



Object Lesson Final Report

Anushritha Sunil

12/11/2020

Sustainability and Production, IND-487

Pr: Frank Millero



Source: [You can watch the video here](#)  
How to master your sense of smell -  
Alexandra Horowitz, Ted-ed

**A D R O P   I N   T H E   O C E A N**



# Estagnon

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KOHL VASE



GREEK CERAMIC VASE



POMANDER



JEWEL BOTTLE



LOUIS XIV PERFUME BURNER



FABERGÉ BOTTLE



VIOLET BOTTLE



ROSINE BOTTLE BY PAUL POIRET



WORTH BOTTLE



FRAGONARD BOTTLE



RELIEF BOTTLE BY FORVIL



ZUT BOTTLE BY ELSA SCHIAPARELLI

3000 BC

15th Century

18th Century

19th Century

20th Century

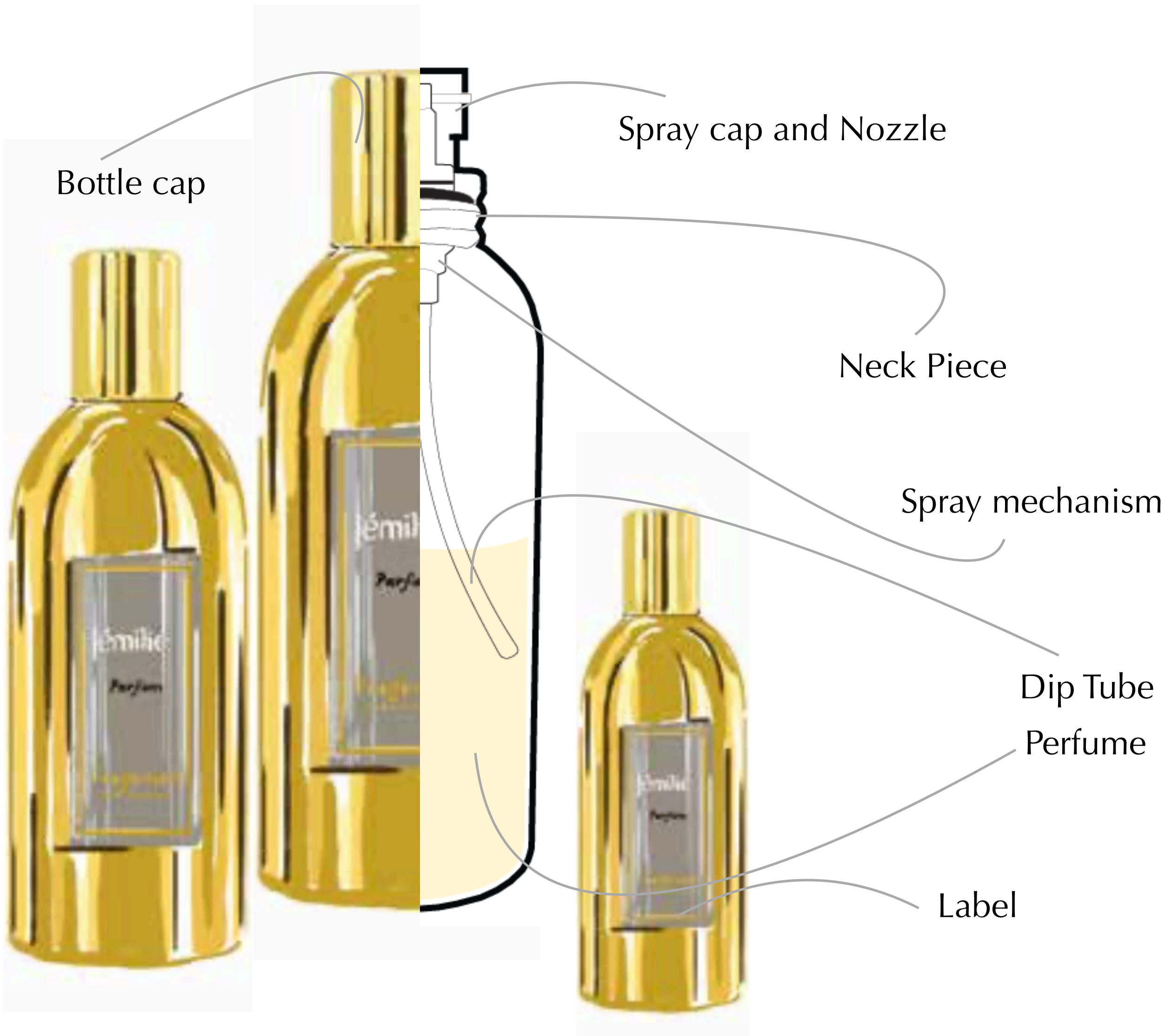


Copper Estagnons - Around 1850-1900



# Anatomy

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# The Story





I came across this modern day Estagnon, 6 years ago, when I visited the Fragonard perfume factory in Grasse, France. I purchased a sample bottle at the end of the factory tour in the perfume store. This golden bottle has a mysterious appearance and looked less like a perfume bottle. I did not use this perfume for a long time until I carried this travel size bottle with me to New York and fell in love with the fragrance.



# Inventory

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	Bottle	Bottle cap	Spray cap and Nozzle	Neck Piece	Dip Tube	Label	Gasket	Perfume
	Gold gilded Aluminum	Gold gilded Aluminum	Polypropylene	Gold gilded Aluminum	Polypropylene	Paper	Rubber	Absolute
	Impact Extrusion	Impact Extrusion	Injection Moulding	Impact Extrusion	Injection Moulding	Hot Stamping	Machine Stamping	Distillation



# Why choose Aluminum?

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A DROP IN THE OCEAN

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- Protects the precious elixirs from light and considerably extending their lifespan
- Refillable
- 100% recyclable
- Advantages: Light weight, soft ,good conductor of electricity, noncorrosive
- **Disadvantages:** Not suitable for high temp environments, Low strength
- **Competing materials:** Steel, Plastic , glass

75%

of all aluminum ever produced is still in use today.

Source: Fragonard Magazine\_2020, "Aluminium (US: Aluminum)". Chemguide.Co.Uk, 2020, <https://www.chemguide.co.uk/inorganic/extraction/aluminium.html>.



Source: [You can watch the video here](#), Producing Endless Possibilities: Alcoa Global Bauxite, ALCOA

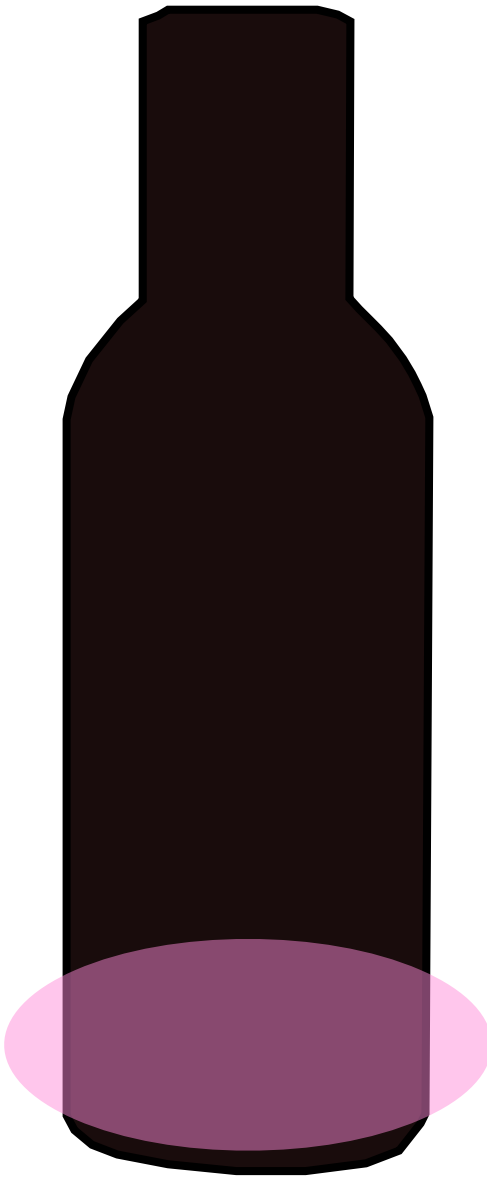
69%

Global recycling rate.(2017)

