acondicionamento, distribuição, até ao uso pelo consumidor e eliminação - de forma a promover o uso sustentável de água neste setor. Pretende também dar a conhecer os esforços e iniciativas de algumas empresas neste sentido, bem como exemplos de produtos *waterless* de diversas categorias já disponíveis no mercado, de forma a sensibilizar consumidores e produtores, e incentivar a mudança nos padrões de consumo e produção de cosméticos.

Palavras-chave: água, *waterless*, cosméticos, ciclo de vida do produto cosmético, sustentabilidade

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Acronyms

BOD – Biological Oxygen Demand

BWFP – Blue Water Footprint

CSR – Corporate Social Responsibility

CM – Continuous Manufacturing

EC – Electrical Conductivity

EU – European Union

FSC – Forest Stewardship Council

GWFP – Green Water Footprint

GrWFP – Grey Water Footprint

HVAC – Heating, ventilation, and air conditioning

INCI – International Nomenclature of Cosmetic Ingredients

ISO – International Organization for Standardization

LCA – Life Cycle Assessment

LCT – Life Cycle Thinking

PAO – Period-after-opening

PET – Polyethylene terephthalate

PCR – Post-Consumer Recycled

SDG – Sustainable Development Goals

SPOT – Sustainable Product Optimisation Tool

SPICE – Sustainable Packaging Initiative for Cosmetics

TCS –Triclosan

TOC – Total Organic Carbon

UV – Ultraviolet

WFP – Water Footprint

WWF – World Wide Fund For Nature

1 Introduction

We are surrounded by water, and we take it for granted. While the Earth is two-thirds water and we call it the blue planet, giving an illusion of abundance, only a small percentage of that water is freshwater, and an even lower percentage is accessible to the billions of organisms that depend on freshwater for survival. In recent decades, overexploitation, pollution, and climate change have been affecting the water cycle leading to water scarcity issues around the world. It is now recognised that humans are consuming freshwater at a rate which is unsustainable for a world where population is increasing towards nine billion people. If we do not change our behaviour and start to protect the planet's natural water resources, it will be increasingly challenging to ensure sufficient and safe water supplies for everyone, including future generations (1).

Like many other consumer products, cosmetics, which are used on a daily basis, consume a considerable amount of water and create a significant environmental impact throughout their life cycles. Not only it frequently forms the core of beauty products formula, but water is also necessary to grow raw materials, carry out production processes, sanitation, packaging manufacture, and product use by consumers. To save water and to limit their dependence on it, cosmetics industries need to rethink their strategies and change how they formulate and manufacture products. Fortunately, rising consumer awareness is pushing brands to design innovative products and processes that minimise their water footprint (2,3).

This dissertation aims to unravel the role of the cosmetics industry on water scarcity and what can be done to improve the sector's water sustainability. By discussing strategies to reduce water consumption in every stage of a cosmetic product life cycle – from the initial formulation design through sourcing of raw materials, manufacturing process, packaging, distribution, consumer use and final disposal – as well as getting to know the efforts already being made by some companies and examples of 'waterless products' currently available in the market, it intends to sensitize consumers and producers, shifting cosmetics manufacture and use patterns towards more sustainable management of water resources.

2 Water – a Scarce Global Resource

Water is Earth's most precious resource and a vital component for all living systems, regulating ecosystem functioning, preserving environmental quality, and supporting human health and welfare. It covers about 70% of the planet surface, but only less than 3% is freshwater, while the remaining is the salty water of the oceans and saline groundwater deposits. Freshwater can be found locked up in glaciers, ice caps or deep groundwater, inaccessible to humans, and a minor fraction in lakes, rivers and aquifers, which are the main sources for human water consumption, corresponding to 0.26% of total global freshwater resources (4).

An inadequate or limited freshwater supply is one of the major problems faced by the world's poorest countries and is becoming a serious global issue and concern for future generations. According to the World Wide Fund For Nature (WWF), an area experiences water stress when annual water supplies drop below 1700 m³ per person, while water scarcity refers to annual water supplies dropping below 1000 m³ per person (5). Water scarcity then refers to the lack of freshwater resources to meet water demand and affects 4 billion people across the world, a number that is likely to climb due to population growth (6).

Water use has been steadily increasing at a rate of about 1% per year for the past hundred years due to increasing population, economic development and changing consumption patterns. This global water demand is expected to continue expanding at a similar rate until 2050, accounting for an increase of 20 to 30% above the present level of water use. Combined with the limited and uncertain supply, climate change has already begun to affect water resources worldwide, through warming, shifts in precipitation patterns and occurrence of extreme weather events (droughts, heat waves and floods). Projections suggest that if the global warming is not kept under 1.5 degrees Celsius there will be severe consequences on the availability of sufficient and clean water for basic human needs and for the production of food and energy. Climate change will aggravate the situation of currently water-stressed regions and generate water scarcity in regions where water resources are still abundant today (7,8). Current data from World Resources Institute (WRI)'s Aqueduct Tools reveal that at least 15 countries, home for one-quarter of the world's population, already face "extremely high" levels of baseline water stress and almost 50 countries face "high" levels of stress, with the Middle East and North Africa being the most water-stressed regions on Earth (Figure 1) (9). At the current consumption rate, this situation will only worsen and by 2025, two-thirds of the world's population may face water shortages (5).

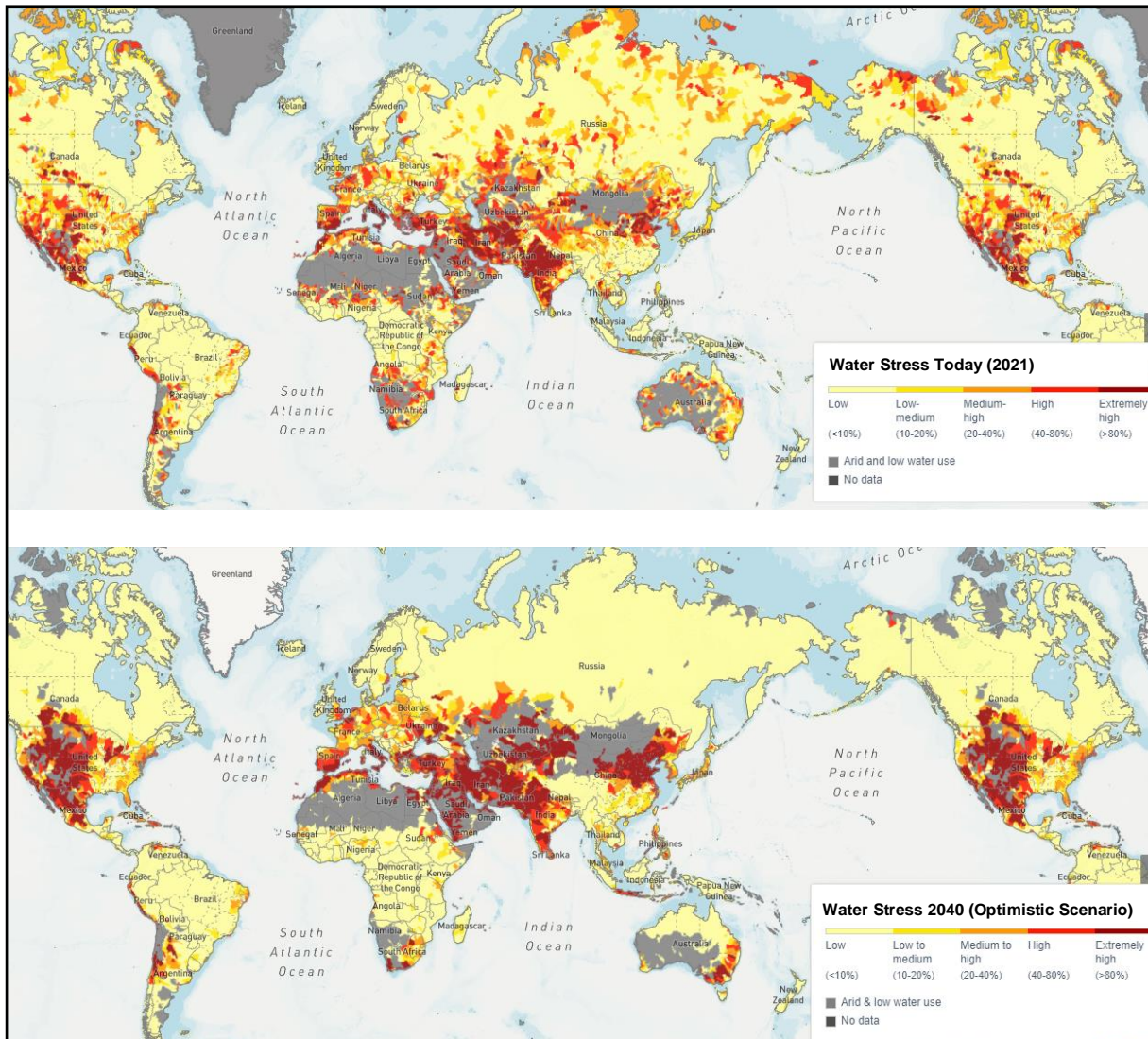


Figure 1. Water Stress worldwide – 2021 versus 2040. [Adapted from (10)]

Conscious of this urgent global threat, the United Nations defined 17 Sustainable Development Goals (SDGs), as part of the 2030 Agenda for Sustainable Development, highly dependent on improved water management. Five of these goals are directly linked to water and include availability and access to water (SDG 6), industry, innovation and infrastructure (SDG 9), responsible production and consumption (SDG 12), climate action (SDG 13), and life below water (SDG 14) (11). Water, therefore, is the ultimate connector in the global commitments towards a sustainable future.

2.1 Water uses

Our very existence depends on water. Water sustains both terrestrial (forests, grasslands) and freshwater ecosystems (rivers, lakes and wetlands), which are essential as water supplies, for food production, as natural purification, as cultural values and for economic activities. On July 2010, safe drinking water and sanitation were in fact recognized as basic human rights by the United Nations General Assembly, as they are essential to sustain healthy livelihoods and fundamental in maintaining the dignity of all human beings (1).

Overall, water uses can be divided in three main sectors: agricultural, industrial and domestic (Figure 2). At a global scale, agriculture remains the largest overall freshwater user, accounting for about 70% of global water withdrawals, the vast majority of which are used for irrigation. But there are also substantial water volumes consumed in the industrial and domestic sectors. Water used by industry, corresponding to 20% of global water withdrawals, is dominated by energy production, cooling/ heating processes and manufacturing. Domestic water use, which roughly accounts for the remaining 10% of global water withdrawals, is expected to increase significantly over the 2010–2050 period in almost all regions of the world, and is associated with a variety of daily activities, such as drinking, bathing, personal sanitation, cooking, washing clothes, household hygiene and gardening (12,13).

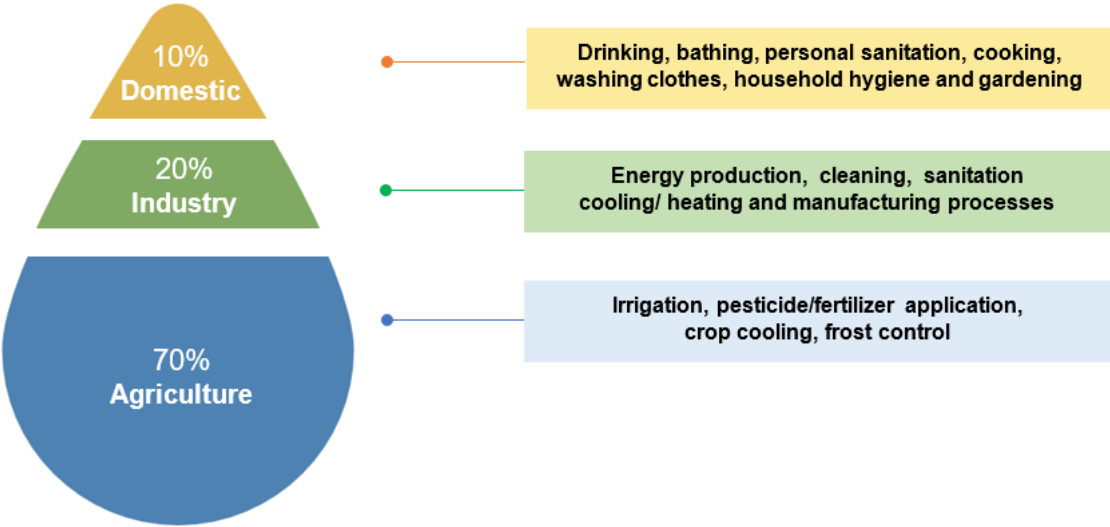


Figure 2. Global water withdrawals.

Frequently, the water use is only associated with the water that is seen, felt and used directly to drink, to produce an item or service or to carry out an operation or activity. However, people use water for both direct and indirect purposes. Indirect water, also called “virtual water” or “embedded water”, is the volume of water hidden in tradable goods and commodities,

required to produce a certain product or service (14). Although it goes unseen by the consumer, virtual water has been consumed throughout the value chain and makes creation of that product or service possible. Visualizing the hidden water use behind products helps to understand the global character of freshwater and quantify the effects of consumption and trade on water resources use.

2.2 Water quality

Global awareness has focused primarily on water quantity, but water quality impacts may be equally, or more, important. Water quality refers to the chemical, physical and biological characteristics of water, usually with respect to its suitability for a particular purpose. Good water quality is a critical element of the SDGs and can be estimated based on five core parameters tracked as part of the indicator SDG 6.3.2. - Proportion of bodies of water with good ambient water quality: biological oxygen demand (BOD), electrical conductivity (EC), as proxy for salinity balance, nitrogen, phosphorus and pH (15).

Driven by population growth, urbanization, industrialization, and expansion and intensification of agriculture, the world's freshwater resources are increasingly polluted, and the deterioration of water quality is expected to keep escalating over the next decades. Being predominantly invisible and hard to detect, poor water quality is already causing ecosystems destabilization, increased production costs, reduction of economic growth and severe human health issues. Waterborne diseases, transmitted through ingestion of contaminated water, like diarrhoeal diseases, cholera, typhoid fever, hepatitis or poliomyelitis, can lead to malnutrition, morbidity and even death (16).

The range of pollutants with well documented direct or indirect negative effects on water safety varies by sector, geography and development level. The major type of pollutants includes chemicals and nutrients, often associated with pathogen loading, and are mostly related to toxic metalloids, nitrogen, phosphorus, sediments, detergents, fertilizers, pesticides and hydrocarbons. Emerging pollutants, including pharmaceuticals, household and industrial chemicals, present new water quality challenges in both developed and developing countries (17).

Climate change also contributes to water quality degradation due to higher water temperatures, reduced dissolved oxygen, global loss of freshwater wetlands, and thus reduced self-purifying capacity of freshwater bodies. In addition, there are further risks of water pollution and pathogenic contamination caused by floods or by the higher pollutant concentrations during droughts, increased due to climate change (13).

Inevitably, water pollution also affects the availability of freshwater. Once contaminated with chemical and microbiological agents, municipal and industrial effluents or heavy metals, water becomes unavailable, leading to exploration of more water resources and exacerbating water-stress issues. On the other hand, improving water quality enables its increased recycling and safe reuse (13).

Water quality is a matter of public health and a serious environmental concern, requiring sustainable management and monitoring to ensure everyone's access to safe water. To control and guarantee water quality, it is essential to protect water sources from microbial and chemical contamination, and use water treatment processes to purify, disinfect and protect water against recontamination. The most common methods of water purification include heat or radiation, chemical treatment and physical removal processes, able to separate pollutants from the water, using sedimentation or filtration techniques. To measure and monitor water quality, it is important to define organoleptic, physical, chemical and biological parameters and consider established threshold values, depending on the type of water and the intended use (human consumption, industrial production, agriculture, residual, among others) (18).

