White Paper

Everything you need to know about Life Cycle Assessment in fashion

BCome.

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Index

Introduction

Few issues have aroused greater consensus over the last decade than sustainability in the fashion industry. Environmental responsibility has shifted from a selling argument to an essential requirement for textile companies. While business profitability remains an imperative, companies are increasingly aware of the need to know and evaluate their most relevant impacts to ensure business success and progress of the planet.

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The current scenario requires brands to aspire to create value from an environmental, as well as economic, point of view. However, information overload, lack of data and the expansion of subjective criteria caused by ignorance are the main problems why applying the concept of sustainability to the fashion industry is almost a pipe dream today. To implement a successful long-term sustainability strategy, it is essential to understand and evaluate the most relevant aspects of the textile sector, given that industrial processes not only generate waste, but are also major consumers of natural resources. From the extraction of raw materials to the distribution of manufactured products, the fashion industry causes diverse environmental impacts at each of these stages that must be taken into consideration when analyzing their effect on the planet. In this context, the Life Cycle Assessment (LCA) is developed as the main operational tool for identifying, studying and evaluating the environmental impacts associated with a product’s life. .

Motivation

Founded in 2019, BCOME is a start-up pioneer in the application of smart methodologies for global sustainability management and has more than 1 million products traced, measured and evaluated in the market. Our vision is focused on providing the knowledge and tools the fashion industry needs to make its production systems more responsible and efficient. We believe it is time to end the lack of transparency and we seek to build alternative models to improve the lives of people and the planet.

We rely on data rather than intuition to provide resources and solutions that enable textile companies to create honest products that respect nature and also improve their competitive advantage. Through this document we want to expose the potential of LCA to identify the impacts of textile products, as well as explore its capabilities as a tool for business decision making.

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Problem Context

Over the last 20 years, the fashion industry has doubled its production volume. We currently consume twice as much clothing than we did two decades ago[1]. Garments are worn half as often and only 13% of the total input of materials is recycled in some way after the clothes are worn[2], most end up in landfills or incinerated. The excessive scalability of the fashion industry has earned its link to climate change.

> “ We are at a turning point where fashion brands need to examine the whole value chain, considering the impact generated throughout the entire product life-cycle. “

This is the context that frames the textile sector as one of the main contributors to environmental pollution:

Consolidation of a linear production system

The production model of the textile industry operates under the linear production system based on “producing, using and disposing.” A cycle that does not contemplate the reintroduction of waste into production and therefore accelerates the depletion of the planet's natural resources, contributing to deforestation, uncontrolled carbon emissions, droughts, floods, global warming and high waste generation.

Unsustainable environmental impact

The fashion industry accounts for between 2% and 4% of global carbon emissions[3], as a result of its reliance on non-renewable resources. Most of the fashion supply chain still needs coal to generate electricity, one of the most contributing fossil fuels to climate change. Furthermore, it is an abusive industry in terms of water consumption. Fashion uses about 93 billion cubic meters of water per year[4], the equivalent of 37 million Olympic pools. To transform raw materials into end products, many synthetic chemicals are used in clothing and footwear.

These chemicals, in addition to being a danger to the health of the people who handle them, also end up polluting the freshwater systems. Cotton production alone uses 4% of all pesticides in the world and 10% of insecticides[5]. And as a climax for this impact, we find the problem of textile waste. The linear production system perpetuates that each ton of discarded textile emits 20 tons of CO_2 into the atmosphere[6].

High supply chain complexity

The fashion industry has one of the longest and most delocalized supply chains in the world. A simple cotton t-shirt can easily go through more than 30 different processes. Each with its own environmental impact. The longer the chain, the more the garment travels, the greater the impact it generates throughout its life-cycle. The lack of visibility, the considerable number of associated processes and the multiplicity of parties involved in the production process lead to a lack of control over the supply chain, resulting in high environmental risks. Ignoring potential impacts throughout a product's life-cycle makes it impossible to identify the critical points that intensify its environmental footprint.

We are at a turning point where fashion brands need to examine the whole value chain, considering the impact generated throughout the entire product life-cycle. It is only possible to improve on what we know.

What is LCA

Life Cycle Assessment (LCA) is an environmental management tool regulated by ISO 14040 which aims to determine and quantify the current and potential environmental impact of a product, process or system throughout its entire life-cycle, in an integral way. According to ISO 14040, LCA is defined as the collection and evaluation of the inputs, results and potential environmental impacts of a product system during its life-cycle.