# Perfume



Source: [You can watch the video here](#), FRAGONARD PARFUMEUR CELEBRE SES 90 ANS, FRAGONARD PARFUMEUR



Alcohol

10-20% Absolute/oil

Top notes

Heart notes

*Base notes*



OLFACTORY PYRAMID

3 tons of flowers →

1 litre of oil

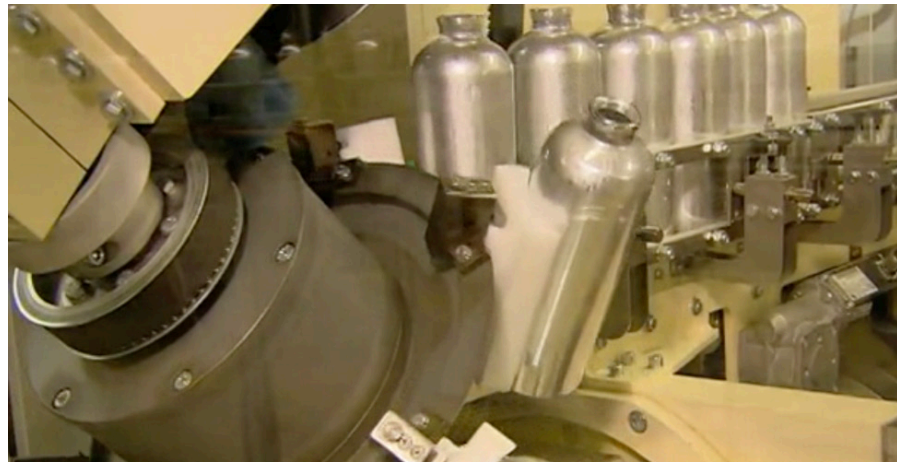
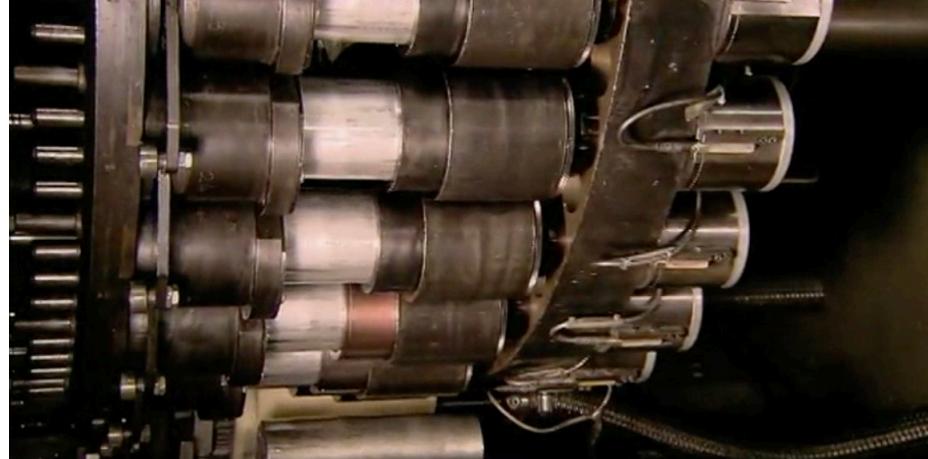
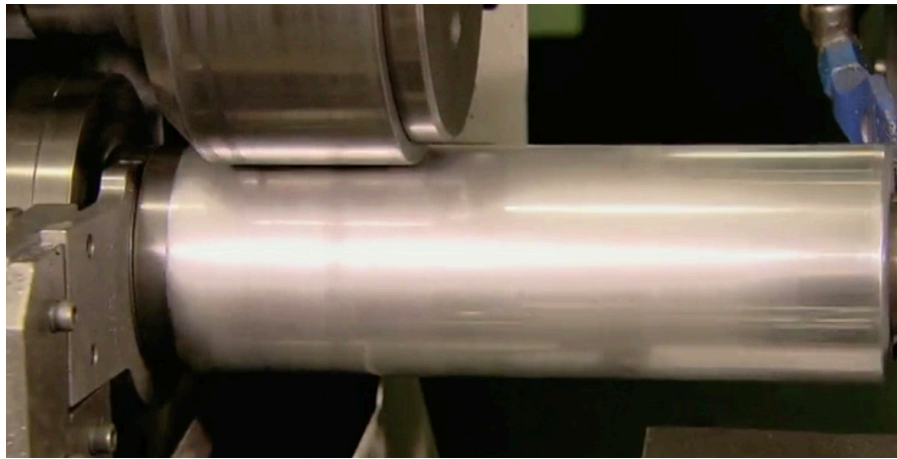
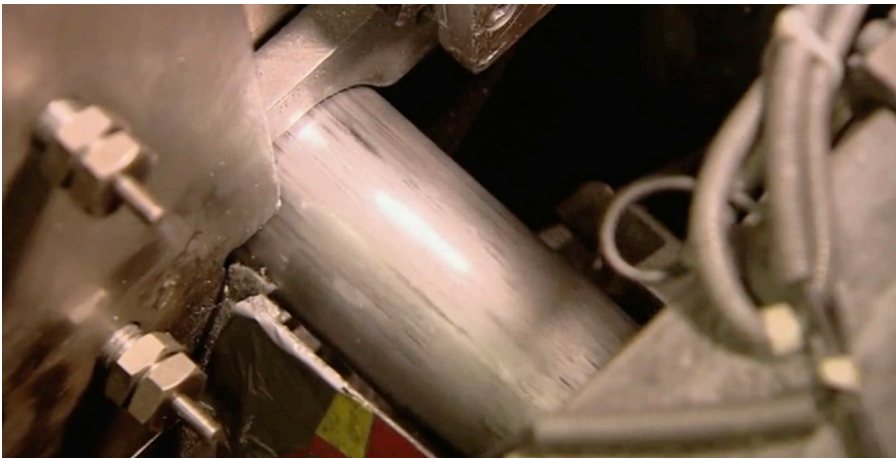
800-1000 varieties →

Scent

Source: "How Perfume Is Made - Material, Manufacture, Making, History, Used, Parts, Industry, History, Raw Materials". Madehow.Com, 2020, <http://www.madehow.com/Volume-2/Perfume.html>.



# Aluminium Bottle Production



Impact Extrusion

Source:2020, <https://www.sciencechannel.com/tv-shows/how-its-made/videos/aluminum-water-bottles>.



