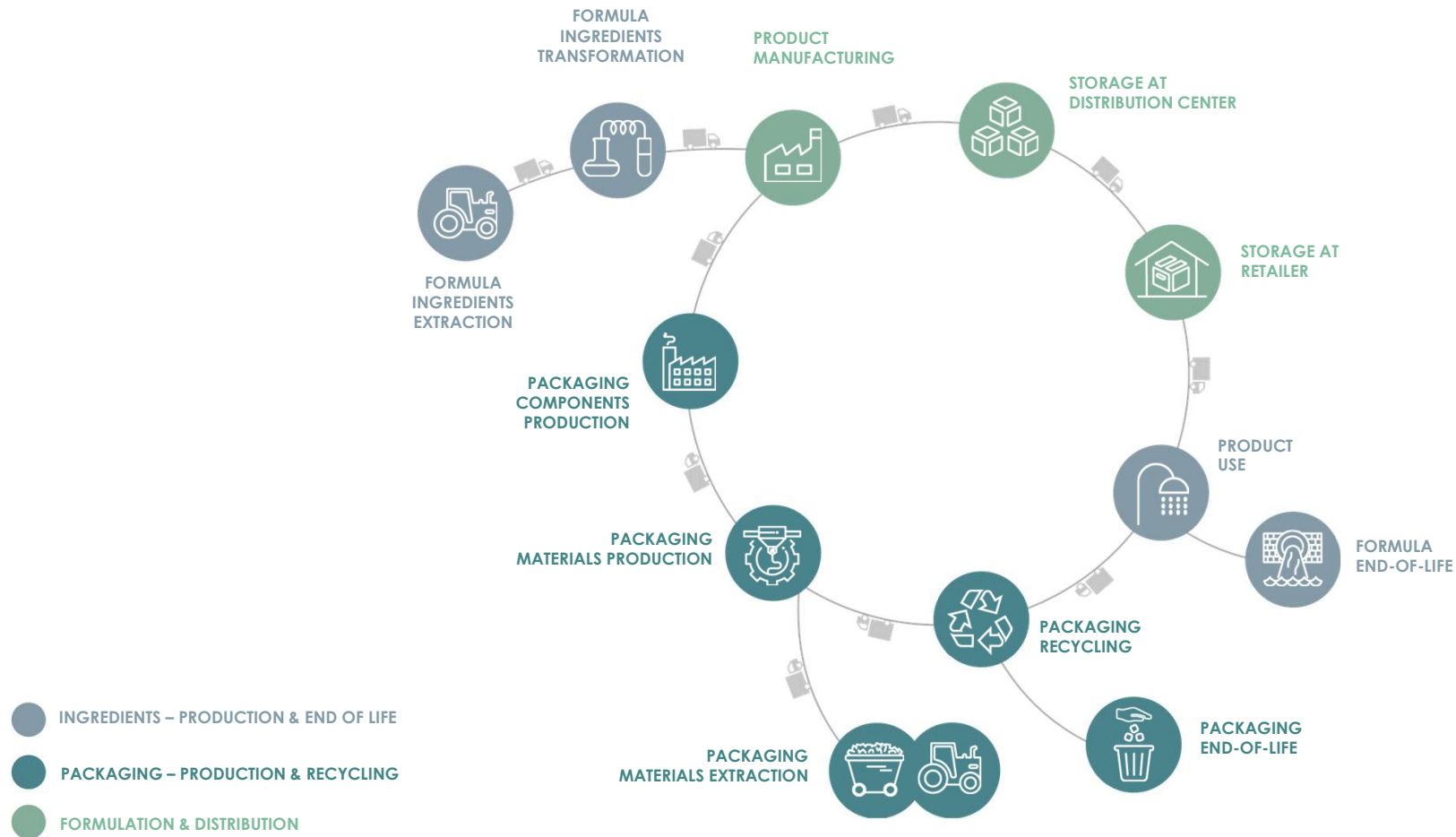


# TAKE A LIFE CYCLE-BASED APPROACH



Credit: Azote for Stockholm Resilience Centre, Stockholm University. Based on Richardson et al. 2023, Steffen et al. 2015, and Rockström et al. 2009)

# FOSTER R&DDD COLLABORATIONS

## PARTNERS

### Partnering with long-standing suppliers

APPLICATION



WHEAT  
↓  
GLUCOSE

1

GREEN  
CHEMISTRY

SORBITOL

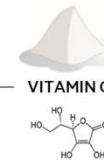
2

BIOTECH  
FERMENTATION

2-KETO-L-  
GULONIC ACID

3

GREEN  
CHEMISTRY



### Partnering with forward thinking start-ups

APPLICATIONS



SUGAR BEET

REFINING

MOLASSES  
(by-product)