The main feature of this tool is its global approach, i.e., the integration of all the parts that make up a system to determine its properties. Hence, LCA contemplates the analysis of all the processes that define the life cycle of a product over the individual study of each of these processes.

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The goal of LCA is to gain a better understanding of the scope of possible impacts arising from the production of an article such as global warming, eutrophication, water use or abiotic depletion of fossil fuels.

What are the main reasons for conducting an LCA?

The main reason for conducting an LCA is to contribute through strong, verifiable data to drive business decisions towards solutions that significantly reduce environmental impacts. Therefore, this tool seeks to ensure that the growth of well-being does not imply environmental degradation In particular, LCA allows us to answer questions such as:

- Comparison between two different manufacturing processes of the same product.
- Comparison between two products of a different nature that have similar applications.
- Comparison between the different stages of the life-cycle of the same product.

Due to its characteristics, LCA can be used transversally by any department of a textile company for a wide range of purposes:

Product development

Having specific metrics and indicators for each of the products in a collection allows actions to be implemented with quantitative criteria with the aim of reducing and eliminating the negative impacts of products at different stages of their life. Identifying the most damaging cycle stages for the planet is the first step in developing products with better environmental performance.

Efficient production processes and waste management

LCA provides information on environmental impacts from a comprehensive approach that extends throughout all stages of the product's life-cycle, going beyond the manufacturing process. For this reason, it provides a clear picture of the real consequences of the system allowing to identify the focus of the problem and implement actions according to the points of high environmental risk. It also improves the efficiency of the supply chain by preventing an environmental problem from being carried over to later stages.

Driving performance and profitability improvements

LCA allows working with a large amount of environmental data and information, which makes it possible to identify opportunities and critical points clearly and precisely. This way, LCA is also a tool for environmental protection and natural resource conservation and has great potential in reducing costs and improving the competitiveness of a company.

Effective marketing communications

LCA transforms the life-cycle of a product into valuable environmental data that allows these indicators to be passed on to end consumers. Therefore, this tool can also be integrated into a company's marketing strategy to transfer these indicators to end consumers. A fashion brand can use LCA to support its communication with truthful data that confirms its environmental commitment.

Compliance and anticipation of legislative requirements

In recent years, the legislation related to the textile sector has moved in the direction of a systemic change towards circularity and sustainability, seeking to minimize environmental and social impacts while maintaining economic and collective benefits. Legislation will be the definitive driver for the fashion industry to move towards sustainability and LCA can help fashion brands meet the requirements established by law to comply with the new regulations. Also, setting standards that support full supply chain traceability is imperative to protect industry transparency.

> "LCA allows us to have an educated discussion about sustainability and to use data systemically."

LCA allows us to have an educated discussion about sustainability and to use data systemically. With quality metrics and indicators we can make responsible decisions and implement solutions that accelerate the transition towards sustainability. Examining the product throughout its life-cycle enables informed decisions to reduce the environmental footprint of fashion.

LCA methodology

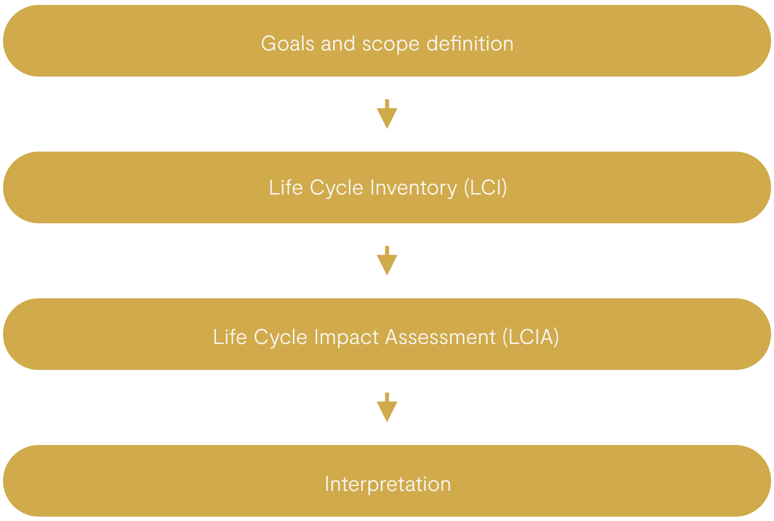
In order to standardize the methodology, the International Organization for Standardization (ISO) has established a framework for the development of an LCA defined by the following standards:

- ISO 14040[7]: Environmental management. Life-cycle assessment. Principles and frame of reference.
- ISO 14044[8]: Environmental management. Life-cycle assessment. Requirements and guidelines.