2.3 Water footprint

The 'water footprint' concept was first introduced by Arjen Y. Hoekstra in 2002, as a multidimensional indicator of freshwater use that considered both direct and indirect water use by a consumer or producer. Hoekstra defined the water footprint (WFP) of an individual, community or business as the "total volume of freshwater used to produce the goods and services consumed by the individual or community or produced by the business" (12).

The WFP is a temporally and geographically specific indicator that can be calculated for a particular product, process, consumer or group of consumers (family, city, state or nation), company or sector. Water use is measured in terms of water volumes consumed by source and polluted by type of pollution, per unit of time, throughout the full production cycle, from the supply chain to the end-user. This defines the water use as well as water pollution along with its geographical location. The WFP is designed for three different types of water: blue water footprint (BWFP), green water footprint (GWFP) and grey water footprint (GrWFP) (Figure 3).

The BWFP refers to the volume of surface and groundwater consumed to produce a good or service. Blue water consumption includes evaporation, incorporation of water in a product, water abstracted not reimbursed to the same catchment region and water not reimbursed in the same period in which it was withdrawn. Irrigated agriculture, industry and domestic water use can all have a BWFP.

The volume of rainwater required and consumed during the production process is known as GWFP. The GWFP consists of water from precipitation stored in the root zone of the soil and evaporated, transpired or incorporated by plants, being particularly relevant for agricultural, horticultural and forestry products, based on crops or wood.

The GrWFP is the amount of freshwater required to assimilate the load of pollutants from production process or human activities in order to maintain the water quality above established standards. It is an indicator of freshwater pollution that can be associated with the manufacture of a product over its full supply chain (12,19).

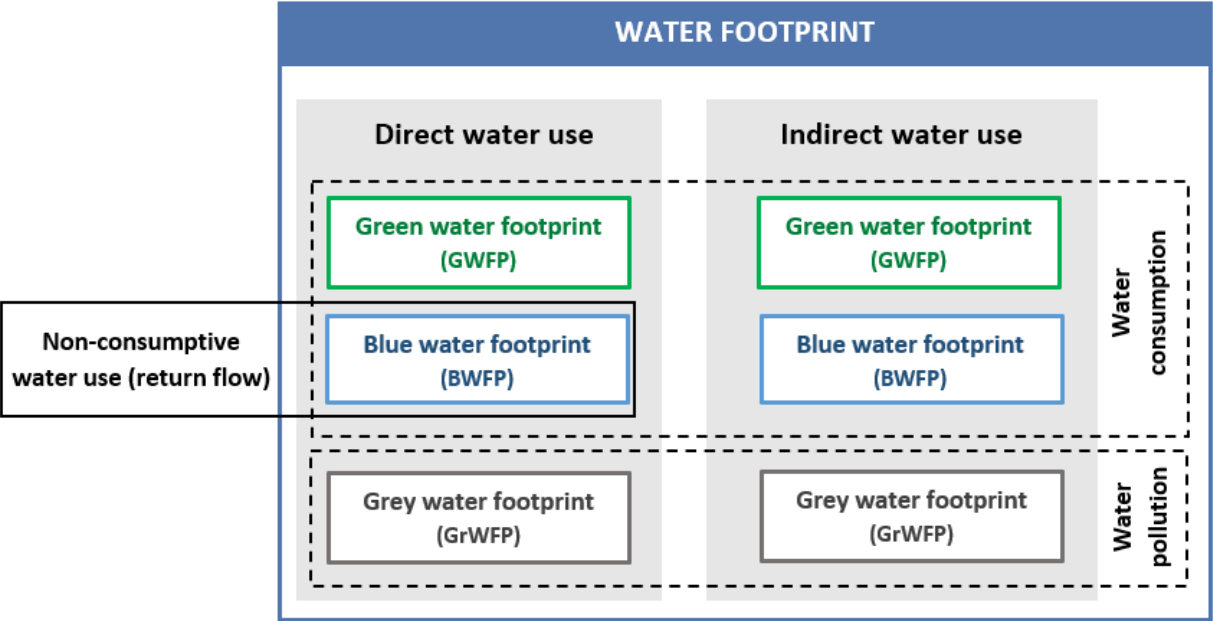


Figure 3. Schematic representation of the components of a water footprint.

[Adapted from (12)]

As a result, the goal of assessing WFPs is to analyse how human activities or specific products and companies relate to water scarcity and pollution issues, revealing water use patterns, from the individual to the national level. It is an important tool to realize how activities and products can become more sustainable from a water perspective and improve the water and wastewater management accounting for future use (12).

3 The Role of the Cosmetics Industry on Water Scarcity

Cosmetics play an essential role in everyone's life. From toothpaste and deodorant to perfume and lipstick, both men and women use several cosmetic products every day.

The Regulation (EC) No 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products is the main regulatory framework for finished cosmetic products placed on the EU market. According to this Regulation, a cosmetic product is defined as "any substance or mixture intended to be placed in contact with the external parts of the human body (epidermis, hair system, nails, lips and external genital organs) or with the teeth and the mucous membranes of the oral cavity with a view exclusively or mainly to cleaning them, perfuming them, changing their appearance, protecting them, keeping them in good condition or correcting body odours" (20).

Cosmetic products have been used for thousands of years and cover a wide spectrum of items, including hygiene and skin care products, such as soaps, shampoo, sunscreens, and beauty products, such as hair dyes, varnishes and makeup. Beyond their contribution to good hygiene and physical health, cosmetics can help enhance appearance, exhibit personal style, improve the mood and boost self-esteem, which are important means of social expression and necessary for the population's sanitary conditions and well-being. Before any cosmetic product is introduced to the market, it must comply with regulatory requirements and go through safety and efficacy evaluation, to ensure it is harmless for all users and that it delivers on the claims and benefits expected. A stability evaluation is also performed to determine the product's expiration date and certify the product formulation is compatible with the packaging and will remain stable throughout its life.

In a competitive world where more choice and greater product quality, efficacy and safety are expected by consumers, the cosmetics industry represents a growing economic sector worldwide, with the EU market valued at €79.8 billion in 2019, providing direct and indirect employment to 2 million people and with over 5 billion units of cosmetic products sold in the EU every year (21,22). Unfortunately, this vast industry deeply depends on water as a key element of formulation and manufacture, leading to massive water consumption and pollution. Additionally, the use of several cosmetics, such as bath and oral hygiene products, requires water consumption. Thus, as water is becoming a rare resource, both consumers and producers are gradually more concerned about the environmental impact of their cosmetic products.

3.1 Water consumption

3.1.1 Water as an ingredient in a cosmetic product

Water, usually identified by its International Nomenclature of Cosmetic Ingredients (INCI) name “Aqua” on cosmetic products labels, is one of the most used ingredients in cosmetics. In fact, water is the first ingredient found in the label of most cosmetics, which contains a list of ingredients based on concentrations in descending order. This means that water is present in greater quantity than other ingredients, accounting for more than 2/3 of the volume of a formula. For example, a regular cream contains from 60 to 80% of water, a lotion up to 90%, and a shower gel or shampoo up to 95% (23).

Known as one of the best universal solvents for a wide variety of chemicals, due to its high polarity and low molecular weight, water is primarily used in cosmetics to dissolve solid, liquid, and gaseous hydro-soluble ingredients. But water is multi-functional and is also frequently used as a vehicle to deliver active ingredients and reduce their concentration to tolerable levels, as well as an element to create emulsions in which the oily and aqueous components of the product are combined to produce creams and lotions (24). Since water is easily available at a very affordable price, inexpensive compared to other ingredients, it has also been used in the cosmetics industry as a filler in a product, increasing its volume and making its production more profitable. Inevitably, this perception of water as cheap and accessible contributes to the wrong belief that it is an expendable and unlimited resource.

The water used in the production of cosmetics must meet the minimum quality specifications. It can be simple tap water, already pathogen-free, safe and proper for human consumption, after going through filtration, disinfection (e.g. UV, chlorine), softening and chlorine removal (e.g. activated carbon filters) pre-treatments. However, the metal and mineral ions composition of tap water is variable and sensitive to seasonal and regional influence, compromising quality standards. Therefore, in order to stabilize water quality and guarantee good reproducibility in production, tap water has been regularly replaced by distilled, deionized or purified water, obtained from the former by certain purification treatments. These include distillation, reverse osmosis, ion-exchange resin columns and electrodeionization processes, used alone or in series, to obtain demineralized and sterile water. The different types of water used in formulating cosmetics are typically tested for total organic carbon (TOC), conductivity, pH, nitrates, heavy metals and microbiological count (25,26).

According to the International Organization for Standardization (ISO) 16128-1, which provides guidelines on technical definitions and criteria for natural and organic cosmetic ingredients and products, water is considered a natural ingredient. Natural ingredients are cosmetic ingredients obtained only from plants, animals, microorganisms or minerals, including

those obtained from these materials by physical processes, fermentation reactions occurring in nature and leading to molecules which occur in nature, and other procedures of preparation including traditional ones (e.g. extraction using solvents) without intentional chemical modification. However, the types of water defined in Table 1 may be treated differently (27).

Table 1. Types of water for the purposes of ISO 16128.

Types of Water (ISO 16128)	
Constitutive water	The liquid (juice) content of fresh plants.
Reconstitution water	Equivalent to the water found in the original material and is used to restore the dry material to its original content.
Extraction water	The water used to physically extract ingredients from a material mixture.
Formulation water	Water which is not defined above.

Nowadays, more than ordinary water, several water alternatives from different sources are used to enrich cosmetics formulas for their recognized virtues or to provide a hint of exoticism, like waters from the depths of distant oceans, lakes, lagoons or glaciers. On the other hand, thermal waters, or spring waters, have been extensively used in the cosmetics industry for their soothing, anti-irritation, and purifying properties, reinforcing the skin's barrier, especially useful in sensitive or diseased skin (e.g., suffering from eczema, rosacea or psoriasis). Constitutive waters are also increasingly used as a solution for organic and natural cosmetics. Floral waters, such as rose water, are obtained by flowers hydro-distillation, with beneficial properties for the skin, additionally to their perfuming abilities; while fruit and vegetable waters are extracted by dehydration or by crushing of the raw material, like coconut and cucumber waters (28,29).

All these special waters fulfil the same role of solvent as pure water, but can additionally act as interesting active ingredients, noted for their rich minerals and oligo-elements contents, and be more sustainable water sources for cosmetic products.

3.1.2 Virtual water

Less obvious than in the formulation, virtual water corresponds to all the water consumption necessary in every stage of the production process of a beauty and personal care product. In cosmetics industry, the manufacture of a product often requires several thousand litres of water to grow natural ingredients, process, clean, refresh, cool and heat (Figure 4).

Attending consumer concerns about synthetic chemicals, a growing number of cosmetics companies are looking for ingredients that come from plant and fruit extracts and concentrates, vegetables and essential oils, to produce the highly demanded natural and organic cosmetics. These natural ingredients, however, depend on agricultural production, the major water consumer, to obtain the raw materials (30). Next, due to its role as a solvent, water is frequently used for extractions, separations and synthesis processes, needed to reach the final product (3).

With a 100 °C boiling point at sea level, water may be used to remove or inactivate microbial pathogens when necessary and be part of heating and cooling systems (31). It is often the heat transfer fluid used to warm manufacturing machines and melt ingredients for blending, as well as in cooling and thermal control procedures during manufacturing. Simultaneously, a large quantity of water is used in cleaning all the production equipment and sanitation operations, and to maintain strict hygiene standards in the cosmetics factory's facilities.

The production of plastic such as HDPE (high-density polyethylene), the most common packaging material in the industry, also requires vast quantities of water. For example, the production of a typical 350 ml water bottle from the supermarket, can use 700 ml of water (32). Multiplying this number by the million bottles produced every day, it is clear that there is a massive water consumption during the packaging and all other stages of the manufacturing process in cosmetics industries.

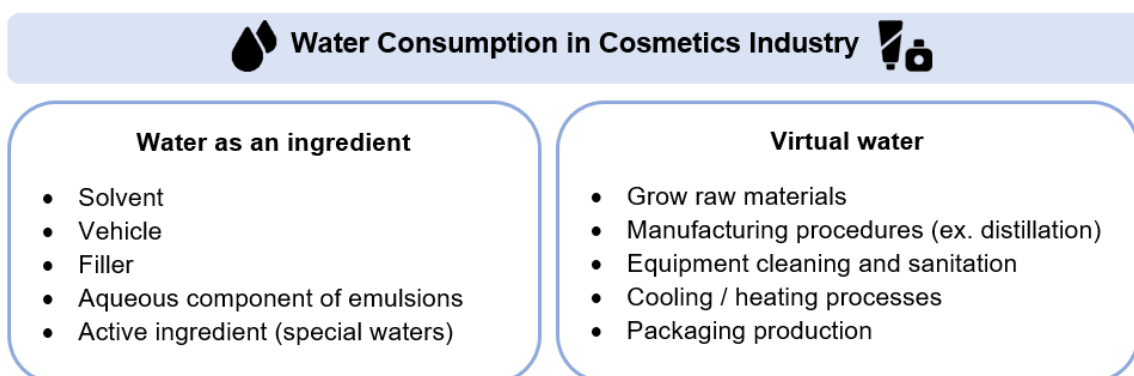


Figure 4. Water Consumption in Cosmetics Industry.

3.2 Water pollution

One of the most important classes of contaminants of emerging concern are cosmetics, and medicines, which, in the past few years, have been raising concerns due to their continuous release into aquatic environments. However, unlike medicines which are intended for internal and/or external use, cosmetics are products for external use, thus are not subjected to metabolic transformation, and are introduced unaltered into the environment through regular usage. In addition, the large number of cosmetics used every day and the fact that sometimes they are environmentally persistent, bioactive and potentially able to bioaccumulate, has led to pressure to recognise their ecological risks and toxic effects on plants, animal species and human health (33).

At the beginning of a product lifecycle, at the farm, wastewater run-off carries fertilizers, pesticides and sediments to surface and groundwater, polluting receiving waters and potentially causing eutrophication. This phenomenon is one of the leading causes of aquatic ecosystem degradation, with the increase of nutrients promoting a high plant mass growth resulting in depletion of oxygen with serious consequences on freshwater resources, fisheries, and all underwater life. Processing of farm products may also result in wastewater that contributes to eutrophication and toxicity. Additionally, all manufacturing steps of cosmetics require rigorous cleanliness, generating more wastewater streams that should be treated before being discharged to receiving waters (30).

During the formulation steps, the role of some cosmetic ingredients in water pollution is also well-known. Surfactants, for example, are present in a broad range of cosmetics intended for cleaning purposes and discharged every day into aquatic and terrestrial environments. Other substances, including disinfectants, preservatives, allergens from fragrances and UV-filters, have been associated with endocrine-disrupting effects. This is the case of triclosan (TCS), an antibacterial ingredient found in numerous consumer products like toothpaste and liquid hand soap, which is among the top 10 most commonly detected organic wastewater compounds concerning frequency and concentration (34,35). Plastic pollution of the marine environment is also a known global issue, and this material is present in cosmetics as plastic microbeads, used to exfoliate or cleanse in face scrubs and shampoos, or simply as a common packaging material. Due to their small size (less than 5 mm), these water-insoluble plastic particles can easily pass through the filters of water treatment plants and end up in the sea (36).