# Perfume production

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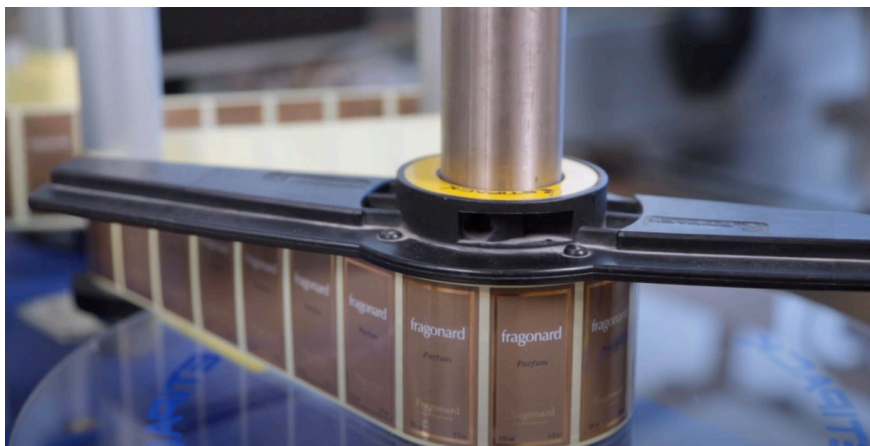
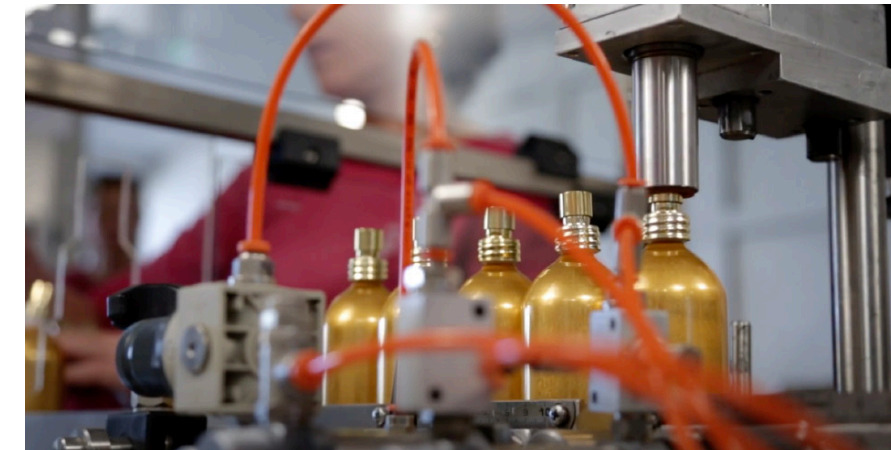
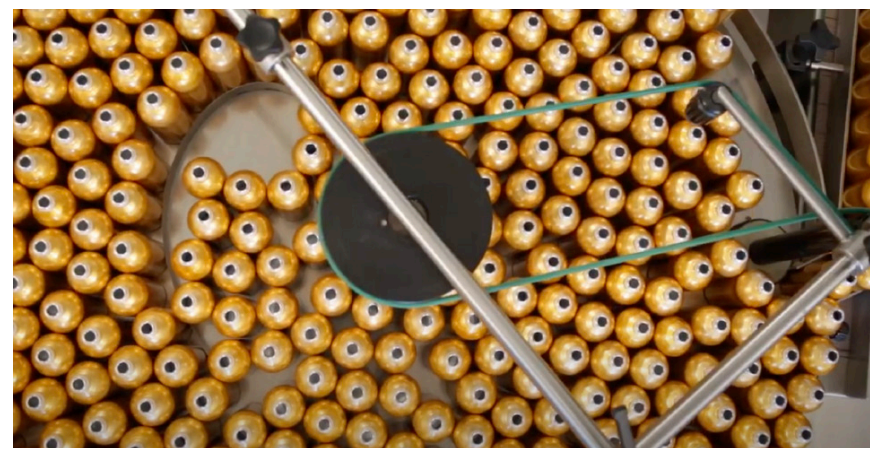
# Assembly

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# The Product



## Belle Chérie



### PERFUME

Belle Chérie in its flowery Bag: A bouquet of flowers, fruits, and wood to celebrate this carefree fragrance: A top note of tangerine and star fruit, a middle note of jasmine, heliotrope and lily-of-the-valley and a back note of sandalwood, tonka bean and vanilla.



### OLFACTORY PYRAMID

Top notes mandarin, starfruit, cinnamon  
Heart notes jasmine, heliotrope, lily of the valley  
Base notes sandalwood, tonka bean, vanilla

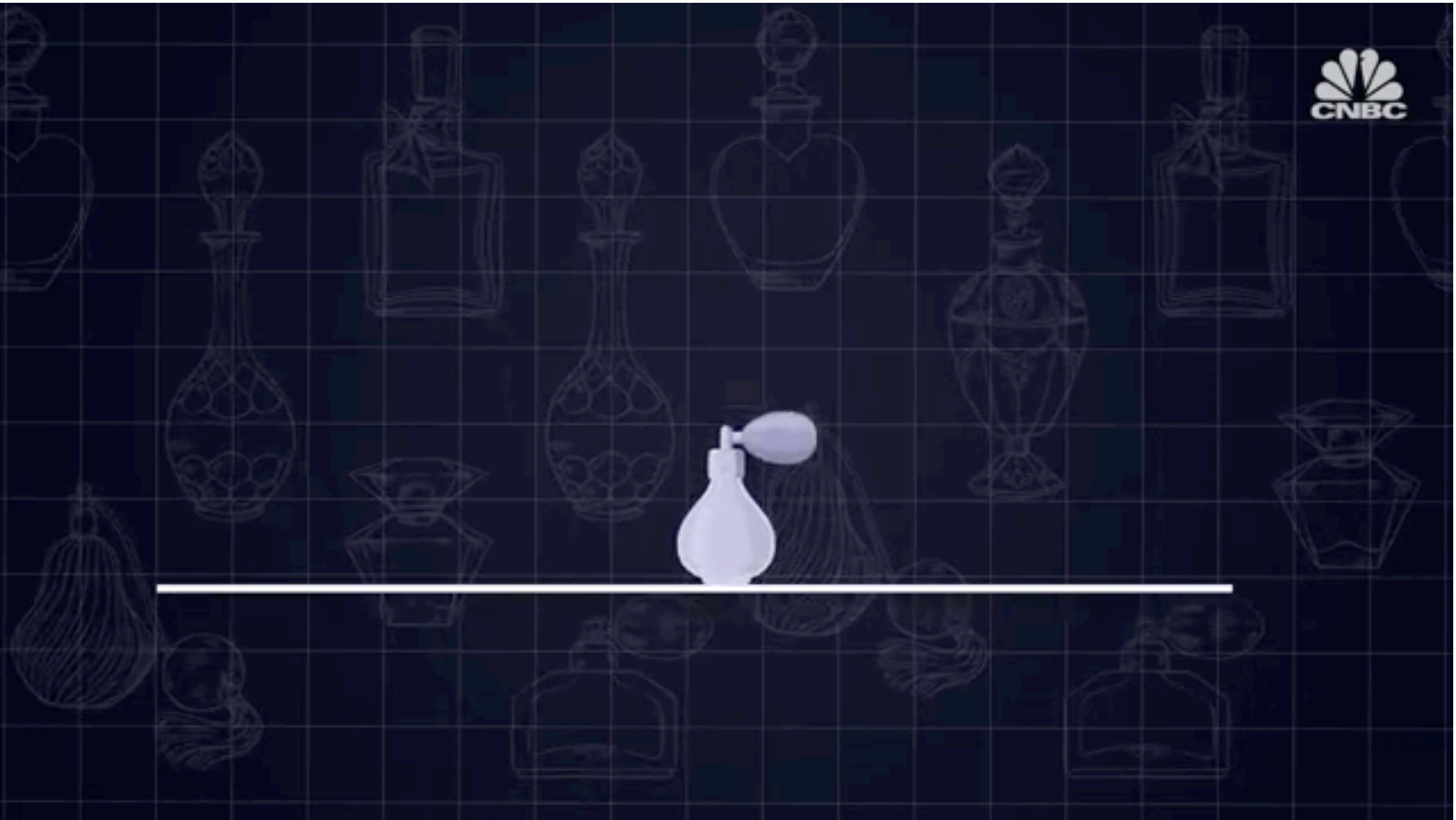
### Gilded Alu Natural Spray 120 ml

REF F0120BC

90.00 €

75,00 €/100ml

### QUANTITY

Source: [You can watch the video here](#), Here's how your designer perfume is really made | CNBC Reports

\$106/120ml

3 years/life span

8-10 hours/longevity

4 fl.oz/weight

Source: "Article - Belle Chérie Perfume". Fragonard.Com, 2020, <https://www.fragonard.com/en/product/F0120BC/women/pouches%20collection/belle%20cherie%20perfume>.





Purchased in 1926, this 18th century tannery became a perfume factory at the very beginning of the following century. Fully renovated and transformed in 2015, the historical factory offers an original journey of discovery into the mysteries of traditional perfume making, from processing the raw materials to packaging the finished products. The machines used, from the copper stills to those in the soap workshops, provide an interesting glimpse of the historical, social and cultural aspects of the techniques and working conditions that prevailed in family-run perfume factories until the 1950s.

A visit to the perfume museum located in the building takes you into the world of perfume from antiquity to the present day. Precious perfumery objects (Egyptian blush spoons, medieval pomanders, etc.) are showcased alongside paintings of women grooming and antique Provençal furniture.

What makes Fragonard so interesting it was the first perfumery to sell perfumery products directly to customers (tourists and locals alike in the French Riviera).



