

Circular Ecodesign

New practical
ecodesign
for a circular
economy
manual

© Ihobe S.A., Noviembre 2023

Edita: Ihobe, Sociedad Pública de Gestión Ambiental
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GLOSSARY OF TERMS

- **Life Cycle Assessment:** Study of the consecutive and interrelated stages of a product system; from obtaining the raw materials to its utilisation by the user and its end-of-life destination in order to measure its environmental impact.
- **Environmental aspect:** Elements of an organisation's activities, products or services that may interact with the Environment.
- **B2B:** Abbreviation of "*Business to Business*". It is a business model where the product or service transactions are from one company to another.
- **B2C:** Abbreviation of "*Business to Consumer*". It is a business model where the product or service transactions are directly between a company and a consumer.
- **Greenwashing:** Practice of making unclear environmental claims and with unfounded, misleading and vague information.
- **Durability:** Measurement of the operating life of a product. The durability concept can be divided into technical durability and real durability. Technical durability refers to the time period in which a product is going to function correctly, while real durability is defined as the time that the consumer decides to use the product.
- **Ecodesign:** Methodology that considers the environmental aspects through the product development process, with a focus on minimising the environmental impact of a life during its life cycle; and identifying priority action areas in order to be able to reduce it.
- **Circular Ecodesign:** Also known as circular design or ecodesign for a circular economy; this way of designing integrates the principles of the circular economy and pursues value retention by means of continuously closing loops.
- **Circular Economy:** Economic system based on maintaining the value of the products and materials for the longest possible time, and which reduces waste generation and the use of resources to the minimum, by keeping the resources within the economy when a product reaches the end of its lifespan to be able to reuse them and continue creating value.
- **Standardisation:** Process to define standards, to ensure that the materials, components, connection systems and, in general, those parts commonly used between different models, meet a series of common uniformity requirements.
- **Customer loyalty:** Strategies aimed at retaining customer, to encourage them to return.
- **Environmental impact:** Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.
- **Downcycling:** Recycling process resulting in products of a lower value and quality than the original ones.
- **Secondary market:** Market on which second-hand market - products used previously by other people and which, therefore, do not have a full, but rather a reduced guarantee - are sold.

- **Life Cycle Thinking:** Framework for a holistic approach to a product, process or service from production to consumption or use until the end of its life cycle
- **Circular Design Thinking:** Design approach that seeks to create products and solutions that are in line with the principles of the circular economy.
- **Reconditioning:** Process of returning a product to its original technical state or “as new” by means of repairing the damaged component and the preventive replacing or repairing of components that will soon become obsolete.
- **Recycling:** Process of extracting raw materials and useful materials from a product to produce new products.
- **Remanufacturing:** Process of returning a product to an equivalent or higher quality status than that of the original product. The product is dismantled to component level, is inspected, repaired and finally re-assembled using the parts recovered from the original product and new parts as necessary. It also includes an upgrading phase to improve the features of the product compared to the original.
- **Refurbishment:** Process of returning the appearance of a product so that it looks “as new” by means of cleaning, polishing and painting it, etc.; including repairing damaged components. Products mainly for secondary markets.
- **Repairability:** Likelihood of a product being repaired or restored after being damaged or breaking down.
- **Reuse:** Using a product again without making any change or with some small changes.
- **Servitisation:** Value creation process by means of adding services to products.
- **Upcycling:** Recycling process that converts materials into higher quality products.
- **Burden shifting:** Transfer of environmental impacts or environmental burdens of an aspect of the life cycle of a product, service or process to another.
- **Energy recovery:** Conversion of materials into heat, electricity or fuel by means of combustion, gasification, pyrolysis, anaerobic digestion or recovery of gas from landfill.
- **Real or useful lifespan:** Estimated duration of an object under real conditions of use, where it is considered practical and efficient in its context, taking into account factors such as obsolescence and the changing needs of the user.
- **Technical Life:** Estimated duration in which an object continues to be functional and operational from a technological and mechanical perspective, correctly fulfilling the function for which it has been created.



INTRODUCTION

BACKGROUND

Over 20 years have passed since the first ecodesign projects in the Basque Country. At a time when companies were beginning to forsake the so-called end-of-the-pipeline solutions for waste minimisation and prevention, Ihobe published the *“Ecodesign Manual: 7 Steps for Implementation”* in the year 2000. The manual was published with the aim of providing Basque companies with simple tools and criteria to take their first steps in product ecodesign from a lifecycle approach.

Many Basque companies have since incorporated environmental criteria as a further factor in the design of its products, along with the usual features such as quality or functionality. Proof of this are the more than 150 products in the *“20 Years of Ecodesign. Made in Euskadi”* catalogue published by Ihobe in 2021 or the *“ZIRKULARRAK: Basque circular products exhibition”*, a travelling exhibition held in 2022 and 2023.

As a result, the Basque Country is today a benchmark region in Europe in the application of a circular vision of the economy, particularly in the industrial sector. That leadership is the outcome of the Basque Country’s vast experience in eco-innovation in a private-public partnership framework and focused on improving the efficiency of the industrial processes and on applying ecodesign methodologies. Those methodologies have facilitated, inter alia, the reparability of products and the reuse of the materials used in their manufacturing.

ECODESIGN IN THE CIRCULAR ECONOMY

The circular economy is a production and consumption model that seeks to extend the lifecycle of the products and services, and their value; thus, optimising the use of resources and avoiding waste generation. The strategies to advance towards a more circular economy therefore require the environmental impacts associated to all the stages of a product or service to be taken into account.

The design stage is decisive, as the decisions taken at that point will have a direct impact on the subsequent stages. It is estimated that 80% of the impacts of a product during its life cycle are defined in the design phase.

Ecodesign is an interdisciplinary methodology that considers environmental aspects overall with the rest of the usual criteria in a design phase (quality, safety, aesthetics, functionality, etc) throughout the product and service development process, in order to achieve products and services with the least environmental impact possible. Therefore, ecodesign implies taking improvement strategies into consideration throughout all the stages of the life cycle of the product.

Life cycle is taken to be the set of interrelated and consecutive stages of a product (or service) system, from purchasing raw materials or generating them using natural resources, to the final disposal. As can be seen in Figure 1, the life cycle of the product includes different stages and involves different stakeholders.

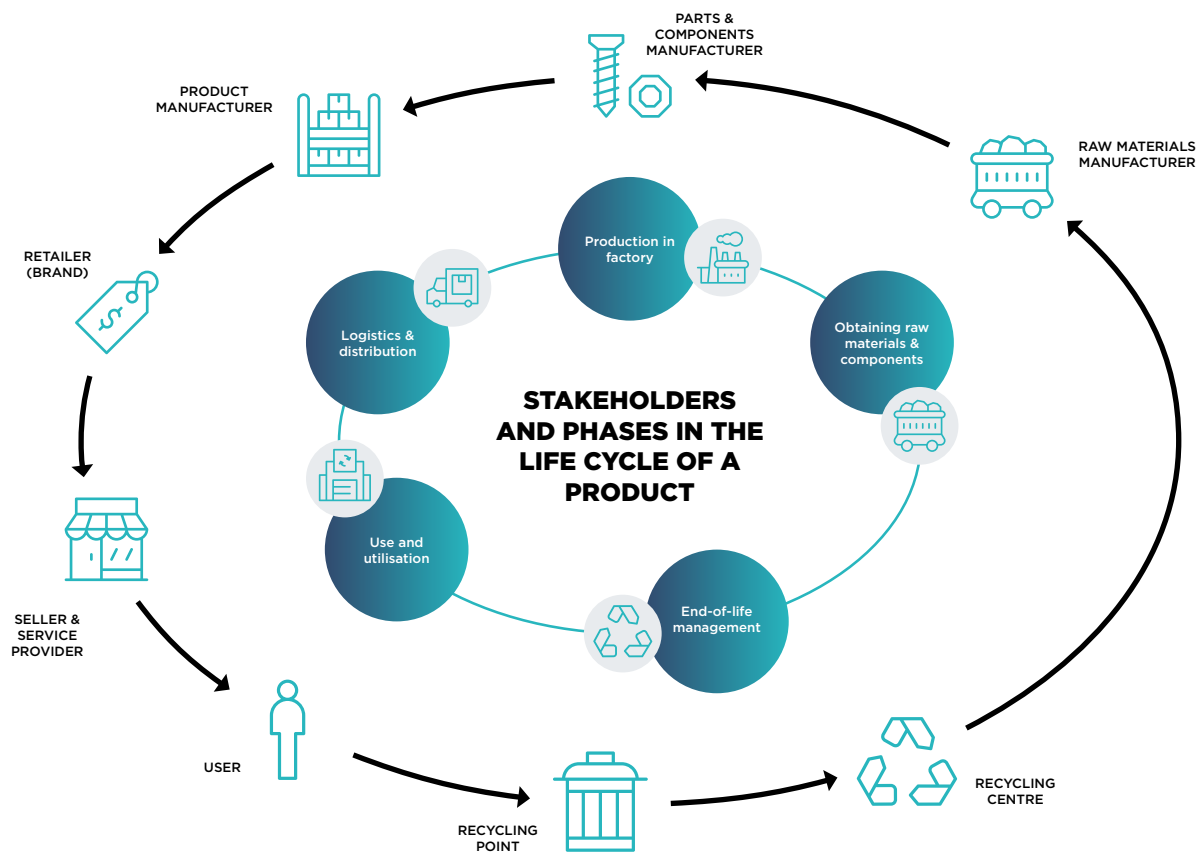


Figure 1. Stakeholders and phases in the life cycle of a product

Considering the full life cycle of a product from the ecodesign perspective provides an in-depth understanding of the environmental aspects in each stage. The relevance of embarking on this approach lies in its ability to clearly identify all the inputs and outputs of the process that generate an environmental impact, and not only covering those caused in the company itself.

This life cycle perspective allows areas for improvement and optimisation to be pinpointed, and establishes the influence of each strategy in every stage and of the product overall, thus avoiding environmental burden shifting between stages.

Applying ecodesign strategies is, therefore, fundamental to achieving the principles of the circular economy: closing loops and retaining the value of the product for as long as possible, thus optimising the use of resources and minimising waste generation.

As can be seen Figure 1, what is known as Life Cycle Thinking is integrated in an initial approach to ecodesign. That framework includes the life cycle perspective in the design of the products, so that their environmental impact can thus be minimised. The ecodesign manual published by Ihobe in 2000 applied that life cycle thinking, which considered how the design phases in the different stages of the life cycle could be improved from an environmental perspective and the loop closed at the end of the lifespan by recycling. However, the circular economy requires a further step to be taken and the loop to be closed in the different cycles prior to end of life.

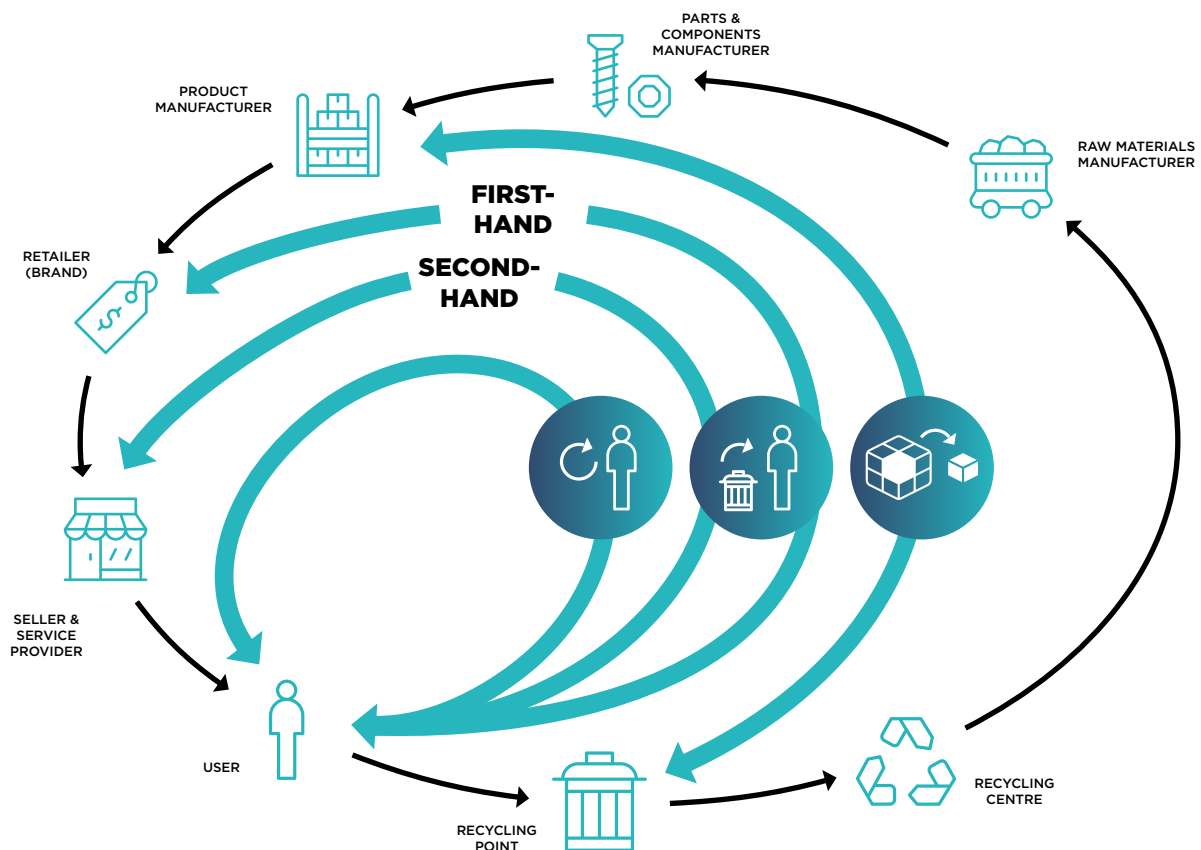


Figure 2. Ecodesign diagram for a circular economy with a circular approach

Therefore, this manual addresses “Circular Ecodesign” and integrates additional mechanisms based on Circular Design Thinking. As can be seen in Figure 2, this new thinking framework goes a step further, particularly as regards reformulating value retention and continuously closing loops. The goal is to completely close the flow of resources in multiple closed loops: by means of increasing the lifespan of products, their reuse or recovery of parts, materials or raw materials.

While “Traditional Ecodesign” based on “life cycle thinking” is focused exclusively on process optimising and reducing the environmental impact, “Circular Ecodesign” further incorporates retaining and recovering the value of the products by means of the circularity of the stages.

BENEFITS OF ECODSIGN

This section analyses the many benefits that ecodesign offers to companies, from improving efficiency to fostering the brand image and complying with the growing expectations of consumers. Ecodesign can become a catalyst for competitiveness and the environmental sustainability of companies. The main benefits that ecodesign can offer companies are set out below:

- **Improving the environmental profile**

By definition, designing products taking the environmental impact into account means reducing the environmental impacts of the product as the first and most direct benefit.

- **Cost cutting**

Optimising the production processes, along with savings in the consumption of resources and minimising waste (and its management costs) means production costs are cut.

- **Innovation**

Incorporating ecodesign criteria adds innovation to the product being developed. Furthermore, introducing new aspects to the usual design methodology generates new ideas to do with aesthetics and functionality that would not have otherwise emerged. That significantly enriches the design process, by fostering creativity and allowing more original and sustainable solutions to be created for the final product. Furthermore, it can facilitate the development of new business models and innovative product concepts.

- **Complying with and anticipating legislation**

Introducing environmental criteria from the design stage can facilitate compliance of environmental legislation, along with anticipating future environmental requirements with all the ensuing benefits for the company.

- **Meeting customer demand**

Industry is increasingly more exacting regarding its suppliers, and expects them to control and improve their environmental aspects. In turn, the green public procurement guidelines mean that public administrations are requiring better environmental aspects from their suppliers. On the other hand, other customer demands can be met by designing the product using environmental criteria.

- **Increasing product quality**

Introducing environmental criteria in the designing of a product can increase the quality of that product, for example, by optimising its durability, reliability and functionality.

- **Making the product and company stand out on the market**

Ecodesign improves the image of the company and its products by implementing environmental improvements. It conveys an image of trust and generates customer loyalty on an increasingly more demanding and aware market. That is true for both on B2C, with more demanding consumers, and on B2B markets, where environmental performance is an ever more important factor when evaluating suppliers.

- **Improving information management throughout the supply chain**

Ecodesign fosters more efficient and responsible management of information throughout the supply chain. On the one hand, analysing the environmental aspects throughout the whole life cycle of the product requires a fluid information flow among the stakeholders of the supply chain. On the other hand, the circular design can lead to companies working together and creating new value networks.

- **Access to new markets**

Ecodesign offers a competitive advantage as it adapts to the expectations of global consumers and to the environmental demands of the markets in constant evolution as it allows companies to expand their scope and penetrate in new business opportunities.

ECODESIGN AS PART OF THE EUROPEAN GREEN DEAL

The European Commission's growth strategy seeks the economic development of the European Union while addressing climate and environmental challenges.

Ecodesign is central to this strategy, particularly in the context of the European Green Deal. The Deal, unveiled in 2019, is a package of policy initiatives and instruments, which aims to set the EU on the path to a green transition, with the ultimate goal of reaching climate neutrality by 2050. It is the basis for the transformation of the European Union into a fair and prosperous society with a clean, circular, resource-efficient and effective economy.

The production and consumer initiatives implemented by the European Union are aimed at supporting and facilitating the transition towards a circular economy, by fostering the reuse and recycling of materials to reduce dependency on natural resources and mobilising industry in favour of a cleaner and circular economy.

As the European Union implements policies and initiatives aimed at supporting an economy that is prioritising efficiency in the use of resources, reducing waste and closing production loops, ecodesign emerges as a key facilitator of that transformation. The European action plans seeks to incorporate sustainability at the heart of the product and system design, by carefully considering durability, reuse, efficiency and reduction of environmental impacts at each stage of the life cycle of a product.

The strategic goal of the European Commission is clear: to make sustainable products the norm on the market of the European Union, with ecodesign as a linchpin for that purpose.



PRESENTATION OF THE MANUAL

MANUAL GOAL

The goal of this manual is to provide companies with guidelines to integrate environmental criteria and incorporate a circularly approach in the design of their products; it also facilitates simple tools to allow them to take their first steps in that direction.

This manual has been published to include more than 20 years' experience driving ecodesign and eco-innovation in the Basque Country; it is an update of the ecodesign manual published by Ihobe in the year 2000 ("Ecodesign Manual: 7 Steps for Implementation") and has integrated a circular approach and has adapted it to the current scenario.

The earlier manual addressed ecodesign exclusively from a life cycle thinking perspective, but did not go further into aspects related to circularity. It was what is known as traditional ecodesign. This new version of the manual provides a more comprehensive approach, with the necessary guidelines to implement circular design thinking.

WHO IS ITS TARGET AUDIENCE?

The manual is aimed at those companies that wish to use ecodesign to improve the environmental profile of their products, by means of environmental improvement plans to advance towards a circular economy.

The manual is suitable both for companies already working on the ecodesign of its products and that now want to incorporate circularity and closed loops in their design, and those companies starting out and wish to begin to implement the range of ecodesign strategies included here.

WHAT RESULTS CAN I EXPECT?

By following the steps of the methodology, you can obtain an ecodesigned product that considers the whole life cycle of the product and its integration in the circular economy.

It should be noted that the methodology used (based on and adapted from PROMISE) – in the same way as the accompanying tools – is not unique. However, the extended use over that time endorses its effectiveness in order for both large companies and SMEs to start working on ecodesign.

The methodology offers the possibility of exploring innovative ways of designing products, and allowing their integration at different levels within the company. However, each company will need to adjust those tools to its specific needs and work methods. This tailored approach will allow the results to be optimised and contribute to continuous improvement in environmental terms in the development of its products and processes.

STRUCTURE OF THE MANUAL

The manual has the same structure as the one published by Ihobe in the year 2000, in order to facilitate the integration of the steps and expand the approach to incorporate more circular thinking. Thus, this manual offers a methodology that maintains the 7 previously defined stages. Useful tools and a case study as an example have been added to the information of each of the stages. That facilitates its use by companies already familiar with the previous manual.

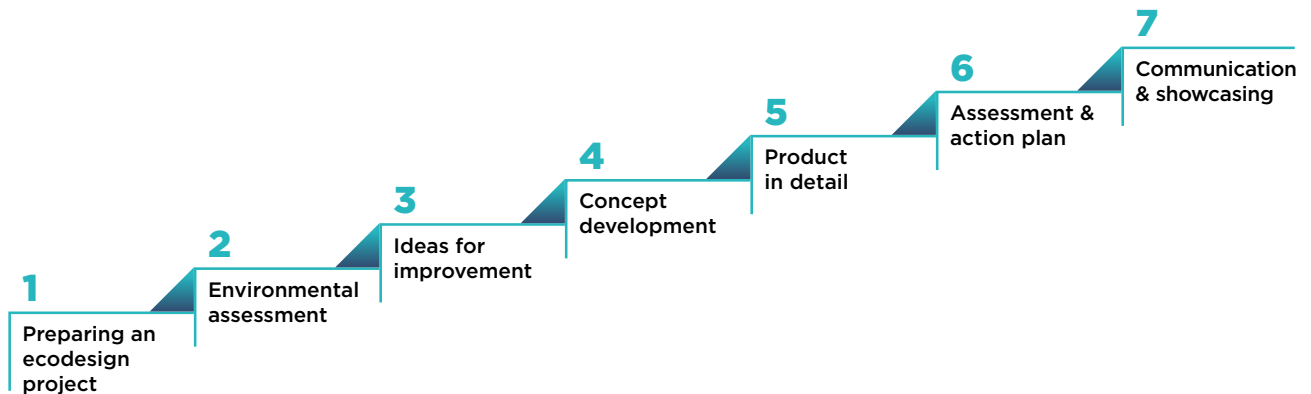


Figure 3. Stages of ecodesign. Proposed methodology

STAGES

- **Stage 1 - “Preparing an Ecodesign Project”**

The product to be ecodesigned, the departments and people involved in the development, and the driving factors of the ecodesign are analysed in the preliminary stage. The ecodesign strategy will be different according to the company’s internal and external reasons for ecodesign and circular design, along with the specific context of the company and the product.

- **Stage 2 - “Environmental Assessment”**

The second stage focuses on the environmental assessment of the product using the baseline information. It will involve establishing the limits of the system, by analysing its full life cycle and assessing the environmental impact in each of the phases involved.

- **Stage 3 - “Ideas for Improvement”**

Once the product is known in detail, this stage seeks to identify the different ecodesign strategies applicable to the product and to define and prioritise the different proposals for improvement.

- **Stage 4 - “Concept Development”**

This stage is the start of the development phase, which will ultimately lead to a new product. It focuses on preparing the product specifications, the development of new product concepts for its initial design and selecting the final concept.

- **Stage 5 - “Product in Detail”**

Once the new concept to be developed has been defined and selected, this stage will focus on the details of the characteristics of the selected concept. The necessary prior analyses are conducted and work is carried out on the technical development for the industrialisation of the different components of the product.

- **Stage 6 - “Assessment and Action Plan”**

This stage involves a detailed assessment of the results obtained in order to reach conclusions. Those conclusions will be fundamental to put a strategic ecodesign and circular economy action plan in place, both at product and business level.

- **Stage 7 - “Communication and Showcasing”**

During this stage, the aim is to highlight the synergies between the environmental improvements and the driving factors of the first stage. The main objective is to inform stakeholders of those advances in a clear and precise manner.

It is important to stress that each and every one of the stages of the manual should be followed, without skipping any, when using this methodology and tools, as they are all interrelated and have proven their importance of achieve a proper and successful implementation.

METHODOLOGY FRAMEWORK

Each of the seven stages of the methodology is structured into four parts:

I. Summary

Each stage has a cover page setting out the goals for the stage, the main activities to be carried out, the departments of the organisation involved, the associated tools (many of which are available in the manual) and an estimate of the hours needed to implement the stage.

II. Description

This section describes the implementation of each stage in detail.

The term “product” in an abbreviated way will be used from this point onwards to refer both to products and services in the context of ecodesign. It should be noted that even though this term is used to make communication easier, the notion of ecodesign continues to be relevant and applicable both to products and to services.

III. Cafeteras Ensueño, S.L. case study

The development of a case study throughout the manual is included to provide a more practical aspect to the methodology and make it easier to understand each of the stages.

The fictitious case of “Cafeteras Ensueño, S.L.”, already included in the earlier manual, is continued here. It is a small coffee maker manufacturer located in Orio. In the year 2000, it decided to integrate the ecodesign methodology as an innovation factor in its company. At

that time, drip filter coffee makers were one of its main products and with which the company took its first steps in ecodesign.

However, the coffee maker market has changed significantly in recent years. One of the largest changes has been the introduction of single-serve coffee makers, which has had a dramatic impact on the home coffee maker market. The growing popularity of single-serve coffee makers led Cafeteras Ensueño S.L. to expand its product range and include pod coffee makers in its catalogue. In recent years, these coffee makers have accounted for approximately 80% of the company's sales. However, the market dynamics are shifting towards preferring another type of coffee maker, such as the automatic and semi-automatic, and there are environmental concerns about the single-serve systems. That has caused the company to rethink the design of this product.

This fictitious company is going to be used as the example for the support case study, to show how the different tools are used and how to follow the methodology.

IV. Tools

Each stage includes at least a tool or datasheet aimed to facilitate the implementation work by the companies. They are simple tools so companies can adapt them to their needs and can begin to work following the ecodesign methodology proposed in this manual. The envisaged tools are set out in the ANNEX.

Stage 1

Preparing an
ecodesign project





GOALS

To organise and plan activities to be carried out in the ecodesign project, along with defining the target project



ACTIVITIES

- Selecting the work team
 - Selecting the product to be ecodesigned
 - Analysing the driving factors for ecodesign
-



DEPARTMENTS INVOLVED

- General Management
 - Product Development Manager
 - Other Departments
 - External stakeholders
-



TOOLS

- Product selection criteria table
 - Worksheet of internal and external driving factors
-



PLANNING

10-20 Hours

1.1. Work Team

The first task of any ecodesign projects is to set up the work team. The team plays a fundamental role in the optimum development of the project. It is important that the team has the following characteristics in order to ensure the effectiveness of the project:

- **Small in size and organised structure**

The team should not have too many members in order to ensure it works effectively. Furthermore, the roles should be properly assigned in keeping with the skills of each member of the team. The aim is to ensure that one of the members of the group, preferably the manager of the product development department, assumes the role of leader to oversee and coordinate the different stages of the project.

- **Decision-making capacity**

The team will need to be empowered to make strategic decisions in the company. Therefore, it is crucial to involve management and staff with decision-making capacity in the work team.