Although all LCA's must cover the same stages, according to ISO 14044, the level of detail may change depending on the objective to be covered:

- Simplified LCA based on secondary data. It consists of applying the LCA methodology to conduct a selective analysis (taking into consideration only generic data and covering the life-cycle in a superficial way), followed by a simplification (focusing on the most important stages) and an analysis of the reliability of the results.
- Complete LCA based on primary data. It is the most complex level. It consists of a detailed analysis of both inventory and impacts, qualitatively and quantitatively.

In accordance with the above standards, LCA methodology integrates 4 stages following ISO 14040 and 14044 standards:

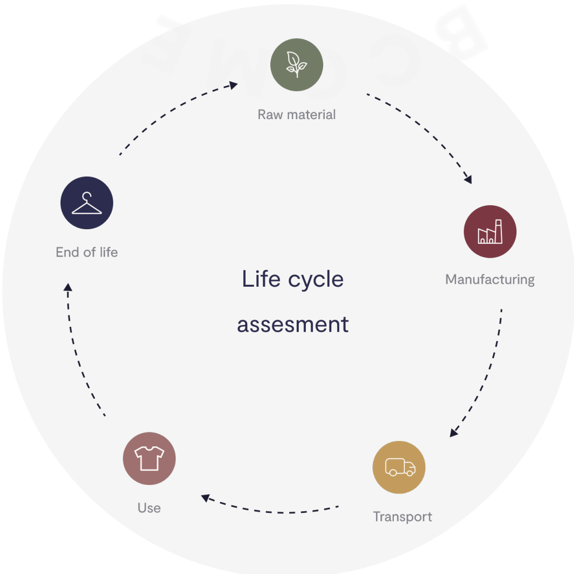


1. Goals and scope definition

In this first stage, both the objective of the study and its scope are defined. In the first case, the purpose of the analysis, the reasons why it is being conducted, the target audience and the description of the system under study are specified. Regarding the scope, the breadth, depth and detail of the study are defined, i.e. the function of the system, the functional unit, the system boundaries and the flows within the life-cycle, as well as the evaluation parameters and the source and quality of the data.

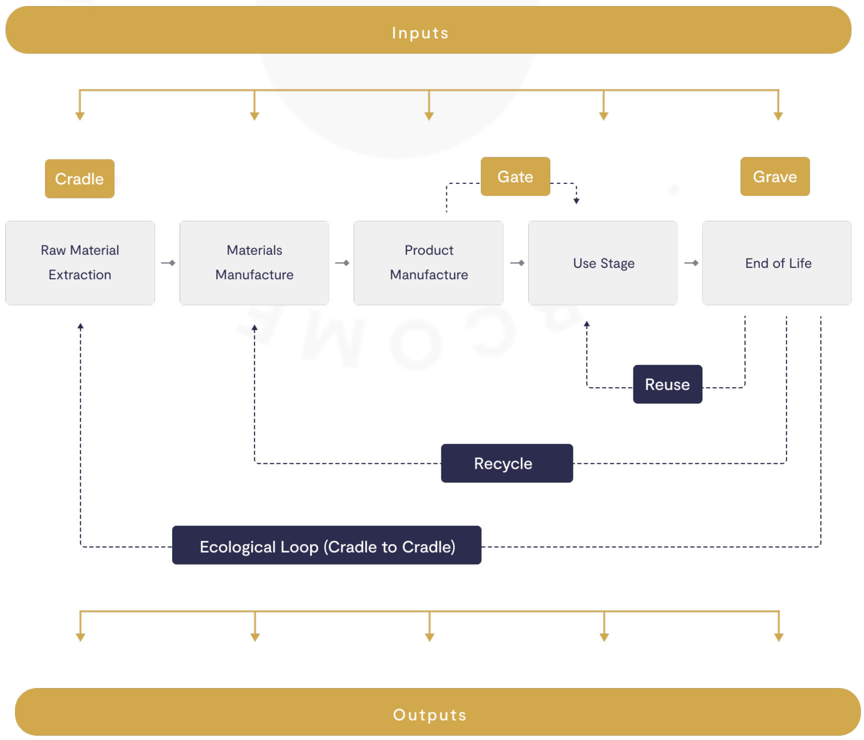
- System function: The functions that define the system in the study are detailed.
- Functional unit: The reference unit used to measure the performance of product inputs and outputs is defined so that different items or systems can be compared.
- System limits: System limits are set to determine which unit processes should be included in the LCA. These will be defined by considering factors such as the purpose of the analysis, the assumptions raised, the exclusions, the quality of the data required or the economic constraints, among others.