FERMENTATION

ISOBUTENE

GREEN  
CHEMISTRY

ISODODECANE

CRUDE OIL

REFINING

NAPHTA

STEAM CRACKING  
PURIFICATION

→ Cosmetics Ingredients  
from micro-algae



### Joining multi-partner ventures

APPLICATIONS



→ Sustainable surfactants



# UPSKILL & RESKILL

## 24.1 Increase corporate training

<ul style="list-style-type: none"><li>• Provide company-based training, and reskill workers so they are prepared for the professions of the future. Link this training to job-to-job transition plans</li></ul>	Industry	S/M
<ul style="list-style-type: none"><li>• Provide in-company training opportunities, career paths, and apprenticeships</li></ul>	Industry	S/M

## 23.2 Adapt secondary, post-secondary and university education

<ul style="list-style-type: none"><li>• Contribute to the activities of the European Year of Youth in cooperation with national associations of chemical employers</li></ul>	Industry	S
<ul style="list-style-type: none"><li>• Adapt university curricula to industry needs, by adding courses on regulation, sustainable chemistry, green chemistry and the principles of SSbD to university programmes in chemistry. Adapt apprenticeships and vocational education and training programmes to teach future-proof knowledge</li></ul>	EU/MS	S/M

# CONTINUOUSLY IMPROVE SUSTAINABILITY EVALUATION METHODOLOGIES

Green Chemistry

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[www.rsc.org/greenchem](http://www.rsc.org/greenchem)

Industrial commitment to green and sustainable chemistry: using renewable materials & developing eco-friendly processes and ingredients in cosmetics

Michel Philippe,\* Blaise Didillon and Laurent Gilbert

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DOI: 10.1039/c1gc15414a

Integrating green chemistry principles into the development of new processes or ingredients and the re-evaluation of existing processes and ingredients is a pivotal element of sustainable development. The aim of this article is to provide a brief description of how L'Oréal, a leading specialist in cosmetic products, is committed to this objective. This commitment is founded on corporate social responsibility (CSR) based on the impact for the five axes of vigilance as shown below, thus allowing analysis throughout the lifecycle of products. The approach of the group regarding the use of renewable raw materials, the development of environmentally-friendly processes and the introduction of green indicators will be presented in more detail later. To illustrate how a green process is implemented we have chosen a recent development, "C-glycosylation in water", as well as an earlier example, "teranide synthesis from renewable raw materials" to demonstrate long-term commitment.

### 1. Introduction

Research and development chemists have always tried to develop processes using new materials and solvents with the lowest possible toxicity levels, even avoiding the use of solvents by relying on high-safety processes. The primary objective has always been to develop ingredients industrially which present neither safety problems nor risks to human health.

The development of corporate social responsibility (CSR), the price and quantity of oil and the proposition of the 12 green chemistry principles in 1998 by P. Anastas and J. Warner<sup>1</sup> have been key elements in establishing sustainable chemistry. Eco-friendly, straightforward processes and innovative products which lessen environmental impact are now being given top priority. This also means that green chemistry has to be based on renewable plant chemistry and less and less on petrochemicals.

To achieve these goals and to replace processes and products with strong environmental impact, it is essential to incorporate eco-design with predictive methods into new processes and products. New processes must use nontoxic materials, save energy and generate less waste. New catalytic methods (chemical catalysis and biocatalysis) developed over the last few years have fully contributed to these objectives. Reductions in the number of steps, "atom economy" and energy reduction through new synthesis routes in particular allow new processes with high chemical, regio- and stereo-selectivity<sup>2-4</sup> to be designed.

The proposition by P. Anastas and J. Zimmerman of the 12 green process principles further amplifies these initial recommendations. In particular, this one introduced the "level of green chemistry" indicator used during any new process and/or

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PAPER

product development with the introduction of the lifecycle analysis.<sup>5,6</sup> For more than ten years now, several green indicators have been proposed, notably by R. Sheldrake,<sup>3,7</sup> to evaluate past and future efforts better.

For a responsible and innovative company measuring these indicators as early on as possible is essential for the eco-design of new synthesis routes and thus to be able to proceed to the final choice of reagents and technology. This green metric is fundamental to making sure only eco-friendly products are launched on the market.