- **Multidisciplinary approach**

It is essential to involve people from different departments given that the ecodesign project must take different aspects into consideration, such as the product quality, the impact on the costs, identifying possible environmentally friendly material alternatives, etc. This will allow information to be gathered first hand and address the ecodesign project in a systematic and comprehensive way, ensuring that all key areas are represented and work in coordination to achieve the goals. Including the following departments should be prioritised:

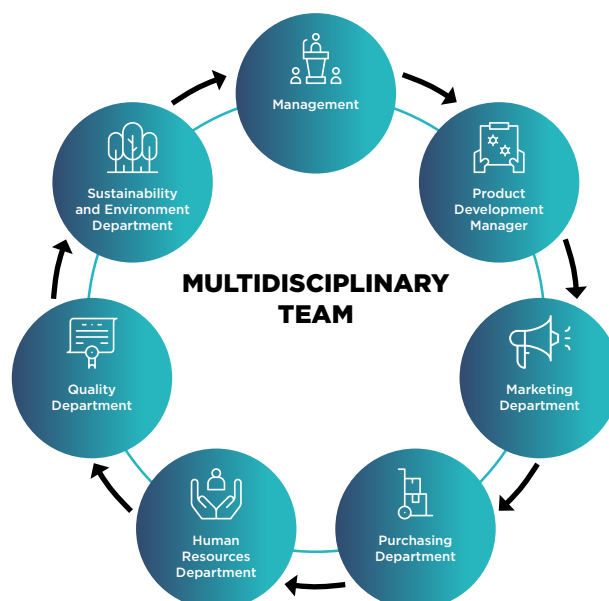


Figure 4. Multidisciplinary work team made up of staff from different departments in the company

- **Management** The presence of Management is fundamental to establish the environmental importance in the operations of the company and to make decisions regarding the incorporation of ecodesign criteria in product development.
- **Product Development Manager:** In charge of designing and developing products taking the environmental and sustainable aspects into account. S/he will usually be assigned the role of leader to coordinate the different stages of the project.
- **Sustainability and Environment Department:** Provides expertise on environmental and sustainability aspects in order to guarantee that the project complies with the established environmental standards and goals.
- **Quality Department:** Makes sure that the products comply with the quality requirements, ensuring that the environmental improvements do not negatively affect performance.
- **Purchasing Department:** Involved in finding and selecting suppliers taking green procurement criteria, along with alternative technologies and materials that comply with ecodesign criteria. It also ensures the feasibility of the ecodesign proposals.
- **Marketing Department:** Contributes to the communication and promotion of the ecodesigned products, by showcasing their environmental benefits by means of a Marketing Plan.
- **Human Resources Department:** Facilitates staff training and skills building in areas related to ecodesign and environmental sustainability.

Furthermore, it may be of interest to involve people external to the project team, such as:

- **External Design Engineering Firm:** When working with external engineering firms, it is essential to inform them of the company's commitment to environmental requirements. Skills building in ecodesign of those external professionals will significantly help to enrich and streamline the process.
- **Environmental consultants:** Their role will be to advise on the environmental sustainability of the different alternatives that arise during the project.



Cafeteras Ensueño, S.L. is a small company located in Orio and employs 50 people. This company, which manufactures coffee makers and has been a trail-blazer in the application of ecodesign since the year 2000, is aware of the changing market preferences and wishes to address the growing environmental concerns around pod coffee makers.

Therefore, it intends to embark on a new circular ecodesign project for one of its leading products on the market. It has therefore set up the following work team:

- **Manager:** Proposed the initiative to continue innovating in this area and made the decision to take part in the new project by supporting the decisions made.
- **Product Development Manager:** Heading the project and will involve different people of the company in the different stages of the project.
- **Quality and Environmental Manager:** Tasked with guaranteeing compliance of the quality standards and environmental targets set.
- **Ecodesign Consultant:** Advising the company on applying the methodology and on assessing environmental criteria.
- **Others:** purchasing, marketing subcontractor, etc... they take part whenever required by providing or receiving key information for the work.



1.2. Product Selection

Once the project team has been set up, the decision must be made regarding the product to be ecodesigned. That may be a product already marketed by the company, encased in a linear system, or it can be a new development that is added to a circular business line or model. In either case, the product needs to be designed from the initial design phases.

The criteria for selecting a product are specific for each company, but the following guidelines should apply as a general norm:

- **Degree of freedom that allows the product to be modified:**

The product must have a degree of freedom that allows modifications to be made. *E.g., Polyethylene (PE) plastic bags have hardly any degree of freedom either regarding the form or the material used; therefore, it is a priori not of interest to carry out an ecodesign project.*

- **Amount of information on the different life cycle stages:**

It is important to be able to obtain sufficient information on the different life cycle stages of the product to be ecodesigned; a representative environmental impact can thus be calculated and burden shifting avoided.

- **Mostly affected by internal and external driving factors:**

The product has to be preferably one which is mostly affected by the ecodesign driving factors for the company, as it is related to the potential benefits that the company will obtain with the project.

- **Product simplicity:**

If it is the first product in which ecodesign criteria are being introduced, the product, or the part of it that is going to be modified, should be relatively simple, as that helps to obtain fast results and thus bolsters the motivation to keep working in ecodesign.

The tool section of the ANNEX includes a table to gather information on the different possible products, along with their technical characteristics, in order to select the product to be ecodesigned. Even though a single final product is selected, this tool facilitates the process to assess the company's future ecodesign projects.



With the boom in single-serve coffee makers, Cafeteras Ensueño S.L. expanded its product range to include pod coffee makers in its catalogue. In recent years, these coffee makers have been very successful and account for 80% of its sales.

The features of this type of coffee makers were for a long time seen to meet the practicality needs of consumers. However, as the market has evolved and consumers have expressed a growing concern about the environmental impact of coffee makers and pods, the company has begun to consider a revision of its flagship product; as environmental commitment is an essential and distinctive aspect of the company.

Therefore, Cafeteras Ensueño has embarked on the process to design this product for a circular economy. The technical characteristics of the product chosen for the ecodesign project are set out below:

CAFETERAS ENSUEÑO

Description of the technical characteristics of the product



Weight: 2.85 kg

Dimensions: 155 mm x 373 mm x 380 mm

Materials: PS, PP, PE, ABS, aluminium, resistant alloys, printed circuit, PVC cable

Power: 1500 W

Energy consumption: 1000 kWh

Energy efficiency: B

Use frequency: 730 hours/year

Estimated total lifespan: 5 years

Tank capacity: 1.2 litres

1.3. Driving Factors for Ecodesign

It is of utmost importance to identify the different driving factors that led the company to adopt ecodesign measures. Those reasons will be fundamental as a guide for decision making and to unify criteria within the work team.

Driving factors for ecodesign can be classified as internal and external. All the driving factors should be recorded to facilitate their consideration and active presence throughout the product design and development process.

1.3.1. External Driving Factors

Perspective	Factor	Description
STAKEHOLDERS	Market/customer requirements and trends	Changing customer demand and market trends can drive companies to implement ecodesign practices to adapt to their needs. There is currently a greater demand for environmental responsibility and lower impact by both customers (B2B) and consumers (B2C).
	Improving the reputation and image of the product and the company	Ecodesign tends to improve the image of a product and of the company in general, by enhancing the company's reputation with the customer, competitors and society.
	Requirements of parent companies and suppliers	Parent companies or business groups can establish environmental standards that its affiliates must follow; while suppliers may require that its customers adopt stricter environmental practices in order to continue working together.
	Sectoral initiatives	Companies taking part in these initiatives can be motivated to implement ecodesign to comply with the sector's requirements and expectations.
	Stakeholder pressure	Stakeholders such as NGOs, environmental activists and consumer organisations can exercise pressure on companies to adopt stricter environmental practices.
ECONOMIC PERSPECTIVE	Investor expectations	Investors, particularly those who follow sustainable investment strategies, can push companies to adopt ecodesign.
	Competitive advantage	Incorporating environmental criteria in product development may be a factor to stand out from the competition.
	Access to international and potential markets	Company may be required to meet specific environmental standards to trade on certain markets and improving the environmental impacts of the products would therefore be essential.
	Economic incentives	Financial stimuli can exist to encourage companies to adopt ecodesign in the form of tax incentives or grants and subsidies for environmental projects.

Table1. External driving factors (cont. ->)

Perspective	Factor	Description
ENVIRONMENTAL PERSPECTIVE	Getting ahead of legislation and regulations	Getting ahead of environmental legislation and regulations is a proactive practice that can drive companies to adopt ecodesign.
	Environmental standards	The intention to comply with additional voluntary environmental standards, such as recognition by means of an eco-label, can result in better environmental characteristics of the products.
INNOVATION	Material and technology innovation	The existence and adopting advanced technologies, along with the availability of new more sustainable materials can drive ecodesign.

Table1. External driving factors

1.3.2. Internal Driving Factors

Perspective	Factor	Description
CULTURE OF THE ORGANISATION	Company's sense of responsibility	Environmental awareness and corporate responsibility may be internal drivers for ecodesign.
	Motivating the workforce	A team committed to sustainability can influence the direction of the company and foster the adoption of ecodesign.
	Corporate culture	When a company embraces a corporate culture that includes environmental sustainability among its values, it is more likely to implement ecodesign in its operations.
ECONOMIC PERSPECTIVE	Cost cutting	Ecodesign can lead to more efficient processes, a reduction in the resources used and to recovering the value of materials, meaning a significant cutting of costs.
	Long-term savings	Ecodesign can lead to significant savings in the long term by cutting operational costs and the risks associated with environmental regulations.
ENVIRONMENTAL PERSPECTIVE	Lower environmental impact	This factor is at the very core of the ecodesign philosophy. Ecodesign is a means to implement improvements to reduce the environmental impact of the organisation.
	Environmental goals and targets	Establishing specific environmental goals and targets as part of the continuous improvement of the organisation can drive the company to adopt ecodesign practices.
	Risk management	The need to manage risks can cause the company to proactively consider the environmental risks in the design decision-making.
INNOVATION	Long-term innovation opportunity	Innovation as a strategy and its application in business models and technologies can lead to competitive advantages in the long run.
	Improving the product features	Assessing and introducing overall improvement to the design of the product in the different life cycle stages results in better product features.
	Increasing the product quality and value	By adopting ecodesign practices, companies can produce long-lasting and more efficient products that are more attractive for consumers. This can lead to competitive advantages, as better quality and value products are usually better received on the market and can justify higher prices. Furthermore, improving the quality can lead to greater customer satisfaction and loyalty in the long-term, which benefits the company and its customers.

Table2. Internal driving factors

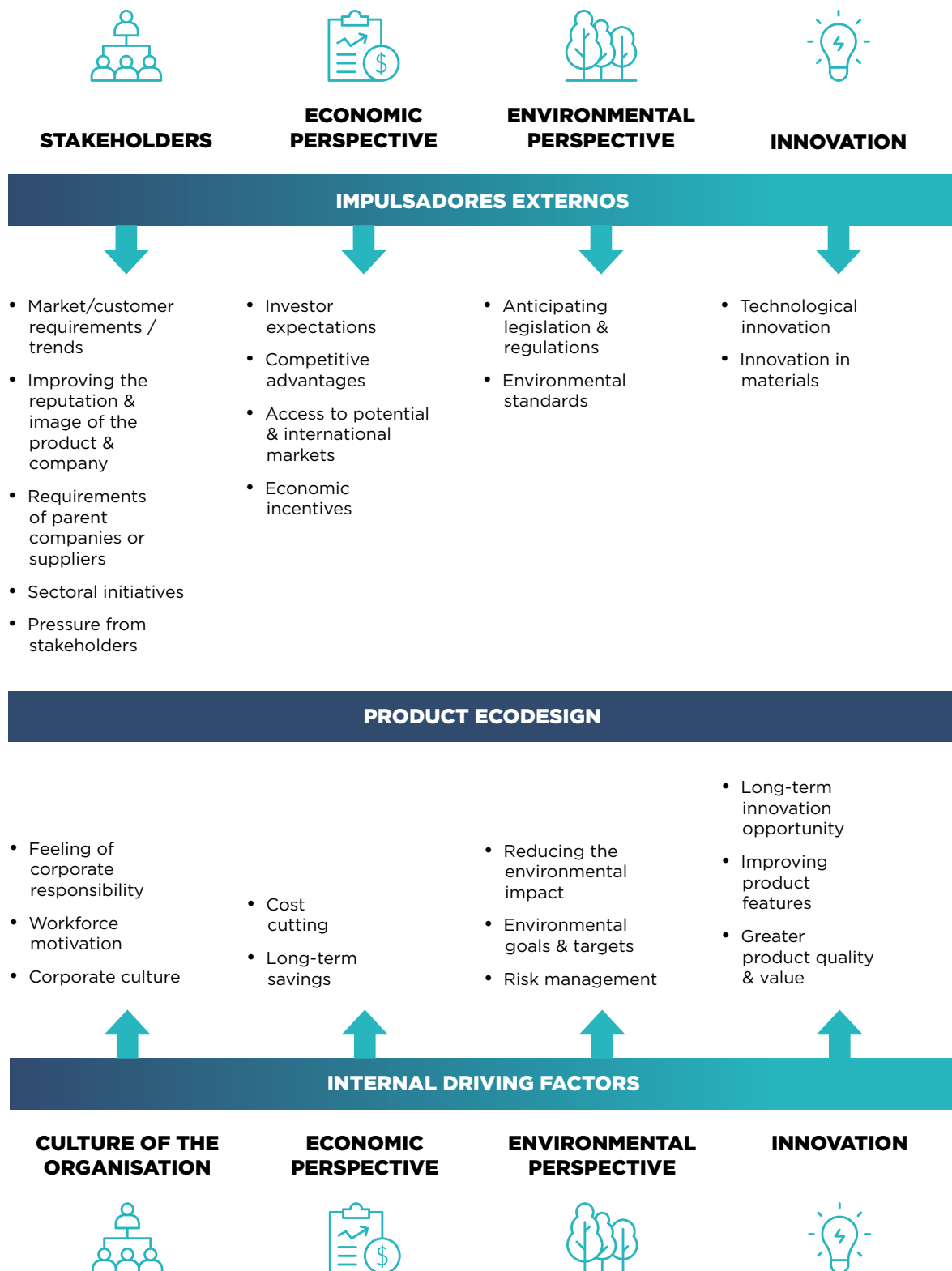


Figure 5. Diagram of internal and external driving factors

The tool section of the ANNEX includes a table to monitor the driving factors.



Cafeteras Ensueño has highlighted the following driving factors for ecodesign:

EXTERNAL DRIVING FACTORS



Customers

- Consumer concern about pod waste
- Demand for energy efficiency
- Demand for ease of repair



Reputation

- Better use and evaluation of environmental claims



Stakeholders

- Demand for durability
- Concern about pod waste
- Greater value in sustainable investments



Competition

- Increasingly more sustainable products
- Higher sales of automatic or semi-automatic coffee makers using ground coffee or beans



Legislation

- Ecodesign regulations
- Product digital passport
- Green Claims directive
- Consumer empowerment
- Right to repair



Sector

- New trend towards selling automatic and semi-automatic coffee makers



Value chain

- Request for carbon footprint and life cycle assessment data in the product value chain



Markets

- Ban on use of pods in public institutions of some cities
- Demand for pod collection
- Increase in speciality coffee consumption



Incentives

- Existence of subsidies for projects fostering the circular economy



Standards

- UNE-EN 45552 to 45559 standards



Innovation

- New recycled plastic materials available
- Innovation in technologies
- Companies interested in joint innovation project to develop industrial synergies or symbiosis

INTERNAL DRIVING FACTORS



Corporate culture and values

Strategic commitment to environmental sustainability



Costs

Long-term savings of manufacturing costs



Risk management

Risks of breaching legislation in the pipeline



Features

Convenience of single-serve coffee makers



Workforce

Workforce motivated by previous ecodesign projects



Environmental goal

Goals of the company's environmental management system: reducing the consumption of virgin raw materials and waste management



Innovation

Extensive experience in the ecodesign process



Quality and value

Maintain quality standard and design

Case Study 3. Driving factors

Stage 2

Environmental assessment





GOALS

To analyse the main environmental aspects and impact of the product throughout its life cycle



ACTIVITIES

- Description of the life cycle of the product
 - Assessment of the product environmental impact
-



DEPARTMENTS INVOLVED

- **Product development manager:** Leading the assessment and prioritisation. Passing on the key points to the external design, where applicable, and the importance of this stage. Coordinating the team.
 - **General Management:** Results reported to them (important for understanding the process and decision-marking).
 - **Other departments:** Facilitating information (purchasing and selling countries, transport calculations, weight of raw materials, ...).
 - **External environmental expert:** Providing their expertise to help in the assessment-prioritisation of environmental aspects.
 - **External designer:** Their participation is recommended in the process to determine and prioritise environmental aspects.
-



TOOLS

- METCO matrix
 - Simplified LCA tools
 - Software tools for the Life Cycle Assessment
-



PLANNING

20-50 hours



2.1. Description of the Product Life Cycle

Products and services interact with the environment, either in the form of consumption of materials, energy and other materials, or as emissions, waste and landfill. That interaction may generate impacts on the environment, such as depleting natural resources, climate change and the depletion of the ozone layer. Therefore, the environmental aspects and impacts need to be identified and prioritised in the development of an ecodesigned product in order to seek to optimise them and establish actions for improvement.

Therefore, analysing the environmental profile of the product from a life cycle perspective is essential. Considering the full life cycle of a product achieves an in-depth understanding of the environmental impacts of the product throughout its life and the most important can be identified.

An assessment of the environmental aspects and impacts associated with each of the life cycle phases is needed to first describe the life cycle of the product:

- **Environmental aspect:** It is the element that interacts or can interact with the environment, and can be directly managed and controlled by the organisation, with the latter not having direct control, but can influence or, merely, not influence it. It is therefore associated to the product itself. An environmental aspect can cause one or several environmental impacts.
- **Environmental impact:** It is the change generated by an aspect in the environment, whether adverse or beneficial, affecting all or part of the activities, products and services of an organisation. It is therefore associated to the global environment. The impacts are classified into the categories described in Table 3 and Figure 6.

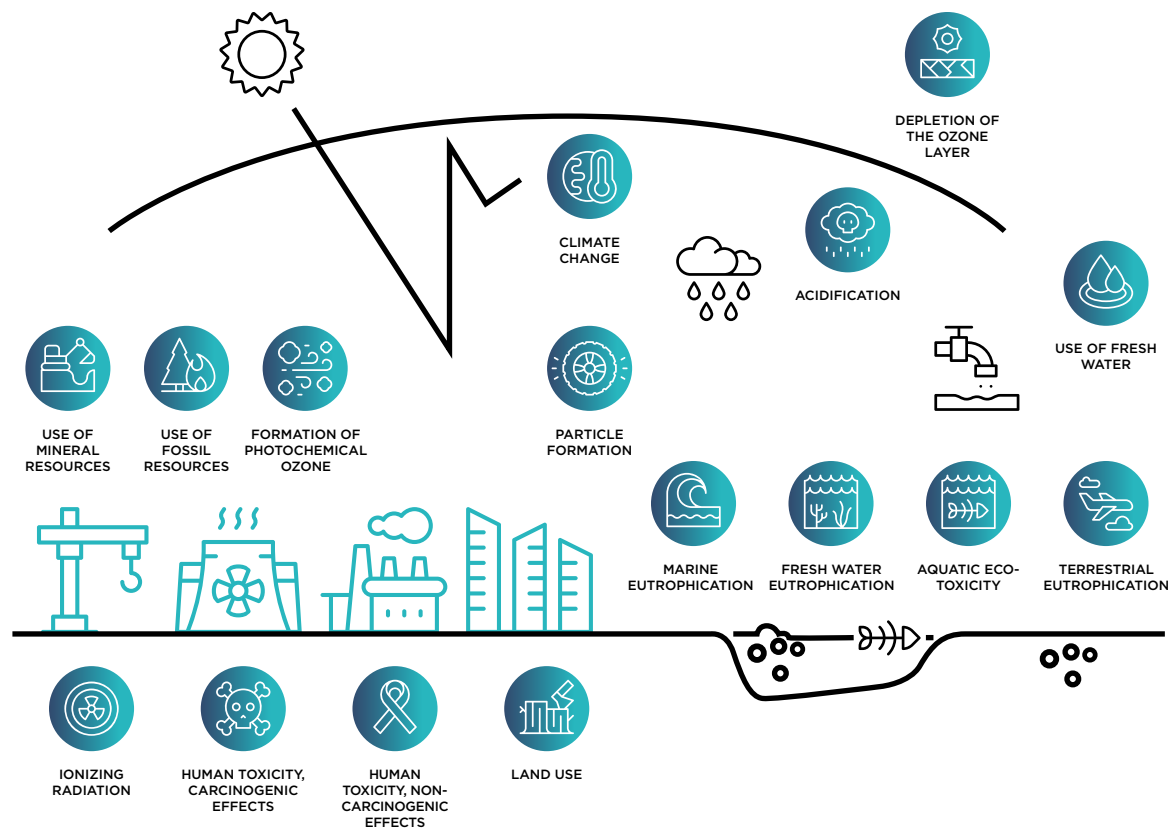


Figure 6. Environmental Impacts

Icon	Impact	Description
	Acidification	Loss of the neutralizing capacity of the soil and of the water, as the result of returning to the Earth's surface, in the form of acids, of nitrogen and sulphur oxides discharged to the atmosphere.
	Depletion of the ozone layer	Negative impact on the ozone layer's capacity to protect against solar ultraviolet radiation due to the emissions of substances that deplete the ozone layer, such as long-lived gases that contain chlorine and bromine (e.g. chlorofluorocarbons, hydrochlorofluorocarbons and halons).
	Use of fresh water	It represents the surface area of the water available that in a basin after meeting the demand of human beings and the water ecosystems. It assesses the water depletion potential, for human beings or ecosystems, starting from the assumption that the less water that remains available by surface area, the greater the probability that another user would be deprived.
	Uses of resources, fossil	Use of non-renewable fossil natural resources (e.g., natural gas, coal, oil).
	Use of resources, minerals	Consumption of non-renewable abiotic natural resources (minerals and metals).

Table3. Description of environmental impacts (cont. ->)

Icon	Impact	Description
	Climate change	Phenomenon observed in the temperature readings that show an average increase in the temperature of the Earth's atmosphere and the oceans in recent decades.
	Aquatic eco-toxicity	Result of a series of different toxicological mechanisms caused by the release of substances with a direct effect on the health of the ecosystem, which are harmful for different species and which change the structure and function of the ecosystem.
	Fresh water eutrophication	Nutrients, mainly nitrogen and phosphorous, from discharges of wastewater and from fertilised farming land that accelerate the spread of algae and other plant life in the water.
	Marine eutrophication	The decomposition of organic matter consumes oxygen, which leads to a deficiency of that gas and, in some cases, the death of the fish.
	Terrestrial eutrophication	Three impact categories are used to assess the impacts caused by eutrophication: terrestrial eutrophication, fresh water eutrophication and marine eutrophication.
	Formation of photochemical ozone	Formation of ozone at ground level of the troposphere, due to the photochemical oxidation of the volatile organic compounds (VOCs) and carbon monoxide (CO) in presence of nitrogen oxide (NOx) and sunshine. The high concentrations of tropospheric ozone at ground level are harmful for vegetation, respiratory tracts and artificial materials due to their reaction with organic matter.
	Formation of particles	Harmful to human health due to the emissions of particles and their precursors (NOx, SOx, NH3).
	Land use	Effects of land use, the size of the surface area involved and the length of the occupancy, along with the transformation of land service due to human activity.
	Ionizing radiation	Harmful to human health due to radioactive discharges.
	Human toxicity, carcinogenic effects	Harmful to human health due to the absorption of toxic substances by means of inhaling air, digesting food or water, or penetrating through the skin, insofar as they are related to cancer.
	Human toxicity, non-carcinogenic effects	Harmful to human health due to the absorption of toxic substances by means of inhaling air, digesting food or water, or penetrating through the skin, insofar as they are related to non-carcinogenic effects that are not cause by particles, inorganic substances with respiratory effects or ionizing radiation.

Table3. Description of environmental impacts

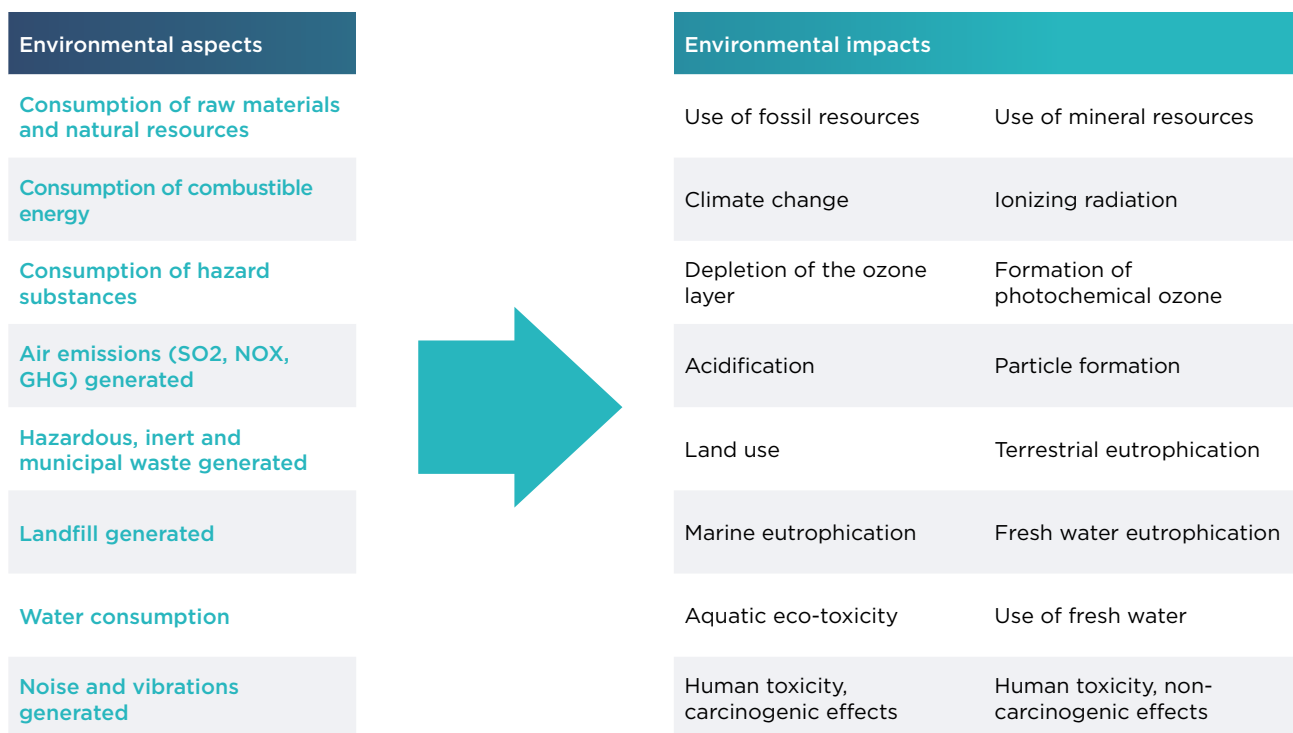


Figure 7. Relationship of environmental aspects and impacts

Figure 7 shows the relationship between the aspects and the associated environmental impacts.