In this phase, the scope of the study is also decided, delimiting which processes and stages of the system are to be included, as well as the criteria used for this decision and their compatibility with the goal of the LCA. The stages to be quantified are those that make up the life-cycle of a product:



- Raw material acquisition: all activities necessary for raw material extraction and energy inputs from the environment, including transportation prior to production.
- Processing and manufacturing: activities conducted to transform raw materials and energy into the desired product. In practice this stage consists of a series of sub-stages with intermediate products formed along the process chain.
- Distribution and transport: Transfer of the final product to the customer.
- Use, reuse and maintenance: Activities arising from the use of the finished product throughout its lifetime.
- End of use: Final destination and derived emissions when the product reaches its end of life and is returned to the environment as waste. It includes recycling and waste management.

Depending on the objective of the study, we can choose between several system limits when developing an LCA, the most common are the following:



- Cradle-to-gate: Part-life cycle of the product. This includes everything from resource extraction, through material transformation and entry into manufacturing, to leaving the manufacturing plant.
- Gate-to-gate: When only the inputs and outputs of manufacturing processes are considered.
- Cradle-to-grave: Total product life-cycle. This includes raw material extraction and the processing of materials necessary for the production of components and products, transportation, storage, distribution, use of the product and, finally, its recycling and/or waste disposal, contemplating its end of life.
- Cradle-to-cradle: When it is accepted that waste disposal outputs of the system can be considered as raw materials and/or inputs for the same or another system.

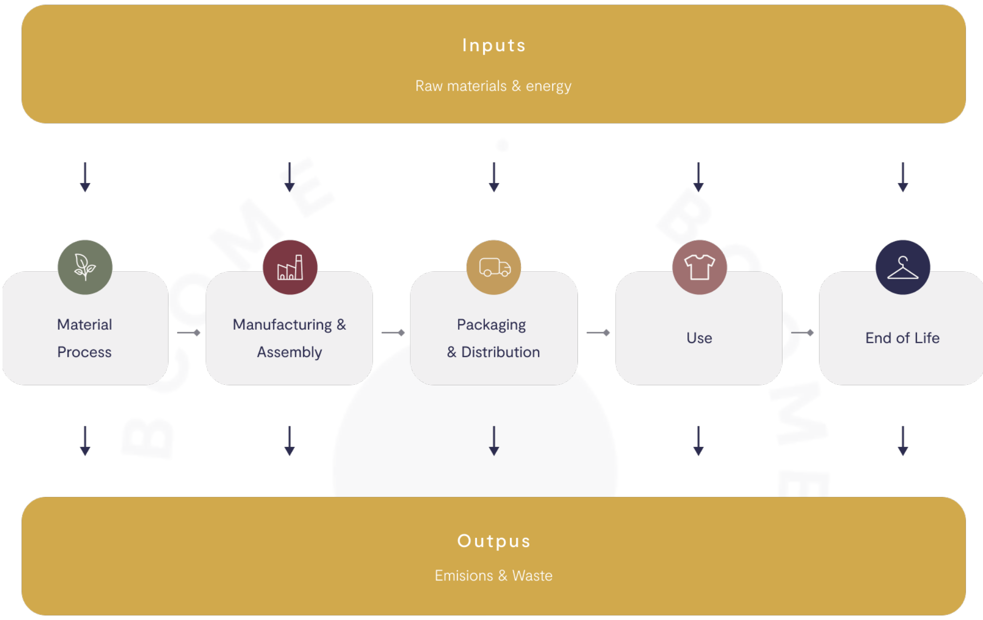
To establish the evaluation parameters, it indicates which impact categories are included in the LCA study, how the inventory data is assigned to each impact, which are the category indicators and the characterization models used. As an example, we can define the climate change impact category, which Greenhouse Gases (GHG) contribute to and whose category indicator is CO2 equivalent.