Regarding the use-phase and its impact on water pollution, cosmetics can be divided into leave-on and rinse-off products. A leave-on cosmetic is intended to stay in prolonged contact with the skin, hair or the mucous membranes, thus only a very small fraction will end

up in the aquatic environment; examples are perfumes, body and face creams and antiperspirants. On the other hand, a rinse-off product is intended to be removed after application through washing, showering or bathing, such as shampoos, shower gels and toothpastes. Rinse-off products have a much higher potential to be released to the environment as they are washed down the drain to the wastewater treatment plant system, and toxic chemicals, finally arriving in oceans, lakes, streams, rivers, and water supplies (37).

Advances in wastewater treatment processes are very important and may reduce some types of pollution, but they are not always effective in removing all chemicals used as cosmetic ingredients and new chemicals keep being introduced continuously into the marketplace. Therefore, cosmetics industry must prevent and make the effort to reduce chemical pollution at the source before it ever reaches the water.

3.3 Water sustainability in Cosmetics Industry

As the global population increases and life expectancy rises, people are finally getting conscious and becoming aware of the growing pressure on the planet's finite natural resources. Shortages of energy, water and other raw materials, as well as concerns about climate change and environment pollution, are encouraging consumers, companies and organizations in several different areas to adopt sustainability initiatives; and the cosmetics industry is no exception.

Sustainability is a concept with multiple meanings and interpretations, but the widely accepted definition is the one from Brundtland Commission's Report published in 1987 and entitled "Our Common Future", where a Sustainable Development involves 'meeting the current needs of the population without compromising the ability of future generations to meet their own needs' (38). It is built on a balanced consideration of three pillars: economic development, social responsibility, and environmental protection. In terms of applying this concept to cosmetics, there is no single definition for a "sustainable cosmetic" but, in general, it refers to a product with environmentally preferable attributes, developed in order to ensure ethical, social, and economic responsibility. Although it is not possible to officially label a cosmetic product as sustainable, there are fair trade labels, eco-labels and sustainability and corporate social responsibility (CSR) indexes that, in this context, manage to get close to the classification of what a sustainable cosmetic is. It is also important to distinguish sustainable products from 'natural, organic or green' cosmetics, which are arousing consumers interest too, but do not necessarily mean sustainable and may even carry sustainability concerns. While natural, organic and green refers to the product ingredients that are categorized by agriculture, originating source or the lack of synthetic substances, sustainable considers all possible impacts associated to the product's life cycle (3).

Luckily, the pressure to move towards more sustainable patterns of production is greater than ever. In our fast-changing world, a crescent amount of people is shifting mindsets, questioning their beauty routines and product choices, and looking for sustainability through their purchases. A recent consumer research conducted by Ingredion, a leading global ingredients solutions company, in 11 different markets concluded that approximately 2/3 of consumers read ingredient labels when buying their cosmetics and at least 50% expect 10 or fewer ingredients, in search of simplified formulations that remove "unnecessary" ingredients (39). This shows a rising level of awareness and conscious effort made by consumers to understand the ingredients behind their product selection. Producers are also starting to consider the responsibility and ethical sourcing of ingredients as well as fair trade, resources consumed during manufacturing, emissions and waste management, packaging potential for recycling or reuse and biodegradability of products (40). Responding to market pressure or to

consumer trends, sustainable development is a demand that businesses must adopt in order to achieve long-term success and viability, creating huge opportunities for innovation, greater relevance and market share. Economically speaking, embracing sustainability practices does not necessarily require big investments and it can bring many benefits to the companies, such as saving money, attracting new customers, increasing sales and profits, and improving the companies' reputation (2).

Water reduction should become a major feature of the sustainability plans of every cosmetic company. Cosmetics have traditionally relied deeply on water, but as worries of freshwater supplies continue to amount, creating high environmental and societal pressures, the cosmetic industry must challenge itself to innovate with less water, reducing its consumption to the minimum essential. Besides minimizing water quantity in product formulation, some strategies already employed include rainwater harvesting, using less water for cleaning procedures, reducing temperatures during manufacture, insulating measurements for heating and conditioning to reduce energy consumption, and optimizing the production through sequence of batches produced using the same equipment (40). Wastewater reduction and treatment before discharge are also big steps that save water and can provide economic and financial benefits. Directly used or recycled after suitable treatment, wastewater represents a vast untapped resource of heat, power and high-value products (17). Water quality monitoring during wastewater treatment processes is crucial for ensuring its safe reuse, increasing water-use efficiency, and helping to reduce the risk of water stress. The adoption of all these strategies can help companies reduce both water and energy consumption, along with emissions and waste, with the aim of decreasing environmental, carbon and WFPs.

Cosmetic companies are increasingly aware of the impact of their products and practices, but it is challenging to find sustainable cosmetics, especially with the aim to decrease water consumption. To achieve higher sustainability, the cosmetic industry must continue its journey to innovate and ensure the functionality of its products and manufacturing processes, without forgetting to influence the customer's pattern of consumption. It is also the companies responsibility not only to work on improving its own sustainable practices, but also to inform and instruct consumers about the sustainable use of cosmetic products (21). The future of cosmetics relies on more sustainable approaches and, although it will not happen overnight, by working together, businesses and communities can change processes and attitudes, aiming to safeguard water resources for everyone.

4 Waterless Cosmetics – a New Trend

The skincare and hair cleansing/treatment shelves at supermarkets, pharmacies or beauty stores, contain an ever-rising number of new product, such as dry shampoos, mousses, shampoo bars and cleansing oils. These products offer a sustainable alternative with little to no water while keeping the performance of traditional formats.

Rooted in the need for more sustainable products in cosmetics industry, waterless beauty is a current fast-rising trend that addresses the concerns around water scarcity. 'Waterless beauty', or 'water-free beauty', is a catch-all term that covers all types of cosmetics developed to reduce or eliminate manufacturing water consumption, the water dosage in the formula, or the water necessary to use the product (39). In place of water, waterless cosmetics are often formulated with soothing botanicals, natural oils, fruit waters and plant extracts, and they come in a variety of forms, including cleansing balms, powders, solids, concentrated oils, body butters, face masks and pressed serums, which can be incorporated within skincare, haircare and make-up.

The waterless beauty concept actually originated in South Korea and has been growing in popularity worldwide since 2015. Many water-free products were initially developed due to their skincare benefits and potency, rather than for environmental reasons. The Korean beauty industry first realised that, without water, cosmetics are less prone to be contaminated by bacterial growth, have a longer shelf life, need fewer preservatives, and are more potent due to a higher concentration of undiluted ingredients (41,42). However, with consumers and brands becoming more conscious of global freshwater shortages, this trend became a solution for cosmetics companies to help preserve limited water resources and minimize their WFP. Thus, waterless cosmetics are beneficial for both skin and the environment.

Nowadays, brands are increasingly being questioned about the transparency of their manufacturing process around the issue of water. Is the production method water-efficient? Does the company recycle water used during the manufacturing process? How will the ingredients in the formula impact consumable water? In this area like in others, consumers who adapt their own behaviour expect cosmetics companies to match these efforts. Therefore, big companies started working towards this sustainable cause and pledged to reduce their water dependence. Beauty giant L'Oréal, for example, has committed to a 60% reduction in water consumption per finished product by 2020, compared to 2005, and to innovate to enable consumers to reduce by 25% the water consumption linked to the use of their products, compared to 2016. Through multiple initiatives, from diminishing water in many formulas to optimizing consumption and developing projects to treat, recycle and reuse water at its production sites, L'Oréal was able to lower the water consumption by 51% between 2005 to

2019 (43,44). Unilever has also achieved a 47% WFP reduction over the past ten years and Unilever's Beauty & Personal Care Division has been working on developing hair conditioners with innovative fast-rinse technology, as well as no-rinse formulas that could save 460 litres of water per bottle of conditioner (45). Similarly, Procter&Gamble has succeeded in reducing its manufacturing water usage by 27% per unit of production since 2010 and sourced 2.6 billion liters of water from circular sources. Its haircare brand "Waterless" was created in 2018 to offer no-wash hair products for all hair types that can be used without a single drop of water, specially to meet the needs of people who live under water scarcity conditions (46). Other common brands like Maybelline, Oriflame, NYX and Makeup Forever, are also including more water-responsible cosmetics in their line of products, such as stick-based solid foundations, replacing the liquid ones.

Simultaneously, smaller brands are implementing water sustainable values from the beginning, drawing the attention of consumers. Pioneer of waterless make-up, "Pinch of Colour" was founded to conserve water, while donating net proceeds to those in need of clean drinking water, hygiene and sanitation. According to Linda Treska, founder and CEO of the world's first waterless beauty brand "Waterless for us is not a trend, it's a lifestyle, and both consumers and the multi-national companies have to realise that water is the new luxury" (47,48). "Vapour" is another make-up brand expert in waterless formulations, which produces 95% of its products without water, and manufactures one hundred per cent lip and cheek products fully water-free (41). Limiting the use of excess packaging, especially plastic packaging, is one more advantage of waterless cosmetics and many brands are also investing on this. For example, "Lush", a fresh handmade cosmetics company, is globally recognized for creating naked products such as naked shampoo bars, which saves more than 450,000 litres or 118,800 gallons per year in water (as compared to making bottled liquids) (49). "Ethique" is one more company that rejects water and plastic bottles in favour of packaging functional ingredients in bar form, producing super-concentrated solid shampoos and conditioners wrapped in biodegradable cardboard (32).

In summary, waterless beauty is a new trend which is already in the spotlight. The way beauty brands respond will surely determine whether this trend will prevail and make a difference. Considering public awareness about water scarcity, to save water and to limit their dependence on it, cosmetics companies will need to adapt and change how they formulate and manufacture products. With the market in transition, waterless cosmetics also appear as an opportunity to innovate within the cosmetics industry from a water-conscious perspective, and even already established names in the beauty world constantly need to innovate so they can stay at the cutting-edge of cosmetics.

5 Cosmetic Product Life Cycle

Cosmetics have an impact on water sustainability throughout a product's life cycle and each phase of the entire supply chain counts. When thinking about a waterless cosmetic, the water reduction in the product does not only concern the formula; it can be applied from the initial design and sourcing of raw materials, and proceed through manufacturing, packaging, distribution, consumer use and disposal or post-consumer use phase, as shown in Figure 5.

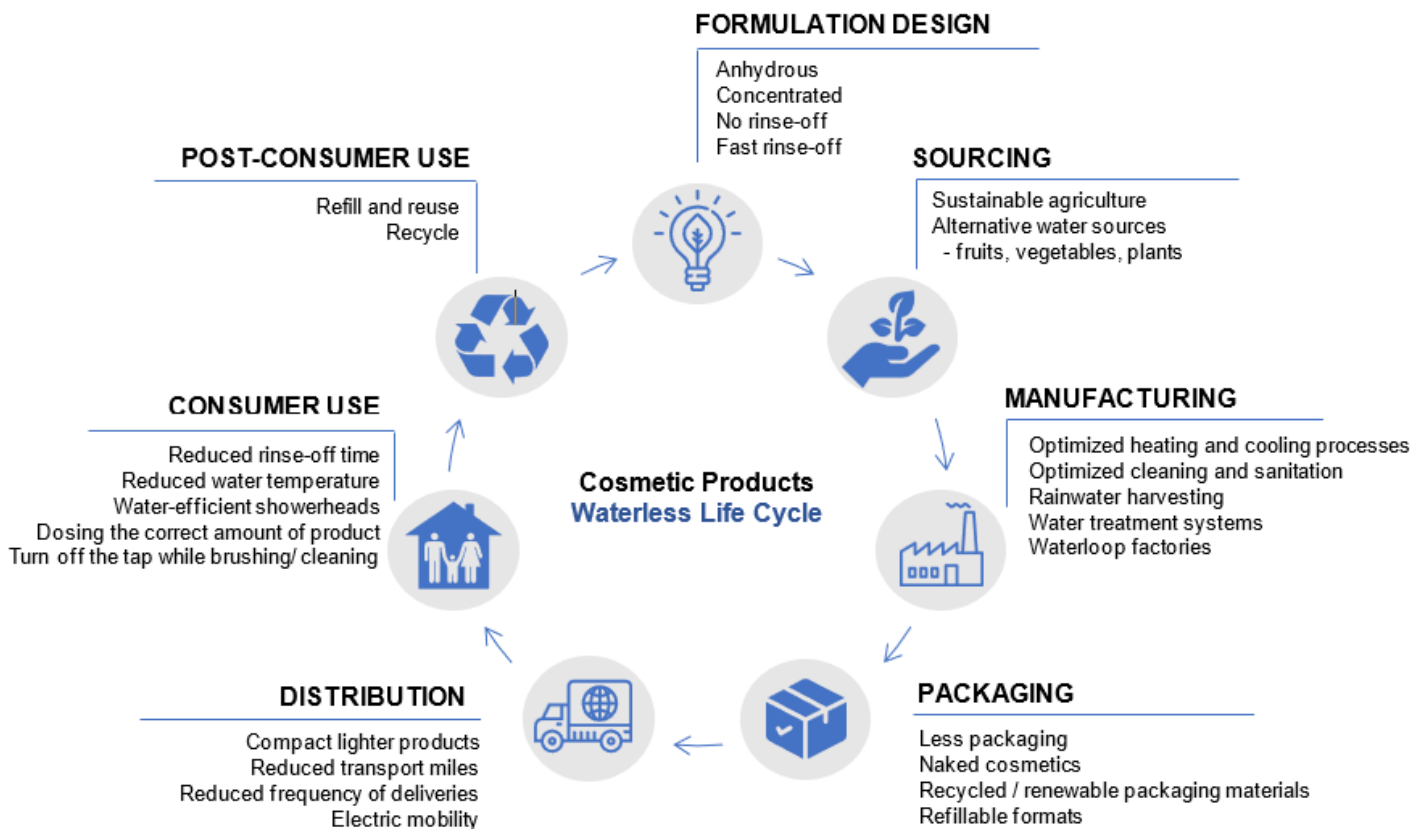


Figure 5. Waterless life cycle for cosmetic products.

5.1 Formulation design

Each phase of a cosmetic product life cycle will affect its sustainability, but a significant part of the environmental impact of a product is usually defined at the design phase, when choosing ingredients to be used in formulation. It is understandable that the actions taken at this early stage will then be reflected in the sustainability of the final product and the associated final phases. In fact, previous studies have shown that the design and selection of raw materials phases are ranked with the same or highest impact percentage (about 16%) on the sustainability of a cosmetic product, even though the exact proportion will vary according to

the product in question (50). There are two main strategies to significantly reduce water consumption early in the design phase: developing 'waterless formulas', with little to no water in their composition; or 'fast rinse-off' and 'non-rinse' formulas, that require less or even no water for usage, respectively. Improving the biodegradability of formulas, their ability to be broken down by natural microorganisms, is another option to minimize the environmental impact of ingredients in water, preventing its pollution and favouring its reuse.

5.1.1 Ingredients

The composition and the ingredient selection of each cosmetic product reflects on its performance, safety and sustainability. An ingredient is any substance or mixture intentionally used in the cosmetic product during the manufacturing process and must be indicated on the product's packaging to inform consumers and achieve transparency. Ingredients can be classified as 'natural', when they occur in nature and are obtained from natural sources, such as plant extracts; or 'non-natural' when they are greater than or equal to 50% by molecular weight of fossil fuel origin or when created in a laboratory for a specific purpose, also known as 'synthetic' ingredients. Both types of ingredients are valid and have to be in compliance with the annexes of the EU cosmetics legislation (20) (27).