Source: Fragonard Parfumeur. 2020. Visit Of The Historic Perfumery Factory Of Grasse. Available at: <<https://usines-parfum.fragonard.com/en/factories/the-historical-factory/>>

# FRAGONARD



Marketing: Factory Tours



All the stores are concentrated in Europe

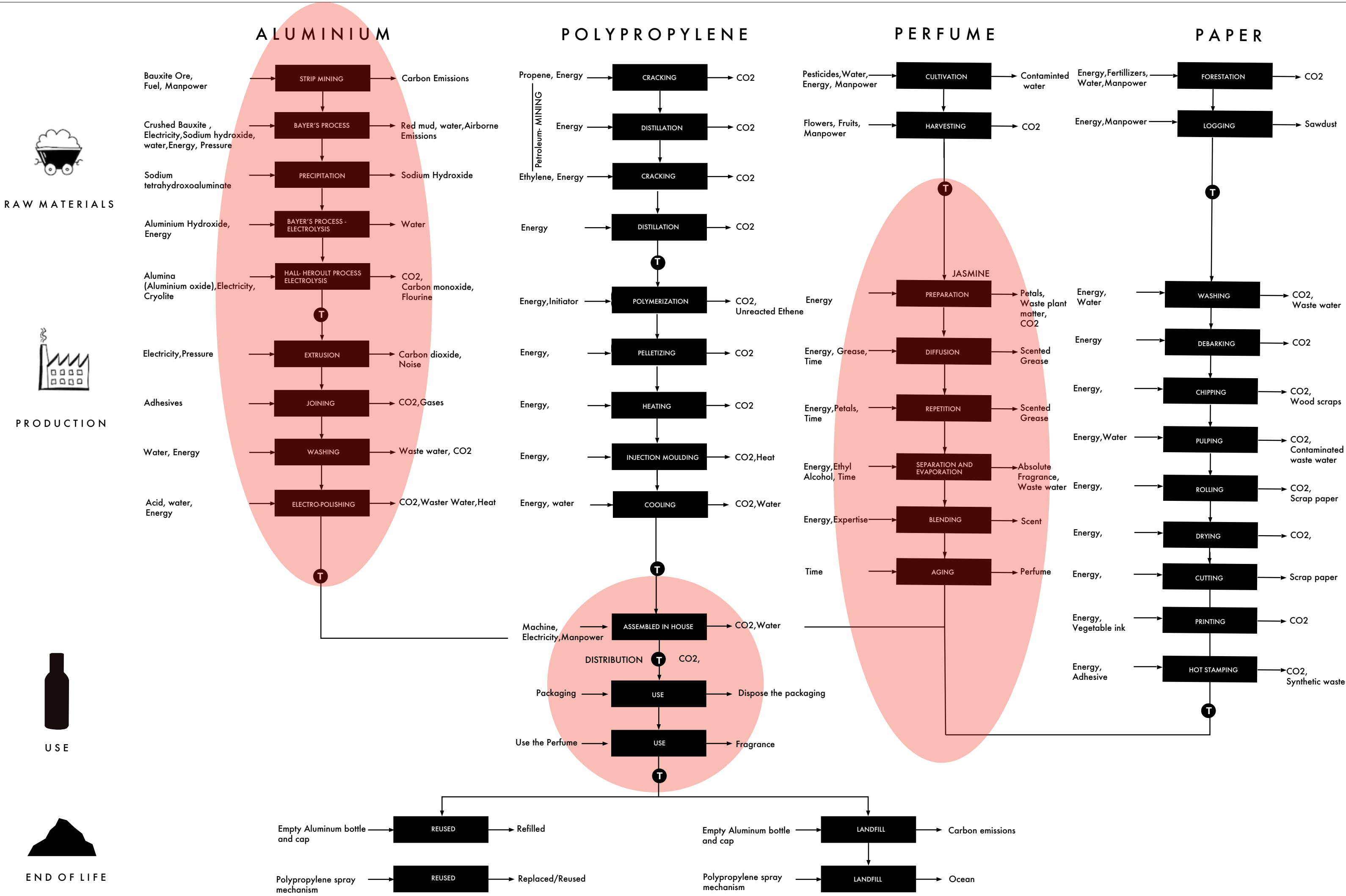


STORES



# Process Tree

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# Associations

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Source: [You can watch the video here](#), JOY by Dior – The new fragrance, *Christian Dior*



# Ecological damage



Plastic parts in the ocean



Bauxite residue, *Western Australia*



Is perfume vegan?

ECOLOGICAL DAMAGE



Many fragrances are made of a complex recipe of ingredients - all of which grow naturally in different parts of the world and require transportation between growth, extraction, and fragrance mixing.

Animal testing

Very high energy use. The amount of energy needed to make aluminium is 211 GJ per tonne

Smelting uses large amounts of water

Emissions to air and water from processing, some of which are hazardous

Highly specific materials for perfume making increases the carbon foot print.

The bottle contains parts made of different materials that involve transportation to the assembly unit.

Long transportation routes between extraction, processing, and fabrication add to embodied energy

Fragrances are complex mixtures of volatile organic compounds (VOCs), formulated to have a specific odor. Once in the air they break down, mix with other pollutants, and form new compounds that are often more irritating or allergenic than the original substance.

Ozone pollution

Small plastic parts end up in oceans and cause pollution. In the aquatic environment, aluminium acts as a toxic agent on gill-breathing animals such as fish and invertebrates



# Human Health Damage



Groundwater contamination. Guinea



Heated conditions of work

HUMAN HEALTH DAMAGE
Labor Intensive
Open-cast mining of bauxite can seriously damage local ecosystems and communities
Steam distillation- Heated conditions of work



# Resource Depletion



Sandalwood deforestation. India



Bauxite residue. Guinea



Resource intensive process

## RESOURCE DEPLETION



Environmental impact: Sandalwood, a “woody” smelling fragrance ingredient, has been overharvested to the point of becoming an endangered species in India and is one of the main causes of deforestation in that country. Alternative sources had to be found and are now used.

Bauxite residue storage and management which demands land use and can sometimes fail (eg Ajka alumina sludge spill, Hungary, 2010)

A huge amount of plant matter is needed to get a small amount of essential oil, that is why perfume is expensive.

- 1 kilo of roses = 500 flowers
- 400 kilos of rose flowers = 600g of absolute
- a 7.5-15ml bottle of french perfume (not eau de parfum or eau de toilette) would have 20-30% concentration of absolute, so about 1.8ml of absolute which is approx 2g