The source type and data quality are defined based on the following criteria:

- Time: Age and minimum collection period.
- Geography: The geographic area to which the data correspond.
- Accuracy: A measure of the variability of values for each data.
- Integrity: The classification of the data source according to its condition, whether measured or estimated.
- Representativeness: Qualitative assessment of the extent to which the data reflect the actual situation at the level of geographical coverage, time period and technological coverage.
- Coherence: Qualitative assessment of whether the study methodology is applied uniformly throughout the analysis.
- Reproductivity: Qualitative assessment of whether the calculation is reproducible from the documentation generated.
- Information uncertainty: Qualitative assessment based on whether the information comes from direct, indirect or assumption sources.

2. **Developing Life-cycle Inventory (LCI)**

In this second stage, the data necessary for the following environmental assessment of the product, process or activity are collected. In short, data corresponding to the inputs (water consumption, energy, fuel, materials, etc.) and outputs for each of the product system processes (water discharges, waste, emissions, etc.) associated with the functional unit are identified and quantified.



Data collection involves a lot of work. On the one hand, it requires knowledge of the materials, processes developed, energy consumed, transport, etc., as well as the quality of the data obtained and their availability. In cases where data cannot be directly obtained, it may be necessary to use internal or external databases. There are various sources of information for the production of life cycle inventory, with Ecoinvent[9] being one of the most recognized and reliable in the sector.

3. **Life Cycle Impact Assessment (LCIA)**

The third and penultimate stage of the LCA is where the inventory of inputs and outputs is transferred to indicators of potential impacts on the environment, human health and the availability of natural resources. The phase in which life-cycle inventory data is transformed into environmental results.

The objective of this phase is to know and evaluate the magnitude and relevance of the potential environmental impacts of a system. An evaluation method is used to transform the data collected in the LCI into environmental results. THE UNE-EN-ISO 14.040 sets out a number of steps for this:

Classification

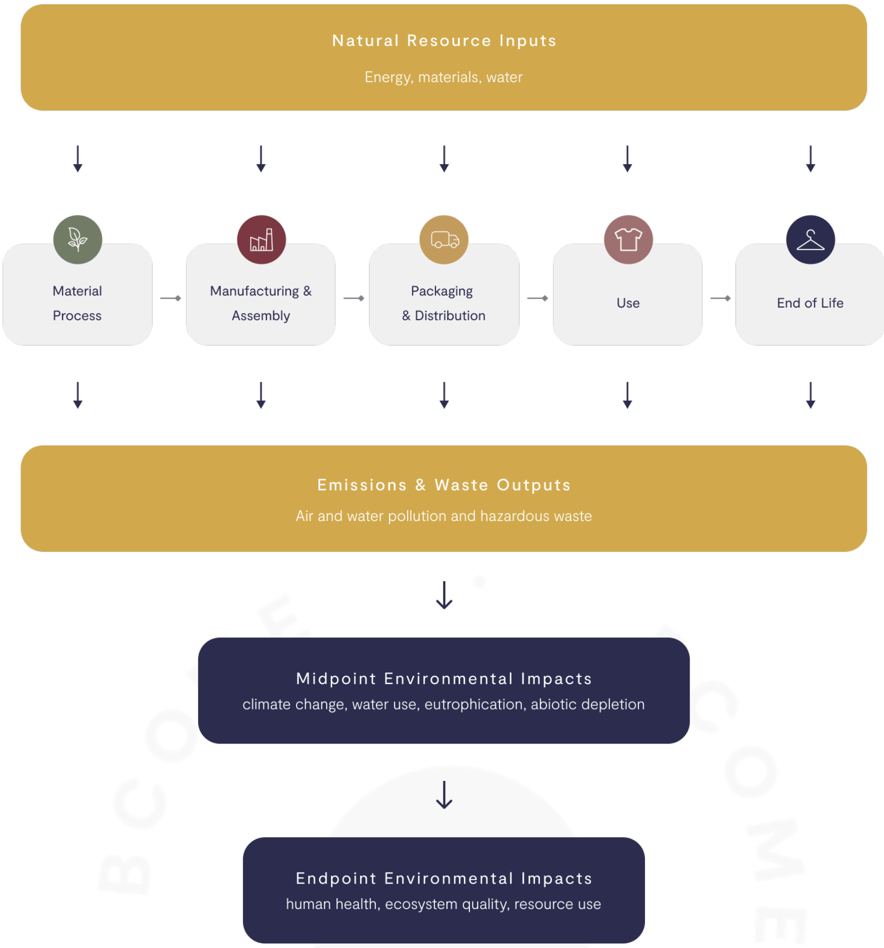
The first step within the framework of an LCA is the selection of environmental impact categories to be considered in the study. These categories represent the environmental impacts of interest to which the results of the LCIA are to be assigned, i.e., the impacts for which results are desired. The selection among the wide range of environmental impact categories will depend on the objective of the study, the profile and the level of accuracy of the results required. Some methods seek to define an environmental profile by quantifying the "midpoints" of the different impact categories, others seek to analyze the final "endpoints" of effects on the environment. Often the midpoint impact categories are calculated, and then generic conclusions are drawn regarding the endpoint impact categories.