According to the International Cosmetic Ingredient Dictionary and Handbook, which provides a comprehensive listing of ingredients used in cosmetics, there are more than 13,000 INCI labelling names for the United States, the European Union, and other countries (51). There are several categories of ingredients that can be used in a cosmetic product in different proportions, depending on their function and the intent of the product. From emollients, exfoliators, surfactants, polymers and solvents, to colorants, fragrances and UV filters, ending with ingredients for stabilizing cosmetic products such as preservatives, pH adjusters, chelating agents and antioxidants, all categories play an essential role in the formula in order to satisfy all the requirements, such as physical stability, chemical inertness, adequate safety and efficacy profile, while maintaining optimal sensory attributes (3).

As previously mentioned, water is mainly used as a solvent in cosmetic products. Thus, to achieve waterless formulas, its use in the design phase needs to be reduced or replaced with sustainable alternatives. However, this is not an easy task and selecting the right alternative ingredients can be challenging, since the consumer, when choosing a sustainable product, expects the same quality and efficacy of a non-sustainable product. Thus, it is crucial to understand the different classes of ingredients and their chemical and physical behaviour when formulating a sustainable cosmetic product.

5.1.2 Waterless formulas

Numerous waterless formulations are entering the market, helping to minimize the WFP of the cosmetics industry and offering an efficient solution to address consumer expectations concerning current clean beauty and environment protection.

With the aim of reducing water quantity in cosmetics, it is possible to develop either anhydrous or concentrated formulas depending on the characteristics of the product and its purpose. Water is often used as a filler and carrier for active ingredients, but in doing so, also dilutes them. Instead of water, waterless products usually have a combination of plant-based hydrators, extracts and nourishing oils in their formula, providing vitamins and antioxidants, so they may have a richer texture and greater performance with smaller quantities per use.

Anhydrous formulas are totally free from water and can be found essentially in oils and serums, fats-based cosmetics or dry products, such as powder-based ones. For skin care and make-up applications, these anhydrous products may include cleansing balms, butters, oil blends, serums, powder mix and solid bars. For hair care, there has been an increasing number of powder dry shampoos, which allow the elimination of both the water in the formula and the consumers' water consumption, by spacing time between two shampoos.

On the other hand, in concentrated products the amount of water in the formula is greatly reduced, leaving only a small amount (23). For instance, shampoo and conditioner bars are increasingly appreciated and are getting into the consumer's hair routine. Being highly concentrated, one shampoo bar can be equivalent to at least three standard-sized bottles of liquid shampoo (32). Other examples are concentrated serums, scrubs, masks, primers, foundations and deodorants.

It is also important to note that some of these products are formulated without water but still need to be rehydrated to be used. This is the case of cleansing/exfoliating powders to which water must be added to form an exfoliating paste or a cleansing foam that can be used daily. In any case, the amount of water added by the consumer is lower than the one used on an industrial scale.

Since water is a propitious medium for bacteria and other microorganisms to multiply, the presence of preservatives is essential in water-based formulas to avoid contamination, ensure proper conservation and increase shelf life. However, preservatives may in some cases cause skin irritation and allergies. Water-free products are much less favourable to microorganism growth, thus it is possible to reduce or eliminate preservatives, resulting in less irritating formulas and simpler product labels. Some active ingredients can additionally be very unstable in water-based solutions, but have much better stability in anhydrous formulations. This is the case of vitamin C, which deteriorates overtime when mixed with water, being

frequently maintained in powder form to preserve it until it is activated with water at the time of use (52).

Waterless formulas also mean smaller, lighter weight packaging, made of significantly fewer materials. Biodegradable paper and cardboard packaging or even packaging-free are now options for waterless cosmetics, avoiding plastics and reducing shipping weight and space, which require less fuel and energy consumption, decreases the CO₂ emissions and leads to a lower overall carbon footprint. Adding to this, is the fact that lighter condensed waterless products can seduce through their practical and travel-friendly aspect. Neither beauty bars, nor powders will count towards airport liquids, so they are more convenient for travel and easier to carry (23,53).

Finally, anhydrous and concentrated products can as well be more economical. Although at first sight they may seem more expensive to customers, it must be taken into account that waterless products last longer and do the work of three or four equivalent non-waterless products, reducing the need to buy new products so frequently, thus increasing savings. Furthermore, this is an opportunity for significant cost reduction in transportation and distribution for cosmetic companies (52).

All these advantages, summarized in figure 6, make waterless beauty products attractive and more eco-friendly than traditional ones, offering a large spectrum of opportunities not only for customers, but also for the manufacturer. Going waterless is a great way to boost the brand image and to earn customers trust by building a stronger ethical profile and contributing to a sustainable business model.

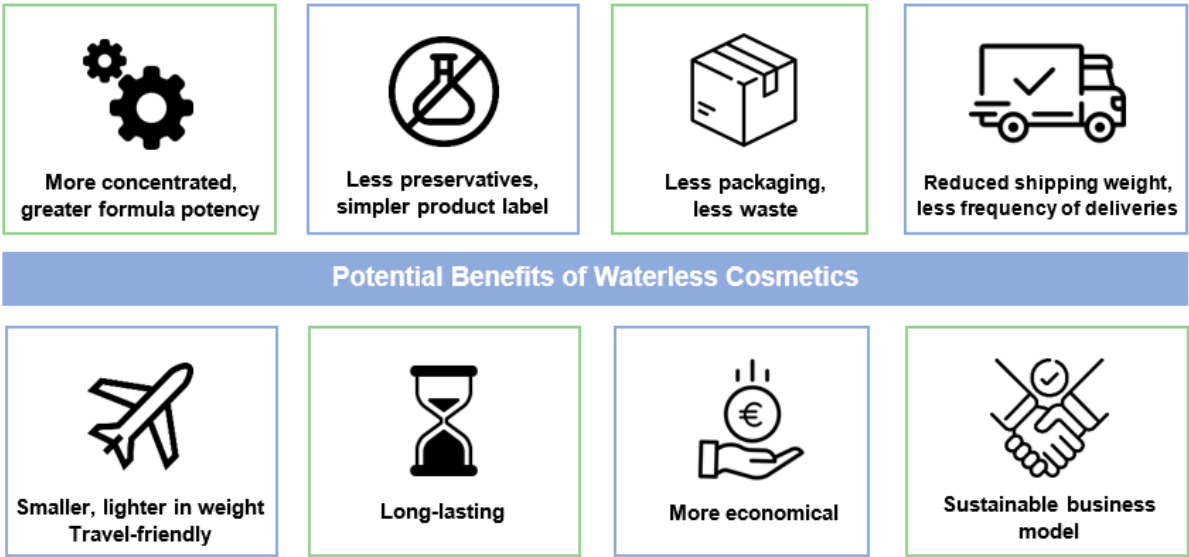


Figure 6. Advantages of Waterless Beauty.

5.1.3 Fast rinse-off and non-rinse formulas

The environmental impact of water consumption in cosmetics is also seen in terms of rinsing. In this regard, another possible strategy on the part of the cosmetic industry to combat the waste of water is the development of formulas that do not need to be rinsed or that can be rinsed quickly.

In the case of products for cleansing/conditioning skin or hair that inevitably need to be rinsed, companies should consider optimization of their products formula to reduce the volume of rinsing water required. In the search for this fast-rinse technology, L'Oréal and the environmental tech start-up GJOSA teamed up to develop a rinse shampoo that only requires 1,5 litres of water, as opposed to the 8 litres that are required for a conventional shampoo (54). The new eco-friendly beauty brand "Love Beauty Planet" from Unilever also created a special fast-rinse conditioner that is highly efficient. According to the research and development partner Matthew Seal, "when you add water to rinse our conditioners out of your hair, our fast-rinse technology helps break down the conditioner into many smaller molecules quickly, which can rinse out of your hair faster and save you time and water" (55).







One way to achieve a fast-rinse formula is through the use of amino acid surfactants, which allow quick and easy foam rinse-off, so less water is used to achieve clean skin and hair (56). These surfactants can be produced via different biotechnological and chemical routes using renewable raw materials such as amino acids and vegetable oils. As amino acids are renewable compounds, surfactants synthesized from amino acids additionally have great potential as sustainable and eco-friendly substances. Besides, their simple and natural structure, low toxicity and fast biodegradation often make them superior to their conventional counterparts (57). For example, Aminosap[®]AR-12 (Arginine Cocoate (and) Water) is an amino acid soap based on arginine which foams quickly in the presence of oils and is easily rinsed off, leaving the skin feeling clean and refreshed without the dryness associated with normal soaps (58).

Beyond the non-rinse products intended to stay in prolonged contact with the skin, the hair or the mucous membranes, it is also possible to create alternative solutions to cleanse skin and hair that do not need any use of water. This is the case of water-based solutions used to cleanse without any need of additional water, like micellar water. Micelles, small complexes composed of gentle non-ionic surfactants, attach to dirt, oil, and makeup, leaving skin fresh and clean, with no follow-up rinsing required. Dry shampoos and conditioners are emerging non-rinse products in many brands too, as they refresh, add volume and nourish the hair between washes while saving water. Another alternative are cleansing wipes, which are not

completely environment-friendly but are convenient for particular purposes, like post-workout or after occasions with significant sweating for a quick cleansing of the face.

In Table 2 is possible to find a summary of the cosmetics formula alternatives for common products, including solid bars, sticks, butter, oils, powder and tablets, with the aim of improving water sustainability in the formulation design phase. Annex A1 provides examples of waterless products on the market in each of the seven main categories of cosmetics: oral care, skincare, sun care, hair care, decorative cosmetics, body care and perfumery.

Table 2. Waterless sustainable cosmetics.

Formula	Macroscopic appearance	Waterless sustainable cosmetics
Solid Bar		<ul style="list-style-type: none"> • Face/ Body cream • Bodywash • Deodorant • Shampoo • Conditioner • Sunscreen
Solid Stick		<ul style="list-style-type: none"> • Body cream • Deodorant • Lipstick • Lip Balm • Highlighter • Perfume
Butter		<ul style="list-style-type: none"> • Cleansing Butter • Body Butter
Oil		<ul style="list-style-type: none"> • Make-up remover oil • Shower oil • Body oil • Hair oil • Sunscreen
Powder		<ul style="list-style-type: none"> • Face/ hair masks • Dry shampoo • Body scrub • Sunscreen • Foundation/ bronzing/ blush powder
Tablet		<ul style="list-style-type: none"> • Toothpaste • Shampoo

5.2 Sourcing of raw materials

Cosmetics companies shall define criteria to select raw materials with respect to their environmental balance, considering energy and water consumption, emissions to water and air and waste formation, but also looking into the question of limited resources (3).

Over the last years, operators from the cosmetic ingredients supply chains have given more attention to sourcing their raw materials from sustainable agricultural production systems. Agricultural water includes irrigation water that is directly applied to the harvestable portion of a crop, water used for preparing crop sprays, and water used for washing or cooling harvested produce. Sustainable water management in agriculture aims to match water availability and water needs in quantity and quality, in space and time, at reasonable cost and with acceptable environmental impact. This can be achieved by improving irrigation application, considering both efficient irrigation methods and irrigation scheduling, soil and plant practices, water pricing, reuse of treated wastewater, farmers' participation in water management and capacity building (59). Extracting only what is necessary, supporting local organic farmers and encouraging them to move from their traditional high-water demand practices to reduced demand systems and technologies, will allow obtaining ethically and naturally sourced ingredients, while preserving water resources and respecting the planet.

The selection of suppliers based on their environmental and social performance, that provide a reliable supply of the best ingredients derived from renewable sources, is the key to a long-term future of cosmetics brands that costumers can trust. Cosmetics companies must assess suppliers' sustainability policies, including their water policies, water consumption, and progress to achieve water targets, as well as guarantee the traceability of raw materials, in order to reduce the WFP linked to this phase of the cosmetic product life cycle and incite changes at a global level.

5.2.1 Alternative water sources – fruits, vegetables and plants

The increasing concerns about freshwater supplies has been forcing the cosmetics industry to consider unconventional water sources.

First, it is possible to rely on alternative water reservoirs on the planet, like sea, glaciers, and marine spring waters. Sea water, directly drawn from the sea, at a particular depth, is filtered to only keep its salt and trace elements. Often more stable in trace elements than sea water, marine spring water is considered a fossil water taken deep in the sea, which always keep the same minerality and temperature and is believed to have the property of reinforcing the skin's barrier. Much appreciated for their purity, glacier waters are also increasingly used

in the world of cosmetics. Some brands retrieve pieces of icebergs, store them at room temperature until they melt, and the water is then filtered to remove any impurities (29).

Flowers, fruits, vegetables, and many different plants can be even more interesting sources of freshwater, classified as constitutive water, with additional properties for cosmetics. Floral water is the condensate water that remains after the extraction of an essential oil by distillation, being rich in aromas and oil remnants with beneficial properties. They are usually designated by the flower's or plant's botanical name in Latin followed by the qualification of the final ingredient in English. For example, '*Rosa damascena* flower water', or rose water, is widely used for its refreshing, purifying and astringent properties, recommended for oily, dry, mature, and sensitive skin care. In turn, 'lavender water' (*Lavandula angustifolia* flower water) is preferable for irritated and damaged areas, due to its healing and soothing abilities (60). Fruit and vegetables waters, known as composition waters, can be obtained through crushing the raw material, followed by filtration, or extracted by dehydration, where fruit and vegetables are put in large steamrooms and slightly warmed up until they are dry. Their INCI names follow the same rules as those applicable to floral waters and we can already find many products containing cucumber, lemon, or coconut water. For instance, the South Korean brand "Too Cool for School's Coconut Milky Mist" claims to contain 87% of coconut water (61). Two more promising options are 'birch tree water', carrying amino acids, enzymes, and antioxidants beneficial for the skin, and 'rice water', considered as an anti-aging ingredient to be used as a raw material for skincare applications. Rice (*Oryza sativa*) water can be obtained from different types of rice present in the human diet and also from rice residues resulting from the rice industry, as a way to transform it into an added-value product (62).

More recently, in 2019, the cosmetic ingredients supplier Seppic has created the Hydralixir™ range, a collection of eco-designed freshwater sourced from seaweed that grows naturally in pure marine water and is ethically harvested. The two ingredients of this range, Hydralixir LD and Hydralixir CC, are cellular waters obtained from gentle evaporation of *Laminaria digitata* algae, and a mixture of *Chondrus crispus* and *Gigartina stellate* algae, respectively. Hydralixir can replace up to 50% of water in a formulation and may reduce the fresh WFP more effectively, compared to flower or fruit-derived waters. In fact, plant waters like rose water require water to grow the plant in the first place or in the extraction process; seaweed grow in the water, so there is no need for additional watering. By-products of algae, that are already engaged in an existing industrial exploitation, these waters combine responsible innovation and natural sourcing (63,64).

Alternative water sources are certainly an opportunity, but researchers, raw material suppliers, and formulators will need to work together to develop and expand this new area.

5.3 Manufacturing process

During the manufacturing phase, there are a few strategies that can be used to reduce water consumption and achieve a more sustainable production.

To start, it is important to optimize water consumption by looking into the current water management. To achieve this, companies can use a waterscan tool in their factories to categorize diverse types of water use (cleaning, lavatories, cooling and heating processes, among others), identify how much water is consumed in each category and establish standards (65). Then, companies can adopt some initiatives to help reduce water and energy consumption, which may include changing energy sources to solar or wind power, optimization of the cleaning procedures using less washing water, reduction of the temperature during manufacturing, insulation measures for buildings (walls, windows) to optimize heating and air conditioning, optimization of the production planning (sequence of batches produced using the same equipment) and replacement of old equipment by new energy-efficient electrical devices, to energy recycling from hot wastewater or air (3).