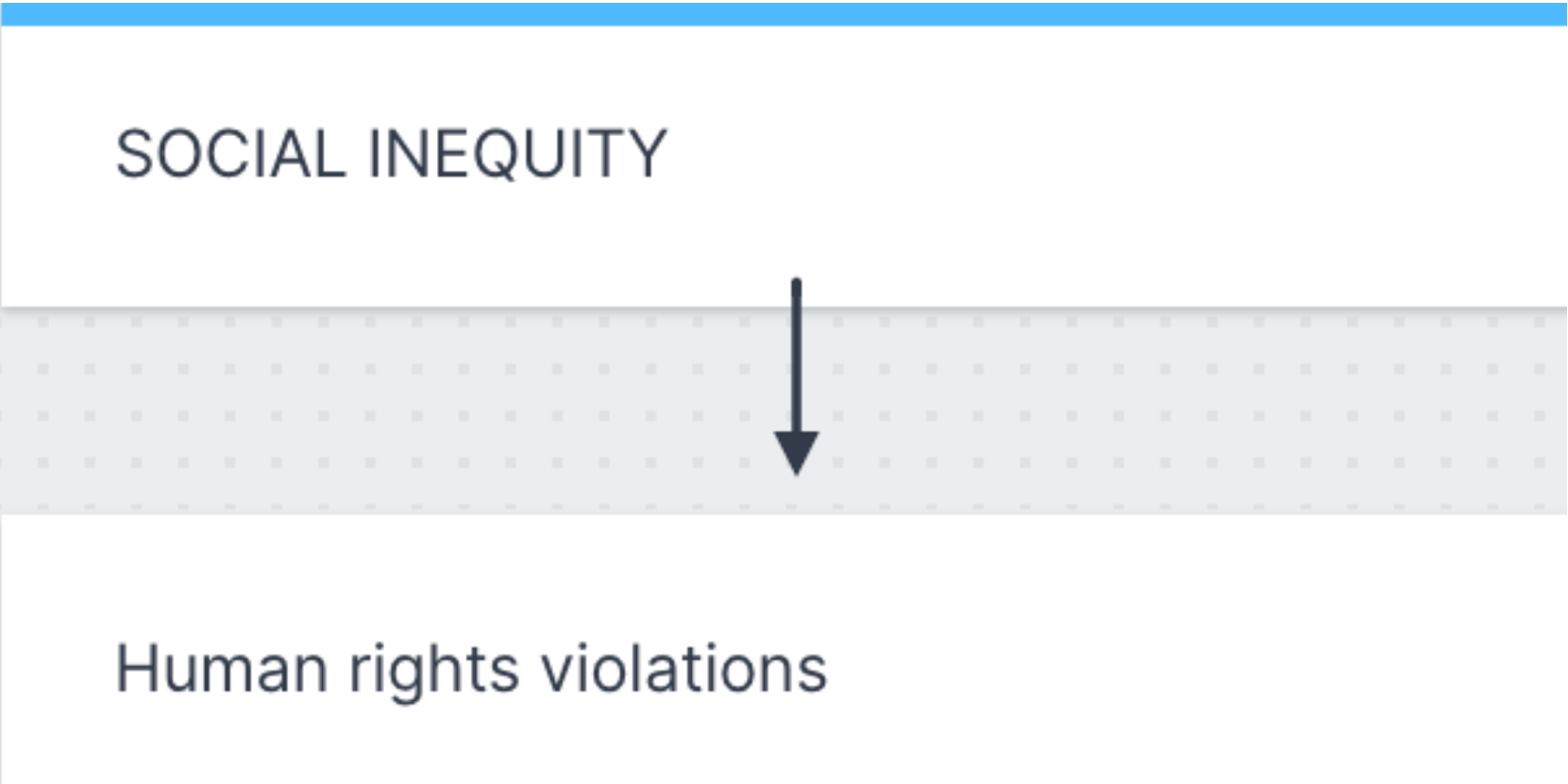
That equates to about 660 roses to get the scent into that small bottle of perfume.



# Social Inequity



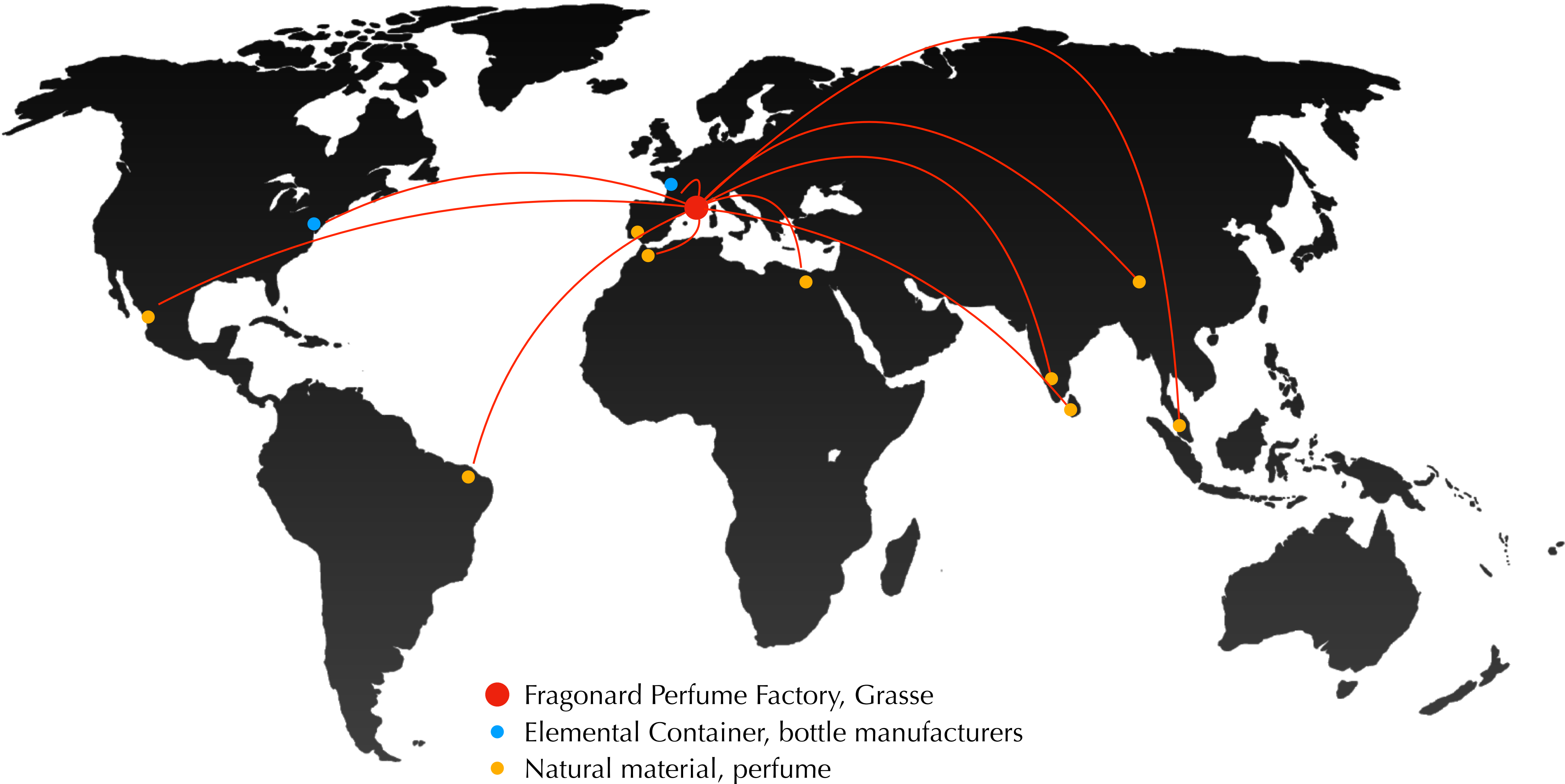
An Indian tribe in Orissa fights back against proposals for a bauxite mine on their land.





# Carbon footprint

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# Expert Interview

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## ALLEN WILPON



Adjunct Associate Professor, Lecturer  
Industrial Design, Continuing and Professional Studies