- Midpoint: referring to the analysis of intermediate environmental effects. These categories are closer to the environmental intervention, and there are calculation models that are better adjusted to the impact in these intermediate categories, which is why they are the most used. Among the most common are climate change, water use, eutrophication or abiotic depletion.
- Endpoint: related to the analysis of the final environmental effect. The final impact categories are variable and directly affect society. On a global scale they are more relevant and understandable however, there is no scientific consensus as they are not fully elaborated. The “endpoint” categories include human health, depletion of natural resources, and ecosystem quality.

Characterization

Once each substance in the inventory has been assigned to one or more environmental impact categories through classification, its value is compared to the reference substance in that category. Using the characterization factors for each of the selected impact categories, the different environmental effects are transformed into indicator units, obtaining equivalent units that can be added to measure the contribution of the substances to the impact category. To do this, each substance in the inventory is multiplied by its corresponding characterization factor. This way, values can be obtained with equivalent units, which can be added to measure the contribution of substances to that impact category.

The characterization phase is one of the most controversial, as there is no common agreement in the international community for the establishment of a single model for environmental impact assessment. For this reason, and as far as possible, BCOME advocates following the recommendations of international organizations. BCOME's LCA methodology defines its impact calculation methods based on suggestions from the Life Cycle Impact Assessment EF (Environmental Footprint 3.0), which correspond to the most recent recommendations of the European Commission.



Standardization, grouping and consideration

Optional steps that can be developed depending on the goal and intended scope.

- Normalization: conversion of the characterization results to neutral global units, dividing each by a normalization factor. These factors represent the degree of contribution of each impact category to the local environmental problem.
- Grouping: classification of impact categories into other groups that include impact categories with similar effects.
- Consideration: conversion of characterized values results to a common and addable unit (if the methodology includes a normalization, it will be done from the normalized values), multiplying them by their consideration factor. Then, all of them are added together to obtain a single total score of the environmental impact of the system.

4. Interpretation of results

In the fourth and final stage of LCA, the results from the two previous stages are interpreted in accordance with the objective and scope defined at the beginning. In this final phase, the findings of the results analysis are recorded, making it possible to identify the stages of LCA that have the greatest environmental impact and, therefore, can or should be improved. In the event that the study is conducted to compare two products, it is possible to determine which of them has a better environmental performance.

Specific issues of the textile industry

Life Cycle Assessment can be complex for some textile companies. On the one hand, it goes beyond their traditional responsibility and, on the other, it implies a comprehensive knowledge of the supply chain, something that is not equally available to all companies. A manufacturing company that has first-hand data is not comparable to a retailer that has multiple intermediaries and is much further away from actual production. In the latter case, obtaining the information required by an LCA is more complicated. Data from suppliers and outsourcing are limited in many ways. From language barriers to confidentiality agreements, there are some details that may limit confidence in the accuracy of the data obtained. In these cases, it will be necessary to train suppliers to better understand what information is required when developing an LCA. In addition, the special features of the fashion industry play an essential role in assessing the life-cycle of a garment. From conception to disposal, the textile sector has the potential to minimize its environmental impacts by implementing different principles:

Application of ecodesign.