Another possible strategy is rainwater harvesting. With potential savings up to 75% on potable water bills and opportunities to reduce main water consumption by 30%, rainwater harvesting systems collect rainwater from the roof of the building, filter it, house it in storage tanks, and redirect it for uses such as flushing toilets, running cooling systems, irrigating land, and numerous other solutions. The storage tanks require less concrete upon installation, are widely self-cleaning, use very little energy, and offer a quick return on investment (65). Ringana is an example of a cosmetic company already employing this system, with a 12,000 litres rainwater tank installed in its facilities which allows to save around 1,000,000 litres of freshwater per year (66).

Recycling the factory's wastewater and investing in water purifying systems is also determinant to obtain high quality water for products and reuse suitable industrial water whenever possible. Babor, considered Europe's number one professional skin care brand, was one of the first companies to address wastewater treatment. Since 1998, it has been using a microfiltration system in production facilities, designed to filter sewage and produce clean water. This system works to recycle water by separating oil and other waste from clean water, creating around 15,000 litres of safe water per day that can be used in the manufacturing process (67). A global leader in water treatment, Veolia group provides water, waste and energy management solutions for communities and industry to help them achieve their sustainability goals. Thus, Veolia can be an important partner, delivering customized water and wastewater treatment solutions, schematically represented in figure 7, for cosmetic companies that aim to improve their economic and environmental performance (68,69) .

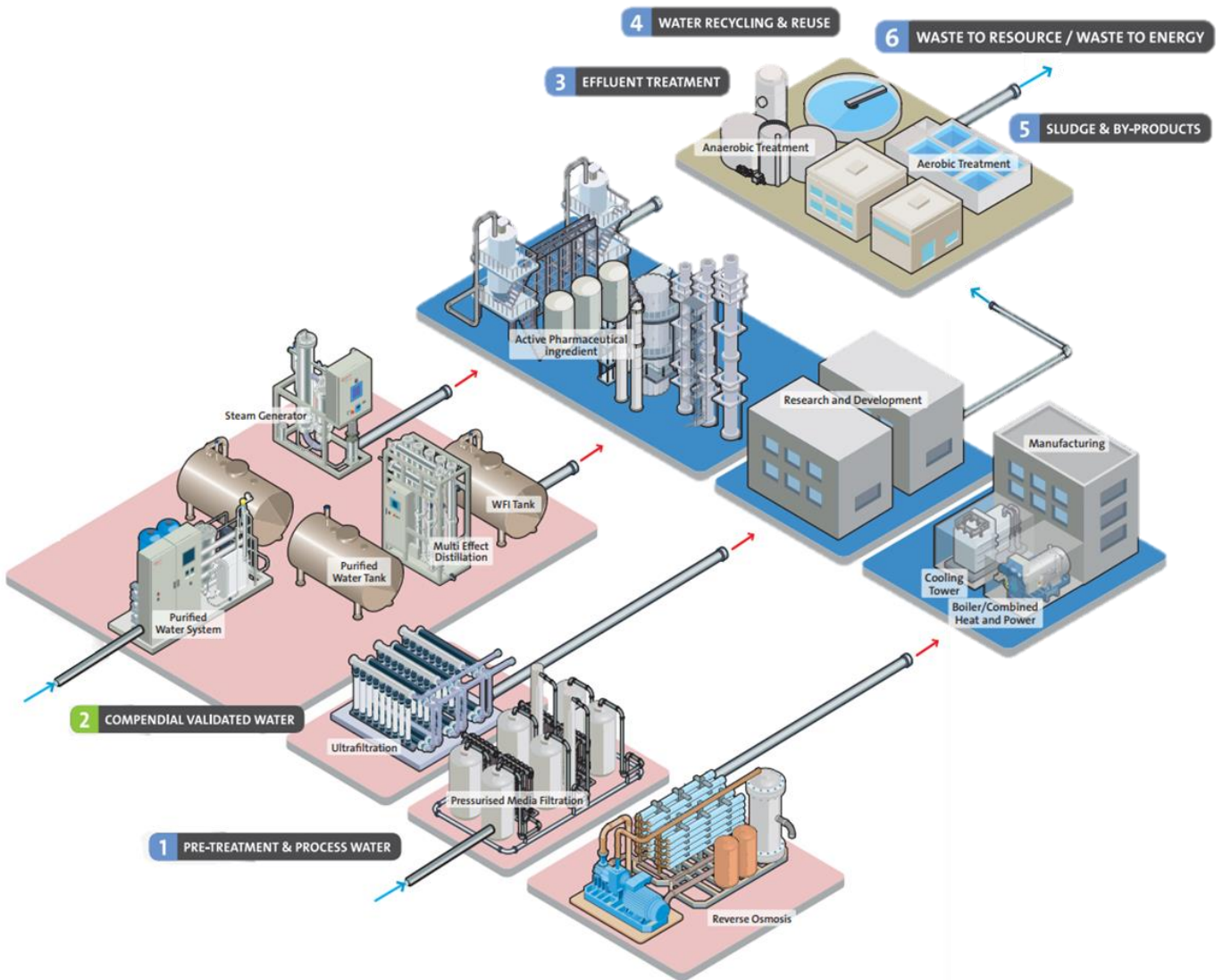


Figure 7. Veolia water solution for the pharmaceutical and cosmetics industry.

[Adapted from (69)]

5.3.1 Heating and cooling processes

The manufacture of a cosmetic product usually involves water-dependent heating and cooling processes, namely for chemical processing, drying, sterilization and distillation activities that require higher temperatures, as well as to cool down the production equipment, by direct or indirect contact.

One early effort to minimize water use at this point can be reducing the need for heating and cooling in manufacturing by pursuing development of product formulae that could be processed at ambient temperature. For instance, more ingredients are becoming available that enable stable emulsions to be manufactured without any heating, through cold emulsification

technology. Although not all types of products can be manufactured this way and the ingredients selected need to be either liquids or readily soluble in the oil and water phases, such strategy can be adopted in the manufacturing of cosmetic moisturizing emulsions and has several advantages when compared with hot processing emulsions. The elimination of the heating and cooling steps makes it easier to process and to control the structure of the emulsion, decreases the time of production and increases production capacity, in addition to the energy and water savings (2,3).

For all the products and operations that inevitably need cooling or heating during manufacturing, the aim is to optimize these operations with water-efficient methods and maximize water reuse. One way to achieve this is for companies to invest in closed-loop heating, ventilation and air conditioning (HVAC) water systems. Cooling and heating systems operate by using the temperature of water and refrigerant to transfer heat from a building to the outside and can either be open loop or closed loop. Open circuits deposit the cooling water into an open cooling tower that exposes the surface of the water to the air. In contrast, closed loops keep the water completely enclosed inside pipes and do not allow the water to receive direct air contact. Thus closed systems do not require additional water periodically to replace that lost from evaporation, in addition to having less risk of contamination and requiring less maintenance throughout the year (70).

5.3.2 Cleaning

Cosmetics manufacturing requires strict attention to cleanliness and sanitary conditions. Most of the water used in cosmetics factories relates to needs in cleaning production equipment, materials and packaging lines, and for maintaining strict hygiene standards. To optimize these essential cleaning procedures, companies need to find ways to use less washing water and reduce its temperature.

For instance, the frequency of vessels cleaning can be reduced by arranging the manufacturing in campaigns where different types of products, like creams or shampoos, are made in a sequence without any intermediate cleaning. To save energy and reduce wastewater, companies should consider a clean-in-place system too, that uses high-pressure water jets from nozzles to clean out tanks, being more efficient at cleaning and requiring less water than the traditional procedures (2). Changing from batch to continuous manufacturing (CM), a method of manufacturing products and processing materials without interruption and with constant material feed and removal already being used in the Pharmaceutical Industry, would also significantly lower water usage because of reduced cleaning and sanitization in place requirements. CM plants need less floor space since multi-step equipment and quality

control are combined in a single unit housed in one room with one air/water system and one common access port (71).

In response to concerns related to the quality, effectiveness and environmental impact of cleanings in industrial installations, a new method called OptiCIP (OPTImization Cleaning In Place Program) has been developed by Schneider Electric, enabling the factoring in of specificities of a given industrial site and further applying the most efficient and specific cleaning processes. OptiCIP is essentially a software solution to monitor and optimize cleaning operations, collecting real-time data on process parameters and providing analysis and recommendations for improvement. It offers many advantages, including a significant reduction in water consumption, reduced cleaning time and operation costs, while allowing higher productivity and validated cleaning procedures, crucial for microbiological hygiene and to avoid cross-contamination (30,72).

5.3.3 Waterloop factories

In view of the increasing water scarcity, to reduce WFP and contribute to preserving water in each geographic area of operation, companies may adopt circular water management in their facilities, where the use of water changes from a linear process with increasing contamination (becoming wastewater) into a circular one where water recirculates and loops back for continual use. At the plant level, circular water management is represented by the 5R approach: reduce, reuse, recycle, restore and recover (Figure 8) (7).

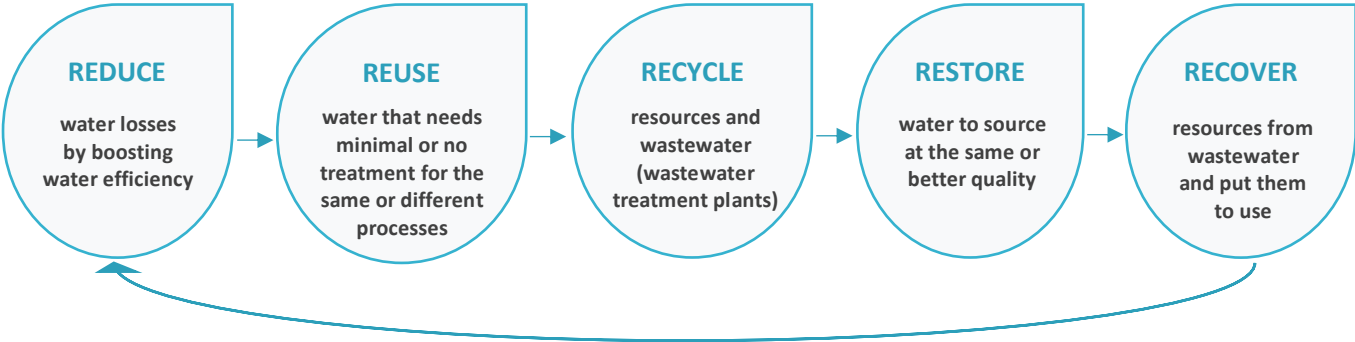


Figure 8. Circular water management. [Adapted from (7)].

When all the industrial water necessary for production processes (cleaning equipment, producing steam, utilities, among others) is entirely derived from water retreated, recycled and reused in a loop on site, the factory achieves the internal “waterloop” standard. This use of wastewater avoids the need to use a public or municipal water supply, unless for human consumption or within the composition of products and provides a potential financial benefit. In fact, the cost of equipping facilities with the required water recycling technology is lower than the potential financial impact of water-related risks (7).

The world’s largest cosmetics company, L’Oréal, already possesses a total of five ‘waterloop factories’, also known as ‘dry factories’, with the first one established in 2017 in Spain, followed by facilities in Italy, Belgium, Russia and Mexico. By 2030, L’Oréal aims to roll out their waterloop approach in all its factories, prioritizing this transition in regions where water is a critical issue due to water scarcity or poor water supply infrastructure. According to the L’Oréal Progress Report 2019, recycling wastewater in its waterloop factories is possible thanks to a combination of ultrafiltration/ reverse osmosis (filtration with membranes) and evapoconcentration (distillation), ensuring a biological and physicochemical treatment of used water to obtain clean water. This enables the recycling of an average of 200 m³ of water per day and 60 million litres per year, which is equivalent to the annual consumption of 600 families. After a few years successfully reclaiming high quality water for processing, L’Oréal goes further to enable water to be reused as a raw material in its cosmetic formulas and to provide water, sanitation and hygiene services for employees too. What is more, waterloop factories are also reducing carbon emissions by using renewable sources and improving energy efficiency (8,43).

The future of cosmetic companies will definitely pass by the adoption of the waterloop concept in every factory, to optimize industrial processes, reduce dependency on water and achieve water sustainability goals.

5.4 Packaging

Virtually all cosmetics are delivered to the consumer in packaging. The packaging must protect the product inside, preventing any losses and degradation, and in many cases must also guarantee a correct application and function of the product. Packaging has a key role in providing consumers information about the product, namely the list of ingredients, particular precautions of use and the date until which the cosmetic product, stored under appropriate conditions, still fulfils its initial function (date of minimum durability), as well as the period of time after opening (PAO) during which the product is safe and can be used without any harm to the consumer, when necessary. For some products and some brands, the packaging is also a way to make the whole product/package attractive, desirable and acceptable to the consumer, contributing to their sense of self-image and well-being (20,21).

Packaging in cosmetics may include primary, secondary and tertiary packaging. Primary packaging is the one in direct contact with the product. Liquids are typically delivered in a watertight container, while other products may be packed in tubes, jars, or boxes. Secondary packaging is a container that holds the primary packaging. In the case of premium skin care products, perfumes and colour cosmetics, it is usually cardboard or other casing that houses the product on store shelves. Tertiary packaging is used for shipping, bulk handling and warehouse storage, and includes cardboard boxes, as well as palettes for storage and shipping (53). The main concerns regarding the cosmetics packaging are precisely the excess layers and the materials used. Common packaging materials include aluminium, glass, paper and paperboard, wood, plastic/polymeric materials and hybrid constructs, even though plastics are normally the number one choice due to their lightweight, stability and high flexibility with regard to colours and shapes. Unfortunately, plastics are not biodegradable, generate environmental pollution and require vast quantities of water to produce (3).

In the EU, packaging is primarily regulated under the 94/62/EC Packaging and Packaging Waste Directive which establishes common rules for packaging and helps prevent obstacles to trade and to reduce the environmental impact of packaging. According to this Directive, packaging shall be manufactured with the minimal volume and weight needed for the safety, hygiene and consumer acceptance of the packed product; keep noxious or hazardous constituents to a minimum; and ensure that packaging can be reused, recycled and/ or recovered once it has been used (21,73). Therefore, cosmetics companies shall implement a sustainable and responsible packaging policy based on three pillars, known as the '3Rs': reduce, reuse and recycle, along with considering the biodegradability and responsible sourcing of the materials.

Waterless formulas alone, with little to no water and more concentrated, allow to significantly reduce the volume and weight of the packaging, as well as to replace fossil fuel-based plastic for recycled materials, like cardboard or biodegradable paper. In fact, waterless products can even be commercialized without any packaging at all, such as in the case of Lush cosmetics 'naked' products. Promoting bulk packaging is another way to simplify and decrease the overall packaging-to-product ratio (30). When products are not pre-packaged, are packaged at the point of sale at the purchaser's request or pre-packaged for immediate sale, and have no label to indicate the ingredients and instructions for use, according to the Regulation (EC) No 1223/2009, such information should be enclosed so that the consumer has access to it (20).

Designing packaging of large sizes and refillable formats is a major opportunity to drive improvement. Containers shall be made of durable material, like aluminium, that is resilient enough to be reused for multiple cycles, including a full journey through production, shipping, use, and cleaning at the highest standards, while using as little water and energy as possible. The reusable container can then be refilled from recyclable pouches, which are made using significantly less plastic, or even in refill stations when available (74,75).