It is important to take into account that the environmental impacts are not only limited to the product production stages, but rather that the whole value chain involves impacts: from extracting raw materials and the processing of materials; transport, storage and distribution of raw materials and the product; the use of the product; to the processing of the waste generated at the end of the lifespan of a product.

As Figure 8 shows, the approach needs to be expanded to consider the whole value chain upstream and downstream in order to establish the full environmental performance of a product. This not only helps to have an overall vision of the whole life cycle of the product, but it also allows any burden shifting to be identified throughout the value chain.

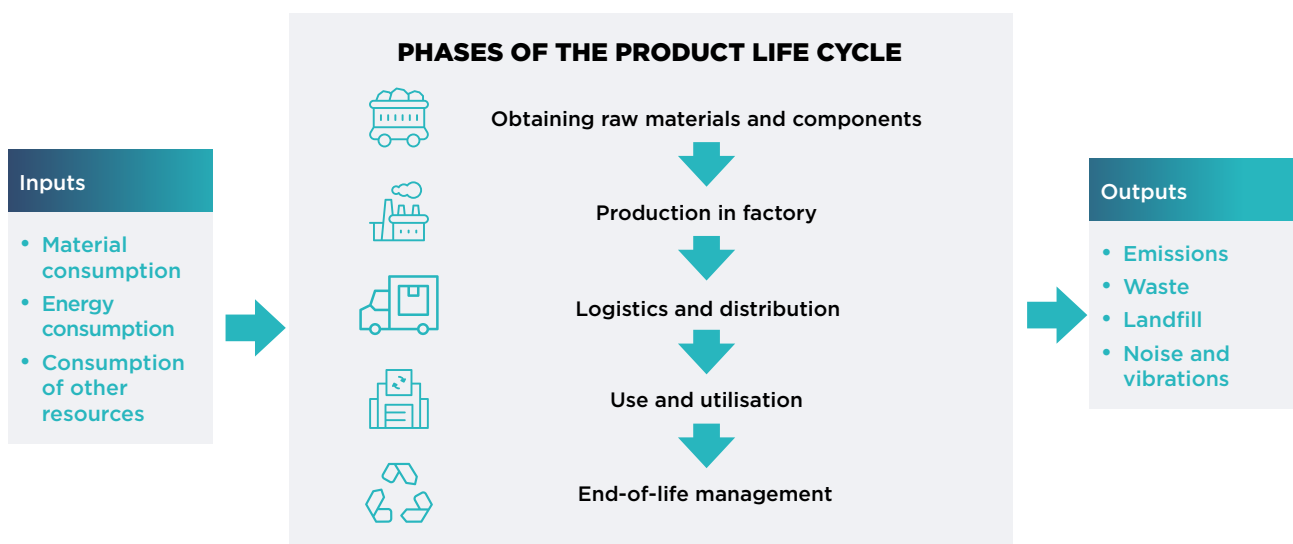


Figure 8. Life-cycle stages and relationship of input and output environmental aspects

2.1.1. Defining the Functional Unit of the Study

While the study unit in traditional ecodesign is in general a physical unit of the product chosen to be improved, the emphasis in circular ecodesign needs to be more on the function that the product offers than on the physical product. The baseline therefore has to always be the establishing of the functional unit of the study.

The functional unit is the quantified performance of a product system for its use as a reference unit. The purpose of the functional unit is to provide a benchmark from which all the input and output data are normalised (in a mathematical sense).

It is important that the study benchmark is associated to the function that the product fulfils and to its lifespan, as all the results refer to that functional unit.

2.1.2. Establishing the Limits of the Study System

First, the limits of the study system must be defined in order to obtain a general perspective of all its aspects that cause environmental impacts. The system will be delimited by the physical product and all the key aspects associated with the product through its full life cycle needed to respond to the defined functional unit. Therefore, the product must be examined and the elements belonging and not belonging to the analysed system must be defined, considering the lifecycle perspective.

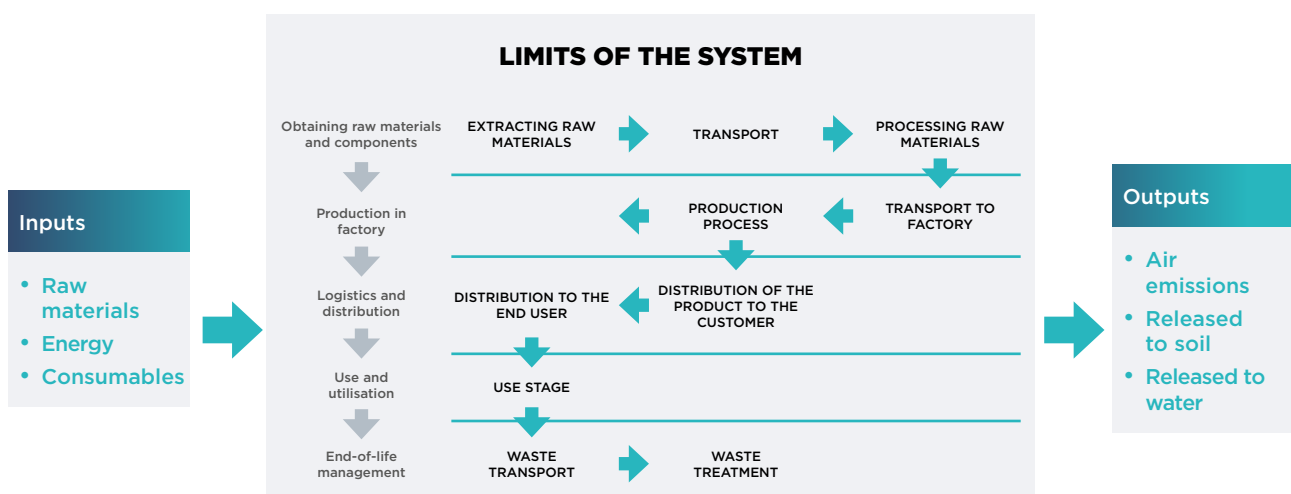


Figure 9. Diagram defining the limits of the system

The limits of the system will be the unit processes included in the system. They may be different depending on the goal of the assessment.

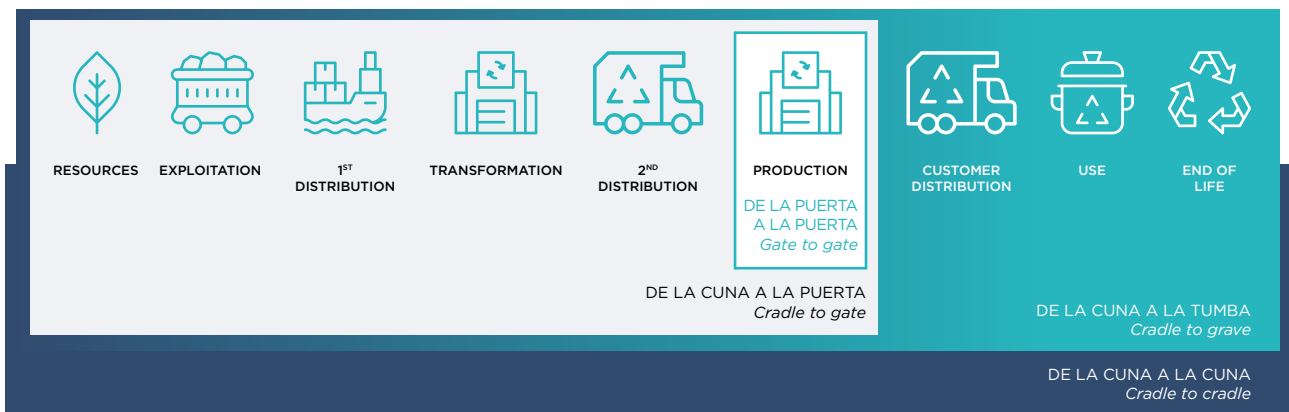


Figure 10. Terminology related to the scope of a Life Cycle Assessment. Ihobe, 2009

Once the scope of a system has been defined, different approaches to the impact assessment can be seen. As Figure 10 shows, if the analysis is limited to the circuit from obtaining raw materials to the product being launched on the market, it is an approach known as “cradle to gate”. When the scope is limited to the production operations within the system, in other words, the manufacturing processes, it is the “gate to gate” scope.

However, it is essential to understand that the full scope of the life cycle, known as “from the cradle to the grave”, which covers from the creation of the product to its final disposal, is the only approach that guarantees that the environmental burden generated in one phase are not shifted to other phases of the life cycle.

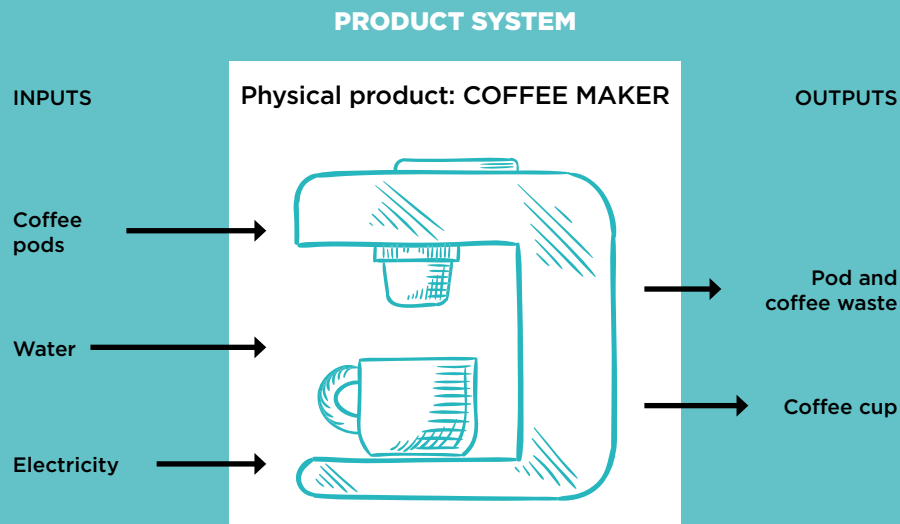


Further information can be found in other Ihobe publications and resources available on its website: www.ihobe.eus



In order to obtain a general perspective of all the aspects of the product that cause environmental impacts, Cafeteras Ensueño first defines the functional unit and the limits of the system of the chosen product, along with a brief description of the life cycle of the product:

- **Functional unit:** Instead of considering the whole product, the focus is on the function that the product offers. In this case the selected functional unit would be obtaining a recently made cup of coffee (using 7 g of coffee and 35 ml of water).
- **Scope and limits of the system:** A “cradle to grave” approach is selected that includes all the stages of the life cycle, both of the coffee makers, and of all the associated consumables, to obtain the defined functional unit.



Case Study 4. Scope, limits of the system and functional unit



Description of the life cycle.

Obtaining and consumption of materials and components		
Material or process	Quantity	Unit
Polystyrene (PS) water tank	200	g
Container of polypropylene capsules	50	g
Drip tray of acrylonitrile butadiene styrene (ABS)	100	g
ABS housing	680	g
Polyamide capsule system housing (PA 6)	150	g
Steel cupholder tray	100	g
50% recycled aluminium (Al) lever	200	g
Pump	230	g
Pumping system	200	g
Printed circuit	240	g
Resistance system	550	g
PVC cable	100	g
Copper wire	50	g
Transport of printed circuit from Asia in boat	0,9	tkm
Production		
Body of the coffee maker and water tank made using a mould	4	MJ
Aluminium lever produced by means of extrusion	3	MJ
Distribution		
<i>N.B.: Includes the final assembly and all the distribution logistics</i>		
Polyethylene bag as packing for each coffee maker	0,01	kg
Recycled cardboard packaging for each coffee maker	0,3	kg
Large recycled cardboard box packaging for 8 coffee makers	0,8	kg
30-page instruction manual	0,04	kg
Distribution of the product by road throughout Europe	10	tkm

Use and utilisation

N.B.: The estimated total lifespan is 5 years, which means a total of 18,250 coffee cups during the service life of the coffee maker.¹

Energy consumption: ²	1.000	
• Coffee period	680	kWh
• Standby mode	320	
Consumption of aluminium coffee pods ³	490	g/week
Water consumption ⁴	2,4	l/week
Water consumption for cleaning ⁵	0,5	l/week

End of life

RECYCLING

• Recycled plastics	1	kg
• Paper (instruction manual)	0,4	

LANDFILL

• Printed circuits	0,24	
• Pump and pumping system	0,43	
• Non-recycled plastics	0,13	kg
• Copper	0,05	
• Aluminium	0,2	
• Steel	0,1	

¹ Coffee cup calculation, based on a consumption of 10 pods a day over 5 years.

² 10 hours a day on standby; 2 coffee period hours a day divided into two coffee periods; and 12 hours a day switched off (no consumption).

³ Based on consumption of 10 coffee pods a day of around 7g.

⁴ 35 ml water consumption for each coffee.

⁵ 500 ml water consumption for cleaning per week.

2.2. Environmental Impact Assessment

The environmental impacts of a product and the associated services are mainly established in the initial design and development stages. Furthermore, once the product is manufactured and launched on the market, making changes that minimise its impact is complicated. It is therefore essential to assess the environmental impact of the products in the design process.

There are different tools with life cycle perspective to analyse the environmental profile of the products. Those tools can be qualitative or quantitative; even though they all pursue the same objective, they are different in terms of application complexity, financial costs, required information and time needed to implement them.

Using the different methods can provide a general perspective of the environmental impacts of the product throughout its life cycle and thus identify the aspects for improvement.

2.2.1. METCO matrix

The METCO matrix is a qualitative method, which is a means to obtain a global view of the more environmental inputs and outputs in each stage of the lifecycle of a product or service. It is defined as a qualitative tool, as despite its handling quantities, the prioritising of the environmental aspects is based on the prior environmental knowledge of the user and on golden rules, not on specific data or results.

The simple matrix structure allows the areas of the product life cycle with greater environmental impact to be easily and quickly identified; each of them are assessed according to five blocks of environmental aspects, which make up the name of the METCO matrix.

M	Materials consumed	Raw materials and resources consumed in each stage of the life cycle
E	Energy consumed	Electricity and other energy resources consumed in each stage of the life cycle
T	Toxic waste and emissions	Managing the waste generated and contaminating emissions in each stage of the life cycle
C	Circularity	Adapting the product to concepts linked to the circular economy, such as the remanufacturing capacity, durability, designing for recyclability or suitability for servitisation.
O	Other environmental aspects	Other additional aspects not envisaged in the above categories, such as land occupancy and transformation, impacts on flora & fauna, and generating noise and smells.

Figure 11. METCO matrix

Those aspects are included in the columns of the METCO matrix in a simplified and organised manner according to the stages of the product life cycle, which are represented as the rows of the matrix. It is important that each member of the work team contributes the information they know about the product. In order to facilitate its deployment, the following figure shows the type of information gathered in each section.

	M	E	T	C	O
	Materials consumed	Energy consumed	Toxic waste & emissions	Circularity	Other environmental aspects
 OBTAINING & CONSUMING MATERIALS & COMPONENTS	Any necessary materials, parts & components that are purchased	Energy to obtain the purchased materials & to transport the materials to the factory	Waste & emissions generated when obtaining & transforming the acquired materials	Aspects linked to the circular economy in the stage to obtain materials, e.g., <i>use of recycled materials</i>	Other aspects of the stage to obtain materials, e.g., <i>land occupancy in the mining stage</i>
 PRODUCTION IN FACTORY	Auxiliary materials and/or substances used in factory e.g., <i>welding or painting material</i>	Energy consumption in the process used in factory	Waste & emissions generated in factory	Aspects linked to the circular economy in the manufacturing stage e.g., <i>product remanufacturing capacity</i>	Other aspects of the manufacturing stage e.g., <i>noise and smells generated during production</i>
 LOGISTICS & DISTRIBUTION	Product/service packaging used for transport & distribution to customer	Energy consumption for the packaging. Energy for the transport from the factory to the end customer	Emissions generated by the transport from the factory to the end customer. Packaging waste.	Aspects linked to the circular economy in the transport stage. E.g., <i>shared use of services</i>	Other aspects of the manufacturing stage e.g., <i>noise associated to transport</i>
 USE & UTILISATION	Product spare parts and consumables needed for the product to function	Energy consumed by the product throughout its estimated lifespan	Spare parts and consumables waste	Aspects linked to the circular economy in the use & maintenance stage. E.g., <i>increased durability</i>	Other aspects of the use and maintenance stage. E.g., <i>impact on the flora and fauna during the use stage.</i>
 END-OF-LIFE SYSTEMS	Consumption of raw and auxiliary materials for the end-of-life treatment	Energy for treating materials (incineration, recycling...). Energy used to transport waste to its end-of-life	Waste generated after the dismantling of the products and emissions associated to the treatment	Aspects linked to the circular economy in the end-of-life stage. E.g., <i>design for recyclability</i>	Other aspects of the end-of-life stage. E.g., <i>smells generated.</i>

Figure 12. Details of the METCO Matrix throughout the life cycle

Once the METCO Matrix is completed with all the identified aspects, the latter will be prioritised according to their importance. In order to prioritise the aspects in the METCO matrix, some golden rules should be followed to identify the main sources of environmental impact. The golden rules are as follows:

- Energy consumption will always be a point of consideration for products that need electricity to function.
- Weight is an indication of the importance attached to the consumption of materials
- Special attention will have to be paid to those materials where high energy consumption (for example Al) or heavy metals (Cd, Zn, Pb, Cu, Cr, ...) is required to obtain them. The weight in both cases will be multiplied by 10 for the comparison and prioritisation purposes.
- Attention should be paid to the consumption of auxiliary materials during the use phase of the product.

A METCO matrix template is provided in the Tools Section of the ANNEX to facilitate the process.



Further information on the use and applications of the METCO matrix can be found in other Ihobe publication and resources available on its website: www.ihobe.eus



Based on all the data set out in the above section, Cafeteras Ensueño performed the METCO matrix of the selected pod coffee maker and obtained the following results:

	M	E	T	C	O
	Materials consumed	Energy consumed	Toxic waste & emissions	Circularity	Other environmental aspects
OBTAINING AND CONSUMPTION OF MATERIALS AND COMPONENTS	- Copper: 0.05 kg - Steel: 0.1 kg - ABS: 0.785 kg - PP: 0.05 kg - PS: 0.2 kg - PVC: 0.1 kg - Printed circuits: 0.24 kg	- High energy content in materials (Al, Cu) - Transporting of assembled printed circuits from Asia (0.03 kwh)	- Flame retardants in printed circuit cards (↓) - Liquid injection moulding (↓) - PS: benzene emissions (↓) - Emissions from painting and gluing (↓)	Recycled aluminium: 0.2 kg	
PRODUCTION	Auxiliary materials: lubricant, degreasing and welding materials for the machines of the company's production system (↓)	Energy in different processes (moulding of polystyrene, aluminium extrusion, welding, ...) (↓)	- Plastic and metal waste (clippings and rejects) (↓) - Machine lubricant and degreasing residue (↓)		
DISTRIBUTION	- Product packaging: polyethylene bat: 0.3 - Instruction manual: 0.04 kg	Diesel for transport (trucks) (0.3 kwh)	- Diesel fuel emissions (↓) - Packaging waste: Polyethylene bag (recyclable): 0.3 kg - Cardboard (recyclable): 0.1 kg	- Product packaging: recycled cardboard: 0.1 kg - Recycled cardboard or repackaging: 0.8 kg	
USE AND UTILISATION	OPERATION - Coffee pods used: 128 kg¹ - Water 873.6 l² - Water for cleaning: 182 l³ - Cleaning materials: descaler (↓) MAINTENANCE - Parts that break easily (↓)	OPERATION - Energy consumption 1,000 kWh: - Coffee period: 680 kWh - Standby mode: 320 kWh MAINTENANCE - Transporting maintenance suppliers (↓)	OPERATION - Pods with coffee grounds - Cleaning wastewater: 10,950 l - Emissions from energy consumption (2,305 kg CO₂) MAINTENANCE - Waste replacement parts (↓)	OPERATION - Automatic switch-off system at the end of a set time MAINTENANCE - Descaler used every 3 months to lengthen service life	OPERATION
END-OF-LIFE			RECYCLING - Recycled plastics: 1 kg - Instruction manual: 0.04 kg LANDFILL - Printed circuit: 0.24 kg - Pump and pumping system: 0.43 kg - Non-recycled plastics 0.13 KG - Copper: 0.05 kg - Aluminium: 0.2 kg - Steel: 0.1 kg	RECYCLING - Removable electric part to facilitate recycling - Plastic parts and cardboard packaging marked to facilitate the subsequent recycling LANDFILL	RECYCLING

¹ Based on a consumption of 10 pods a day over 5 years, and on each pod containing 7 g of coffee.

² Based on a consumption of 10 pods a day over 5 years, and 35 ml of water for each coffee.

³ Based on 500 ml of water for weekly cleaning over 5 years.

2.2.2. Simplified LCA Tools

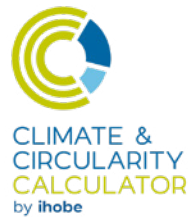
When the assessment goal requires quantitative data, but does not require great accuracy or detailed results, an alternative consists of conducting a simplified life cycle assessment.

In some cases, even though a full life cycle assessment (LCA) provides more stringent results, this cannot be adapted to the initial design stages. This is because it requires a high degree of definition that is often missing in development projects. Furthermore, its development requires great experience in handling software, selecting databases, adapting data and outcome evaluation.

By comparison, the simplified life cycle assessment tools offer the advantage of having predefined parameters and inventories, which significantly streamlines the environmental assessment process. The ease of having predefined indicators has the drawback that they cannot be tailored to the needs of the organisation.

Therefore, simplified LCA tools are particularly useful for companies that lack the resources, time or necessary technical knowledge to conduct a full LCA. Furthermore, by offering faster and more simplified results, these tools allow organisations to pinpoint areas for environmental improvement and decision making in earlier design stages where not all the necessary quantitative data are available.

Ihobe offers companies a computer tool for the simplified assessment of the environmental behaviour of products and services with a life cycle approach and environmental impact multicriteria. This, called "2Climate & Circularity Calculator", allows the life cycle to be described of the product to be researched; the hierarchical structure of the product to be introduced and the materials and production processes of each part or piece to be specified; the energy and transport components to be entered in the use phase, along with specifying the disposal of the product or the different parts or materials.



Climate & Circularity Calculator by Ihobe is available free of charge for all those entities with own access profile to the Ihobe website: www.ihobe.eus



A fragment of the use of the Climate & Circularity Calculator tool offered by Ihobe and applied to the Cafeteras Ensueño product is set out below

The Ihobe online tool includes the materials, processes, energy consumption, transport and end-of-life processes as per the data set out in the table of *Case Study 5. Description of the life cycle*.

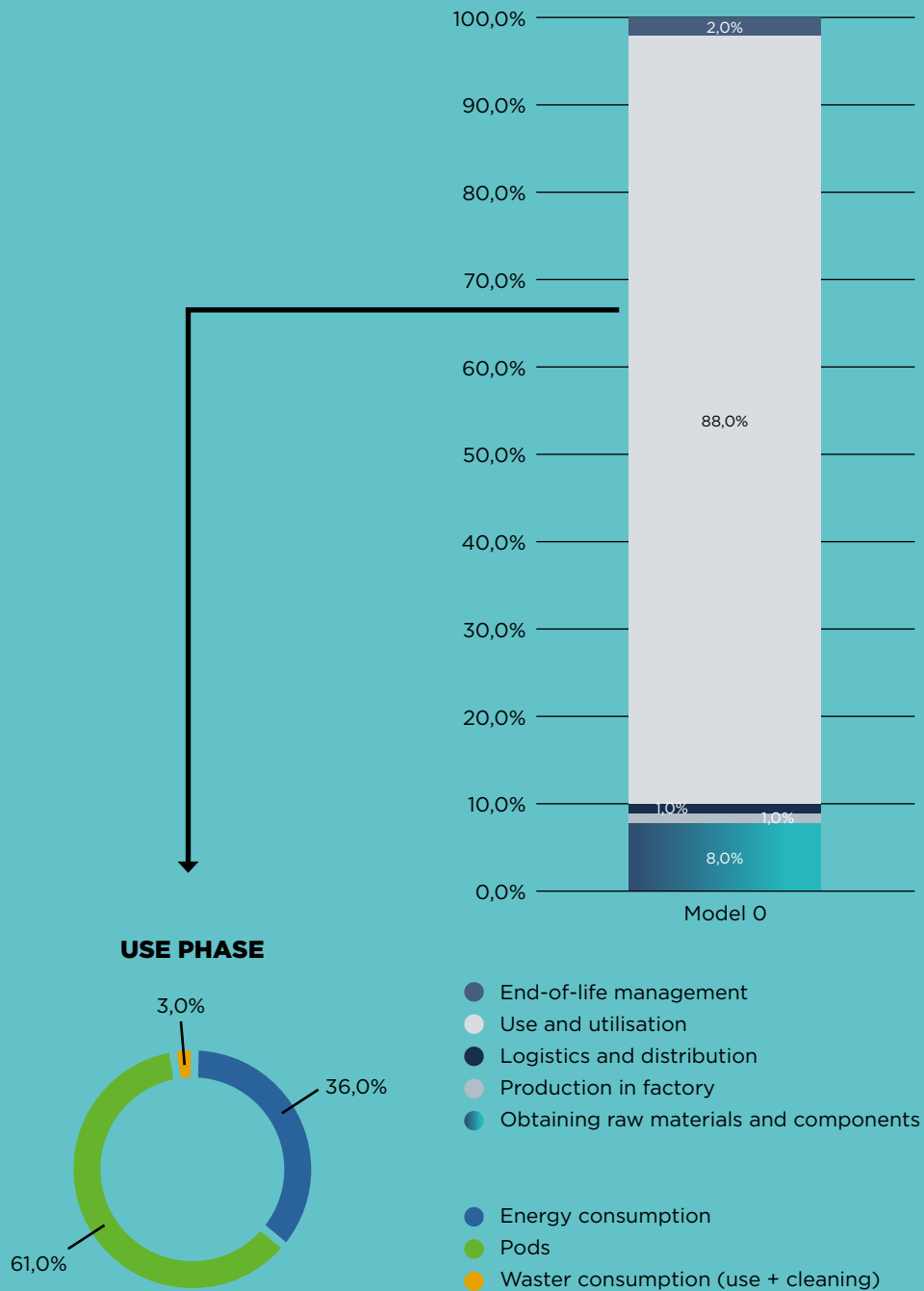
Nombre	Cantidad	Unidad	Impacto ambiental absoluto (Pt)
Depósito de agua	1	unidad	-
Poliestireno	0.2	kg	1.87E-4
Contenedor de cápsulas	1	unidad	-
Bandeja de galletas	1	unidad	-
Carcasa	1	unidad	-
Carcasa de plast. de cápsulas	1	unidad	-
Bandeja portacápsulas	1	unidad	-
Palanca	1	unidad	-
Bomba	1	unidad	-
Sistema de bombeo	1	unidad	-
Circuito impreso	1	unidad	-
Sistema de resistencia	1	unidad	-
Total			4.48E-4

Thus, the results are obtained of the potential environmental impact by product phase:

Nombre	Cantidad	Unidad	Factor de caracterización	Unidad	Impacto ambiental absoluto (Pt)
Obtención y consumo de materiales y componentes			-	-	4.48E-4
Transporte de materiales y componentes a fábrica			-	-	5.80E-7
Producción en fábrica. Consumo de electricidad			-	-	2.02E-6
Producción en fábrica. Uso de combustibles y aspectos directos			-	-	
Producción en fábrica. Gestión de residuos externos			-	-	
Distribución			-	-	1.14E-5
Uso			-	-	7.90E-3
Fin de vida			-	-	1.27E-7
Total					7.46E-3

Case Study 7. Simplified LCA tool (cont. ->)

The simplified LCA results may provide information on the most important environmental impacts and phases of the product:



In this case, the results reveal that, when considering the whole life cycle of the product, the greatest environmental impact is focused on the use phase of the coffee maker. Energy consumption and, particularly, the use of the aluminium coffee pods are critical factors to be taken into account in the development of a new ecodesigned product.