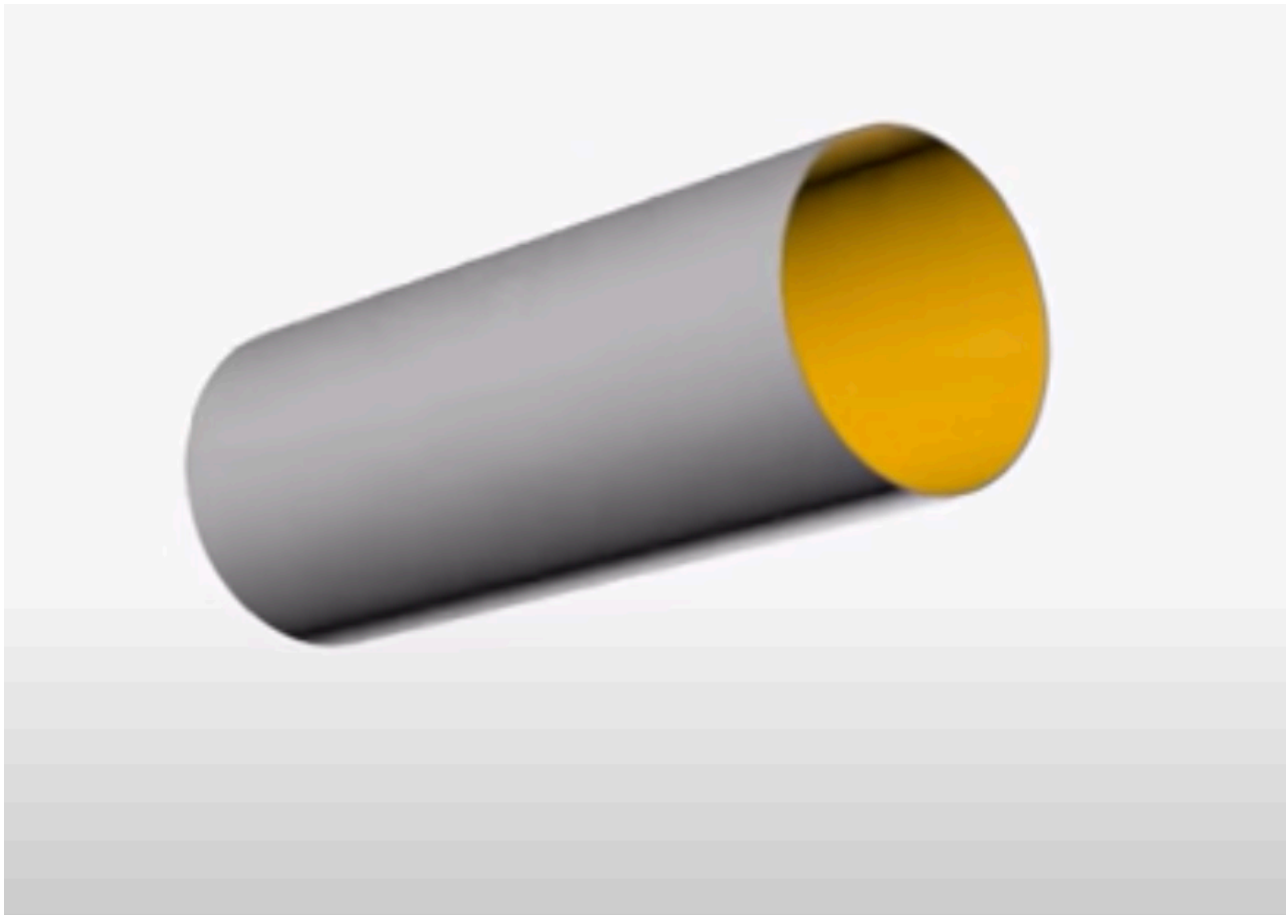
Allen gave me useful about the beauty industry from a packaging point of view. I learnt from him that there is certainly an **inner coating** in the perfume bottles that prevents a reaction between the bottle and the fragrance. He broke down the design considerations that go into making a perfume bottle, a symbol of luxury. In terms of sustainability, he named brands like Chanel, Tom Ford, Victor and Roff , that are exploring refills as a possible strategy. New products like **sustainable scents, freeze dried perfumes and pour fragrances** could replace the conventional perfume in the market. Possible points of intervention in his point view was the **plastic dip tube and secondary packaging** that make these fragrances unsustainable.



Secondary packaging



Dip tube



Inner coating



# Design strategies

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**Botanical musks**

1



**Alternative Materials**

2



**Solid Perfume**

3



**Alternative production**

4



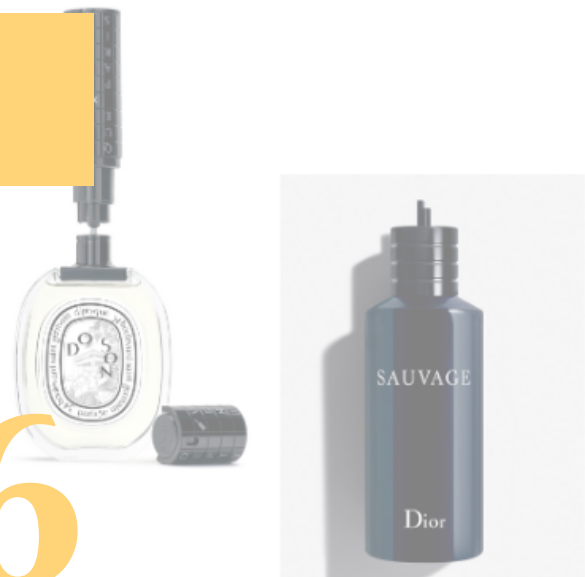
**Optimizing design**

5



**Refill**

6



**Bottle Reuse**

7



**AI**

8



**Cradle to cradle**

9





# Refill system

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## Life cycle stage: Use

**Impact type:** Ecological and Resource depletion

**Impact/Issue:**

- Small plastic parts end up in oceans and cause pollution. In the aquatic environment, aluminium acts as a toxic agent on gill-breathing animals such as fish and invertebrates.
- The bottle contains parts made of different materials that involve transportation to the assembly unit and increases its carbon footprint.
- Since the life cycle of the perfume and its bottle involves energy and resources, the design can extend its life span by making it **refillable**.

## STRATEGY

An **accessible refillable system** can reduce the bottle production thus minimizing the impact. This system can include a common supplier of refillable bottles, refillable stations or social swaps in lifestyle stores and refill packets delivered through online platforms.

## CASE STUDY

**Analysis-**This company manufactures special bottles equipped with a refill nozzle. They associate with various perfume brands and enable refills for their perfumes.

Specific bottles might pose a challenge to the already existing production lines in perfume companies.



**Techniplast: Refill bottle supplier for perfumes**

## BENEFITS

- Reduced production.
- Direct and loyal relationship between the company and its consumers.
- Innovative packaging solutions.
- Extending the life span of the product in the use phase.

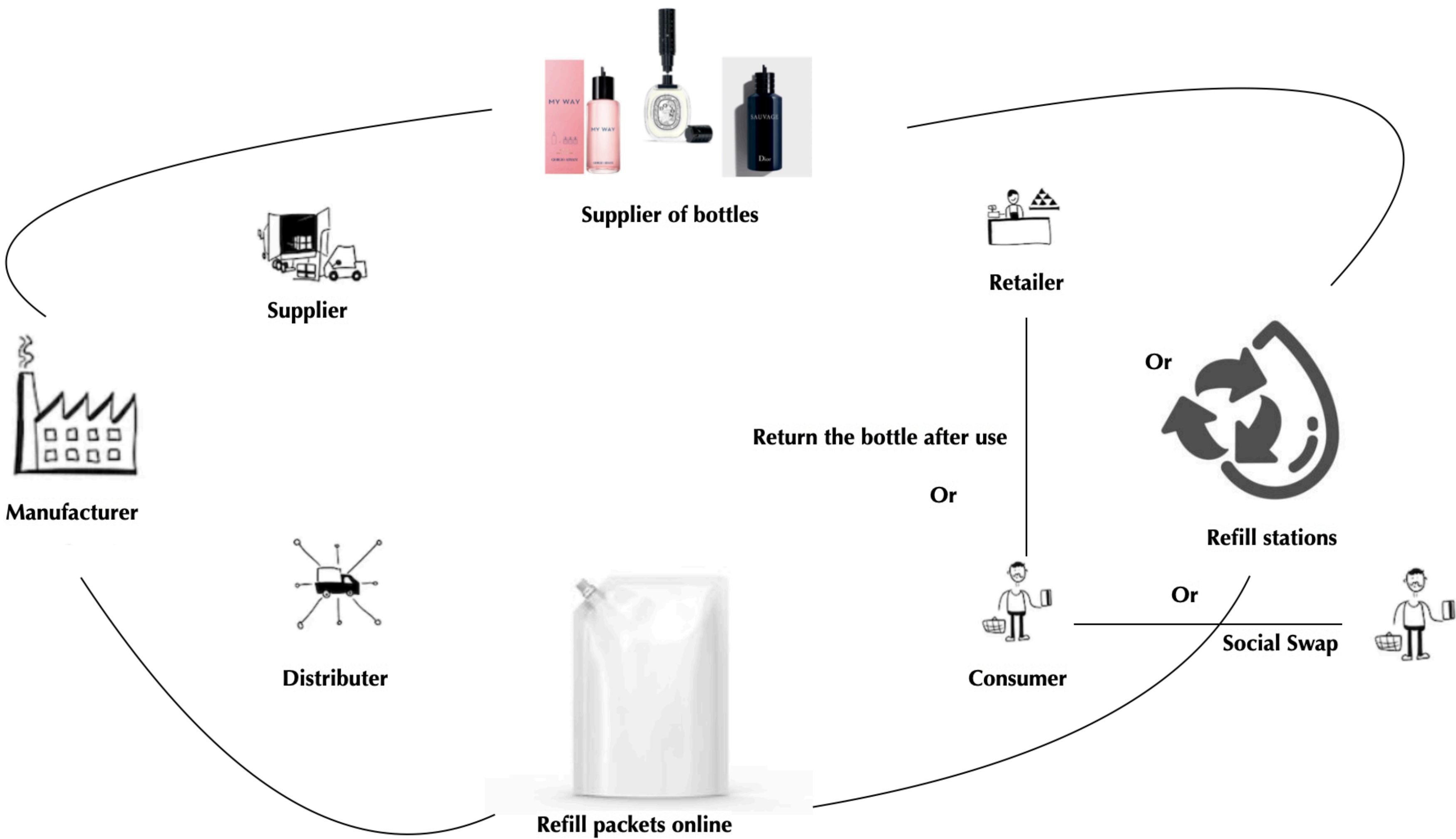
## LIMITATIONS

- This shift in purchasing behavior might be challenging for the consumers.
- Expensive for local establishments to create a refill system globally.
- Expensive set up.