The use of recycled materials is also gaining strength in the market. While glass, aluminium and cardboard have been recycled for decades, recycling plastics is quite recent, and a growing number of cosmetic companies are now using post-consumer recycled (PCR) plastics in their packaging. The most commonly used 100% recyclable plastic material is clear PET (polyethylene terephthalate), an ecological biodegradable resin produced using naturally occurring ethylene glycol and terephthalic acid, although it still requires water to manufacture and recycle (3,76). Alternatively, a brand new sustainability strategy in relation to plastic is replacing fossil fuel-based virgin plastic with certified renewable polypropylene (PP), to produce renewable plastic packaging. In late 2020, Beiersdorf announced the face-care products of 'Nivea Naturally Good' whose packaging is made of this renewable plastic from the global petrochemicals manufacturer Sabic. The raw material base is certified renewable tall oil, a second-generation feedstock and a by-product of the forestry industry, which replaces crude oil in the manufacturing process, without the need to establish a separate production process. Plus, the containers made of renewable PP are not distinguishable from the those made of fossil fuel-based plastic, keeping visual and tactile features that consumers are acquainted with (77). Undeniably, packaging has a significant impact on water consumption and pollution, so it is important for cosmetic companies to work on more environment-friendly solutions to deliver their products. The goal is to avoid packaging at every possible opportunity and, when needed, design packaging of optimal size and weight with fewer resources, replacing conventional materials with alternatives from recycled or renewable sources.

5.5 Distribution

Transportation of ingredients, materials, packaging and final products can also be a determining factor of cosmetic products sustainability. The main impact of the distribution phase in the life cycle of a cosmetic product is the combustion of fossil fuels releasing pollutants and CO₂ into the atmosphere, a greenhouse gas that contributes to global warming, accelerating water scarcity issues (3). To reduce these emissions associated with the transport of cosmetics, the industry must adapt its distribution practices.

First, it is important to understand that the higher the load of the transport vehicle the more the vehicle will go into effort, which will have a direct influence on how much fuel is used, leading to an increase in harmful emissions. Thus, companies need to reduce the weight of products and, consequently, the load to transport, by using lighter materials, optimising structural and material design, developing more concentrated products and eliminating unnecessary packaging. Water is often the heaviest ingredient in cosmetic formulations, or at least the most plentiful, so waterless formulas are a promising way to obtain compact, lighter and more sustainably shipped products (21). Compact products are smaller in size and volume than their conventional counterparts and they generally require less packaging. Besides, a larger number of units can be transported simultaneously, which reduces the frequency of deliveries and subsequently the greenhouse gas emissions associated with their distribution (78).

One more possible sustainable transport strategy adopted by cosmetic companies is to consolidate their distribution networks to reduce the distance between distribution centres and retailers, cutting transportation miles. Some have also started using mega-warehouses, large scale distribution centres where products are stored until the required quantities are due for delivery, to cut down on unnecessary journeys. Additionally, to minimize the impact as much as possible, companies are shifting their transportation from road to rail and from air to sea, or introducing hybrid or electric vehicles, avoiding the emission of tonnes of greenhouse gases, which in turn helps fighting against the effects of climate change (78).

5.6 Consumer use

Cosmetic products are directly used by consumers or applied by professionals, like hairdressers, makeup artists or beauticians. Depending on the type of product, the use phase can significantly contribute to the cosmetic product sustainability impact. This has been well documented, particularly for cleansing products, including shampoos, soaps, hand washes, among others, due to the use of water to rinse or wash the product and the energy consumed for heating the water, as well as the discharge of these products down the drain and their impact on the aquatic environment. To fairly compare different products in terms of their sustainability impact, it is essential to have a good insight on use patterns. Information on these patterns may include the amount per use, use frequency, product size when available in different sizes, and additional processes related to its use, like hot water applications in shampoos, being important to know temperature differences and the amount of water required (21). The industry is facing these consumption impacts on water sustainability by innovating in products and educating consumers.

Designing innovative products and technologies that minimize water consumption in the use phase offer great perspectives for water sustainability in the daily hygiene and personal care practices. Companies can invest on the development of non-rinse, faster rinse-off formulations for quicker showers and even 'two-in-one products' that eliminate the need to use a second product. Besides these strategies, L'Oréal and Swiss environmental tech start-up Gjosa went further and co-developed a smart hair care system called 'Water Saver', that blends and distributes product in a way that ensures water savings of up to 80%. This system, already available for salons, works by blending specially designed hair care formulas from L'Oréal Professional and Kérastase, including shampoos, conditioners and treatments, directly into a micronized water stream through a showerhead cartridge, to obtain a patented 'cloud foam' with smaller droplets for better absorption and faster rising. Water Saver only uses two litres of water per minute, compared to the eight litres consumed by a standard showerhead, and also features a data dashboard that allows salon professionals to monitor their water, energy and product consumption and look at the whole cost savings. So that consumers can also enjoy a sustainable and unique hair care experience, a home version of Water Saver is under development, to provide a convenient shower device that can be connected to the consumer's mobile phone to track overall water use, and will be launched at a later date, according to L'Oréal (79,80).

In addition to innovative products, educate and influence consumer product-use of beauty products is certainly on the agenda for beauty brands in the coming decade. Cosmetic companies can serve an important role in shifting consumers toward environmentally responsible practices, namely through education about water conservation, which is

fundamental to influence consumer behaviour and purchasing decisions. There are numerous opportunities to educate consumers on how best to use products in a systematic way, thus overall reducing water consumption. For instance, providing consumers information about simple actions, such as spending less time in the shower, reducing water temperature by 1 or 2 °C, turning off the tap while tooth-brushing or soaping, installing water-efficient showerheads, and dosing the correct amount of product for the purpose, can make a real difference in water savings. Providing numbers and statistical data on water scarcity issues and products' WFP is also an effective way to raise awareness, encouraging consumers to look for more environmental-friendly cosmetics.

Companies can communicate with consumers using different strategies, including off-pack leaflets, in-store information, websites, advertising, product labels and education campaigns (21,40). Nowadays, social media is probably the most powerful tool to communicate directly and interact with customers worldwide, allowing to deliver instantaneous and updated information about sustainability measures and new products through engaging texts, images and videos (78). On the other hand, information about the product's sustainability and suggestions for better use and discharge visible on the product label may have a bigger influence at the time of purchasing, to choose that product over others, and when using the product, constantly reminding the consumer on how to act. The name of the products and brands can also be attractive and affect consumer behaviour in a creative way. This is the case of a brand called 'Stop the Water While Using Me!' which created a variety of cosmetics, highlighting to consumers that they can make a big difference by just reducing water use while the product is being applied. What is more, this brand has many alternatives of waterless products, refill possibilities for all care products and founded its own global water initiative 'Good Water Projects' financed from the proceeds of the sales, with the aim to donate water to water-stressed regions, educate consumers and actively campaign against pollution, waste and unfair distribution of water resources (81).

Hence, although at first it may seem out of the producers and cosmetic industries responsibility, how consumers interact with a product depends largely on product design and marketing. If consumers are aware of the efforts of the cosmetic companies and realise they can actually make a difference by their purchasing decisions and proper use of products, they are more likely to act in a responsible manner.

5.7 Post-consumer use

Regarding the post-use phase, cosmetic products that have been washed or rinsed-off go to wastewater treatment plants, and packaging waste is subjected to various waste management techniques which depend on infrastructure and consumer habits, local demographics, investments made in modern collection, separation and processing systems, availability of efficient recovery and recycling technologies, the packaging type and materials, among others (78).

The packaging waste of cosmetics shall be managed in a way that minimizes its environmental impact. Once again, cosmetic companies have an important role in influencing the customer toward responsible disposal practices, through choices in packaging types, weight, size, labelling and promoting the optimum waste management techniques - reusing, recycling, incinerating with energy recovery or composting (3). The material choices and design should encourage and enable consumers and municipalities to maximise appropriate collection and disposal at the market level.

Companies need to work together with national associations, municipalities, waste management companies, retailers and packaging manufacturers in order to reduce the waste as much as possible and protect water bodies (21). One example of cooperation between different entities is the creation of 'New Plastics Economy Global Commitment', an initiative of businesses, governments, and other organisations, whose vision is a circular economy for plastic in which it never becomes waste. For this purpose, signatories commit to "eliminate all problematic and unnecessary plastic items, innovate to ensure that the needed plastics are reusable, recyclable, or compostable, and circulate all the used plastic items to keep them in the economy and out of the environment" (78). Since its responsibility does not end when the products leave the factories, the cosmetics industry must definitely work on its part in this post-consumer use phase and rethink the life cycle of its packaging.

5.7.1 Refill and reuse

Reusable packaging is an effective solution to help eliminate packaging waste and contribute to cosmetics sustainability. Reuse, according to 94/62/EC Packaging and Packaging Waste Directive, means "any operation by which packaging, which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations, is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled; such reused packaging will become packaging waste when no longer subject to reuse" (73).

Using refill/reuse systems holds many benefits for both businesses and the environment. It essentially allows to save on raw materials, including water, while also reducing costs of packaging, increasing customer loyalty and perceptions of added value by the customer. Some companies have also introduced consumer incentives, e.g. free products or vouchers, for returning packaging that can be refilled and/or reused, which are also advantageous for consumers (40,78). However, not all formulations are suitable for reuse of packaging, concepts that can only be considered when the quality of the cosmetic product categories can be assured. One primary concern is safety due to potential contamination, so the suitability of the product form for such reuse must be carefully studied and the packaging needs to be designed to withstand a number of such rotations within its life cycle before being recovered, when it can no longer be used (21).

Numerous cosmetic companies are already opting for long-lasting packaging that can be refilled. In the perfumery field, the Spanish brand Equivalenza stands out, offering more than one hundred fragrances in reusable glass bottles (82). On the first purchase, consumers buy a perfume package, which they bring whenever returning to the store, to be refilled for a more affordable price. The make-up brand Inglot provides many eye shadow cases for customers, to be refilled whenever needed (3). Rituals, a cosmetics company with an extensive set of products for home and body, also has a refill collection which, according to the brand, allowed to save 8.5 million litres of water in 2019, along with less waste, less energy and reduced CO₂. Based on the usage of five refills on one original product packaging, Rituals saves up to 75% of water in skincare and 60% in home products, like fragrance sticks (83). Investing in refillable 100% aluminium bottles for their best-sellers and embracing a circular economy approach, The Body Shop introduced refilling schemes in new concept stores. Similarly, P&G Beauty, relaunched its Head & Shoulders, Pantene, Herbal Essences and Aussie products in reusable bottles along with recyclable refill pouches, which are already available in supermarkets and beauty stores (84,85).

This year, L'Oréal-owned Biotherm is launching a new pilot to reduce packaging waste through its first refillable skincare technology, designed for the iconic serum Life Plankton Elixir. Once the bottle is empty, consumers can easily refill it using the Life Plankton Elixir Blue Fountain with the help of a specially trained Beauty Advisor. The process takes place in front of the consumers, creating a unique and immersive experience, and happens in three steps: clean, refill, customize. Life Plankton Elixir's glass bottle is first cleaned with water and completely emptied of any residue. The bottle is then dried with filtered air before being sterilized with UV light. Next, the bottle is placed on the refill set and filled anew from a rechargeable tank. Finally, the bottle is custom-engraved with a wave motif, symbolizing its regeneration and indicating how many times the bottle has undergone the refill process.

Besides, this serum has a high concentration of ingredients that are sensitive to contact with air, like vitamin C, and the refill is made directly into the sanitized bottle, preventing the product's deterioration and keeping the quality, efficiency and safety required for cosmetic products (86).

Whatever the strategy, design, and type of refillable packaging chosen by cosmetic companies, this growing initiative to reduce the environmental impact of cosmetics enables significant water saving and carbon footprint reduction, compared to producing non-refillable packaging, without compromising the product and consumer's experience.

5.7.2 Recycling

Recycling plays a key role in the environmental performance of many materials, and it is widely recognised within the cosmetics industry that the use of recycled and/or recyclable packaging can help reduce the amount of consumer waste sent to landfill. Recycling can be defined as "the reprocessing in a production process of the waste materials into products, materials or substances for the original purpose or for other purposes, including organic recycling but excluding energy recovery", and should be adopted when it results in lower environmental impacts than alternative recovery options, and when other requirements, such as safety, are met (21,73).

Cosmetics companies are increasingly using recycled materials (PCR), including recycled paper, cardboard, glass, aluminium, PP and PET for packaging, rather than virgin materials. For example, launched in 2020, the Nivea Shower Fresh Blends are entirely made from recycled PET (87). Similarly, the bottles used in the Garnier Organic and Ultimate Blends ranges are produced from 100% recycled plastic, and by 2025 Garnier commits to 100% reusable, recyclable or compostable packaging (88). Furthermore, to boost the uptake of recycled plastic, the European Commission is taking action to ensure that by 2030 all plastic packaging placed on the EU market is either reusable or can be recycled in a cost-effective manner (78).

Recyclable packaging is made of components that can be collected and treated by a special industrial process to give rise to a new material. Cosmetic companies cannot guarantee consumers will actually recycle their packaging, but they can do their part, ensuring that the material used in the products is recyclable whenever possible. It is also possible to develop strategies to encourage consumers to recycle and show them how to do it properly. For instance, M.A.C. developed a programme called "Back to M.A.C.", which calls on the consumer to return the primary packaging of the products previously purchased and by returning six empty containers, customers can get a free lipstick of their choosing (89). Adding recycling

instructions and tutorials to the product’s packaging, brands’ websites and social networks will certainly help to improve recycling habits among consumers.

To help businesses and consumers getting serious with recycling, TerraCycle was born in 2001. TerraCycle is an innovative recycling company that has become a global leader in recycling particularly hard-to-recycle waste. Funded by brands, manufacturers, and retailers around the world and using circular methods, its programme collects recyclable consumer and post-consumer waste, so fewer products are incinerated or sent to landfills. TerraCycle partners with companies, like Beiersdorf, P&G and L’Oréal, introducing in-store drop-offs to collect any used or old cosmetics. Then, turns this waste into raw materials that can be recycled into new products or repurposed into new items like watering cans, storage containers or children’s playgrounds, reducing the need to extract new resources from the planet (88,90).

Several people consume cosmetic products daily, generating great quantities of waste. By purchasing consciously, preferring biodegradable products with no packaging, reusable packaging or packaging made with recycled and recyclable materials, as the ones exemplified in table 3, along with recycling the waste in proper bins or sending it to TerraCycle, individual consumption will have a smaller impact on nature and freshwater availability.

Table 3. Examples of sustainable packaging alternatives.

Recyclable Cardboard Packaging		Renewable plastic (PP) packaging	Refillable aluminium packaging
Ex. Garnier Ultimate Blends Shampoo Bar (91) 		Ex. Nivea Naturally Good Regenerating Night Cream (77) 	Ex. Pantene Pro-V Shampoo Refillable Kit (92) 
Naked Product	Mix of paper/plastic packaging	Recycled PET packaging	Recycled and refillable glass packaging
Ex. Lush Jumping Juniper Naked Shampoo Bar (93) 	Ex. Anthelios Eco-conscious Hydrating Lotion SPF 50+ (Eco-Tube) (94) 	Ex. Nivea Shower Fresh Blends (87) 	Ex. Biotherm Life Plankton Elixir (86) 

6 Sustainability Assessment of Cosmetic Products

Assessing sustainability meets an emerging industrial need and requirement to evaluate the impacts of existing products, processes, strategies and technologies, in order to set improvement goals and then report progress. Specifically for the cosmetics industry, sustainability metrics are becoming more important to companies, as it is crucial to define indicators and use specific tools to measure, monitor and evaluate the potential environmental, social and economic impacts of products, contributing to change production patterns, facilitating decision-making and promoting optimization from the beginning (3).