2.2.3. Life Cycle Assessment

Life Cycle Assessment (LCA) is a quantitative method that allows the environmental impact of a product, process or service throughout its life cycle to be evaluated.

The procedure to conduct a life cycle assessment is set out in the following international standards:

- ISO 14040:2006 - Environmental management - Life Cycle Assessment - Principles and framework.
- ISO 14044:2006 - ISO 14044:2006, Environmental management - Life Cycle Assessment - Requirements and guidelines.

Pursuant to the aforementioned standards, the process to prepare the life cycle assessment consists of 4 consecutive steps set out in the following figure.

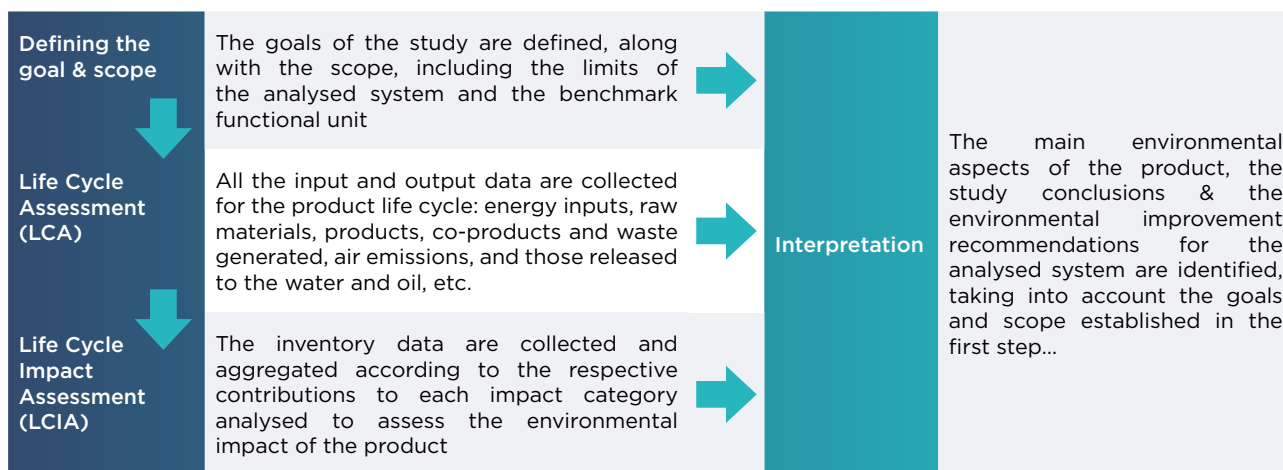


Figure 13. Stages of the Life Cycle Assessment (LCA)

Once the goal and scope have been defined, and the limits of the system determined, all the relevant information on the inputs and outputs of the life cycle of the product will then be compiled.

Different sources – data records of the company, environmental indicators of the management systems, technical datasheets, invoices, etc. – will need to be used to gather that information. In many cases, part of the information may not be directly available in the company and will have to be requested upstream and downstream in the supply chain.

Once the information has been gathered, the data is organised according to the relevant life cycle stage and related to the functional unit of the study. Once all the information of the product/service inventory has been gathered, a life cycle model is created in a LCA software tool. This model will represent the whole life cycle of the product from the perspective of its environmental impact.

There are a wide range of software tools to conduct the Life Cycle Assessment. The leading LCA software tools are set out below.

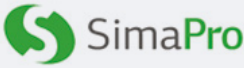
Name	Developer	Characteristics	Database
	Greendelta (Germany)	• Open source software • Free version • Can be customised	• Ecoinvent • GaBi Databases • Agrifootprint • IDEA • SOCA • PSILCA • SHDB • Ökobaudat • Others
	PRé Consultants (The Netherlands)	• Under licence • Advanced assessment • Good integration	• Ecoinvent • Agrifootprint • ELCD • USLCI • Input-Output
	Thinkstep (Germany)	• Under licence • Modelling and scenario appraisals	• GaBi Databases • Ecoinvent • USLCI • Data on demand
	Ifu Hamburg (Alemania)	• Under licence • Modelling industrial and manufacturing processes	• Ecoinvent • GaBi Databases • EstiMol

Table4. Software tools for the Life Cycle Assessment

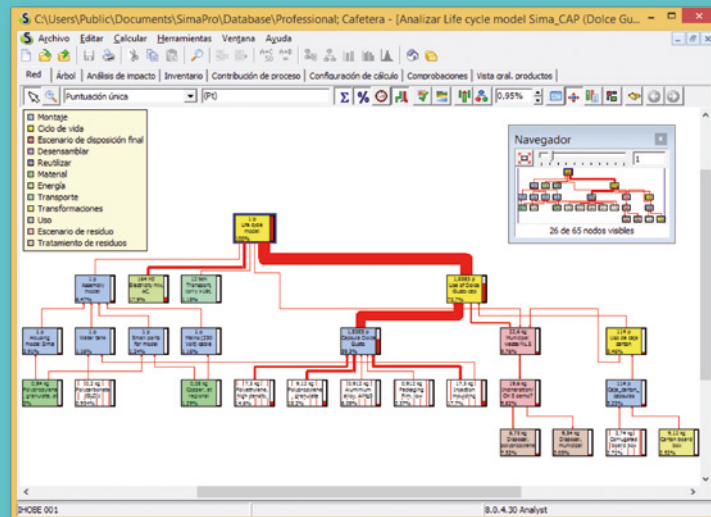
It should be noted that when creating LCA models, each element of the life cycle of the product needs to be associated with its environmental impacts. Therefore, the study must be supported by life cycle inventory databases. It is important that the quality of the databases used for the assessment are coherent with the purpose of the study.

 Further information on the Life Cycle Assessment (LCA) and the commercial software tools available on the market can be found from the other Ihobe publications and resources available on its website: www.ihobe.eus

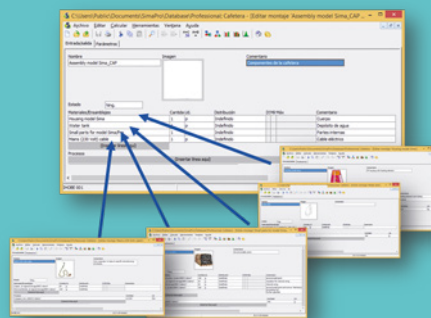


A fragment of the LCA conducted by Cafeteras Ensueño for its coffee maker (conducted using the SimaPro LCA software) is set out below; it is not the whole assessment, but just part as an example.

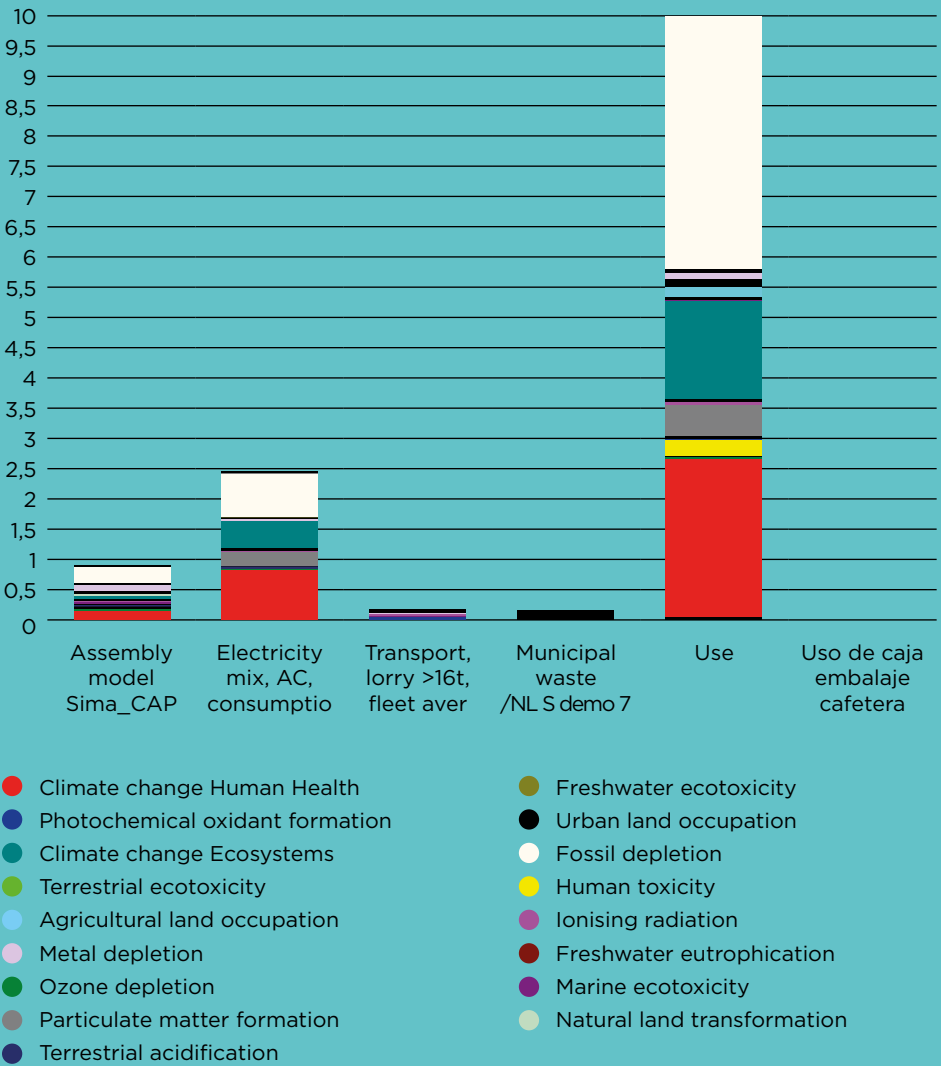
First, a life cycle model – a flow diagram including the whole life cycle of the coffee pot, from cradle to grave – was prepared.



The product was broken down into parts, components and materials to perform a full inventory.



Tracing each material, process and activity with the relevant database obtained a concise analytical rest on the environmental impact of each phase by each impact category.



Case Study 8. Life Cycle Assessment (LCA)

2.2.4. Differences Between the Types of Tools

Each company must assess what is the most appropriate tool based on the goals, requirements and capabilities of the organisation.

The selection of the most appropriate tool for a certain product depends on many factors, such as, the assessment goal, the application complexity, the detail level of the results, and the time required. Furthermore, each instrument is more appropriate depending on the development stage of the project: prior or comparative assessment, or internal/external communication. The following figure shows the different environmental assessment tools, taking three dimensions in account:

- **Complexity of the process:** Establishes the ease or complexity of the implementation of the tool and the time required to obtain the results.
- **Level of detail of the results obtained:** Establishes the information that the tool provides regarding the quality and level of detail, with those being qualitative or quantitative.
- **Implementation process:** Establishes the recommendable prioritisation order, taking into account the experience of the organisation in ecodesign projects.

Figure 14 and Table 5 shows the fundamental differences and characteristics for the 3 tools analysed in this chapter.

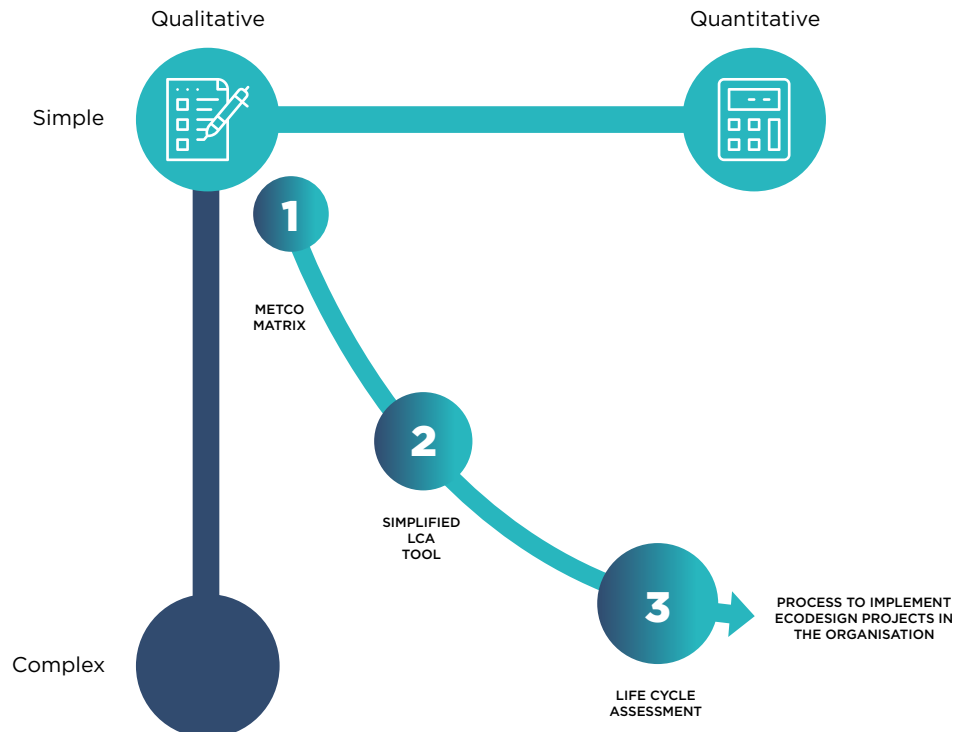


Figure 14. Assessment tool comparative diagram

METCO matrix	Simplified LCA tool	Life Cycle Assessment
• When it is the first time of working on an ecodesign project, as it facilitates the understanding of the whole process. • To compile data prior to using an LCA software tool, as it allows all the information to be organised for each stage of the life cycle. • When there is interest in quickly obtaining an overview of the environmental priorities without great accuracy.	• When the aim is to provide quantitative grounds for the environmental prioritisation. • In preliminary design phases. • When not great accuracy is required. • When there no experience or external support to prepare a full LCA.	• When the aim is to provide quantitative grounds for the environmental prioritisation. • When the aim is to share the environmental aspects of different alternative of a single product. • When complex products are assessed. • When the assessment of environmental aspects is going to be conducted on a regular basis, as collecting data is a laborious process, but once done, the procedure is facilitated.

Table 5. Assessment tool comparison

In addition to the life cycle assessment, integrating different environmental assessment metrics may be relevant depending on the characteristics of the product and of the organisation. Furthermore, if the organisation has conducted preliminary studies and/or has expertise in environmental assessment studies, the acquired experience and the data compilation methodology used will be of great help to facilitate the integration of new environmental assessment tools.

Stage 3

Ideas for improvement





GOALS

To generate, select and assess possible environmental improvement actions for the product in question



ACTIVITIES

- Ecodesign strategies.
 - Environmental improvement measures.
 - Pinpointing environmental improvement actions.
 - Selecting environmental actions.
-



DEPARTMENTS INVOLVED

- **Design or technical department:** Leading and participating in the generation, selection and assessment of the improvement actions.
 - **Other departments:** Support with generating, selecting and assessing improvement actions based on their specific expertise.
 - **Management:** Approval of the selected improvement actions.
 - **External environmental expert (if taking part in the project):** Their participation is recommended in the process to generate, select and assess improvement actions, as they can provide ideas and information on measures and improvements from an environmental perspective.
 - **External designer (as applicable):** Their participation is recommended in the process to generate, select and assess the improvement actions.
-



TOOLS

- Tools to generate improvement ideas
 - Tools to assess improvement ideas
-



PLANNING

20-80 hours

According to the results of the environmental assessment performed in the previous stage, the aim is here to optimise the environmental aspects, by generating ideas for improvement. Different ecodesign strategies should be taken into account as a starting point, as they facilitate the formulating of ideas, in order to generate ideas for environmental improvement.

Each strategy is classified according to the life cycle stage that they impact. Therefore, the first step is to decide the life cycle stages in which to act according to the results obtained in the environmental assessment or according to the company's capacity for action, and the relevant strategies will be identified. Each strategy includes environmental improvement measures that streamline the process for the organisation to generate ideas for improvement. Based on these environmental improvement measures, the company generates the specific ideas for improvement to be implemented in their products to be ecodesigned.

Furthermore, generating ideas is a creative process for which different techniques exist. The process will result in a whole range of ideas for improvement. Therefore, once all the ideas have been collected, they will be short-listed, analysed and prioritised, as the goal is to focus on those improvements that refer to significant environmental aspects or are aimed at complying with the driving factors of the company to ecodesign.

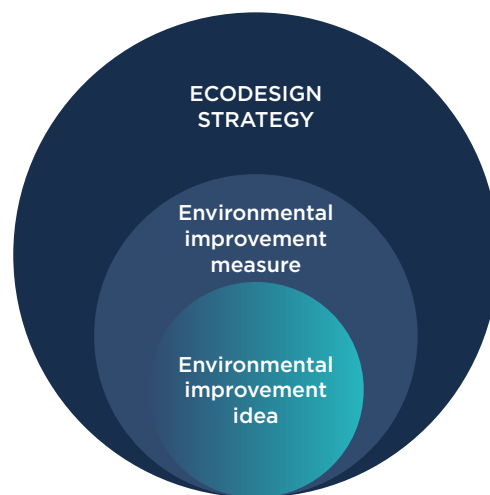


Figure 15. Ecodesign strategies diagram



3.1. Identifying Ecodesign Strategies

Ecodesign strategies must be in line with the principles of the circular economy, seeking to sustain the product value in time and extend the life cycle of the product. There are currently different strategies in which the measures for the environmental improvement of a product can be classified.

The tool known as the “circular ecodesign wheel” helps to classify the different strategies and areas of interest to be analysed in an ecodesign process. As shown in Figure 16, this wheel embodies a conceptual design model on 8 core points:

- 7 ecodesign strategies related in turn with the different stages of the life cycle of the product, and
- An additional strategy focused on creating new business models.

The first three strategies can be classified within “traditional ecodesign”, i.e., a model based on “life cycle thinking” and focused on improving the first phases of the product cycle: from obtaining raw materials to the use phase.

Strategies from 4 to 7 are classified as “circular ecodesign” and set out new approaches based on “circular design thinking”. These strategies contain measures to foster value retention and closed loops.

Strategy eight, “optimising the function”, is a radical change strategy that goes beyond the design of products and proposes introducing new business models with innovative ways of meeting the needs of the market and environmental demands. This last strategy is developed in detail in the *“From Product to the Business Model: Servitisation in a Circular Economy”* handbook published by Ihobe.



Figure 16. Ecodesign wheel: 8 strategies

The following sections develop each of the strategies in detail and show possible ideas for improvement in each of them.

3.2. Identifying Traditional Ecodesign Strategies

What we call traditional ecodesign is focused on improved the environmental impact throughout the life cycle of the product. The following strategies are included in this design model:

- Reducing the impact on the company
- Optimising distribution
- Optimising the use phase

In this case, the end of life of the product is exclusively addressed from recyclability. Boosting recycling from the decisions made in the phases to obtain raw materials and components, and production.

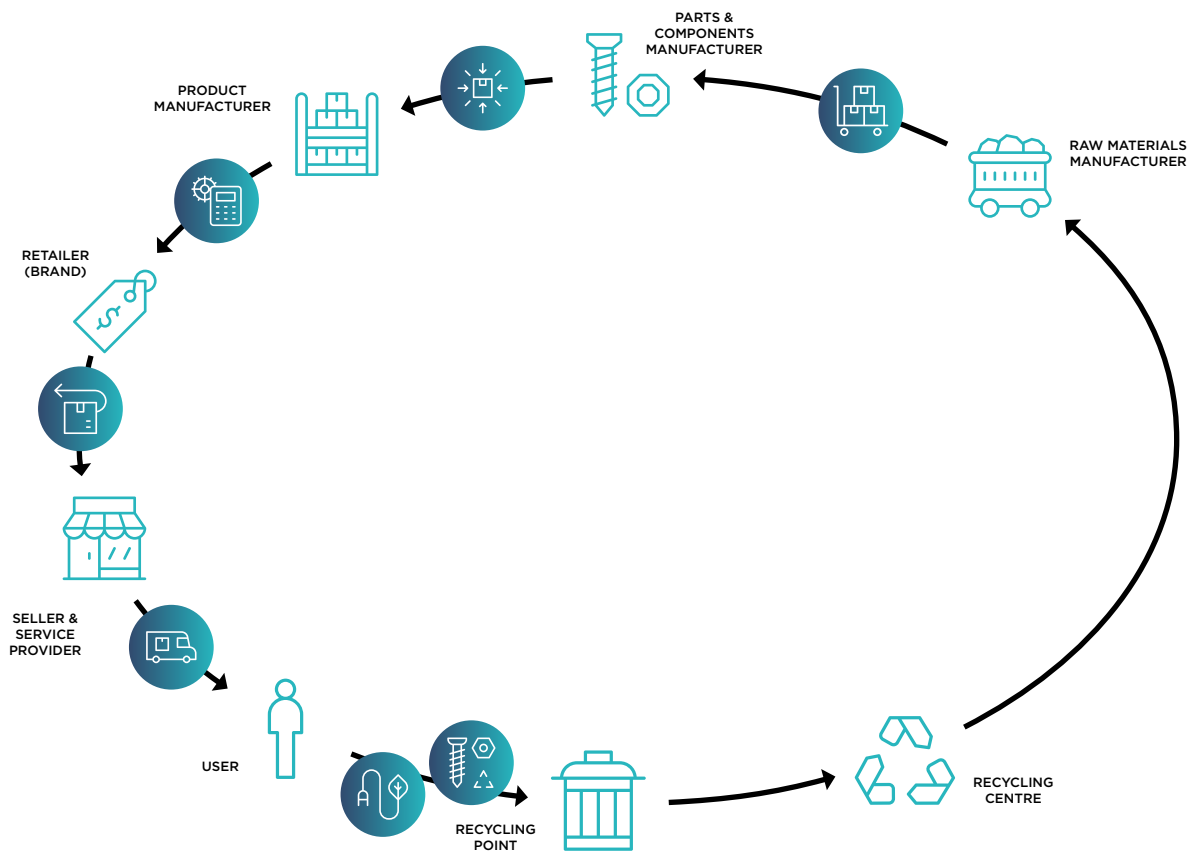


Figure 17. Product or service cycle in the application of traditional ecodesign strategies

3.2.1. Strategy 1: Reducing the Impact on the Company

The first ecodesign strategy focuses on reducing the impact on the company by seeking to minimise the environmental impact generated by the organisation in the different life cycle stages. Specifically, it envisages the life cycle stages prior to the transport and use by customers or consumers, in other words, the stages to obtain and consume materials and components, along with the production of the product.

In this stage, special mention should be made of the importance of selecting a low impact environmental impact in the extracting, processing, distribution, use and end-of-life stages, and maintaining or even improving the technical features of the product. The aim is also to minimise the amount of materials used and the volume of the product to optimise transport and storage, which means a considerable reduction of the economic costs. Finally, the importance of establishing new technologies and energy efficiency criteria to achieve efficient production is stressed, which will thus reduce the environmental impact generated by the company.

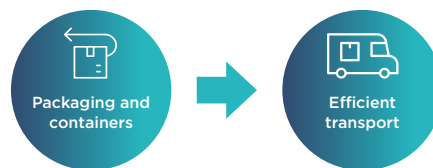


Phases of the life cycle	Ecodesign strategy	Improvement measure	Objective of the measure	Improvement idea
 OBTAINING & CONSUMPTION OF MATERIALS & COMPONENTS   PRODUCTION IN FACTORY 	 1 Reducing the impact of the company	 Selecting LOW IMPACT MATERIALS	To select other alternative materials that have a lower environmental impact throughout the life cycle of the materials used, while maintaining the technical features or even improving them	Incorporating recycled materials to reduce the demand for new virgin materials
				Analysing the option of cleaner and renewable materials
				Avoiding materials or substances that are hazardous, toxic or harmful to the environment
				Selecting materials that require less energy for their manufacturing
				Assessing nature-based materials or the use of natural materials
				Incorporating recyclable materials
		Considering environmental criteria when selecting suppliers		
		 Reducing WEIGHT AND VOLUME		Reducing the weight and thickness of the parts and of the product
				Optimising the product volume to optimise transport and storage
				Avoiding the product being oversized
			Avoiding superfluous elements with little functionality	
		 EFFICIENT PRODUCTION techniques	To obtain clean production by means of applying improvements to the production techniques by means of technological innovation, improved auxiliary measures, establishing operational best practices in production or industrial symbiosis	Analysing innovative alternative production techniques that optimise the product
				Reducing energy consumption by using efficient equipment, energy saving systems and renewable energy sources
				Reducing the quantity of production consumables and using cleaner ones.
				Optimising the final finish process of the product, thus reducing consumption of materials and emissions from the process
				Introducing byproducts or production waste from other companies as raw material (industrial symbiosis)
Minimising the waste production and ensuring the waste is correctly managed to facilitate its reuse and recycling				

Table 6. Application of Strategy 1: Reducing the impact of the company

3.2.2. Strategy 2: Optimising Distribution

Distribution generates significant environmental impacts and it is therefore important to focus efforts on optimising the distribution system. The ecodesign strategy aimed at optimising distribution aims to reduce the environmental impact associated with packaging, logistics and distribution of the products. Elements such as the type of transport and the logistics system used will be taken into account, along with the design of the product packaging or container for its distribution and storage. Apart from the delivery of the product to the customers or end users, taking the transport of raw materials from their storage to the place of the transformation process into account is crucial.