According to the European Commission, 80% of the environmental impact of textile products is defined at the design stage. In this first stage it is possible to create a 100% recyclable product by using materials without mixed compositions, the use of a single color, limited finishes, in addition to the use of easily separable elements. The product circularity achieved through ecodesign, together with the development of sustainable production models that consume resources efficiently and give rise to durable, repairable and reusable products, will result in a significant reduction in environmental impacts.

Care recommendations.

A fashion brand's responsibility does not end with garment production. About 20% of greenhouse gas emissions are produced during laundry, washing, tumble drying, ironing and dry cleaning. It is essential that brands communicate that garments are made to last and provide the necessary care instructions. Companies that want to minimize their impact will have to share that responsibility with the consumer and consider the full life-cycle of the product, taking into account its durability.

Reuse and recycling systems.

Waste recovery consists of reintroducing textile waste into the production chain. In this sense, knowing the Material Circularity Indicator (MCI) of the product portfolio provides brands with the information required to establish their recycling capacity. A key point at the end of a garment's life is fiber mixing and material heterogeneity. Thus, the use of mono-materials can facilitate their recycling, minimizing their environmental impact.

Future trends

The future of the fashion industry is to go beyond sustainability and look for production systems that are regenerative for the planet. While LCA aims to measure the environmental impacts associated with the life-cycle of a product, the focus of the upcoming field of environmental assessments should be on measuring the regenerative potential of a garment.

As pointed out in the introduction, one of the main problems in the textile sector is linked to the volume of waste generated and its lack of recyclability. Currently, LCA's are often developed with a cradle-to-gate or cradle-to-grave approach, without assessing the ability to reintroduce waste as raw material. The evolution towards a cradle-to-cradle approach will drive the circular economy, allowing not only to reduce negative impacts, but also to increase positive impacts.
Through a cradle-to-cradle approach, products are developed for closed-loop systems in which each output is productive, either to biodegrade naturally and restore the soil, as a biological nutrient, or to be recycled into quality materials, as a technical nutrient. Adopting this approach will allow companies to optimize their sustainability strategy to promote the regeneration of their products.

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Beyond a company's environmental management, the fashion industry can complement LCA with other tools that offer a broader view of the impacts linked to the life cycle of products, such as S-LCA[10] and LCC[11]. Two resources that respectively allow to assess the social aspects and economic costs associated with each stage of an article's life-cycle. Methodologies that, together with LCA, provide an integrated perspective of the scope and consequences of business activity: from an environmental, social and economic point of view.

Conclusion

The aim of this white paper has been the study of Life Cycle Assessment in fashion in order to discover its potential to identify the impacts of textile products and use it as a tool for business decision-making.

The magnitude of the environmental footprint of the textile industry makes climate pressure one of the main factors determining an urgent paradigm shift in current fashion. Sustainability has become an essential requirement for companies in the textile sector. The perpetuation of a linear production system, the massive environmental footprint of fashion, in addition to the great complexity of supply chains, show the large amount of natural resources that the industry consumes, as well as the excessive volume of waste that it generates.

In this context, brands must work to create value from an environmental point of view, as well as an economic one. In this way, LCA emerges as a tool that allows informed decisions to be made through the identification of the environmental impacts of textile products.

Through the integral evaluation of the stages of the life cycle of a product, LCA allows knowing the impacts of the production of an article such as global warming, eutrophication, the use of water or the abiotic depletion of fossil fuels. Being able to define and quantify the current and potential impacts of that product. Due to the complexity of textile processes, the intensity and type of impact will be closely related to the specific stage of the process. This information will allow reducing the environmental footprint by acting in each of the stages in a specific way, always considering the most relevant impacts for each one of them.

Having a comprehensive vision of the value chain will ease the identification of those processes that are reducing the environmental quality of textile products and will enable the activation of measures that benefit the impact of businesses as well as their competitiveness in the market.

Thanks to the metrics, data and quality indicators obtained from Life Cycle Assessment, brands can draw conclusions that allow them to optimize the development of their products, improve the efficiency and profitability of their processes, as well as strengthen the relationship with their customers. A tool through which the fashion industry has the ability to implement responsible solutions that accelerate its transition towards sustainability.

Annexes

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