# Possible consumer roles

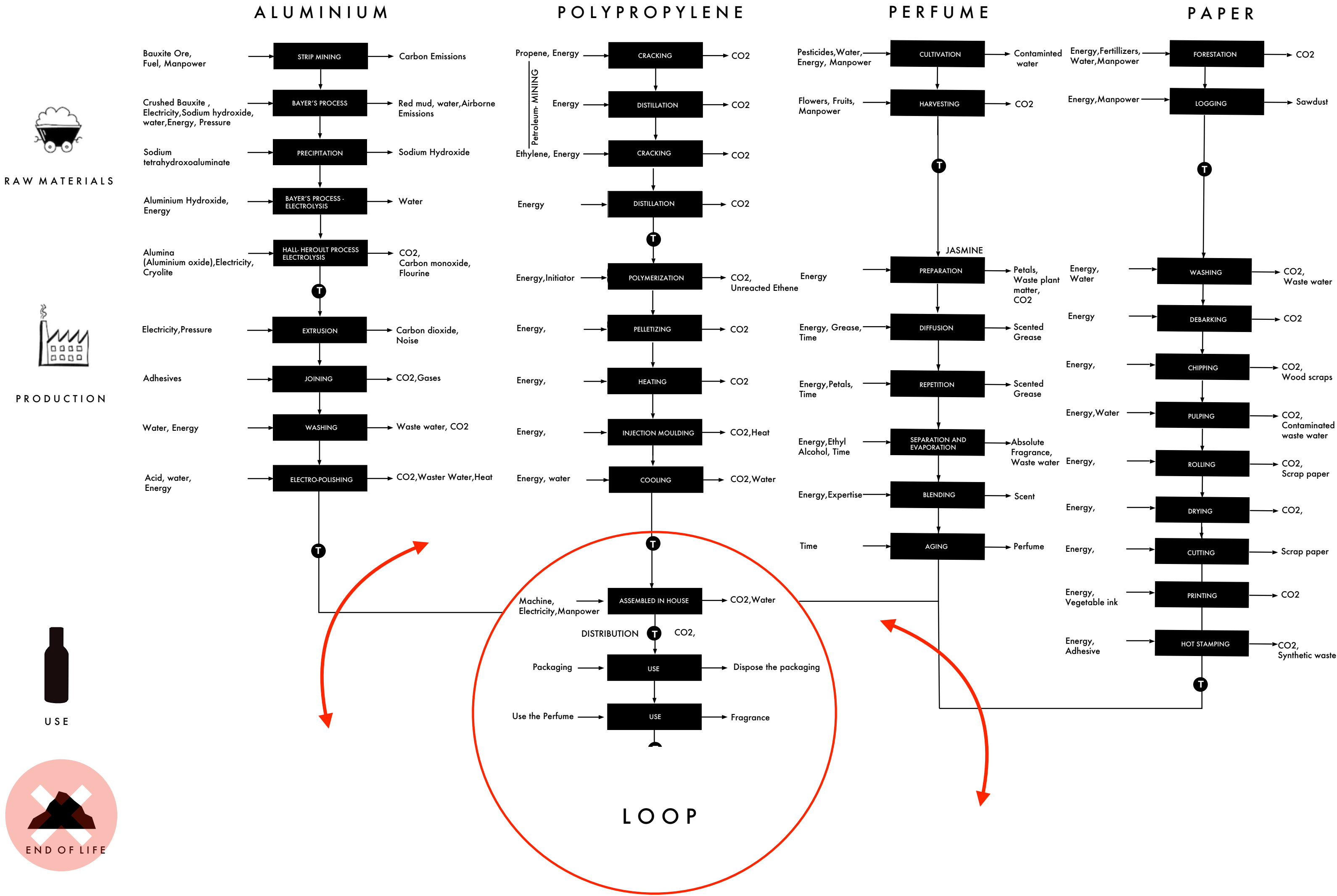
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# Comparisons

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# Historical associations: Glass, Ceramics

## Life cycle stage: Raw material

**Impact type:** Ecological damage and social inequity

### Impact/Issue:

- Aluminum production is **energy intensive**.
- Bauxite residue during production contaminates the environment and lead to climate migration.
- Unless recycled aluminum is used, environmental impact remains high.
- Small plastic parts end up in oceans and cause pollution. In the aquatic environment, aluminium acts as a toxic agent on gill-breathing animals such as fish and invertebrates

## STRATEGY

Using alternative materials like **glass or ceramics**. These materials have been used over time in history to store essential oils, elixirs and fragrances.

## CASE STUDY

**Analysis-** Both these materials have the same ecological impact compared to virgin aluminum.



18th and 19th century



3 Lalique Perfume Bottles, 20 century



Porcelain

## BENEFITS

- Recycled glass has a lesser production impact compared to aluminum
- Historical associations
- Delicate appearance for perfume branding

## LIMITATIONS

- Easily breakable.
- Production of virgin glass is also energy intensive
- Very difficult to recycle ceramic



# Comparisons

Scorecard

Reference

Aluminum Perfume Bottle




Image not provided

This concept is the reference for this project. The reference is a baseline to which other concepts in this project will be compared.

Impacts per functional unit

8.3x10<sup>-5</sup> mPts per Daily pumps sprayed/ applied

Total amount of service delivered

730 x Daily pumps sprayed/ applied

Impacts of total service delivered

0.061 mPts

Assessment level

Estimate

Greatest impacts

SBOM input

Aluminium, primary

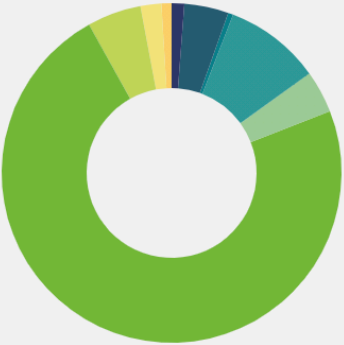
Impact category

Carcinogenics

Life cycle stage

Manufacturing





Total impacts by impact category



Impact category	%
Ecological damage	
Acidification	1.2
Ecotoxicity	4.21
Eutrophication	0.5
Global warming	9.13
Ozone depletion	0.01
Resource depletion	
Fossil fuel depletion	4.04
Human health damage	
Carcinogenics	72.84
Non carcinogenics	5.13
Respiratory effects	1.99
Smog	0.96

Functional unit: Daily pumps sprayed/ applied

Create a new Concept +

Reference	Impacts / functional unit mPts/func unit	CO <sub>2</sub> eq. kg / functional unit CO <sub>2</sub> eq. kg/func unit	Performance improvement from reference mPts	Performance improvement from reference %	Units of svc delivered Svc. Units	Assessment type
<div><div><p>Image not provided</p></div><div>Aluminum Perfume Bottle</div></div> <div>Copy</div> <div>Declare as:   Final</div>	8.3x10 <sup>-5</sup>	5.3x10 <sup>-4</sup>			730	Estimate
<div><div><p>Image not provided</p></div><div>Recycled Aluminum Perfume Bottle</div></div> <div>Copy   Delete</div> <div>Declare as: Reference   Final</div>	5.4x10 <sup>-6</sup>	7.6x10 <sup>-5</sup>	+7.8x10 <sup>-5</sup>	+93%	730	Estimate
<div><div><p>Image not provided</p></div><div>Ceramic Perfume Bottle</div></div> <div>Copy   Delete</div> <div>Declare as: Reference   Final</div>	1.5x10 <sup>-5</sup>	1.1x10 <sup>-4</sup>	+6.8x10 <sup>-5</sup>	+82%	730	Estimate
<div><div><p>Image not provided</p></div><div>Glass Perfume Bottle</div></div> <div>Copy   Delete</div> <div>Declare as: Reference   Final</div>	1.7x10 <sup>-5</sup>	1.3x10 <sup>-4</sup>	+6.6x10 <sup>-5</sup>	+79%	730	Estimate



# Solid Perfume

Life cycle stage: Raw material and Production

**Impact type:** Ecological and Human health damage

**Impact/Issue:**

- Fragrances are complex mixtures of **volatile organic compounds (VOCs)**, formulated to have a specific odor. Once in the air they break down, mix with other pollutants, and form new compounds that are often more irritating or allergenic than the original substance. **They cause Ozone pollution.**
- VOC's are associated with exacerbating respiratory disease, such as asthma.
- **Small plastic parts** end up in **oceans** and cause pollution. In the aquatic environment, aluminium acts as a toxic agent on gill-breathing animals such as fish and invertebrates.