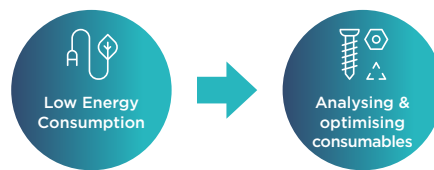


Phases of the life cycle	Ecodesign strategy	Improvement measure	Objective of the measure	Improvement idea
 LOGISTICS & DISTRIBUTION	2 Optimising distribution	 Taking the PACKAGING AND CONTAINERS INTO ACCOUNT	To reduce the environmental impact of the distribution process by taking action regarding the packaging and containers used	Reducing the use of containers by including them as part of the product as far as possible Reducing the weight of the raw materials and container volume, and use materials with good resistance-weight ratio Using recycled or renewable raw materials free of substances that are harmful for the environment Prioritising reusable containers and packaging throughout the value chain by setting up a deposit and return system Using easily recyclable materials along with their marking. Avoiding material mixes that hinder their recyclability Designing modular, foldable or stackable containers Optimising the amount of product by load unit, meaning that a larger amount of product is transported with less amount of packaging material Using adequate marking to improve the final management of the packaging and containers
		 EFFICIENT TRANSPORT	To use energy efficient means of transport to optimise fuel consumption and reduce the environmental impact from the transport, along with the additional costs associated to the distribution operations	Prioritising the use of raw materials and local components to minimise the transport impacts Establishing more energy efficient transport systems Optimising transport routes Using cleaner fuel (e.g., green hydrogen) Incorporating 4.0 technologies to optimise the transport route Optimising the amount of product pr load unit Implementing an inverse logistic system to avoid vehicles returning empty

Table 7. Application of Strategy 2: Optimising distribution

3.2.3. Strategy 3: Optimising the Use Phase

The strategy to optimise the use phase seeks to reduce the environmental impact generated in the use phase of the product, in other words, during the period when the product is in hands of the users. This life stage of the product of the product can have a great impact in terms of consuming energy and consumables. Therefore, strategies aimed at ensuring low energy consumption and optimising the consumables used will be developed by fostering more efficient and sustainable use practices.



Phases of the life cycle	Ecodesign strategy	Improvement measure	Objective of the measure	Improvement idea
 USE & UTILISATION	 Optimising the use phase	 Ensuring LOW ENERGY CONSUMPTION	To significantly reduce energy consumption in the use phase of the product, in order to minimise the environmental impact generated	Designing more energy efficient products Considering cleaner energy sources Avoiding wastage of energy consumption, such as when on standby Making heat exchanging more efficient and using new materials and components that improve that exchange Providing the user with clear and accurate information on the most appropriate use of the product to save energy
		 Analysing and optimising CONSUMABLES	To optimise consumption of consumables in the use phase of the product by the final user in order to minimise the environmental impact generated	Optimising the use of consumables. E.g., detergents in washing machines, lubricants in machinery Minimising auxiliary consumables to use the product or opt for reusable consumables Cutting use of resources in the product maintenance process Using consumables with less environmental impact Avoiding wasting consumables Reducing water consumption by using water saving systems Providing the user with clear and accurate information on the most appropriate use of the product to optimise the use of consumables

Table 8. Application of Strategy 3: Optimising the use phase

3.3. Ecodesign Strategies for a Circular Economy:

The following ecodesign strategies are based on “circular design thinking”, mainly addressing the retention and recovery of the value of the product or services by means of the continuous circularity of the stages. This thinking involves 4 strategies aimed at:

- Extending the lifespan of the product
- Promoting a second life
- Bolstering recovery
- Optimising the end of life

Figure 18 shows the possible strategies when circularising each stage.

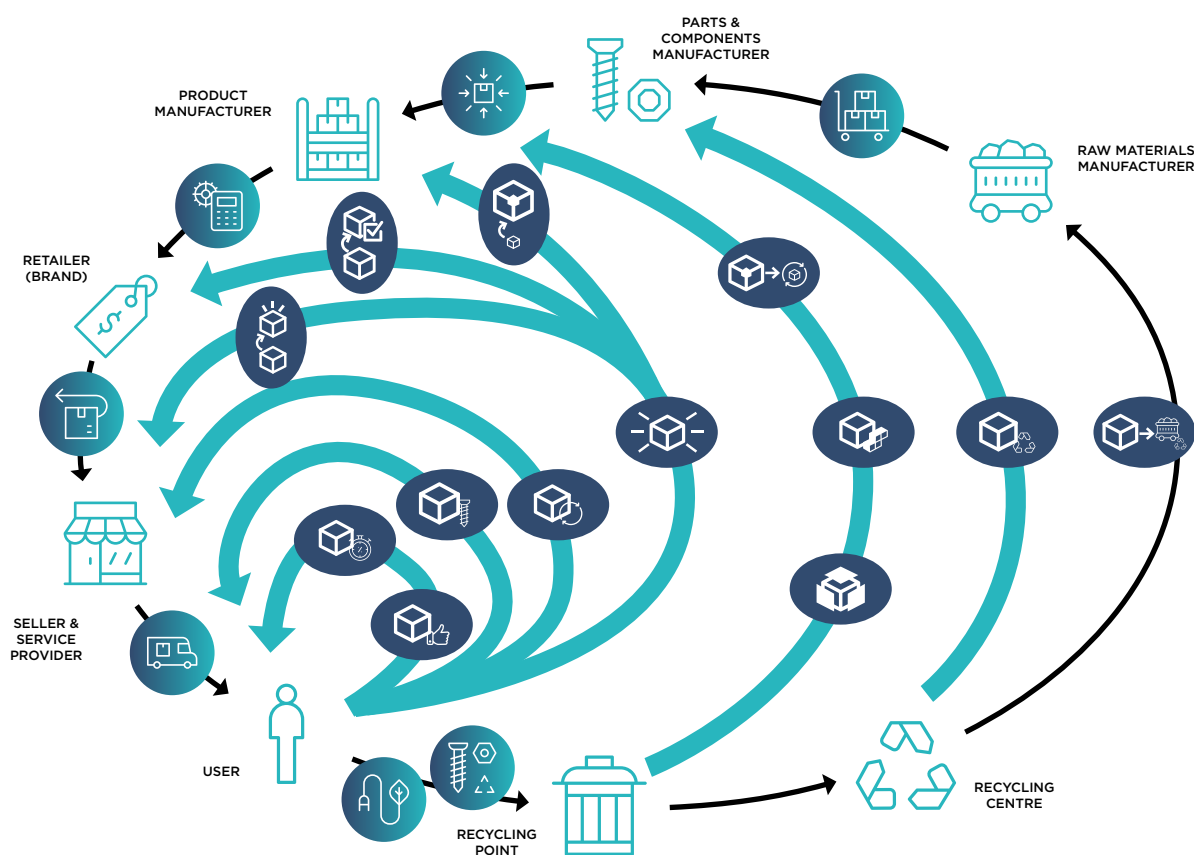


Figure 18. Product or service cycle in the application of ecodesign strategies for a circular economy

3.3.1. Strategy 4: Extending the Lifespan of the Product

The aim of the ecodesign strategy aimed at extending the lifespan of the product is for the user who owns or use the product to keep it in top working order during the longest time possible, and delaying the time when they dispose of it. Therefore, it is essential for the product to be designed to overcome the appearance or functional faults, along with any technical ones, that may lead to the end of the service life of the product. In order to avoid those end-of-life issues, three ecodesign strategies are established: ecodesign for customer loyalty, ecodesign for durability, and ecodesign for maintenance and repair.



Phases of the life cycle	Ecodesign strategy	Improvement measure	Objective of the measure	Improvement idea
 USE & UTILISATION	 Extending the product lifespan	 Fostering CUSTOMER LOYALTY	To foster the degree of emotional tie between the user and the product, to ensure that the product is not discarded voluntarily by the user before the estimated end of its technical life	Establishing a modular product that can be enlarged and/or reduced in size and features, so that it can be adapted to new requirements of the user Establishing a classic design of the product, which is not affected by changing fashions. If a classic design is not wanted, consider a design that can easily be altered by the user to the new trends (colours, surface finishes, etc.) Creating a strong of user-product belonging, by offering a product that meets the real needs of the user
		 Increasing the DURABILITY	To extend the lifespan of the product, by ensuring a robust component design for greater durability	Establishing a robust product design that ensures durability of the product overall and of its critical components Prescribing unified product support devices (connectors, operating systems, supplies, etc.) and which do not change over time. Avoiding chrome plated and other surface finishes that can deteriorate with use, making the product looking rather unattractive Adding iconography on the product to be used for its appropriate handling, and avoiding the use of printing systems
		 Facilitating MAINTENANCE & REPAIRABILITY	To facilitate correcting the inevitable failures and wear that the product suffers over its life cycle that stops the product from working correctly. It should be noted that the repair process usually happens then the user still has the product or after discarding it	Using modular sets that allow critical components to be replaced Guaranteeing easy access to the parts that may be required for regular servicing Using robust connectors that make dismantling-assembly easy Standardising between product and across different generations of it Setting up technical assistance services, along with spare parts at a competitive price. Defining freely accessible or open code technical documentation Including lists of parts and references Creating user interfaces and problem solving tools to assess problems

Table 9. Application of Strategy 4: Extending the lifespan of the product

3.3.2. Strategy 5: Promoting a Second Life

The fifth strategy consists in promoting a second life for the products, by recovering them to be able to reintroduce them again on the market. After disposal by the user, the product enters a recovery process, during which it will undergo several modifications aimed at achieving greater value of the product. There are different recovery processes that are differentiated by the modifications to the product: reusing, renewing, refurbishing and remanufacturing. Once the recovery process has finished, the product reenters the market, either as second or first hand, and meaning that a single product has more than one closed loop.

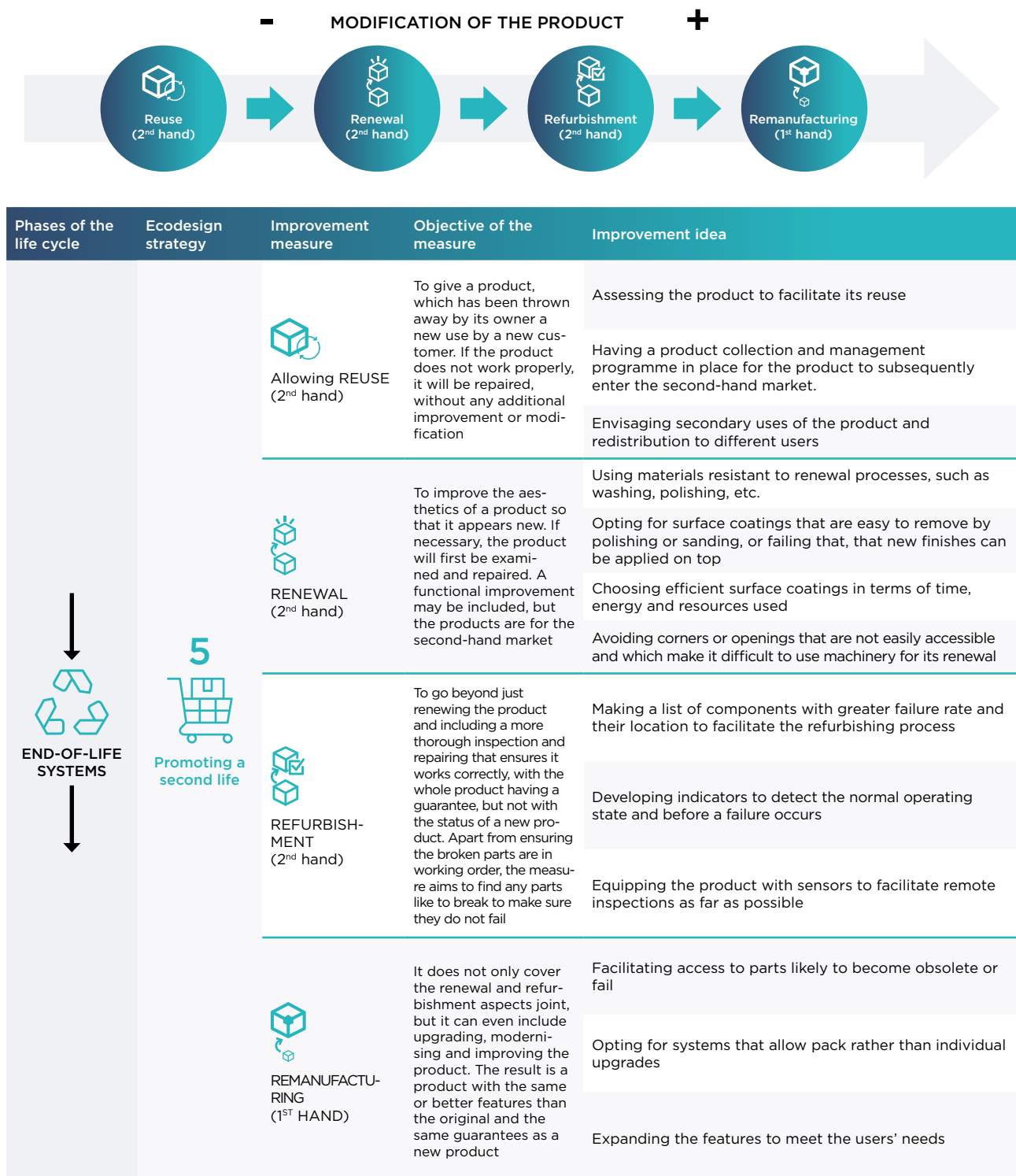


Table 10. Application of Strategy 5: Promoting a second life

3.3.3. Strategy 6: Bolstering Recovery

If the strategy cannot be recovered in full, the ecodesign strategy will focus on bolstering the recovery of parts and components. This strategy aims to recover discarded parts and/or components, and reintroduce them into the production processes in order to give them a new use. The parts and components can be from both the products that have reached the end of their service life, and be part of a withdrawn product. Part of the demand of spare parts and components for new products is thus met, thus avoiding the need to extract new resources to manufacture them. The product must have been designed to be easily dismantled in order to be able to implement the process to reuse the parts and components. Furthermore, the design of standardised parts will bolster the interchangeability of the recovered parts and/or components between the different products, thus driving reuse.



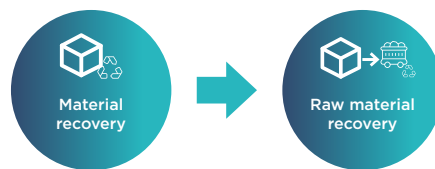
Phases of the life cycle	Ecodesign strategy	Improvement measure	Objective of the measure	Improvement idea
 END-OF-LIFE SYSTEMS	 Bolstering recovery	 Improving the EASE OF DIS-MANTLING	To remove the parts of interest from the product overall. Therefore, the product needs to be easily dismantled and that the parts can be separated without being damaged or altered	Avoiding permanently joining (adhesives, welding) two parts that prevents the ease of dismantling Establishing a modular design so that the product structure is organised in blocks that group together parts with a certain function Using screws with the most resistant head possible to avoid wear in the successive assembly operations Preparing instruction manual for assembling and dismantling the product
		 STANDARDISING key parts	To establish a series of standards to ensure that the materials and components used, the joining systems and the commonly used parts of the different models meet a series of common uniformity requirements, in order to foster the interchangeability of the parts between different products	Analysing the common or similar parts for different types of products and establish internal standards that set their common characteristics to enable their interchangeability Unifying or make compatible the accessories, spare parts, consumables, connectors, etc. for different products of the same family Unifying the type of joints (metric, threaded, adhesive etc.) If the standardisation is not possible, set rules for the complementarity or accounting of different solutions
		 Ensuring parts and components can be REUSED	To give a new use to those parts of value and functionality in the cases when it is not possible or recommended to recover the whole project; the rest of the product is subject to recycling strategies	Identifying those parts of high value likely to be reused and make them accessible Forgoing permanent union between the parts to be recovered, opting for mechanical joints that can be dismantled and which do not harm the product (clipping, threaded,...) Preventing the unions from deteriorating (rusting or wear of the threads, change of the adherence properties, obstructing of sliding parts,...) Increasing the technical life of the high value parts, taking their reuse cycles into account

Table 11. Application of Strategy 6: Bolstering recovery

3.3.4. Strategy 7: Optimising End-of-Life

After the recovery process is completed, the parts of the product that have not been recovered and have reached the end of their lifespan are considered for waste; their recycling must be encouraged in order to avoid waste-to-energy or the waste ending up in landfill. Therefore, action needs to be taken in the first stages of the design, with waste considered as useful resources that will be used again by means of a recycling process, and closing the material loops. Priority will be given to recovering the materials and, if that were not possible, to fostering the recovery of raw materials, in other words, the substances that make up those materials.

The product should preferably be designed in such a way that the end-of-life option were upcycling process, obtaining materials of even better quality; and, in any event, with the focus from the design stage to minimise the proportion of materials aimed at downcycling processes.



Phases of the life cycle	Ecodesign strategy	Improvement measure	Objective of the measure	Improvement idea
 END-OF-LIFE SYSTEMS	 Optimising end-of-life	 Fostering MATERIAL RECOVERY	To increase the use time of the materials making up a product so that they are reused in a new production cycle after being identified, separated, classified and processed	Selecting easily recyclable materials, prioritising those that are suitable for upcycling Preferably opting for single material solutions If different materials are necessary, selecting materials that are compatible, can be reprocessed together or easy to separate using industrially means Using glued joints only for those parts that are compatible in the recycling process Reducing the painting and the surface coatings that may contaminate the material and made the recycling process invalid. Establishing the marking of the materials to facilitate their recycling. <i>E.g., in the case of plastics as per UNE-EN ISO 11469:2001 standard</i>
		 Fostering RAW MATERIAL RECOVERY	If the recycling of materials is not possible, to foster the recovery of the basic raw materials	Selecting raw materials that can be easily recycled, limiting those that are usually sent for downcycling Avoiding finishes and treatments that can include the processes to recover the raw materials Prioritising raw materials from biological sources/ fostering the recovery of raw materials from biological sources

Table 12. Application of Strategy 7: Optimising the end of life



3.4. From Ecodesign to a New Business Model

3.4.1. Strategy 0: New business Model

The last strategy integrates an innovative approach based on the design of new business models. Those business models are in line with the principles of the circular economy by means of product servitisation.

Unlike the former ecodesign strategies, which are focused on specific aspects of the life cycle of a product, this strategy embraces a fundamental change in the way of designing and using the products. Servitisation proposes rethinking the traditional model based exclusively on selling products to consider new product-service systems.

Those systems represent offers that combine both products and services to integrally address the specific needs of the users. Integrating complementary services, intervening in the management of the ownership of the products and ecodesign strategies facilitate the creation of product-service systems.

This new approach not only optimises the reuse of resources, but rather also fosters innovation in business models by bolstering the partnership and co-creation between companies and consumers.

The “new business model” strategies are developed in detail in the *“From Product to the Business Model: Servitisation in a Circular Economy”* handbook published by Ihobe

The company may use the table of the 8 Ecodesign strategies in the Tools ANNEX of the manual as a model to generate ideas.

3.5. Identifying and Selecting Environmental Improvement Ideas

Once the different generic measures have been evaluated, ideas based around the existing eight strategies are contributed and will be the specific measures for improvement. There are different tools for the process to come up with ideas, including brainstorming.

3.5.1. Brainstorming

Brainstorming is a method for sharing ideas when the members of the work team must contribute ideas by means of a constant feedback process. Specifically, it consists of gathering together different people from different departments of the company that make up the work team to compile the ideas that occur to them regarding the aforementioned 8 ecodesign strategies.

Different departments of the company taking part is important, as each has a different perspective and that can enrich the process and ensure that all the relevant topics are considered. The presence of management is essential for that same reason, as it will understand the conclusions more easily and will facilitate their approval.

There are basic rules for running brainstorming sessions that must be explained to the participants at the start of the session.

Steps	Description
DEFINING THE ROLES	A moderator must be appointed to guide the session so that it is effective and meets the objectives; a person must also be nominated to record the different ideas that emerge
EXPLAINING THE BRAINSTORMING RULES	The moderator must explain the basic rules for running brainstorming sessions to the participants at the start of the session: • State all the ideas • Criticism not allowed • Say the first thing that comes to mind • That it is about the quantity and not the quality of the ideas (as the quality will be taken into account when selecting) • Ideas can be combined with other ideas. The idea is of the group not the individual
OUTLINE THE 8 STRATEGIES.	The person leading the brainstorming must outline the 8 strategies so that they are inspiration for the participants
SELECT THE IDEAS FOR IMPROVEMENT	Once the brainstorming has ended, each participant must select the best ideas by voting as they see fit. The votes will then be counted up and the 10-15 with the most votes selected
GROUP THE SELECTED IDEAS FOR IMPROVEMENT (OPTIONAL)	It may be recommendable in some cases to group together those ideas for improvement that the group believes are about the same improvement, and define them in a practical way in order to include them in the specifications

Table 13. Guidelines for defining ideas for improvement



Once the environmental aspects had been defined and taking the Driving Factors for ecodesign into account, Cafeteras Ensueño conducted a brainstorming session, which produced the following ideas to improve the product for the 8 ecodesign strategies.

Each idea was allocated a code consisting of three parts:

- **Life cycle stage:** the first part of the code indicates the life cycle stage that the measure is going to impact. The code use is then shown:

Life cycle Stage	Code
Obtaining and consuming materials & components	MP
Production	P
Distribution	D
Use and utilisation	U
End-of-life systems	FV
New product ideas	NP

- **Ecodesign strategy and improvement measure:** the second part of the code is the ecodesign strategy (number) and the type of measure proposed (letter).
- **Numbering:** the third part of the code refers to the number that the company gives correlatively to the brainstorming ideas.

An example of the code would be “FV-6A-01”: This code indicates that it has a greater impact on the end-of-live (FV) stage of the system, refers to the strategy to improve the ease of dismantling (6A), and 01 because it was the company’s first idea in that category.

All the ideas for improvement generated during the brainstorming session and the selected ideas (in bold) are described below.

Life cycle phase	Ecodesign Strategy	Improvement measures	Improvement ideas generated in the brainstorming session	Code
 OBTAINING & CONSUMPTION OF MATERIALS & COMPONENTS   PRODUCTION IN FACTORY   LOGISTICS & DISTRIBUTION   USE & UTILISATION 	1  Reducing impact in the company	A. Selecting LOW IMPACT MATERIALS	• Use of 100% recycled plastic • Use of 100% recycled aluminium • Use of 100% recycled steel • Use of cables without PVC • Use of 50% recyclable materials • Use or reused components	MP-1A-01 MP-1A-02 MP-1A-03 MP-1A-04 MP-1A-05 MP-1A-06
		B. Reducing the WEIGHT AND VOLUME	• Slimmer and lighter coffee maker body • Use of lighter material for the water tank	MP-1B-01 MP-1B-02
		C. EFFICIENT PRODUCTION TECHNIQUES	• Degreasing using water-based products (instead of solvents) • Using highly efficient moulding machines to reduce energy consumption • Eliminating printing and painting from the parts • Using renewable energy sources • Reusing the waste generated in the injection processes	P-1C-01 P-1C-02 P-1C-03 P-1C-04 P-1C-05
	2  Optimising DISTRIBUTION	A. Taking the PACKAGING & CONTAINERS into account	• Thinner cardboard using for packing • Using recycled cardboard • Using compostable plastics for the product packaging • Eliminating secondary cardboard packaging • Inverse logistics system to recover packaging • Instruction manual using QR code to avoid printed paper	D-2A-01 D-2A-02 D-2A-03
		B. EFFICIENT TRANSPORT	• Prioritising local suppliers to reduce the transport impact • Using efficient electric vehicles for urban deliveries • Design pallet patterns to better use the space of the loading unit	D-2B-01 D-2B-02 D-2B-03
	3  Optimising the use phase	A. Ensuring LOW ENERGY CONSUMPTION	• Reducing the automatic shutdown time • Incorporating eco mode (requires less powers) • Energy recovery system (hot water recirculated and used)	U-3A-01 U-3A-02

Life cycle phase	Ecodesign Strategy	Improvement measures	Improvement ideas generated in the brainstorming session	Code
 USE & UTILISATION	3  Optimising the use phase	B. Assessing and OPTIMISING CONSUMABLES	• Optimising amount of coffee needed per pod	U-3B-01
			• Adjusting coffee intensity	U-3B-02
			• Incorporating options to select cup size: automatic or 3 sizes	U-3B-03
			• System compatible with different pod types (including reusable pods)	U-3B-04
			• Use of loose coffee (ground or beans)	U-3B-05
			• Reducing consumables (water and cleaning product) needed for cleaning cycle	U-3B-06
			• Offering cleaning product with no harmful substances	
			• Connection to hot water	
	4  Extending the product lifespan	A. Fostering CUSTOMER LOYALTY	• Opting for neutral and timeless colours	U-4A-01
			• Incorporating large and clearly labelled buttons to avoid unnecessary complexity.	
		B. Increasing DURABILITY	• Opting for longer lasting polymers	U-4B-01
			• Longer lasting pumping system	U-4B-02
			• Avoiding external chrome plating	U-4B-03
			• Increasing sensor durability (tank full and pod recognition)	U-4B-04
		C. Facilitating MAINTENANCE & REPAIRABILITY	• Adding a water level sensor to preventing operating when dry	U-4B-05
			• Offering a guarantee that is at least 2 years longer than required by law	U-4B-06
			• Designing parts that can be dismantled without tools to facilitate cleaning and maintenance	U-4C-01
			• Adding an automatic washing option	U-4C-02
			• Facilitating access to critical components that failure (water full sensor, pod sensor)	U-4C-03
			• Modules with QR code with information about repairing and access to website with available spare parts)	U-4C-04
			• Offering spare parts and guarantee (beyond legal obligations)	U-4C-05
			• Offering descaler and cleaning kits	U-4C-06

Life cycle phase	Ecodesign Strategy	Improvement measures	Improvement ideas generated in the brainstorming session	Code
 USE & UTILISATION	4  Extending the product lifespan	C. Facilitating MAINTENANCE & REPAIRABILITY	- Maintenance tutorials (if there is a screen, that guides you in the process) - Offering repair service - Offering a repair kit (e.g., screwdrivers) - Incorporating predictive maintenance system, such as a sensor that warns when critical components are about to fail: Self-diagnosis system	U-4C-07 U-4C-08
 END-OF-LIFE-SYSTEMS	5  Promoting a second life	A. Allowing REUSE	- Setting up a collection programme for subsequent reuse - Offering incentives for returning coffee makers in good repair - Offering online assessment (checklist) based on parameters such as year of manufacture, year of use, etc.	FV-5A-01 FV-5A-02 FV-5A-03
		B. RENEWAL	Providing panel and housings of interchangeable colours so users can change and improve the aesthetics of the product	FV-5B-01
		C. REFURBISHMENT	Providing a guarantee to inspired user confidence about the quality and performance of the refurbished product	FV-5C-01
		D. REMANUFACTURING	- Modular design for a water and milk heater to be included to offer additional features and improve the versatility - Upgrading	FV-5D-01 FV-5D-02
	6  Bolstering recovery	A. Improving ease of DISMANTLING	- Establishing a modular design that is easy to dismantle and separate for cleaning and reuse/remanufacturing. - Developing manuals on dismantling	FV-6A-01 FV-6A-02
		B. STANDARDISATION of key parts	- Standardising the size and design of the parts used in different types of coffee makers (pod system, water tank, etc.) - Long series of critical parts (ensuring continuity and compatibility) - Using standard electric resistances so replacements can easily be found	FV-6B-01 FV-6B-02

Life cycle phase	Ecodesign Strategy	Improvement measures	Improvement ideas generated in the brainstorming session	Code
 END-OF-LIFE-SYSTEMS	6  Bolstering recovery	C. Enabling the REUSE of parts and components	- Recuperar y reutilizar componentes eléctricos como cables, conectores y sensores. - Reutilizar los botones y perillas de control en otras cafeteras.	FV-6C-01
	7  Optimising end-of-life	A. Fostering MATERIAL RECOVERY	- Using easily recyclable materials such as aluminium - Avoiding plastic and metal mixes or combinations that hinder recycling - Including programmes that indicate how different parts of the coffee makers are separated and recycled. - Modules with QR code with information on recycling (Passport material)	FV-7A-01 FV-7A-02 FV-7A-03 FV-7A-04
		B. Fostering RAW MATERIAL RECOVERY	Identifying the raw materials that make up the materials that are difficult to be recycled and can be recovered	
 NEW PRODUCT IDEAS	0  New business models	A. INTEGRATING FEATURES B. SERVICISATION C. USE ACCESS D. ACCESS TO THE RESULT	Analysed in the example of the servitisation manual	

Case Study 9. Ideas for improvement

3.6. Evaluating and Prioritising the Ideas for Environmental Improvement

Once the measures with the largest number of votes have been obtained, those ideas for environmental improvement must be evaluated in detail.