Currently, there are different types of sustainability assessment instruments available, differing in their goal, scope, and data requirements. Based on a Life Cycle Thinking (LCT) approach, considering effects along the supply chain and during the use and end-of-life management of products, the Life Cycle Assessment (LCA) is usually the preferred measurement tool to analyse overall product impacts and the resultant contribution to a company footprint. The LCA is a structured, internationally standardised concept for quantifying the emissions, resources consumed, as well as potential environmental and health impacts that are associated with goods and services, taking into account the product's full life cycle (21,95). The WFP can be applied in the LCA of a product, being a relevant indicator of how much of Earth's scarce freshwater resources are used and its quality, including geographical and time-based considerations.

A cosmetic product WFP is expressed in terms of water volume per unit of product (usually litre/kg) and can be estimated by summing the WFPs of the process steps taken to manufacture the product, considering water consumption and pollution throughout the whole production and supply chain. The WFP assessment refers to the full range of activities to quantify and locate the WFP of a process, product, producer or consumer (including blue-green-grey components); assess the environmental, social and economic sustainability of this WFP; and formulate a response strategy (Figure 9). As a mean of awareness-raising and basis for product choice, labelling of products with their total WFP, like a water label, or making this information available through the internet, while reporting the progress, can be efficient ways to provide product and business transparency and show the company's efforts to offer more sustainable products (12).

With this in mind, cosmetic companies have begun to create and adapt their tools to measure and report sustainability. For instance, L'Oréal's Sustainability, Packaging and Research teams worked, from 2014 to 2016, on developing an innovative tool to assess the environmental and social performance of the group's products, known as the Sustainable Product Optimisation Tool (SPOT). Based on a LCA approach, SPOT uses 14 sustainability

criteria, including water scarcity, from sourcing, production and packaging to consumer use, to measure a product’s impact, but also seeks to identify opportunities to improve the company’s footprint and to share gathered information online with consumers through a comparative score system, so they can make informed choices. Starting with Garnier haircare products, every product is classified in comparison to other products in the same category, on a scale from A to E, where A is the most favourable profile for the planet (Figure 10) (88,96). The Sustainable Packaging Initiative for Cosmetics (SPICE) is an initiative co-created by L’Oréal and the consultancy Quantis in 2020 that unites a number of companies and organisations from the cosmetics sector and releases a science-based eco-design tool to assess the environmental footprint of any cosmetics packaging. This publicly-available SPICE Tool calculates a holistic environmental footprint across the full lifecycle of a product’s packaging, covering 16 environmental indicators (climate change, resource depletion, water use and quality, effects on biodiversity and more), empowering cosmetics packaging engineers to make more sustainable design choices and accelerate innovation toward sustainability (78,97)

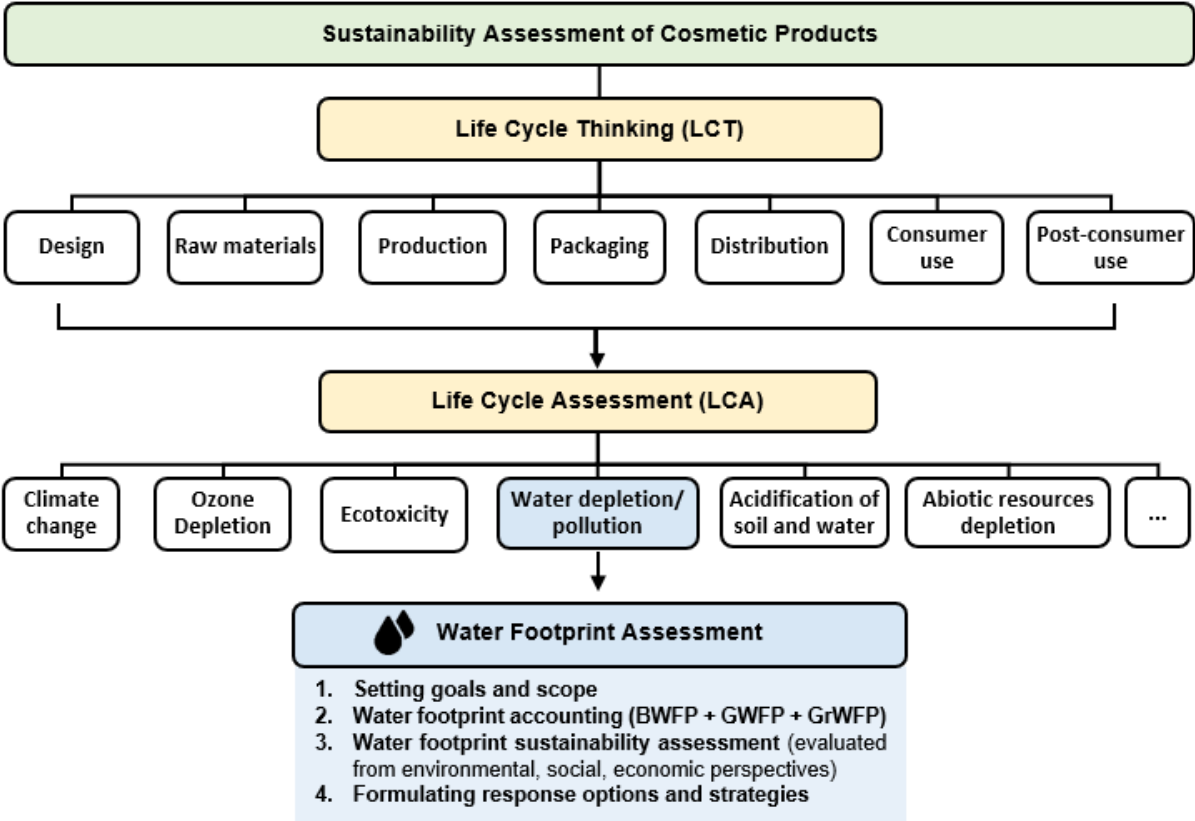


Figure 9. Sustainability Assessment of Cosmetic Products – LCT approach.

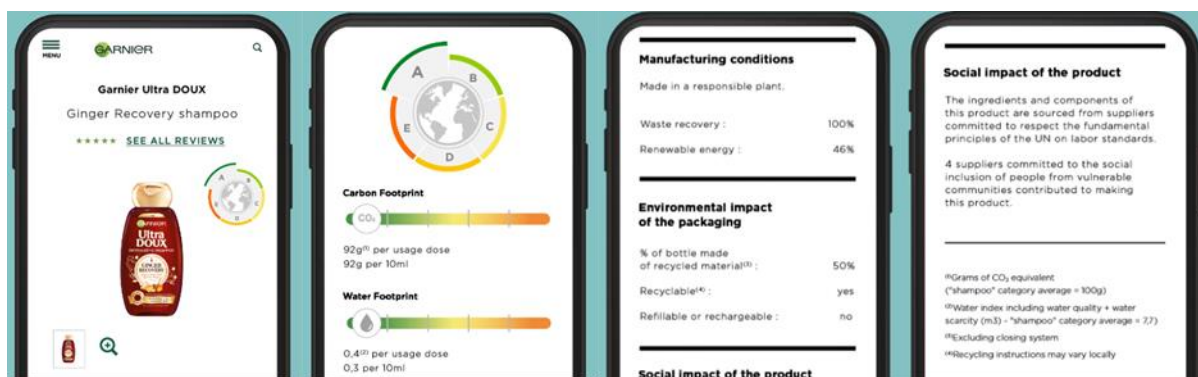


Figure 10. L'Oréal Product Environmental and Social Labelling [Adapted from (96)]

To evaluate companies' environmental performance Carbon Disclosure Project (CDP) was created. This is an independent, non-profit international organisation that runs the global environmental disclosure system and supports thousands of companies of all sectors, cities, states and regions, to measure and manage their risks and opportunities on climate change, water security and deforestation. Every year, CDP attributes scores in the three conducted rankings and releases a public Global Water Report, assessing companies' water management efforts across indicators of governance, strategy, risk management, and disclosure of metrics and targets. L'Oréal is the only company in the world to have been honoured by CDP in 2020 for the fifth year running with an 'A' score, the highest possible, in its ranking of corporate performance on sustainable water management (8,43).

Regarding sustainability certification labels, the EU Ecolabel is a voluntary environmental performance certificate to products and services meeting high environmental standards throughout their life cycle, recognised worldwide. The EU Ecolabel can be awarded to any rinse-off substance or mixture falling under the scope of Regulation (EC) No 1223/2009 on cosmetic products intended to be placed in contact with the epidermis and/or the hair system, with the main purpose of cleaning, to improve the condition of the hair or to protect the epidermis and lubricate the hair before shaving, while guaranteeing reduced impact on aquatic ecosystems, fulfilling strict biodegradability requirements, and having limited packaging waste (98). Alternatively, UL's Environmental and Sustainability certifications are also recognized by buyers and purchasing organizations around the world. As the global safety science leader, UL helps companies meet regulatory requirements and deliver safer, more sustainable cosmetics and PCP to the market, providing full-cycle supply chain quality assurance testing. Specifically, a WFP certificate from UL, in accordance with ISO 14046:2014 (which specifies principles, requirements and guidelines related to WFP assessment of products, processes and organizations based on LCA), ensures consumers that the claims made about products have been tested and verified to a rigorous set of science-based standards (99).

Acquiring a water sustainability certification will certainly help to easily identify products as safe for both people and the planet so that consumers can make informed, sustainable consumption choices and contribute to a positive change (Figure 11).



Figure 11. Examples of Sustainability Certifications, including WFP assessment.

7 Future Challenges

As cosmetics are an essential part of everyday life, it is crucial to develop more environment-friendly products and reduce their overall impact on the planet, namely on freshwater resources. But, concerning water, creating sustainable products can be a challenge for cosmetic companies and it still has a lot to evolve.

First, it is true that waterless products are usually more complex to formulate and manufacture, and can limit the texture possibilities. Water has been one of the main ingredients in cosmetics, and water-based products like creams and lotions have organoleptic characteristics pleasant to use, with a fresh and easy application. It is important to ensure the ingredients used to replace water will add to the performance and not affect consistency, stability and the sensory experience expected by consumers in beauty products. Actually, one of the great challenges of the cosmetic industry in terms of formulating sustainable alternatives, is that the consumer expects the same quality and efficacy of a “non-sustainable” product.

Regarding manufacturing, because many formats of waterless products are solid or powder, with low moisture content, proper equipment and safety measures are needed to handle proper mixing and blending of ingredients. In addition, sourcing raw materials and alternative ingredients to freshwater can also be an issue (39). All these concerns may prevent companies from investing and replacing their conventional products with more sustainable alternatives.

Concerning the product's packaging, the cosmetics industry recognises that consumers frequently have aesthetic expectations, thus packaging must be designed in such a way that it communicates to and meets the expectations of the consumer regarding product performance and design. Hence, it can be a challenge for packaging designers to maintain or enhance the consumer acceptance and impact of the packaging, while supporting sustainability objectives. When developing recyclable packaging and refillable packaging systems, the convenience for the customers must also be considered. If the recycling procedures are not easy to understand, the consumer will not properly recycle the packaging, and the cosmetic industries efforts will be worthless (40).

The access to waterless products is still another major challenge. There is still little offer in local physical stores and many of these products, especially from smaller brands, can only be bought online, often must be shipped internationally, which takes time and might not be convenient to every consumer. Furthermore, the simple fact that people are used to consuming a certain product is a barrier to wanting to risk trying more sustainable alternatives. Most products, like shampoo, toothpaste, and deodorant, became part of our everyday hygiene and most preferences are commonly based on the price and ease of purchase, at the supermarket

and local stores for example, instead of the environmental-friendliness of the product (100). This is the reason why it is so important to encourage consumers, providing accessible alternative products they can trust, and showing them the positive impact they can have on the planet by changing consumption patterns.

Inevitably, there is also an economic challenge. Reducing water throughout the cosmetic products life cycle requires initial investment and can significantly increase the cost of manufacturing. Water is one of the cheapest ingredients and its replacement with high quality natural botanical hydrators or oils, more ethically sourced, will probably originate more expensive products. Sustainable packaging materials also cost more than conventional materials, with PET costing up to 20% more than virgin plastic, so the goal is to use 100% PCR packaging (88). Plus, the technology needed to manufacture these products and optimize production processes to minimize water dependence, tends to have an additional cost. However, this should not discourage consumers nor producers, because most sustainable initiatives will have a positive return on investment over time. Reducing water also means reducing waste and improving efficiency, and developing more concentrated products, that last longer and do not need to be so frequently renewed (41).

Several people are not yet aware about water and how their consumption and disposal habits can have a huge impact on water scarcity. To move towards more sustainable consumption patterns and make significant changes, a partnership approach between industry, regulators, consumers and other stakeholders is required (21). This partnership should aim to provide environmental information on product categories and related processes, as well as educate consumers on the importance of preserving water resources and how to use alternative formats of products and correctly dispose of them. Companies, whether large or small, must maintain an open dialogue with society, and communicate past achievements and future priorities on the road to water sustainability.

8 Conclusion

Water scarcity can be an abstract concept to many, but it is a hard reality to several others. While the amount of freshwater on the planet has remained fairly constant over time, being continually recycled through the atmosphere, the population has been increasing immensely, climate change has been intensifying and businesses risk draining the planet's finite freshwater resources and polluting what remains. This means that, if behaviours do not significantly change, water will soon become a luxury for everyone, and future wars will be fought over this precious and diminishing resource.

To prevent the worst impacts of water scarcity, pollution, and damage to people, the planet and business, companies need to undertake a paradigm shift in their water stewardship and management. Cosmetic companies are getting conscious of this global crisis and starting to improve the water sustainability of their products and practices. It is key to note that it is not possible for a product to not use any water in any part of its life cycle and supply chain. However, with appropriate strategies, it is possible to drastically reduce the impacts of any type of cosmetic product on freshwater resources.

Based on a Life Cycle Thinking approach, companies can act in multiple strands, from developing new waterless formulas, responsible sourcing ingredients and finding alternative water sources, implementing optimized production processes and adopting circular water management in their facilities, designing biodegradable, recyclable and reusable packaging when needed, adapting their distribution practices and reducing the frequency of deliveries, to finally inspire consumers to use and dispose of the products in a sustainable manner. This way, cosmetic companies will surely be able to reduce their WFP with the potential to achieve long-term cost savings and a more resilient future, while enabling consumers to benefit from safe and effective products with better sustainability profiles and adopt more sustainable consumption habits.

Environmental sustainability programmes, regulations and certifications related to water consumption and pollution will certainly continue evolving in the future, and the cosmetic industry must continue its journey to guarantee access to water-friendly products and look for innovative ways to progress. Protecting the environment and Earth's natural resources is everyone's responsibility and success is more easily achieved if businesses and communities work together, with individual everyday contributions helping attain a water-secure world.