### 2. Commitment to green and sustainable chemistry

#### 2.1 Green chemistry strategy for sustainable development

For several years our group has been implementing action plans for sustainable innovation and reporting progress annually in the sustainable development report.<sup>8</sup>

Various research and development actions have been reported including green chemistry initiatives in particular and results achieved.

One of the key concepts is the complete integration of green chemistry within sustainable development as described in Fig. 1.

Respecting the green chemistry principles as closely as possible is essential for sustainable development. The selection and evaluation of the ingredients we use are based on five axes of vigilance after the thoroughness of the product lifecycle:

- Health and safety of people.
- Respect for the environment.
- Preservation of biodiversity.
- Fair trade practices.
- Social and societal impacts.

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sustainability

MDPI

Article

SPOT: A Strategic Life-Cycle-Assessment-Based Methodology and Tool for Cosmetic Product Eco-Design

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Abstract: The cosmetics industry is facing growing pressure to offer more sustainable products, which can be tackled by applying eco-design. This article aims to present the Sustainable Product Optimization Tool (SPOT) methodology developed by L'Oréal to eco-design its cosmetic products and the strategies adopted for its implementation while presenting the challenges encountered along the way. The SPOT methodology is based on the life cycle assessment (LCA) of a finished product and its sub-systems (formula, packaging, manufacturing and distribution). Several environmental indicators are assessed, normalized and weighted based on the planetary boundaries concept, and then aggregated into a single footprint. A product sustainability index (a single rating, easy to interpret) is then obtained by merging the environmental product rating derived from the single environmental footprint with the social rating (not covered here). The use of the SPOT method is shown by two case studies. The implementation of SPOT, based on specific strategic and managerial measures (corporate and brand targets, Key Performance Indicators, and financial incentives) is discussed. These measures have enabled L'Oréal to have 97% of its products stated as eco-designed in 2022. SPOT shows how eco-design can be implemented on a large scale without compromising scientific robustness. Eco-design tools must strike the right balance between the complexity of the LCA and the ease of interpretation of the results, and have a robust implementation plan to ensure a successful eco-design strategy.

**Keywords:** eco-design; life cycle assessment; implementation; strategy; change management

check for updates

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sustainability

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Article

Mineral Resource Abundance: An Assessment Methodology for a Responsible Use of Mineral Raw Materials in Downstream Industries

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Abstract: The sustainability of mineral resources and, in particular, their abundance is a topic of growing interest. Nevertheless, the abundance of mineral raw materials is an extremely complex notion as it not only encompasses geological considerations but also environmental, technical, economic, and social constraints. In addition, to the best of our knowledge, no tools are currently available to allow a comprehensive evaluation of mineral raw material abundance. This research paper, therefore, aims to present an innovative and unique methodology to evaluate the abundance of non-energy mineral resources and determine a mineral abundance index (MAI). Based on a multicriteria analysis, MAI considers the natural abundance of a mineral raw material in the Earth's crust and its availability on the market and integrates the influence of factors that could constrain or promote future market changes. This new index ranging from 0 (very scarce) to 100 (very abundant) aims to qualify the abundance of mineral resources in a simple and rapid manner based on published and reliable data. This new methodology could be a powerful decision-making support tool for any downstream industrial and end-users making use of mineral raw materials.

**Keywords:** mineral resources; sustainable development; downstream industry; depletion; abundance; bentonite

### 1. Introduction

Throughout history, human beings have exploited natural resources and interacted with and transformed their environment [1,2]. According to [3] and references therein, human activities can be divided into four main subsequent phases: primitive, slavery, feudal, and capitalist, with the last one corresponding to the current period. Each of these phases involves varying degrees of interaction with the environment and use of natural resources. The impact of human activities on the environment, particularly since the capitalist phase, has been a major concern for the United Nations since June 1972, with the organisation of the first World Conference on the Environment in Stockholm, Sweden [4]. Concurrently, the Club of Rome published a report pointing out the risk of mineral resource depletion and environmental degradation due to human activities in a world of economic growth [5]. The year 1972 can, therefore, be considered a reference point for the formulation of concepts on the consumption of natural resources and economic development. Later on, this led to a definition of sustainable development by the Brundtland Report, published in 1987 by the Commission on Environment and Development of the United Nations: "Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [3,6,7].

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# ENABLE CONSUMERS TO MAKE MORE SUSTAINABLE DECISIONS

## PRODUCT IMPACT LABELLING