3.6.1. Evaluating feasibility

In order to choose the environmental improvement measures with greatest potential, the environmental, market, commercial, financial and technical feasibility of each of the measures with the highest votes must be evaluated, along with considering the coherence of the actions with the driving factors. Furthermore, whether the feasibility involves a new business model can be analysed.

- **Technical feasibility:** Refers to the possibility of applying the proposed improvement with the company's available technological measures.
- **Financial feasibility:** Refers to the possibility of the company assuming the economic cost of the proposed idea.
- **Commercial potential:** Evaluates whether the proposed improvement meets the demand of the customer companies to provide better value than the competition.
- **Market potential:** Evaluates the existence of a market for the product proposal and if the envisaged sales are realistic with the company's approach.
- **Environmental benefit:** The proposed idea shows a significant improvement on the environmental impact from the life cycle approach with respect to the baseline situation.
- **Response to driving factors:** Assess the coherence of the action with respect to the proposed driving factors.

Each of the aforementioned points can be assessed using the following criteria:

Score	Feasibility criterion	Potential criterion	Environmental benefit and alignment with driving factors
2	Very feasible	Very positive potential	Very high
1	Feasible	Positive potential	High
0	Neutral	Neutral	Neutral
-1	Nearly unfeasible	Negative potential	Low
-2	Unfeasible	Very negative potential	Very low

Table 14. Defining criteria to evaluate the feasibility of the ideas

It should be noted that each company can define more criteria according to its characteristics or needs (for example, quality) or give greater weight to some criteria than others.

3.6.2. Prioritising the Ideas for Environmental Improvement

Once all the improvement ideas are selected and evaluated, they are then prioritised, deciding whether each of them is in fact interesting and applicable in the short (ST), medium (MT) or long term (LT).

This whole process will be conducted using the evaluation and prioritisation matrix of the Tools ANNEX that relate the improvement idea with the feasibility evaluation and prioritisation (short, medium and long term).



The Cafeteras Ensueño prioritisation matrix is set out below, based on the ideas selected in the brainstorming session.

	Technical feasibility	Economic feasibility	Commercial potential	Market	Environmental benefit	Driving factors	Timeline
MP-1A- 01	0	2	-1	1	2	2	MT
MP-1A- 02	2	2	2	2	2	2	ST
MP-1A- 03	2	2	2	2	2	2	ST
MP-1A- 04	1	-1	-1	1	1	1	Discarded
MP-1A- 05	1	1	0	0	0	1	Discarded
MP-1A- 06	-1	2	0	1	2	2	MT
MP-1B- 01	2	2	2	2	2	2	ST
MP-1B- 02	2	2	2	2	2	2	ST
P-1C- 01	1	-1	-1	0	1	0	Discarded
P-1C- 02	1	-1	0	0	1	2	Discarded
P-1C- 03	2	1	1	1	1	1	MT
P-1C- 04	2	2	2	2	2	2	ST
P-1C- 05	-1	1	0	0	1	2	Discarded
D- 2A- 01	2	2	2	2	2	2	ST
D- 2A- 02	2	2	1	2	2	2	ST
D- 2A- 03	2	2	2	2	2	1	ST
D- 2B- 01	2	2	2	2	1	1	ST
D- 2B- 02	-2	-1	1	1	1	1	Discarded
D- 2B- 03	2	2	2	2	1	1	ST
U- 3A- 01	2	2	2	2	2	2	ST
U- 3A- 02	2	2	2	2	2	2	ST
U- 3B- 01	-1	2	2	0	1	1	LT*
U- 3B- 02	1	1	1	1	1	1	MT
U- 3B- 03	1	1	1	2	1	1	MT
U- 3B- 04	2	2	1	2	2	2	ST
U- 3B- 05	-1	-1	2	2	2	2	MT

	Viabilidad técnica	Viabilidad económica	Potencial comercial	Potencial de mercado	Beneficio ambiental	Factores impulsores	Plazo
U- 3B- 06	1	2	1	1	1	0	MT
U- 4A- 01	2	2	2	2	1	0	ST
U- 4B- 01	1	2	2	2	2	1	ST
U- 4B- 02	-2	-1	2	2	2	2	LT*
U- 4B- 03	-1	-1	1	2	2	1	LT*
U- 4B- 04	2	2	2	2	2	1	ST
U- 4B- 05	-1	-1	2	2	2	2	LT*
U- 4B- 06	-1	-1	2	2	1	2	LT*
U- 4C- 01	0	-1	1	2	1	2	LT*
U- 4C- 02	2	2	2	2	2	1	ST
U- 4C- 03	-1	0	0	1	2	2	LT*
U- 4C- 04	1	-1	2	-1	2	2	LT*
U- 4C- 05	1	-1	2	-1	2	2	LT*
U- 4C- 06	2	1	2	2	1	1	ST
U- 4C- 07	1	-1	2	-1	2	2	LT*
U- 4C- 08	1	-1	2	-1	2	2	LT*
FV- 5A- 01	-1	-1	2	2	1	2	LT*
FV- 5A- 02	1	-1	2	-1	1	2	LT*
FV- 5A- 03	2	1	2	2	2	2	ST
FV- 5B- 01	2	1	2	2	1	2	ST
FV- 5C- 01	1	-1	2	-1	1	2	LT*
FV- 5D- 01	0	-1	2	-1	2	2	LT*
FV- 5D- 02	0	-1	2	-1	2	2	LT*
FV- 6A- 01	1	0	1	-1	1	2	LT*
FV- 6A- 02	0	0	2	-1	1	2	LT*
FV- 6B- 01	2	2	2	2	2	2	ST
FV- 6B- 02	-1	-1	1	2	2	2	LT*
FV- 6C- 01	1	2	2	2	2	1	ST
FV- 7A- 01	2	2	2	2	2	1	ST
FV- 7A- 02	2	2	2	2	2	2	ST
FV- 7A- 03	2	2	2	2	2	0	ST
FV- 7A- 04	2	2	2	2	2	2	ST

Ideas with a score under 4 were discarded. The adopted ideas have been classified into: apt for the short term (range between 9 and 12), apt for the medium term (range between 6 and 8), and apt for the long term (range between 4 and 6).

The ideas considered of interest, but not viable with the current Cafeteras Ensueño business model are marked with an asterisk. They are mainly improvements aimed at fostering a second life and considerably extending the lifespan of the coffee makers, along with incorporating repair services or sale of consumables, and which are considered of particular interest given their potential environmental and commercial benefits, or as responses to the driving factors. However, these ideas

are not compatible with the current business model the company, based on the manufacturing and sale of coffee makers, as sales would be seriously affected.

All the apt ideas for improvement – whether viable in the short, medium or long term – were considered for the development of possible product concepts, and those aspects were evaluated afterwards. That has allowed the company to remain open to different alternatives when redesigning the product.

The *“From Product to the Business Model: Servitisation in a Circular Economy”* guidebook published by lhobe contains advice on how to develop ideas for new business models.

The following tables contains the list of apt ideas classified into short, medium or long term.

SHORT TERM
Use of 100% recycled aluminium
Use of 100% recycled steel
Body of the coffee maker lighter and slimmer
Use of lighter material for the water tank
Use of renewable energy sources.
Thinner cardboard packaging
Use of recycled cardboard
Instruction manual using QR code to avoid printed paper
Prioritising local suppliers to reduce the impact of transport
Designing pallet patterns that better use the space of the loading unit
Reducing the automatic shutdown time
Incorporating “eco” feature (requires less power)
System compatible with different types of pods (including reusable pods)
Opting for neutral and timeless colours
Opting for more durable polymers
Increasing the durability of the sensors (recognising tank full and pod)
Adding an automatic washing option
Offering descaler and cleaning kits
Offering online diagnosis (check list) based on parameters including year of manufacture, years used, etc.
Providing panels and housing with interchangeable colours so that the users can change and improve the aesthetics of the product
Standardising the size and design of the parts used in different types of coffee makers (pod system, water tank, etc.)
Recovering and reusing electrical components such as cables, connectors and sensors
Using easily recyclable materials such as aluminium
Avoiding mixes or combinations of metal and plastic materials that hinder recycling
Including pictograms that indicate how to separate and recycle different parts of the coffee maker.
QR code modules with information on recycling (Passport material)

MEDIUM TERM
Use of 100% recycled plastic
Use of reused components
Eliminating the printing and painting of the parts
Introducing coffee intensity adjustments
Incorporating options to select the cup volume: automatic or 3 sizes
Use of coffee without packaging (ground or beans)
Offering cleaning product with no harmful substances
LONG TERM
Longer lasting pump system
Avoiding external chrome plating
Adding a water level sensor to prevent operating when dry
Offering at least a guarantee that is 2 years longer than the one required by law
Designing parts that can be removed without tools to facilitate cleaning and maintenance
Facilitating access to critical components that fail (water full sensor, pod sensor)
QR code modules with information about repairs and access to website with available spare parts.
Offering spare parts and guarantee (beyond those legal obligations)
Offering a repair service
Incorporating a predictive maintenance system as a sensor to warn when the critical components are likely to fail: Self-diagnostic system
Establishing a collection system for their subsequent reuse
Offering incentives to return the coffee maker in good working order
Providing a guarantee to inspire user confidence about the quality and performance of the refurbished product
Technological upgrading
Introducing a modular design that is easy to dismantle and separate for its cleaning and reuse/ remanufacturing
Developing manuals for dismantling the product
Long series of critical parts (ensuring continuity and compatibility)

Case Study 10. Ideas prioritisation matrix

Stage 4

Concept development





GOALS

To generate different product concepts using the pinpointed actions



ACTIVITIES

- Developing the specifications
 - Generating product conceptual alternatives
 - Selecting the new product
-



DEPARTMENTS INVOLVED

- **Quality Department:** Establishing quality, legal or technical requirements for the specifications.
 - **Design or Technical Department:**
 - Establishing environmental requirements for the specifications using the ideas selected in Stage 3.
 - Concept development
 - Study of the environmental aspects of the different concepts and selection.
 - Providing the external designer with criteria, when one is used (in which case their remit will include the two tasks above).
 - **Purchasing Department:** Information on new alternatives for materials, technologies, etc.
 - **Marketing Department:** Information on specific demands of the consumers to establish the specifications or the concept appraisal, as well as on materials with good or poor image on the market, etc.
-



TOOLS

- Creative techniques
 - Tools to select the specifications
 - Tools selected by the company to study environmental aspects
-



PLANNING

50-80 hours

Given that the design activity does not follow a strictly linear method, but rather an iterative process, this stage aims to structure the design process in detail for a new product. Once the improvement ideas have been generated and the most important options selected in the short, medium and long term, this stage is focused on developing product concept that will ultimately lead to a new product. Therefore, the environmental improvement ideas generated in Stage 3 help to define the new requirements that must be included in the specifications to be developed in this Stage 4.

Given the requirements established in the specifications, this stage seeks to come up with new product concepts. Therefore, the conceptual proposals developed must be assessed according to the degree in which they comply with the different terms and conditions of the specifications. Based on that assessment, the final concept with the best appraisal will be selected to be subsequently developed in Stage 5.

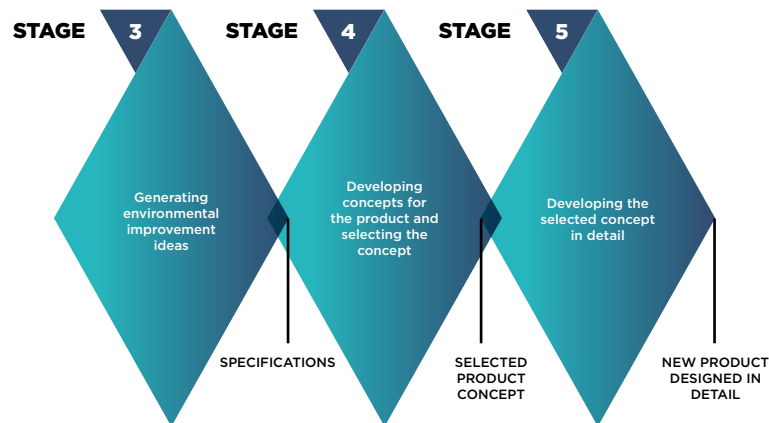


Figure 19. Product definition and design stage iteration

4.1. Preparing Specifications

In order to avoid any ambiguity of the different variables that may emerge during future stages and specify the necessary conditions that the product must fulfil to meet the project's goals, specifications based on the criteria of the multidisciplinary work team are prepared.

The specifications are prepared taking into account the information obtained in the previous stages. Unlike the earlier stages, the economic, aesthetic, functional and technical specifications must be taken into account, along with the environmental requirements. Furthermore, the importance should be noted of evaluating the degree of priority of the different requirements established in the specifications to, thus, ensure that the priority requirements are incorporated in the conceptual proposals of the product.

The Tools ANNEX contains a template to help prepare the specifications.



Cafeteras Ensueño has developed the new coffee maker concepts based on analysing the environmental aspects of the products and the ideas for improvement generated in the earlier stages. First, the specifications of the new product were established. Only the improvements to the product itself were defined, without entering into the improvement pinpoints for the production or distribution processes.

SPECIFICATIONS

REQUIREMENTS	PRIORITY
Technical requirements	
Keep single-serve functioning requirements	☑
Design removable parts to facilitate cleaning and maintenance and the dismantling and recycling (QR for parts)	☑
Option of automatic washing/maintenance	
Functional requirements	
System compatible with different types of pods (including reusable pods)	
System that allows pods to be eliminated (ground coffee or beans)	

SPECIFICATIONS

REQUIREMENTS	PRIORITY
Environmental technical requirements	
Use of 100% recycled aluminium for the handle	✓
Use of 100% recycled steel for the tray	✓
Use of 100% recycled plastic	
Avoiding mixes or combinations of metal and plastic materials that hinder recycling	✓
Body of the coffee maker lighter and slimmer	
Use of lighter material for the water tank	
Automatic shutdown time under 10 minutes	✓
“Eco” use mode with consumption of 350 kwh	✓
Introducing coffee intensity adjustments	
Incorporating options to select the cup volume: automatic or 3 sizes	
Opting for more durable polymers	✓
Increasing sensor durability	✓
Increasing pump system durability	
Add a water level sensor to prevent operating when dry	
Standardising the size and design of the parts used in different types of coffee makers (pod system, water tank, etc.)	✓
Recovering and reusing electrical components such as cables, connectors and sensors	
Aesthetic requirements	
The basic version available in neutral colours	
Eliminating the printing and painting of the parts	✓
Panels and housing in interchangeable colours	
Eliminate chrome plating	
Economic requirements	
Lower product manufacturing costs	



4.2. Generating New Product Concepts

New product concepts are developed for the preliminary design of the product to be developed, taking into account the requirements established in the specifications. Several conceptual proposals have been put forward in tandem in order to find the solution that best stick to the specifications.

In this stage, apart from the technical or product development departments, those making up the work team play an important role in gathering the relevant information. Thus, the communication and marketing department may report on possible alternative materials or production processes detected for their use by the competition, while the purchasing department may come across the same information due to its availability on the market. Should the company work with an external designer, the latter should meet with the different departments of the company at the start of this stage to take all this information into account.

The process of generating new concepts does not have an established fixed pathway, as it depends of the method used by the design or technical department. However, it may be of interest to conduct a brainstorming session for a myriad of proposal to meet the requirements in the specifications. Furthermore, sketches, renders, models, prototypes, etc. should be used to clearly see the different proposed alternatives and their structure.

Should the product to be ecodesigned be considered a complex product, it should be divided into different but interrelated functional subsystems that make up the product. The relationship between the different subsystems can be depicted using a flow diagrams. Even though each of the subsystems is in turn made up of a large number of parts, this stage will not enter into that level of detail.



Based on the specification requirements, Cafeteras Ensueño developed different coffee maker concepts. Those three concepts represented different approaches to designing the new coffee makers, tackling the specifications in different ways. The 3 coffee-machine concepts designed are as follows:

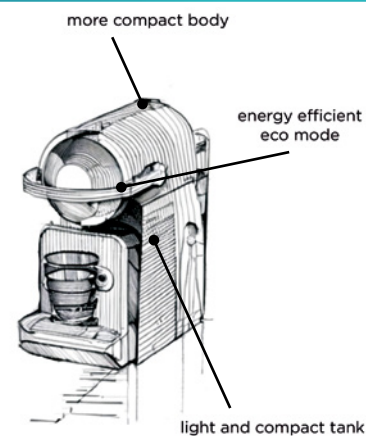
DEVELOPMENT OF CONCEPTS BASED ON SPECIFICATIONS

NEW PRODUCT CONCEPT

NEW PRODUCT DESIGN

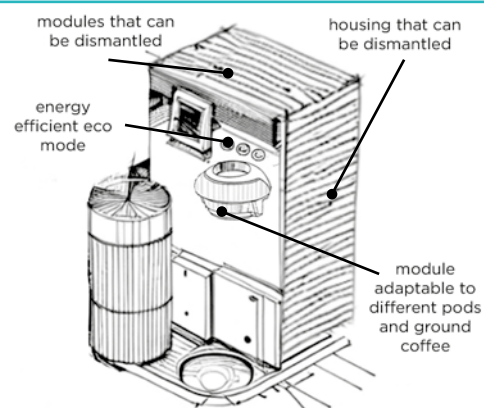
A. Compact coffee maker:

- Lighter and 100% recycled materials
- More energy efficient
- Only uses aluminium pods
- 5-year technical life



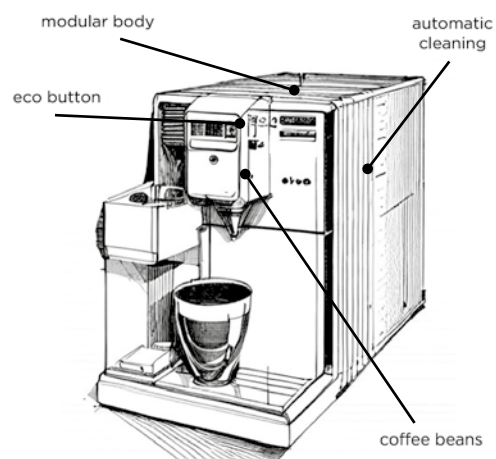
B. Modular coffee maker:

- Modular and easily dismantled
- More energy efficient
- Different pods and ground coffee can be used
- 8-year technical life



C. Automatic coffee maker:

- Greater energy efficiency
- Only uses coffee beans
- 15-year technical life





4.3. Selecting the Product Concept

The different conceptual proposals described in the previous section are then analysed to select the concept with the greatest potential economic, technical and environmental feasibility, for its subsequent development. Given that all the conceptual proposals have been developed taking into considerations the requirements set out in the specifications, the evaluation will be performed based as those requirements, as not all the concepts will fulfil them to the same extent. Furthermore, the possibility of combining the best characteristics of each must be envisaged.

There are different evaluation methods, such as scoring from 1 to 10, in order to evaluate each of the concepts generated according to the specification requirements. Thus, a global estimate will be obtained for each of the concepts developed that will make it easier to select the concept to be developed in the following stage. Each company will be able to define the evaluation method that is the best fit or give greater importance to some requirements over others.

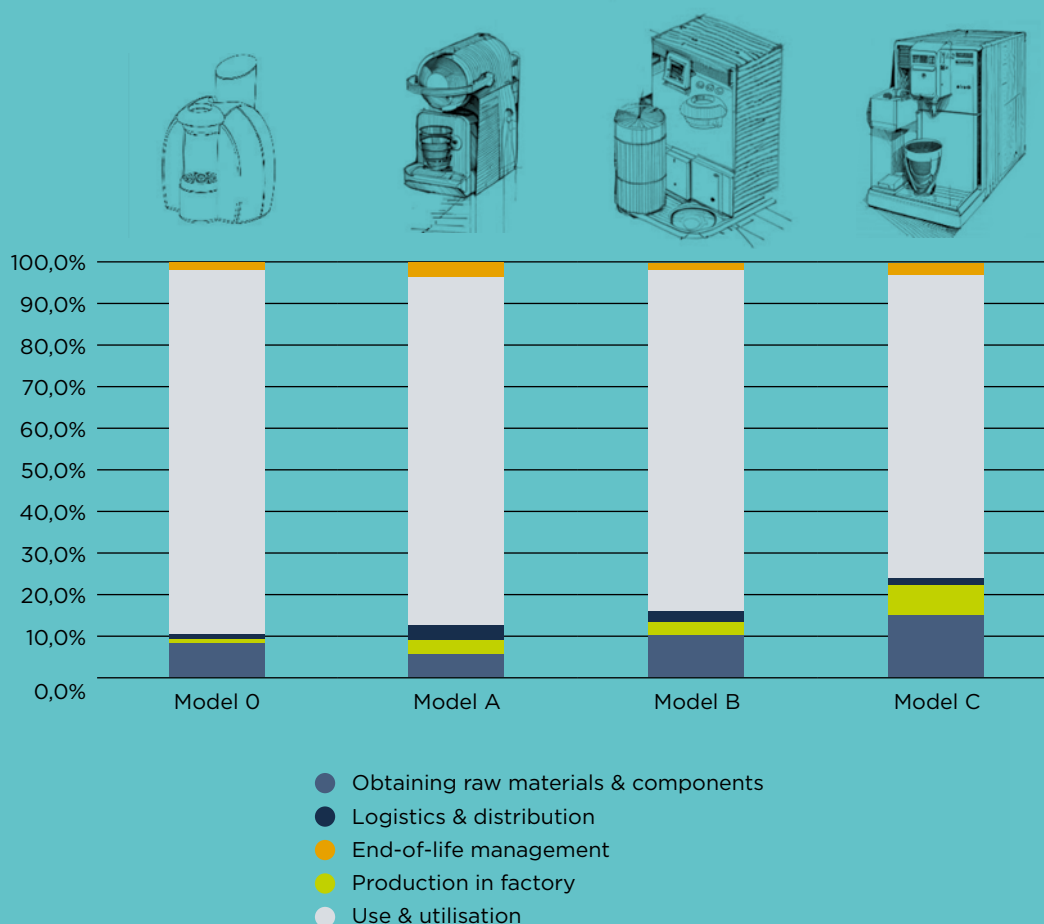
However, the tools to assess environmental aspects mentioned in Stage 2 in order to objectively assess compliance of the environmental requirements of the different concepts may be useful. An approximation of the expected environmental improvement can be obtained using the estimates of materials, amounts and process for each of the concepts. Thus, an idea can be obtained of not only which is the best of the concepts from an environmental perspective, but also whether it is better than the preliminary design or the products existing on the market. It should be noted that the same functional unit must be established for all the assessments in order to carry out the comparison.

After all the conceptual proposals have been evaluated, the concept closest to the established requirements will be selected. The following stage will develop the selected concept in detail to establish a final product design.



Cafeteras Ensueño had to select one of the coffee maker concepts developed. Therefore, it first performed a simplified LCA of the three models and compared them with the current product to see the improvement potential regarding the environmental impact of each of the solutions.

The simplified LCA showed the impact profiles for each phase of the life cycle. The most significant phases were use and obtaining raw materials and components in all cases; however, differences existed between them. The proportion of the impact of the phase to obtain raw materials and components was less in Model A, as it is more compact and lighter, while it increased for Models B and C, whose manufacturing require a greater number of parts and material. All the models had less of an impact in the use phase due to better energy efficiency of the coffee maker. That was the only improved by Model A in the use phase. In addition to that improvement, Model B used fewer pods, as it can use ground coffee (it was estimated that 50% of the coffee used would be as pods and the remaining 50% ground coffee). Model C completely eliminated the impact associated to the coffee pods. Furthermore, Models B and C also increased the durability of the coffee maker.

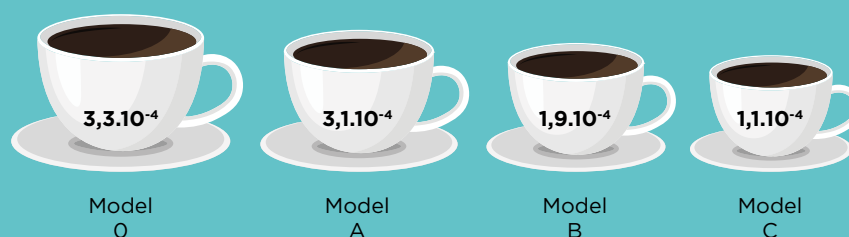


The following table shows the result of the LCA indicated in mPt (milipoint), a unit of the ReCiPe methodology where 1 point represents the hundredth part of the annual environmental burden of an average European citizen. This table indicates the total impact of the life cycle of the coffee maker and the impact per functional unit (a coffee cup).

	MODEL O	MODEL A	MODEL B	MODEL C
Total impact (mPt)	5,999	5,699	5,399	6,179
Impact per coffee cup (mPt)	0,000328	0,000312	0,000185	0,000113

It is important to perform the comparison of the results with respect to the chosen functional unit, in this case, the coffee cup, in order to be able to evaluate in a precise and relevant way the environmental impact of the product in relation to its main function, and thus be able to perform comparison that allow informed decisions to be made. That difference can be clearly seen in Model C. The total impact of the automatic coffee maker throughout the life cycle increased with respect to the pod coffee makers; however, the increase was mainly due to greater durability of the machine itself (which meant greater energy consumption and of consumables). When analysing the total impact, we are comparing a pod coffee maker that would be working for 5 years with an automatic coffee maker that would be in use for 15 years, a comparison that is meaningless. Therefore, it is essential to compare the impact per use, in other words, per each of the cups of coffee that are prepared with each maker.

The result is shown in the following figure, where the impact per cup can be seen to be significantly lower in the case of the automatic coffee maker.



Once the comparison of the environmental impact of the different models of coffee maker had been performed, the company evaluated the three proposals according to the degree of compliance of the requirements of the specifications and driving factors, by means of scoring from 1 to 5 (with 5 being the highest score). For simplicity's sake, the same weight was given to age, even though some requirements may have greater weight than others in other cases.