## STRATEGY

Using perfumes in the **solid state**, dried-freeze state, in the brush or pen form will prevent VOC emissions and reduce the size of the perfume. This will further reduce cost of production and transportation.

## CASE STUDY



Jo Malone: Solid perfume



Bastide: Potpourri crystals



YSL Click & Go Pen Jo loves brushes

## BENEFITS

- Very concentrated. Lasts longer than liquid fragrances and acts as a moisturizer.
- Reduced size and packaging makes it travel friendly.
- No VOC emissions.
- Does not require a dip tube and spray mechanism.
- Spill proof

## LIMITATIONS

- Varied application comes with a user behavior risk.
- Since the application is direct and specific, it may easily rub off.
- Repeated touching may lead to contamination.



# Cultural and historic inspirations

**Analysis-** Solid perfume has been around for some time in history. They were used in different ways across cultures, for example, as a decorative locket by the Korean royal family. Thus, a new ritual/trend of perfume application can be developed that is different from a liquid spray bottle from these cultural cues.



Numerous drawings from the era display Egyptian people with an object resembling a beehive or **cone** sitting on their heads. These cones – what at first glance appears to be a symbolic **fashion accessory** – it was discovered that these were actually **waxy, meltable forms of solid perfume**.



Lady Guinevere 1893



In modern times, the first company to produce and sell solid perfume was **Molinard in 1925 with their “Concreta” range**. Unlike most modern solid perfumes where fragrance is mixed with beeswax or other wax base, the Concreta solids were composed of the genuine wax from the flowers, making them extremely concentrated.



**Hyangrkdam Therapy Solid Perfume.** Inspired by Royal Korean skincare. 2016. It is a locket that is worn as jewelry accessory.



# Alternative production methods



*AGILE EMBRACE: based upon principles of form created from flow, the lines embrace the inner core that contains the heart of the design. Acting as a sensual protection similar to how the cars structure surrounds and protects the driver with anatomic precision (3D printed).*



*FLUID SYMMETRY: derived from the evolving organic lines of the cars aerodynamic design, this conception is proof that the physics of natural forces in unison with advanced materials can produce a new form of technological bio aesthetic for the 21st Century (3D printed + blasted titanium)*



*COMPACT SUSPENSION: a space frame as an exoskeleton with layers that suspend the inner flask inside a 3D printed geometry that is strong, and references the engineering of advanced innovative structures (3D printed)*



## Formula 1 launches 3D printed F1 Fragrance collection with designer Ross Lovegrove

Collector bottles 3D printed in metal, mass produced versions using Carbon technology



# Redesigning the bottle for reuse

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**Life cycle stage:** Use and end of life

**Impact type:** Ecological and Resource depletion

**Impact/Issue:**

- Small plastic parts end up in oceans and cause pollution. In the aquatic environment, aluminium acts as a toxic agent on gill-breathing animals such as fish and invertebrates.
- Since the life cycle of the perfume and its bottle involves energy and resources, the design can extend its life span by making it **reusable**.
- The bottle is made of more than 3 materials and ends up in the landfill as the recycling process becomes very complex.

## STRATEGY

The bottle of the perfume can be designed in such a way that it can be **reused for other purposes** when the perfume empties out. This will redirect the end of life outcomes for the bottle and **create less waste**.

## CASE STUDY



The contrasting halves of these perfume bottles can be repurposed separately, or in combinations as vases and incense holders. The modular forms can also be stacked up in various combinations for decorative purposes. The designers from Esrawe studio had an awareness of recycling and permanence during the creative process.

**Analysis-** The bottle cannot be reused for many things due to the limited size and design of the perfume bottle.



Reusable perfume bottle for Xinu

## BENEFITS

- Creates less waste.
- Reduces cost.
- Increases brand value and provides a creative boost for its users and designers.

## LIMITATIONS

- The fragrance might linger in other things.
- Easy access to bottles might be a reason for this strategy failure.
- Might need more materials or involve additional production processes to make it reusable.



# Digital future of fragrance

Life cycle stage: Use

- Scent technology is making headway as the sense of smell seems to answer many of the demands of our present culture.

## STRATEGY

Can AI create immersive smell experiences for the users? Can they personalize their perfume? Can **Artificial intelligence** replace human noses in perfume note blending process?

**Benefits-**

- Personalization
- Digital medium reduces the need for production of physical products.
- No wastage

**Limitations-**

- Data breach
- Primitive research



**Cyrano**

It is a scent speaker which uses a range of scent capsules to emit “playlists” of smells. Cyrano also allows users to create a mood melody and then send the combo to a friend through their app. The scent is paired with a video on the app so they travel through each scene: kind of like a scent-o-gram.

**Scentee Machina**

This Japanese device is the next generation smart room diffuser equipped with AI technology, allowing users to control the fragrance via smartphone. This diffuser can integrate with the users’ calendar to prepare the house when he or she comes home.

Source: [You can watch the video here](#), SCENTEE Machina PV



# Cradle to Cradle

## Life cycle stage: End of Life

**Impact type:** Ecological and Human health damage, Resource depletion

### Impact/Issue:

- Small plastic parts end up in oceans and cause pollution. In the aquatic environment, aluminium acts as a toxic agent on gill-breathing animals such as fish and invertebrates.
- Since the life cycle of the perfume and its bottle involves energy and resources, waste materials can be redirected into the production processes in order to form a closed loop.

## STRATEGY

**Waste materials** from production processes can be used as ingredients for perfume making and as a potential raw material for the bottle as well. Therefore, by redirecting the waste, a **closed loop** is established in the product system.

## CASE STUDY

**Analysis-** This innovation looks feasible at a very small scale. Production challenges have not been disclosed. Therefore, little is known if perfumes can be preserved in these bottles.



Jade888 uses orange peels as one of their perfume ingredients

## BENEFITS

- Creates less waste
- Room for innovation
- Closed loop
- Less ecological damage



A time bottle by Anna Sakaguchi - Miki Kawamura  
Recycled ocean plastic waste

## LIMITATIONS

- Untapped materials come with production challenges.
- Might not be ideal for mass production.
- Increases the market value.



# Sustainable future of fragrance

73%



of brand senior decision-makers see sustainability as an opportunity for their brand

51%



have created packaging with sustainable features in the past 12 months

52%



had little to no knowledge of legislations and packaging regulations affecting the packaging industry

API Group 2018

The future of sustainable packaging in beauty looks bright as it becomes a larger conversation in the industry, but brands must play their part in educating consumers alongside their packaging innovation.



Collector bottles 3D printed in metal, mass produced versions using Carbon technology



L'occitane's refillable packets



## Key words

- Inner Coating
- Refillable
- Packaging
- Dip tube

Refillable

Solid perfume

Artificial Intelligence

Feasibility

Reuse

Exchange/swap

Social

## Leading Research Questions

What is more sustainable? Bottle or perfume?

Will the the design of the bottle make a difference if the perfume making process is unsustainable?

Can solid perfumes replace the trend of liquid perfumes?

Are there any new bio materials that can replace traditional packaging materials?

How can the present perfume refill system be made more efficient?



Websites:

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# PHASE III - SOURCES