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ANNEXES




A1. Waterless Cosmetics

Category		Product	Description / claims	Ingredients (INCI)	Reference
Oral Care	Toothpaste	Ecoliving Toothpaste tablets 	Toothpaste tablets packed in compostable pouch or a recyclable metal tin. 1 or 2 months' supply 100% vegan, plastic free	Sorbitol, Calcium carbonate, Kaolin, Sodium bicarbonate, Sodium lauroyl sarcosinate, Hydrated silica, Maltodextrin, Yeast extract, Sodium monofluorophosphate, Magnesium stearate, <i>Mentha arvensis</i> leaf oil, Menthol, Stevioside, <i>Mentha piperita</i> oil.	(101)
	Facial cleanser / Make-up remover	The Body Shop Camomile Sumptuous Cleansing Butter 	Gently removes make-up and impurities. Suitable for sensitive skin.	Ethylhexyl palmitate, Synthetic wax, PEG-20 Glyceryl triisostearate, <i>Olea europaea</i> fruit oil, <i>Butyrospermum parkii</i> butter, Caprylyl glycol, Tocopherol, Parfum, Aqua, Linalool, Limonene, <i>Helianthus annuus</i> seed oil, <i>Anthemis nobilis</i> flower extract, Citric acid.	(102)
Skincare	Serum	The Ordinary Vitamin C Suspension 23% + HA Spheres 2% 	Water-free, silicone-free stable suspension. Visibly reduces multiple signs of aging and brightens the skin tone.	Ascorbic acid, Squalane, Isodecyl neopentanoate, Isononyl isononanoate, Coconut alkanes, Ethylene/propylene/styrene copolymer, Ethylhexyl palmitate, Silica dimethyl silylate, Sodium hyaluronate, Glucomannan, Coco-caprylate/caprates, Butylene/ethylene/styrene copolymer, Acrylates/ethylhexyl acrylate crosspolymer, Trihydroxystearin, BHT.	(103)
	Moisturizer	Lush Enzymion Hydrating face cream 	Leaves oily skin feeling fresh, matte, bright and light. Made with real fruit juices and a dose of soothing aloe vera. Recycled black pot can be returned to Lush to be recycled again.	<i>Citrus limonum</i> , <i>Aloe barbadensis</i> , <i>Theobroma cacao</i> , stearic acid, <i>Persea gratissima</i> *, Glycerine, <i>Carica papaya</i> , Triethanolamine, <i>Oenothera biennis</i> *, <i>Triticum vulgare</i> *, <i>Citrus reticulata</i> , <i>Citrus aurantifolia</i> , <i>Citrus limonum</i> , Cetearyl Alcohol, Citral**, Citronellol**, Limonene**, Fragrance, Metylparaben, Propylparaben. *Cold pressed oil, **Essential oils	(104)
	Facial Mask	Ede Born again treat mask 	A brightening and resurfacing powder mask to trickle in water.	Kaolin, <i>Moringa oleifera</i> leaf powder, Ascorbic Acid, <i>Ananas sativus</i> fruit powder, <i>Carica papaya</i> fruit extract.	(105)

Category		Product	Description / claims	Ingredients (INCI)	Reference
Skincare	Shaving Cream	<p>Umai The solid shaving cream</p> 	<p>Made of seaweed extract to apply on wet skin, for a smooth and irritation-free shave. Case made of textile cotton scraps and recycled paper fibres. 100% compostable</p>	<p>Sodium cocoyl isethionate, Palmitic acid, Stearic acid, Sodium stearate, Aqua, Glycerin, Parfum, Citric acid, Algin.</p>	(106)
	Deodorant	<p>Ben&Anna Deodorant Papertube – Pure</p> 	<p>Effective protection against odor and wetness. 100% Natural origin FSC certified paper packaging</p>	<p>Sodium bicarbonate, <i>Zea mays</i> starch, <i>Maranta arundinacea</i> root powder, <i>Butyrospermum parkii</i> butter, Cetyl alcohol, Stearyl alcohol, <i>Cocos nucifera</i> oil, <i>Helianthus annuus</i> seed cera, <i>Helianthus annuus</i> seed oil, Cococaprylate/caprate, <i>Ricinus communis</i> seed oil, <i>Rhus verniciflua</i> peel cera, <i>Shorea robusta</i> resin, Caprylic/capric triglyceride, <i>Daucus carota sativa</i> root extract, <i>Rosmarinus officinalis</i> leaf extract, <i>Rosmarinus officinalis</i> leaf oil, <i>Simmondsia chinensis</i> seed oil, Ascorbyl palmitate, Tocopherol, Limonene.</p>	(107)
Body Care	Shower oil	<p>Rituals The Ritual of Karma Shower Oil</p> 	<p>Intensely hydrating shower oil to be applied on dampened skin and massage with a rotating movement until it transforms into a silky soft foam.</p>	<p>Canola oil, Laureth-4, MIPA-Laureth sulfate, Parfum/fragrance, Polyglyceryl-3 diisostearate, <i>Ricinus communis</i> (Castor) seed oil, Tocopherol, <i>Helianthus annuus</i> (Sunflower) hybrid oil, <i>Camellia sinensis</i> leaf extract, <i>Nelumbo nucifera</i> flower extract, Propylene glycol, Laureth-2, Benzyl alcohol, Benzyl salicylate, Limonene, Linalool, Hexyl cinnamal, Alpha-isomethyl ionone, Citronellol, Citral.</p>	(108)
	Body Scrub	<p>Unii Blooming Salt</p> 	<p>Nourishing body scrub made with Portuguese salt, cork and grape seed oil, to be applied on wet skin.</p>	<p>Sodium chloride, <i>Vitis vinifera</i> seed oil, <i>Helianthus annuus</i> oil, <i>Olea europaea</i> fruit oil, <i>Prunus amygdalus dulcis</i> oil, <i>Quercus suber</i> bark, <i>Pelargonium graveolens</i> flower oil, <i>Cananga odorata</i> flower oil, <i>Litsea cubeba</i> fruit oil, <i>Cedrus atlantica</i> wood oil, <i>Zingiber officinale</i> root oil, <i>Citrus limon</i> peel oil, Tocopherol, Limonene, Linalol, Geraniol, Citronellol.</p>	(109)
	Body lotion	<p>Ethique Hydrating Body Lotion Concentrate</p> 	<p>Concentrated bars to mix with boiling water to make a fresh batch of 350 ml creamy, hydrating liquid body lotion in minutes. Certified compostable cardboard packaging.</p>	<p>Behentrimonium methosulfate, <i>Theobroma cacao</i> (cocoa) butter, Vegetable glycerine, <i>Cocos nucifera</i> oil, Brassica alcohol, Benzyl alcohol, <i>Citrus aurantifolia</i> essential oil, Xanthan gum, <i>Eucalyptus globulus</i> (eucalyptus) essential oil, Dehydroacetic acid, Water, Limonene, Citral, Linalool.</p>	(110)

Category	Product	Description / claims	Ingredients (INCI)	Reference
Hair Care	Garnier UltimateBlends Coconut Hydrating Shampoo Bar 	Shampoo bar, easy to lather and fast rinsed. 97% Biodegradable formula with sustainably sourced Coconut oil & Organic Aloe Vera. Lasts for up to 2 months. Packaging made from 100% recyclable FSC certified cardboard.	Sodium cocoyl isethionate, Hydrogenated vegetable oil, Aqua/water, Polyglyceryl-4 laurate, Glycerin, <i>Argania spinosa</i> kernel oil, fragrance, <i>Aloe barbadensis</i> leaf juice powder, <i>Cocos nucifera</i> oil/ coconut oil, Myristyl lactate, Tetrasodium glutamate diacetate, Linalool, Coumarin, Limonene, Citronellol, Benzyl alcohol.	(91)
	Waterless Dry shampoo no residue 	Dry shampoo mousse that absorbs oil and refreshes hair without using water, leaving no residue and.	Isobutane, Alcohol denaturated, Propane, Tapioca starch, Silica, Fragrance, Dimethylsiloxane, Panthenyl ethyl ether, Panthenol, Niacinamide, Caffeine.	(111)
	Foamie Coconut oil solid conditioner 	Conditioner bar suitable for normal hair 3 in 1 solid hair care: massages, cleanses and conditions. 100% plastic-free	Sodium cocoyl isethionate, Hydrogenated vegetable oil, Aqua, Polyglyceryl-4 laurate, Glycerin, Parfum, Panthenol, Cetyl alcohol, <i>Cocos nucifera</i> (Coconut) Oil, Behentrimonium chloride, Lactic acid, Tetrasodium glutamate diacetate, Limonene, <i>Triticum vulgare</i> (Wheat) bran extract, Linoleic acid, CI 77492 (Iron oxides).	(112)
	Musa Solid Tips Serum 	Solid serum for all types of hair. Directly applied after washing the hair. Plastic free, handmade, zero waste, biodegradable.	Cetearyl alcohol and behentrimonium methosulfate, <i>Ricinus communis</i> (Castor) seed oil, Cetyl alcohol, <i>Theobroma cacao</i> (Cocoa) seed butter, <i>Solanum lycopersicum</i> seed oil, Parfum, Tocopherol, C.I. 77019, C.I. 77491, C.I. 77891.	(113)
	Klorane Mask Powder with Organic Nettle and Clay 	Purifying treatment mask in powder-to-liquid formula that delivers instant oil reduction. Biodegradable formula 100% recyclable packaging.	Sodium cocoyl isethionate, <i>Zea mays</i> starch, <i>Oryza sativa</i> starch, Hectorite, Kaolin, Coconut acid, <i>Acacia senegal</i> gum, parfum, <i>Urtica dioica</i> root extract, Glyceryl laurate, <i>Bambusa arundinacea</i> juice, Polyquaternium-10, polysorbate20, Propylene glycol, Water, Xanthan gum.	(114)
Sun Care	Sol de Ibiza Face & Body Plastic Free Tin SPF50 	Natural mineral sunscreen, water-resistant, organic ingredients, waterless. Plastic-free, aluminium packaging, 100% recyclable and reusable.	Caprylic/capric triglyceride, Zinc oxide, Silica, <i>Euphorbia cerifera</i> cera, <i>Cocos nucifera</i> oil, <i>Prunus amygdalus dulcis</i> oil, Cetyl alcohol, Polyhydroxystearic acid, Tocopheryl acetate, <i>Calendula officinalis</i> flower extract, <i>Helianthus annuus</i> seed oil, <i>Aloe barbadensis</i> leaf juice, Lecithin, Tocopherol, Ascorbyl palmitate, Oryzanol, Citric acid.	(115)

Category	Product	Description / claims	Ingredients (INCI)	Reference
Decorative Cosmetics / Make-up	<p>Lush Feeling Younger Highlighter</p> 	<p>Skin-soothing and hydrating highlighter, gives all skin types a natural, luminous glow.</p> <p>Made with plastic-free shimmer.</p>	<p><i>Avena sativa</i>, <i>Citrus aurantium amara</i> (Orange Flower water), <i>Prunus dulcis</i> (Almond Oil), Titanium dioxide, Synthetic fluorophlogopite, <i>Theobroma cacao</i> (Fair trade organic cocoa butter), Glycerine, Stearic acid, Triethanolamine, <i>Simmondsia chinensis</i> (organic jojoba oil), Cetearyl alcohol, Methylparaben, Propylparaben.</p>	(116)
	<p>Vapour Beauty Bronzing powder</p> 	<p>Silky smooth vegan bronzing powder, waterless.</p> <p>FSC Certified paper box Terracycle® for recycling packaging. Vapour donates \$1 from every Bronzing Powder sold to protect freshwater rivers and streams.</p>	<p>Mica, <i>Zea mays</i> Starch, Magnesium stearate, Zinc stearate, Silica, Octyldodecyl stearyl stearate, Squalane, Glyceryl caprylate, Lauroyl lysine, P-Anisic acid, Pentylene glycol, Cinnamic acid, Glyceryl undecylenate; May contain +/-: CI 77891/Titanium dioxide; CI 77491, CI 77492, CI 77499/Iron oxides</p>	(117)
	<p>Pinch of Colour Matte Velvet Waterless Lip Colour Amelia</p> 	<p>Matte lipstick, waterless.</p>	<p>Phenyl trimethicone, Dicaprylyl carbonate, Ceresin, Silica, Kaolin, Talc, Polyglyceryl-2 triisostearate, Caprylic/capric/ myristic/stearic triglyceride, Caprylic/capric triglyceride, Microcrystalline wax, Iron oxide yellow, Titanium dioxide, <i>Copernicia cerifera</i> wax, Mica, Red 7, Polybutene, Iron oxide black, Tocopheryl acetate, Dimethicone, Fragrance, Red 27, Methicone, <i>Mangifera indica</i> seed butter, <i>Rosa canina</i> fruit oil.</p>	(118)
	<p>The Body Shop All-in-One Face Base</p> 	<p>Compact high-coverage foundation and setting powder in one product.</p>	<p>Talc, Dimethicone, Silica, <i>Zea mays</i> starch, Polymethyl methacrylate, Zinc stearate, Ethylhexyl methoxycinnamate, <i>Sclerocarya birrea</i> seed oil, Octyldodecyl lactate, Pentylene glycol, Tocopheryl acetate, Benzyl PCA, Tocopherol, Lauryl alcohol, PCA.</p>	(119)
	<p>Le Papier Lip Balm Pure</p> 	<p>Sustainable lip balm based on natural ingredients.</p> <p>Biodegradable, paper packaging, plastic-free.</p>	<p><i>Simmondsia chinensis</i> seed oil, <i>Prunus amygdalus dulcis</i> oil, Caprylic/capric triglyceride, Hydrogenated coconut oil, <i>Butyrospermum parkii</i> butter, Hydrogenated soy polyglycerides, Stearyl heptanoate, Coco-caprylate/caprato, <i>Oryza sativa</i> bran wax, Hydrogenated castor oil, Stearyl caprylate, Dilinoleic acid/propanediol copolymer, <i>Helianthus annuus</i> seed wax, <i>Oryza sativa</i> bran oil, Tocopherol, <i>Vanilla planifolia</i> fruit extract, Glycine soja oil.</p>	(120)

Category	Product	Description / claims	Ingredients (INCI)	Reference
Decorative Cosmetics / Make-up	<p>MAC Cosmetics Eye Shadow Yogurt</p> 	<p>Saturated eye shadow, highly pigmented pressed powder, can be used wet or dry.</p>	<p>Talc, Zinc stearate, Octyldodecyl stearoyl stearate, Isostearyl neopentanoate, Tocopheryl acetate, Caprylyl glycol, Hexylene glycol, Phenoxyethanol, [+/- Silica, Mica, Titanium dioxide, Iron oxides (Ci 77491, Ci 77492, Ci 77499), Bismuth oxychloride, Blue 1 Lake (Ci 42090), Carmine, Chromium hydroxide green (Ci 77289), Chromium oxide greens (Ci 77288), Ferric ferrocyanide (Ci 77510), Manganese violet (Ci 77742), Red 40 Lake (Ci 16035), Ultramarines (Ci 77007), Yellow 5 Lake (Ci 19140)].</p>	(121)
	<p>L'Oréal Paris Lash Paradise™ Washable Mascara</p> 	<p>Voluptuous volume and intense length mascara, water-free, easily removed with soap and water.</p>	<p>Ethylene, Acrylic acid copolymer, Styrene acrylates, Ammonium methacrylate, copolymer, <i>Cera alba</i>, bees wax cire dabeille, Synthetic beeswax, Bis-diglyceryl polyacyladipate-2, Polybutene cetyl alcohol, Steareth-20, Glyceryl dibehenate, Steareth-2, Phenoxyethanol hydroxyethylcellulose, <i>Acacia senegal</i> gum, Tribehenin, Caprylyl glycol, Glyceryl behenate, Sodium dehydroacetate, Hydrogenated jojoba oil, Hydrogenated palm oil, Disodium EDTA, Butylene glycol sodium laureth sulfate, Silica, Tetrasodium EDTA, Potassium sorbate bht.</p>	(122)
Perfume	<p>Lush Rose Jam Solid Perfume</p> 	<p>Travel-friendly solid perfume to melt onto skin. Recyclable glass pot made from up to 10% recycled material.</p>	<p><i>Simmondsia chinensis</i>, <i>Ricinus communis</i>, <i>Euphorbia cerifera</i>, fragrance, Citronellol, Geranoil, <i>Rosa damascena</i>, <i>Pelargonium graveolens</i>, <i>Citrus limonum</i>, Citral, Coumarin, Eugenol, Farnesol, Limonene, Linalool, Red 7 Lake.</p>	(123)