The scoring awarded is shown below to compare the degree of compliance of the requirements:

REQUIREMENTS	A	B	C
Technical requirements			
Keep single-serve functioning requirements	5	5	5
Design removable parts to facilitate cleaning and maintenance and the dismantling and recycling (QR for parts)	2	5	4
Option of automatic washing/maintenance	1	1	5
Functional requirements			
System compatible with different types of pods (including reusable pods)	1	5	1
System that allows pods to be eliminated (ground coffee or beans)	1	4	5
Environmental technical requirements			
Compliance of priority environmental technical requirements	5	5	5
Compliance of other environmental technical requirements	3	4	5
Environmental impact per functional unit (coffee cup)	2	4	5
Aesthetic requirements			
The basic version available in neutral colours	4	4	4
Panels and housing in interchangeable colours	1	5	2
Economic requirements			
Lower product manufacturing costs	4	3	1
Driving factors			
Compliance of driving factors	3	4	4
TOTAL	32	49	46

After the assessment was completed, the company **opted for Concept B** as the best option for ecodesign with a circular approach.

First, Concept B includes improvements to multiple stages of the product's life cycle. That means that not only is it focused on optimising the manufacturing and use of the product, such as Option A, but it also considers the durability, maintenance and end-of-life, thus reducing the environmental impact throughout the life cycle and in the long term. One of the most significant improvements was the option to dispense with the need to use aluminium pods, one of the key factors both from an environmental perspective and to meet what the market is demanding.

Another point in favour of this concept is that it offers additional features that may be welcomed by consumers, as it is in line with one of the key driving factors. That not only increases the perceived value of the product, but also helps to increase customer loyalty.

On the other hand, Concept B is noted for its design aimed at durability and modularity.

In manufacturing terms, modularity offers significant advantages. Production becomes more efficient and cost-effective by standardising the parts and components used in the product. Furthermore, it is easier to maintain and repair.

This durability approach seems to be inconsistent with the current business model. However, that can also open new business opportunities. For example, module upgrading services can be offered to keep the current products in peak working order. Furthermore, it opens up the way to explore additional business models.

The *“From Product to the Business Model: Servitisation in a Circular Economy”* guidebook published by Ihobe contains advice on how to assess new business models.

The score obtained for Concept C was very similar. Model C has a substantially lower environmental impact and complies with the driving factors identified. However, this product would currently be a challenge for Cafeteras Ensueño. A product with a 15-year lifespan is a positive achievement from the environmental perspective. However, it is not feasible within the framework of the company's current business model. The investment required for this change in production and infrastructure exceeds the available resources, and the current strategy of the company is not in line with the marketing of such long-lasting products. Despite its appeal in environmental terms, its feasibility in the current business context is limited and it was therefore discarded.

Stage 5

Product in detail





GOALS

To define the ecodesigned product in detail



ACTIVITIES

- Defining the product in detail
 - Selecting the final product
-



DEPARTMENTS INVOLVED

- **Design or Technical Department:**
Developing the product in detail
Assessing the different alternatives and selecting materials, processes, etc., based on environmental criteria.
Providing the external designer with criteria, when one is used (in which case their remit will include the above tasks). The technical or design department will be in charge of setting the necessary criteria, along with any other information that the external designer requires).
 - **Quality Department:** Supplying specific information on fulfilling quality requirements for the developments of the technical department.
 - **Purchasing and Marketing Department:** Providing specific information requested by the technical department or external design and reporting on possible problems of the new product.
-



TOOLS

- Tools selected by the company to study environmental aspects
-



PLANNING

280-480 hours

This stage seeks to define the selected concept in detail for a final product design. Starting from the alternative selected in the previous stage, the exact product dimensions, materials and production techniques must be determined for its subsequent introduction into the market.

In the same way as in the previous stage, the procedure will be iterative and highly dynamic, due to the lack of a set process methodology. In practice, Stages 4 and 5 are usually undertaken simultaneously. However, the conception of the product evolving from an initial embryonic design phase to achieving a greater degree of detail is essential.

Furthermore, and as mentioned in the previous stage, environmental criteria will not be the only aspect to be taken into account, but will be an important aspect to evaluate, along with the aesthetic, functional, technical and economic requirements.

5.1. Defining the Product in Detail

The outcome of this stage will be a detailed design of the product, nearly ready for its manufacturing and launch on the market. Therefore, the characteristics of the concept selected in Stage 4 must be first defined. In this stage, the main decisions about the form and construction of the product will be made, taking into account the environmental aspects, the functionality, reliability, possibility of its manufacture and costs. The general arrangement plan to scale will thus be obtained and which will show the main dimensions and the list of preliminary materials.

Once the general details of the product have been defined, the second step will be to define the exact number of parts, the geometric shape of each one, its dimensions, surface properties, materials, etc. That must all be shown on the overall drawings, detailed drawings, list of materials and, as applicable, prototypes.



Figure 20. Steps in defining the product to be ecodesigned

The designer must take into account a whole range of specifications to define the product in detail. Working with different agents of the supply chain will be very helpful to facilitate the process. For example, it may be useful to be in direct contact with supplier to pinpoint materials or components with less environmental impact, lower economic costs or which have greater functionality in order to facilitate the process. At the same time, some of the LCA software tools assessed in Stage 2 that allow the different options to be evaluated may be useful to help select materials and processes with lower environmental impact.

5.2. Selecting the Details of the Product Concept

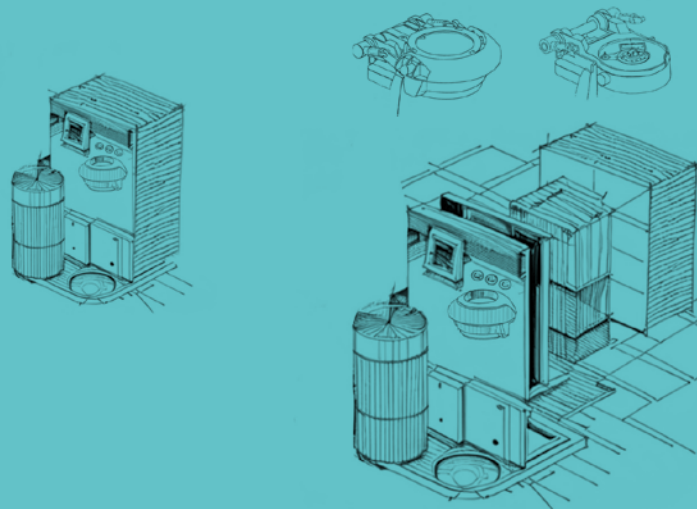
Several solutions can be generated in the detailed design process for a specific aspect. After analysing and assessing them in detail, the designer or project team must select the best.

The following may be useful when gathering data to evaluate the concept details:

- **Cost analysis:** Calculating the cost price of the final product (Financial Department).
- **Quality tests:** Conducting quality tests to check that the new product will maintain or improve its features (Quality Department).
- **Product test:** Preparing a questionnaire for users to learn how the new ecodesigned products fits within their needs (Communication and Marketing Department):
- **Environmental assessment:** Assessing the environmental impact of the product using the environmental assessment tool (Sustainability and Environment Tool).
- **Prototyping:** Control models, functional and aesthetic models or prototypes to observe the feasibility of each of the defined details (Product Development Department).



As the final result of this stage, Cafeteras Ensueño defined the new chosen market in pull, with detailed drawings of the whole and of the different components of the product.



Stage 6

Assessment and action plan





GOALS

- To assess the results and extract conclusions regarding the ecodesign project, at product and at process level
 - Develop a plan of action to drive continuous improvement
-



ACTIVITIES

- Assessing the technical, social, economic and environmental performance of the ecodesigned product.
 - Comparing the ecodesigned product and the original product, identifying the main improvements obtained and possible future improvement actions.
 - Developing the action plan at product and business level.
-



DEPARTMENTS INVOLVED

This stage requires the intervention of all the departments involved in the ecodesign project. On the one hand, they must evaluate the characteristics of the ecodesign process and product; and, on the other hand, they will have to approve the tasks allocated in the action plan. That includes the following departments:

- Technical Department
 - Quality Department
 - Marketing Department
 - Sustainability and Environment Department
 - Purchasing Department
 - General Management and other departments
-



TOOLS

- Tools to evaluate the product and/or project.
 - Tool to develop the product action plan.
 - Tool to develop the business action plan.
-



PLANNING

60-80 hours

This stage will involve a final evaluation of the ecodesign project, considering the results attained, on the one hand, and the improvement points identified during the project, on the other hand. That will facilitate the extraction of conclusions and the defining of an action plan based on ecodesign and the circular economy, both at product level and at business level, so that the greatest benefit can be obtained from the project.



6.1. How to Evaluate the Ecodesign Project

The project can be evaluated in different way, in order to integrate it in the standard evaluation procedures of the company. However, this section sets out the minimum criteria and/or procedures that must be considered during this stage.

The project must be evaluated by analysing to what extent its driving factors and the requirements established have been met, along with the benefits obtained from it. Therefore, the redesigned initial product and the process used to design it will be taken as the benchmark, identifying the following aspects and relating them with the measures and actions carried out:

- **Degree of improvement:** Social, economic, technical and/or environmental benefits.
- **Possible improvement actions:** Useful strategies to design future products.

Those aspects will be assessed based on predefined parameters (improvement indicators), which may (and must) be evaluated by means of quantitative and qualitative proof that allows a cross-cutting overview of the main results obtained. Those indicators may be grouped to facilitate the interpretation of the results (for example, by stage, by area, by requirement, or by driving factor). The Tools Section of the ANNEX contains a table as guidance regarding the aspects that should be considered in the evaluation, but which may be adapted to the needs of the company.

6.1.1. Qualitative

The qualitative proof may be used to assess the impact of the improvements applied to comply with the driving factors (Stage 1), in other words, to analyse to what extent the goals of the ecodesign project have been achieved and, therefore, to evaluate the project overall. In general, they may not be adequately evaluated until sometime after the launch of the product, but they may be estimated by means of dialogues and/or surveys with the stakeholders: including employees (whether or not involved in the development of the project), customers and/or consumers.

IMPROVEMENT INDICATORS

One of the main qualitative indicators is the perception of the different aspects involved in the process, along with those directly related to the driving factors. Some of the indicators proposed for this stage are:

- **Altering the product:** Perception that the redesigning of the product was so radical.
- **Difficulty of the process:** Perception of the team involved in the ecodesign process of the more complex stages and which require greater attention/work.
- **Improvement obtained:** Perception of the general or specific improvements obtained. For example, perception of the quantitative indicators defined may be evaluated.

- **The company:** Change in the general perception of the company (identity, authenticity, reliability, commitment, ...).
- **Competitiveness of the sector:** Perception of better competitiveness within the sector for the product being studied.
- **General satisfaction:** General perception of the project.



Part of the qualitative evaluation carried out by Cafeteras Ensueño is shown below as an example:

Improvement indicators	Degree of improvement	Requirements	Motivating factor	Proof	Related measures
IMPROVEMENT INDICATORS					
Degree of ease of dismantling to be repaired, reused and recycled	Very satisfactory	✓	✓	Customer survey	Measures focused on ease of dismantling and modular model
MOTIVATING FACTOR INDICATORS - ENVIRONMENTAL GOALS					
Amount of raw material in the product (by mass unit)	Improvable	✓	✓	Dialogue/ Survey/ Others	Structural and component design measures, use of materials
Amount of waste generated in the process	Satisfactory		✓	Waste indicators	Standardisation measures, eliminating paint
MOTIVATING FACTOR INDICATORS - COMPETITION					
Market share	Improvable		✓	Market studies	Keep single-serve model

Case Study 15. Qualitative evaluation of improvements

6.1.2. Quantitative

The quantitative evaluation requires assessment tools that allow the initial values and the values of the ecodesigned product to be compared. In this vein, the environmental benefits may be evaluated by repeating the initial environmental assessment of the product (Stage 2) for the ecodesign product, analysing whether the established requirements have been met (Stage 4) and the effectiveness of the strategies implemented (Stage 3). Furthermore, the stages of the life cycle can be identified where better environmental results have been obtained and which should be improved in future development. Nonetheless, other additional improvements indicators could be analysed. Some examples are offered below.

IMPROVEMENT INDICATORS

Based on the applied improvement strategies, specific quantifiable indicators may be established in order to evaluate to what extent the product and/or service being studied has improved. For example:

- **Environmental improvements:** Durability, reparability, recyclability, use of critical raw materials, etc.
- **Technical improvements:** Functionality, resistance, hardness, elasticity, etc.
- **Economic improvements:** Cost of materials, production costs, transport costs, etc.
- **Social improvements:** Employability, occupational health and safety, accessibility, health and safety of the product, etc.

In any event, **all the benefits of the ecodesigned product must be assessed based on the previously defined functional unit** in order to ensure a correct interpretation of the results.



Part of the quantitative evaluation carried out by Cafeteras Ensueño is shown below as an example:

Improvement indicators	Degree of improvement	Requirements	Motivating factor	Proof	Related measures	Stage
ENVIRONMENTAL IMPROVEMENT INDICATORS						
% of aluminium recycled	50 %	✓	✓	METCO	Measures related to purchasing recycled raw materials	Obtaining raw materials
% of steel recycled	12 %	✓	✓	METCO	Measures related to purchasing recycled raw materials	Obtaining raw materials
Energy consumption of the product	22 %	✓	✓	LCA	By means of the Eco mode and shutdown time	Use

Case Study 16. Quantitative evaluation of improvements (cont. ->)

Improvement indicators	Degree of improvement	Requirements	Motivating factor	Proof	Related measures	Stage
TECHNICAL IMPROVEMENT INDICATORS						
Degree of ease of dismantling to be repaired, reused and recycled	75 %	✓	✓	Part inventory	Measures focused on ease of dismantling and modular model	
Degree of comparability with existing pods on the market	85 %	✓	✓	Testing	System compatible with different types of pods (including reusable pods)	Use and end of life
ECONOMIC IMPROVEMENT INDICATORS						
Production cost	-7 %	✗	✗	ERP	Measures focused on the use of raw materials and standardisation	In-factory production
Cost of transport	2 %		✓	Bill	Measures to optimise packaging	Logistics and distribution
SOCIAL IMPROVEMENT INDICATORS						
Level of exposure to VOCs (occupational health & safety)	20 %			VOC indicators	Paints and chemical products	In-factory production

Case Study 16. Quantitative evaluation of improvements



6.2. Defining an Action Plan

Assessing the ecodesign project at product level and process level will provide a more comprehensive view that will help to define the action plan for continuous improvement.

In order to gradually implement the improvement measures identified in Stage 3, an action plan will be established at product level that will allow the different timelines to be visualised and, therefore, will streamline an effective implementation. An appropriate action plan will allow the monitoring of the whole implementation process, ensuring that the long-term advantages are obtained.

However, the greatest advantage arising from the process is the experience obtained, which may be showcased by means of developing a business action plan. The purpose of the plan will be to improve the environmental management of the company and integrating ecodesign as part of the process. Accordingly, the integration with the strategic planning of the company is put forward, by coordinating several departments of the company and establishing a roadmap to circularity and decarbonisation, based on ecodesign.

6.2.1. Medium- and Long-Term Product Action Plan

The product action plan must include the following characteristics to foster and facilitate an effective implementation:

- The **improvement measures** previously identified in Stage 3.
- **Specific actions** needed to implement each of the improvement measures.
- **Timeline:** It should be indicated whether implementation is expected in the medium or long term, along with an approximate start and end date. It should be given for proposed actions and measures, considering the relationship existing between them.
- **Review frequency:** It should be stated for all the measures and for all the actions to which it applies. Some actions may not require active monitoring, depending on the complexity of the action and/or person in charge, inter alia.
- **Remit:** The department and person in charge of the proposed measures and actions.

In any event, the action plan should be adapted and adjusted to the needs of the company; therefore, additional aspects of interest, such as the cost, resources and/or progress indicators, could (and should) be included.



Part of the action plan for the Cafeteras Ensueño product is shown below as an example. It is based on the improvement measures that had been considered of interest, but not feasible in the short term and which, therefore, had not been included in the ecodesigned model. These measures are included in the product plan to be able to integrate them in the future.

Measures and actions	Timeline	Start date	End date	Remit
U-4B-05 Increase durability by adding water level sensor	LT	Month 0	Month 15	Technical and Quality and Environment Dept.
Technical/environmental potential assessment	ST	Month 0	Month 1	Technical Dept.
Identifying alternatives	MT	Month 1	Month 2	Technical Dept.
Supplier appraisal	MT	Month 2	Month 4	Technical and Quality and Environment Dept.
Cost-benefit analysis and return on investment	MT	Month 5	Month 6	Technical and Quality and Environment Dept.
Risk assessment	LT	Month 7	Month 9	Technical and Quality and Environment Dept.
Implementation Plan	LT	Month 10	Month 15	Technical Dept.
U-4C-04 Extension of guarantee and availability of spare parts	LT	Month 3	Month 24	Technical Dept.
Market analysis	MT	Month 3	Month 5	Technical and Quality and Environment Dept.
Legal Assessment	MT	Month 3	Month 5	Technical and Quality and Environment Dept.
Designing guarantee policy alternatives	LT	Month 5	Month 8	Technical and Quality and Environment Dept.
Inventarios de recambios críticos	LP	Mes 5	Mes 9	Dpto. Técnico
Monitoreo de demanda	LP	Mes 5	Mes 9	Dpto. Compras y Ventas
Análisis de costo beneficio	LP	Mes 9	Mes 12	Dpto. Compras y Ventas
Plan de implementación	LP	Mes 12	Mes 24	Dpto. Técnico Calidad y MA

Case Study 17. Product improvement action plan

The implementation effectiveness will depend on a great extent on correct planning, with dividing the measures into clear and simple actions one of the key points for success. Furthermore, the planning must be dynamic: it should be updated and adjusted during the development of the project, amending and applying the necessary changes according to the advances achieved.

The action plan may be developed using the strategic planning of the company itself or other planning models, such as the Gantt diagram or the planning matrix.

6.2.2. Company ecodesign action plan

The ecodesign process will have to highlight the positive aspects, the negative aspects and the opportunities for improvement in the product development. That will allow the tools and methodologies of interest to the company to be identified, which may be implemented in a cross-cutting way.

The steps below can be followed to integrate these tools.

1. Relating the identified tools and methodologies with the current produces: points in common, differences, possibilities of integration, benefits, costs, etc.
2. Putting forward options for the joint incorporation of related and/or valid elements, taking the needs of the company into account. The approach must consider all the ecodesign stages, along with all the measures and actions needed for their development. A person will be given this remit, and they will establish the time limits and regular reviews in a similar way to the product action plan.
3. Amending and adapting the proposed procedures.



Part of the company ecodesign plan of Cafeteras Ensueño is provided as an example below:

Scope	Improvement actions	Steps	Timeli- ne	Start date	End date	Person in charge
Management System	Certifying as per ISO 14006 standard	Integrating ecodesign in the current management system	ST	Jan. 2024	Apr. 2024	• Management • Technical Dept. • Quality and Environment Dept.
		Certifying process	MT	Jun. 2024	Oct. 2024	• Management • Quality and Environment Dept.
Environmental assessment and communication	Defining assessment and communication strategy	Assessing environmental assessment and communication instruments	ST	Jan. 2024	Jan. 2024	• Technical Dept. • Quality and Environment Dept.
		Selecting instrument	ST	Feb. 2024	Feb. 2024	• Management • Technical Dept. • Quality and Environment Dept.
	Developing assessment and communication strategy	Deploying selected instrument	MT	Q2 2024	Q4 2024	• Technical Dept. • Quality and Environment Dept.
		Integrating instrument in management system	LT	Q1 2025	Q2 2025	• Quality and Environment Dept.
		Evaluating certification	LT	Q3 2025	Q3 2025	• Management • Quality and Environment Dept.

Scope	Improvement actions	Steps	Timeli- ne	Start date	End date	Person in charge
Alternative business models	Exploring servitisation models	Current business model assessment	MT	Q2 2024	Q2 2024	• Management • Commercial Dept. • Technical Dept. • Quality and Environment Dept.
		Identifying services to be offered	MT	Q3 2024	Q3 2024	• Management • Commercial Dept.
		Assessing changes in management product ownership and new ecodesign options	MT	Q3 2024	Q3 2024	• Management • Commercial Dept. • Technical Dept. • Quality and Environment Dept.
		Configuring new servitisation model	MT	Q3 2024	Q4 2024	• Management • Commercial Dept.
	Piloting servitisation model	Implementing new servitisation model	LT	Q1 2025	Q4 2025	• Management • Commercial Dept. • Technical Dept. • Quality and Environment Dept.
		Assessing results	LT	Q4 2025	Q4 2025	• Management • Commercial Dept. • Dpto. Calidad y MA
		Developing improvement actions	LT	Q1 2026		• Management • Commercial Dept.

Case Study 18. Business improvement action plan

Furthermore, establishing guidelines in the action plan to set up and systematise the gathering of environmental information on the input and output aspects provided by the supply chain would be of interest.

Part of the family of ISO 14000 standard

The ISO 14001 standard - Environmental management systems is focused on the environmental performance of organisations. It therefore provides a basic continuous improvement structure into which the operations, the products and the services of an organisation are integrated, by means of a series of minimum requirements that the organisation must meet. Those requirements include many of the aspects considered during the ecodesign process, such as identifying the significant environmental aspects with life cycle perspective or establishing goals and targets to improve environmental performance.

Therefore, if there is no Environmental Management System (EMS) in place, ecodesign can act as a first step for its development.

This option can be deployed as per the ISO 14001 standard, but that task could be simplified and standardised by means of using the ISO 14006 standard, that addresses and links the areas considered in ecodesign (environment, design & development, and management systems, Figure 21); it can be useful for companies that are interested in reducing the environmental impacts of their products systematically.

The international ISO 14006 standard provides the guidelines to establish, document, implement and maintain ecodesign as a standard practice and, therefore, continuously improve the environmental performance of the organisations. The main objective is environmental improvement focused on products and services, by providing the guidelines to establish a systematic methodology for continuous improvement in the design of products and/or services.

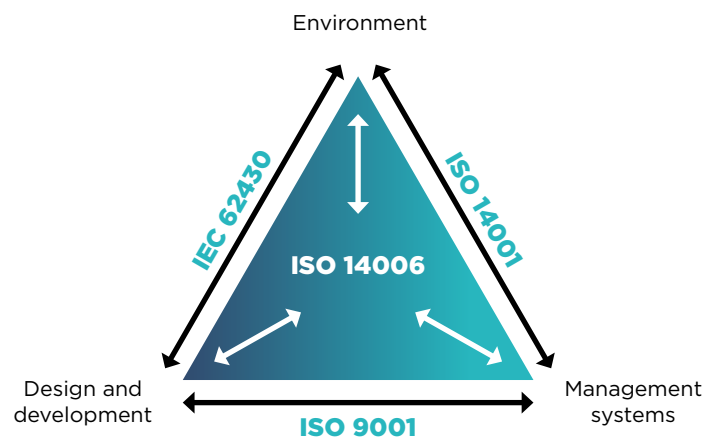


Figure 21. Relationship between the ISO 14001, ISO 9001, IEC 62430 and ISO 14006 standards and the business functions of the organisation. Source: International Standardisation Organisation (2020)

However, the contribution of the ecodesign process extends to other management operations. Ecodesign can contribute to environmental management in the framework of ISO 14001, and, as regards circularity, to the family of ISO 59000 and UNE-EN 45550 standards, inter alia. 14

Family of ISO 59000 standards

The series of ISO 59000 standards seek to establish sound patterns for the circular economy by means of structures, requirements, guides and support tools for the organisation to adopt the circular economy effectively and efficiently.

The family of 59000 circular economy standards is made up of 6:

- **ISO 59004 Circular Economy** - Terminology, Principles, and Guidance for Implementation.
- **ISO 59010 Circular Economy** - Guidelines for the Transition of Business Models and Value Networks.
- **ISO 59020 Circular Economy** - Measurement and Evaluation of Circularity.
- **ISO TR 59031 Circular Economy** - Performance-based approach - Analysis of case studies.
- **ISO TR 59032.2 Circular Economy** - Review of existing value networks.
- **ISO 59040 Circular Economy** - Product Circularity Data Sheet.

Special mention should be made of the relationship of the ecodesign project with the ISO 59004 and ISO 59010 standards, which seek to provide guidance on the implementation of the circular economy in the business model. Therefore, design is established as a key stage or step towards a circular economy, by driving measures such as design for the recovery of the product and/or materials, minimising the use of resources and the design to foster durability and increase the lifespan of the products, inter alia. These measures coincide with many of the ecodesign strategies put forward in Stage 3, showing the benefit of using ecodesign as a tool towards an increasingly more circular business model.

Even though there is no direct reference to ecodesign in the assessment of circularity, regulated by ISO 59020, the assessment process shows obvious similarities. Furthermore, integrating ecodesign in the assessment of circularity provides a more comprehensive and holistic vision from the start, thus simplifying the circularity assessment process and reducing the need of subsequent reviews.

Family of UNE-EN 45550 standards

A series of standards for energy-related products (ErP) have been developed, in order to support and complement the activities driven by the European Commission in the field of ecodesign and the circular economy. Those standards may help to generate ideas of measures for energy-related products.

- **UNE-EN 45552:** General method for the assessment of the durability of energy-related products.
- **UNE-EN 45553:** General method for assessing the remanufacturability of energy-related products.
- **UNE-EN 45554:** General methods for the assessment of the ability to repair, reuse and upgrade energy-related products.
- **UNE-EN 45555:** General methods for assessing the recyclability and recoverability of energy-related products.
- **UNE-EN 45556:** General method for assessing the proportion of reused components in energy-related products.
- **UNE-EN 45557:** General method for assessing the proportion of recycled material content in energy-related products.
- **UNE-EN 45558:** General method to declare the use of critical raw materials in energy-related products.
- **UNE-EN 45559:** Methods for providing information related to material efficiency aspects of energy-related products.



For further information, Ihobe has technical publications on this series of standards available on its website www.ihobe.eus

6.3. New job opportunities linked to ecodesign

As has been seen, the implementation of ecodesign for a circular economy may challenge traditional business models, as it may imply a reduction in the production and sale of product units. However, it is essential to understand that this transition towards the circular economy also opens up the way to new employment opportunities.

Figure 22 shows how closing the loops in each stage can generate a growing demand for services related to durability and recovery. Those include jobs to maintain and repair products, material and part recovery services, along with the development of innovative technologies to facilitate reuse and recycling.

That all contributes to a more diversified job market and in line with the principles of a circular economy.

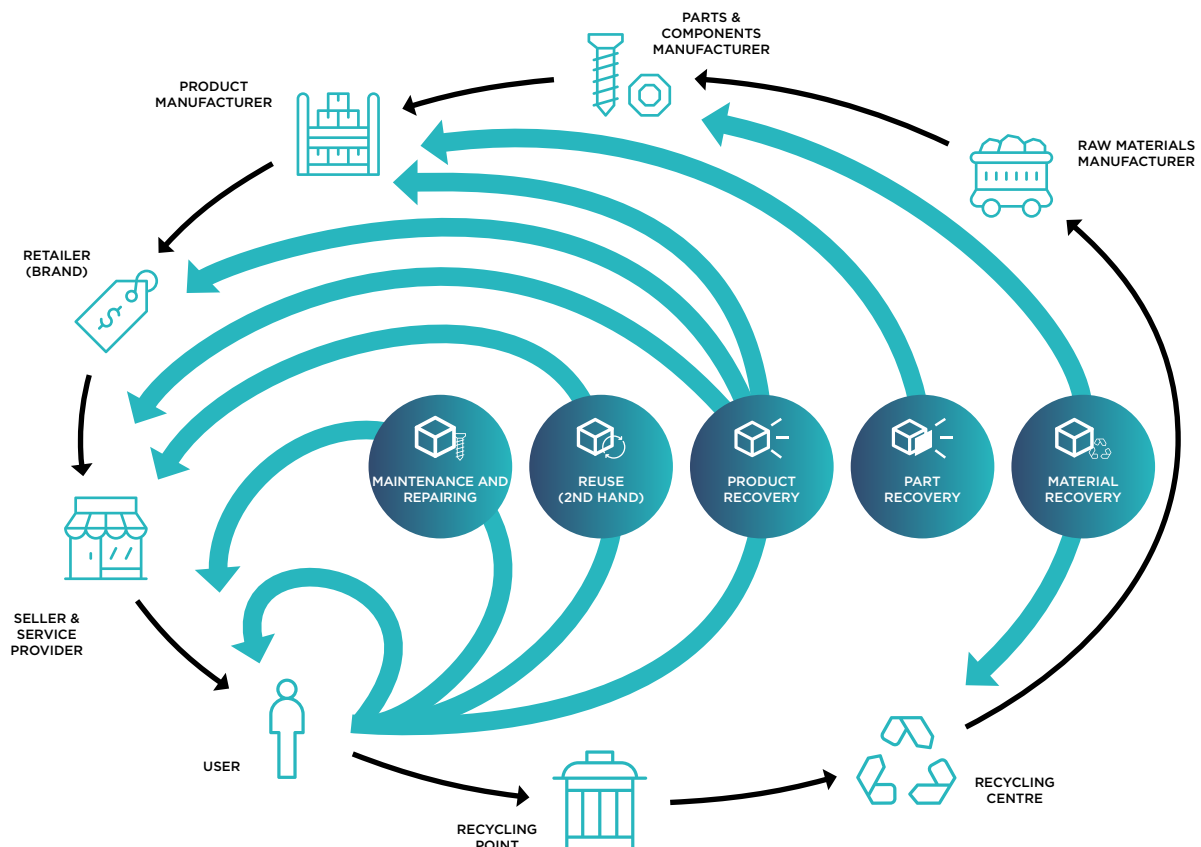


Figure 22. Stakeholders involved in a circular economy model

Stage 7

Communication
and showcasing





GOALS

To communicate and showcase the ecodesigned product and the project implemented



ACTIVITIES

- Defining the communication goals
 - Developing an internal communication plan
 - -Developing an external communication plan
-



DEPARTMENTS INVOLVED

- **Human Resources Department:** Preparing an internal communication plan and disseminating the project results within the company in tandem to the company action plans
 - **Marketing Department:** Preparing a marketing plan once the results of the projects and the environmental characteristic of the product are recognised; analysing and integrating (if of interest to the company) green marketing techniques.
 - **Management:** approval of the communication plans and marketing strategies.
-



TOOLS

- External and internal communication plans
-



PLANNING

20-30 hours

In the current climate, where environmental sustainability is a fundamental aspect in decision making, the task of implementing environmental improvements in the products goes beyond mere corporate responsibility; it has become a strategic opportunity to mark the difference.

It is therefore important that environmental improvements are accompanied by effective communication. This stage analyses how good communication and showcasing of the ecodesign result not only strengthens the image of a company committed to the environment, but rather that it performs an essential role in the awareness raising of consumers and in engaging other companies.

The environmental improvements of the product or service needs to be combined with compliance of the driving factors defined in Stage 1 of the process in order to showcase the work carried out. The meeting point between both aspects will pinpoint the key points to be communicated and the stakeholders to which the communication is addressed.

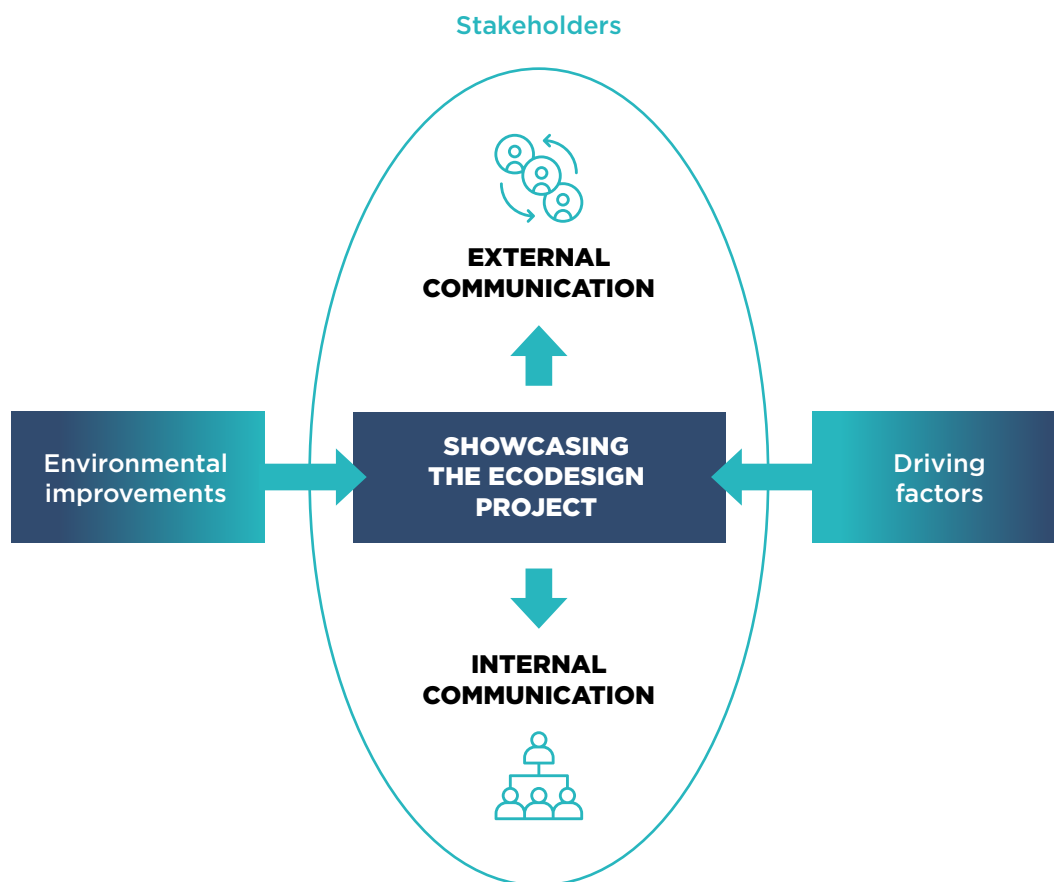


Figure 23. Factors for showcasing the project



7.1. Communication Goals

Communicating the results obtained in the ecodesign process has the following goals, namely to:

- Provide robust information about the environmental performance of the products to stakeholders, whether suppliers, customers, investors, shareholders, consumers or the general public.
- Rally the different stakeholders of the value chain, by identifying the improvement aspects throughout all the stages of the life cycle of the product. Ecodesign can drive a change in the different stakeholders to minimise the environmental impact in each of the stakeholders of the chain.
- Help purchasers and users to make comparisons between products and services and, thus, make better buying decisions.
- Foster the continuous improvement of environmental performance.



7.2. Recipients of the Communication

7.2.1. Internal Communication

The internal communication of the results obtained in the process may be a motivation incentive for all the members involved in the company, whether employees, partners or shareholders.

If an action plan has been implemented to integrate the ecodesign methodology in the company, the project results are essential to incentivise the areas involved. That prevents ecodesign from been seen as an additional obligation, by transforming it into proof of the positive change, innovation and business improvement.

The results can be disseminated using the usual internal communication channels of the company.

7.2.2. External Communication

The external communication covers the value chain, end consumers and other external stakeholders. Particularly current and/or potential customers, distributors, suppliers, social or sectoral associations and institutions.

7.3. Marketing and Greenwashing

Showcasing the environmental improvements carried out and integrating them within the marketing campaigns of the company is what we call green marketing. The aim is to use the environment as a key differentiating factor for the company.

Green marketing offers the following benefits:

- Improving the company's image to customers, competitors and society in general.
- Access to new markets.
- The associated enhanced competitiveness.
- Constructing a more relevant brand for the customers.
- Addressing the regulatory and legislative demands.

It is fundamental to differentiate between green marketing and greenwashing. Greenwashing is used to refer to misleading information that an organisation disseminates in order to present a false image of environmental responsibility and deflect attention from its negative practices.

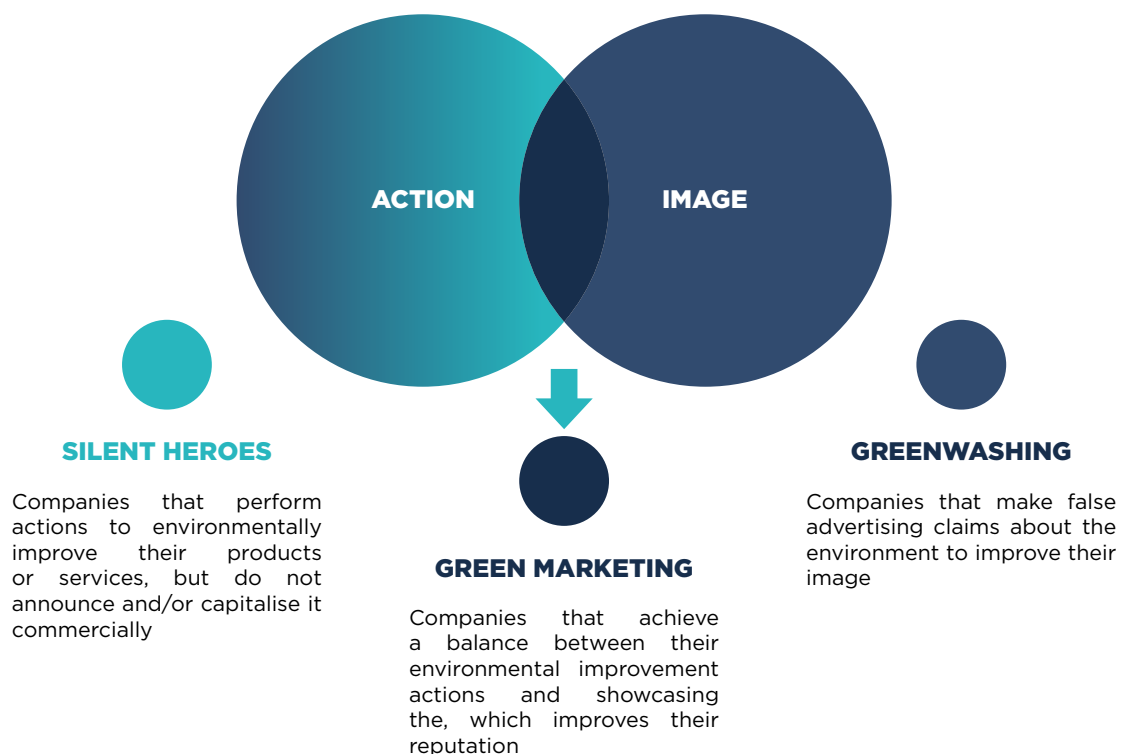


Figure 24. Venn diagram about green marketing

Companies that do green marketing are at the intersection between action and image, and are leading the change in environmental improvement.

Figure 25 shows 7 poor communication practices that may lead an organisation to greenwashing.



Figure 25. Characteristics of green washing

European policies are dealing with this problem by hitting greenwashing hard. The European Commission recommends that environmental claims take the following aspects into consideration:

- Not be misleading or vague.
- True and justified.
- Based on comparable, reliable and measurable data.
- Be verifiable.
- Specify if the allegation refer to the whole product or a certain part.
- Provide the greenhouse gas (GHG) offsetting as separate identical information.
- Identify whether there is burden shifting with the environmental improvement reported.

7.4. Environmental Communication Instruments

A good way of communicating the results obtained is the use of environmental communication instruments, which enable effective communication to the stakeholders and/or general public. The ecolabelling systems are the most widely used.

7.4.1. Ecolabelling

Environmental communication can be by means of voluntary ecolabels. Ecolabels are hallmarks aimed at providing environmental information on the products or services that bear them. There are different types of ecolabels.

Type	Subtype	Description	Covers the life cycle	Amount of information shown	ISO standard	Verification Certification
TYPE I LABELLING Recognition systems (<i>Best in Class</i>)	Single-criterion approach (Semi type I)	This label shows that the product complies with pre-defined environmental requirements, agreed by recognised entities and can be publicly accessed, and refer to environmental aspects that the associations consider as priority.	No	Little	-	Third-party verification and certification
	Multicriteria approach (Ecoetiquetas)	Indicate that the product has met a series of requirements that imply a lower environmental impact than other marketed products of the same type.	Yes	Little	ISO 14024	Third-party verification and certification
TYPE II LABELLING	Auto-declaraciones ambientales ¹	They report on environmental criteria of the products chosen by manufacturers.	No	Variable	ISO 14021	Third-party verification and own certification

¹ The current regulatory framework, aimed at safeguarding the right to information of the consumers, may lead to significant challenges for the Type II ecolabels continuing to be used in the future.

Table 15. Types of ecolabels (cont. ->)

Type	Subtype	Description	Covers the life cycle	Amount of information shown	ISO standard	Verification Certification
TYPE III LABELLING: TRANSPARENCY	Single-criterion approach (Carbon Footprint) (Water Footprint) (Hydric Footprint)	Label providing detailed information on the impact of a product or service in a specific impact category.	Yes	Medium	ISO 14064 ISO 14046	Third-party verification and third-party certification
	Multicriteria approach (Environmental Product Declaration) (Environmental Footprint)	Technical report that summarises the most significant data of the environmental performance of a product.	Yes	Large	ISO 14025 EU recommendation	Third-party verification and third-party certification

Table 15. Types of ecolabels

The different types of labelling and some typical examples are described below.

TYPE I LABELS - SINGLE-CRITERION (SEMI-TYPE I)

Semi-Type I labels focus on specific environmental aspects, such as energy consumption in the case of energy efficiency labels. These labels do not comply with **a specific standard, but rather guarantee compliance with the criteria that each specific programme establishes.**



TYPE I LABELS - Multi-criteria (ecolabels)

Ecolabels are part of the “Best in Class”, recognition systems, which make it possible to identify those products with the best environmental performance among those on the market. These labels impose criteria that cover the entire life cycle of the product, defined for different environmental aspects and that must be fully complied with in order to obtain the certificate.

In this case, the fact that two similar products have the same ecolabel does not make it possible to identify which of them has a better environmental performance throughout its life cycle.



TYPE II LABELS – Environmental Self-Declarations

Environmental self-declarations are communication tools (statements, symbols or graphics) that can be displayed on product labels or packaging, and are created by each manufacturer. This type of environmental labels must comply with the requirements established by the ISO 14021 standard. However, all communication elements are established directly by the manufacturers.



TYPE III – Single-Criteria Labels:

Carbon Footprint

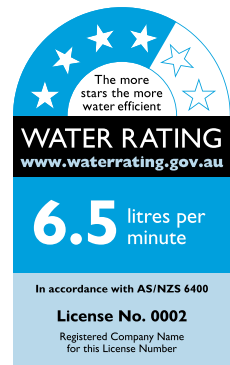
The Carbon Footprint refers to the amount of greenhouse gas (GHG) emissions associated with the life cycle of a product to determine its contribution to climate change. It measures both direct and indirect emissions of compounds that contribute to global warming, such as methane (CH_4), nitrogen oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and carbon dioxide (CO_2).



Hydric Footprint or Water Footprint

The Hydric Footprint and the Water Footprint aim to measure the volume of fresh water used throughout the entire product production chain.

The Hydric Footprint refers to a volumetric approach to the total freshwater used to produce a good or service directly or indirectly. While the Water Footprint also evaluates the environmental impacts related to water, based on the life cycle analysis and including geographical and temporal dimensions. Furthermore, the Water Footprint by scarcity is the quantification of the potential environmental impact related to water in a partial way. In contrast to the Comprehensive Water Footprint, the impact is assessed in relation to a single category of environmental impact, the scarcity of water in a given environment.

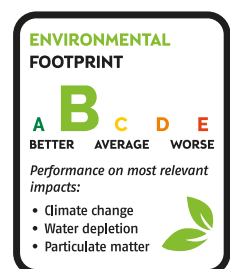


TYPE III – Multi-Criteria Labels:

Environmental Footprint

The Environmental Footprint is a multi-criteria indicator of environmental impact that reflects the consequences of business activity on the environment from the perspective of the entire life cycle.

Unlike the previous footprints, considered as single-criterion assessment methods, the Environmental Footprint not only measures the contribution of the product or service to climate change or water use, but also evaluates environmental performance in up to a total of 16 impact categories.



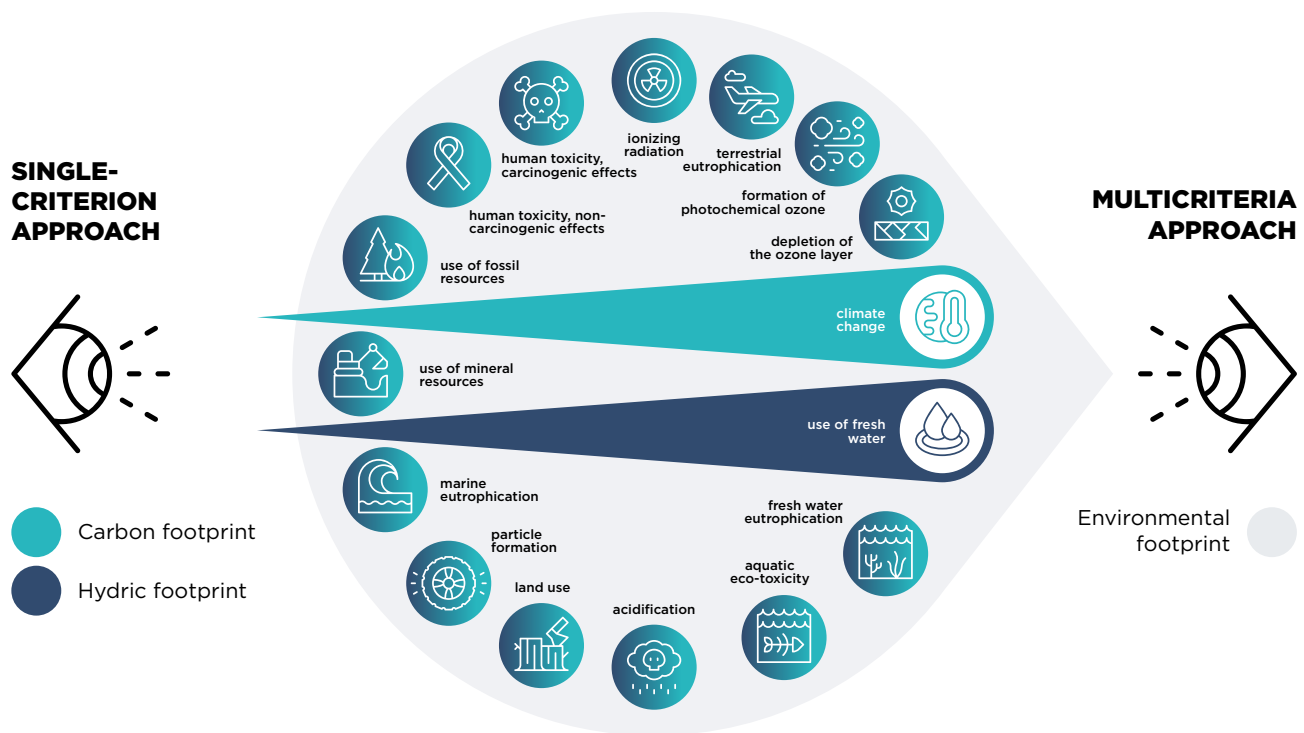


Figure 26. Multi-criteria and single-criterion approach

Environmental Product Declaration

The Environmental Product Declaration (EPD) is a verified and registered document that provides concise and objective information about the environmental impact of a product throughout its life cycle. With a multi-criteria approach, EPD is based on a comprehensive analysis and includes data on natural resource use, greenhouse gas emissions, effects on air and water quality, as well as other relevant indicators. This information promotes transparency in the environmental communication of products.



7.4.2. Other media

However, information on the environmental performance of products does not always have to be reflected in the product itself, it can also be reported by other means such as sustainability reports, ESG reports or non-financial reports.

Companies can also be certified under the aforementioned international Ecodesign standard ISO 14006 Environmental Management Systems - Guidelines for the incorporation of Ecodesign, as a way of communicating continuous improvement in relation to the ecodesign of products and services.



Further information on environmental communication tools is available in the specific publications and resources on the lhobe website.



Cafeteras Ensueño has developed a plan to disseminate the results of the eco-design project carried out.

INTERNAL COMMUNICATION				
Communication	Remit	Target (to whom)	When	Mode
Project results	Project Manager	Development & Production Staff	February	30 min face-to-face presentation
Summary of project results	MarketingDept.	Whole workforce	March	In-company newsletter
Ecodesign process	Project Manager	Quality & Environmental Dept.	April	Work meeting
EXTERNAL COMMUNICATION				
Communication	Remit	Target (to whom)	When	Mode
Results Environmental footprint ¹ and news	Marketing Dept.	General Public	June	Website
New Product Specifications & Improvements	Commercial Dept.	Distributors	May	Email presentation
Project results	Marketing Dept.	Specialized and sectoral magazines	May	Press release
Environmental indicators and project results	Quality & Environmental Dept.	General stakeholders	September	Sustainability report
Environmental indicators	Quality & Environmental Dept.	Customers & suppliers	September	Supplier appraisal system platform
New product specifications & improvements	Commercial Dept.	Distributors & customers	May	Catalogue
Environmental footprint results	Marketing Dept.	Potential customers	June	Product box and specifications

¹ In stage 6.2.2 - Ecodesign Action Plan at company level, different environmental assessment and communication instruments were evaluated, finally opting for the product's Environmental Footprint.

A.2. Worksheet of internal and external motivating factors

EXTERNAL DRIVING FACTORS



Customers



Reputation



Stakeholders



Competition



Legislation



Sector



Value chain



Markets



Incentives



Standards



Innovation

INTERNAL DRIVING FACTORS



Corporate culture and values



Costs



Risk management



Features



Workforce



Environmental goal



Innovation



Quality and value

A.3. Matriz METCO

	M	E	T	C	O
	Materials consumed	Energy consumed	Toxic waste & emissions	Circularity	Other environmental aspects
 OBTAINING & CONSUMING MATERIALS & COMPONENTS					
 PRODUCTION IN FACTORY					
 LOGISTICS & DISTRIBUTION					
 USE & UTILISATION					
 END-OF-LIFE SYSTEMS					

A.4. Tools to generate ideas for improvement

Life cycle phase	Ecodesign Strategy	Improvement measures	Improvement ideas generated in the brainstorming session	Code
 OBTAINING & CONSUMPTION OF MATERIALS & COMPONENTS ↓  PRODUCTION IN FACTORY ↓  LOGISTICS & DISTRIBUTION ↓  USE & UTILISATION ↓  END-OF-LIFE-SYSTEMS ↓	1  Reducing impact in the company	A. Selecting LOW IMPACT MATERIALS	MP-1A-XX	
		B. Reducing the WEIGHT AND VOLUME	MP-1B-XX	
		C. EFFICIENT PRODUCTION TECHNIQUES	P-1C-XX	
	2  Optimising distribution	A. Taking the PACKAGING & CONTAINERS into account	D-2A-XX	
		B. EFFICIENT TRANSPORT	D-2B-XX	
	3  Optimising the use phase	A. Ensuring LOW ENERGY CONSUMPTION	U-3A-XX	
		B. Assessing and OPTIMISING CONSUMABLES	U-3B-XX	
	4  Extending the product lifespan	A. Fostering CUSTOMER LOYALTY	U-4A-XX	
		B. Increasing DURABILITY	U-4B-XX	
		C. Facilitating MAINTENANCE & REPAIRABILITY	U-4C-XX	
	5  Promoting a second life	A. Allowing REUSE	FV-5A-XX	
		B. RENEWAL	FV-5B-XX	
		C. REFURBISHMENT	FV-5C-XX	
		D. REMANUFACTURING	FV-5D-XX	
	6  Bolstering recovery	A. Improving ease of DISMANTLING	FV-6A-XX	
		B. STANDARDISATION of key parts	FV-6B-XX	
		C. Enabling the REUSE of parts and components	FV-6C-XX	

(cont. ->)

Life cycle phase	Ecodesign Strategy	Improvement measures	Improvement ideas generated in the brainstorming session	Code
 END-OF-LIFE-SYSTEMS	 Optimising end-of-life	A. Fostering MATERIAL RECOVERY		FV-7A-XX
		B. Fostering RAW MATERIAL RECOVERY		FV-7B-XX
 NEW PRODUCT IDEAS	 New business models	A. INTEGRATING FEATURES		NV-0A-XX
		B. SERVITISATION		NV-0B-XX
		C. USE ACCESS		NV-0C-XX
		D. ACCESS TO THE RESULT		NV-0D-XX

A.5. Tools to assess ideas for improvement

Selected idea for improvement	Technical feasibility	Economic feasibility	Commercial feasibility	Market feasibility	Environmental feasibility	Driving factors	Prioritisation (ST/MT/LP)

Score	Criterion
2	Very viable
1	Feasible
0	Neutral
-1	Nearly unfeasible
-2	Unfeasible

A.6. Prioritisation Matrix

Requirements	Priority
TECHNICAL REQUIREMENTS	YES / NO
FUNCTIONAL REQUIREMENTS	
ENVIRONMENTAL TECHNICAL REQUIREMENTS	
AESTHETIC REQUIREMENTS	
ECONOMIC REQUIREMENTS	

A.7. Developing new concepts

New product concept	New product structure
A.	
B.	
C.	
D.	

A.8. Product concept selection tool

Specifications requirements		Concepts			
TECHNICAL REQUIREMENTS	A	B	C	D	
FUNCTIONAL REQUIREMENTS					
ENVIRONMENTAL TECHNICAL REQUIREMENTS					
AESTHETIC REQUIREMENTS					
ECONOMIC REQUIREMENTS					
TOTAL SCORE					

A.9. Tool for the qualitative assessment of improvements

[illegible]

A.10. Tool for the qualitative assessment of improvements

[illegible]

A.11. Medium- and long-term product action plan

[illegible]

A.12. Company ecodesign action plan

[illegible]

A.13. External and internal communication plan

[illegible][illegible]

New practical
**ecodesign for a circular
economy manual**