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Lean & Green Initiative action plan for reducing greenhouse gases in the logistics of a pharmaceutical company: The case of Perrigo Portugal

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September, 2023



**BUSINESS
SCHOOL**

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Dedication, acknowledgements, and references to funding

With heartfelt gratitude, I extend my sincerest appreciation to the pillars of my life who have helped me in my path with unwavering support and love.

To my cherished parents, your encouragement and efforts to make me reach my full potential have not been unseen, and this work is just one of many great outputs of all your scarifies. I am eternally grateful.

To my dear siblings, you are more than just kin; you are my confidants and lifelong companions. As well as incredible support systems.

To my beloved friends, who feel like family, and have become an integral part of my life. You have filled my heart with warmth and a sense of belonging.

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Resumo

A Sustentabilidade ambiental tornou-se uma preocupação urgente e as empresas do setor farmacêutico devem contribuir ativamente para mitigar a sua enorme pegada de carbono. Esta tese tem como objetivo examinar o potencial da adoção de medidas de redução de CO₂e e saber como promover práticas sustentáveis dentro da indústria. A pesquisa procura identificar um caminho viável que as empresas possam seguir para desenvolver planos de ação eficazes e avaliar o impacto na redução das emissões de gases de efeito estufa.

Para obter uma compreensão abrangente, utilizou-se uma abordagem de métodos como o *Backcasting* e a análise comparativa no âmbito do Programa da União Europeia, Lean & Green. Especificamente, foi realizada uma análise do atual cenário de emissões de CO₂ na empresa farmacêutica Perrigo Portugal. Aproveitando uma combinação da metodologia *action reasearch* e análise multicritério, desenvolveu-se uma estrutura sólida que facilitou a identificação e o desenvolvimento de diversas ações para melhorar o cenário ambiental existente.

Ao longo da investigação, reconheceu-se a importância do envolvimento e colaboração das partes interessadas para fomentar uma transformação sustentável. Os resultados destacaram a relevância de alinhar as práticas de negócio com os objetivos ambientais, abrindo caminho para operações responsáveis e ecologicamente corretas no setor farmacêutico.

Concluindo, esta tese contribui com percepções valiosas para a sustentabilidade ambiental na indústria farmacêutica. Ao aprofundar o campo das medidas de redução de CO₂e, oferece-se um guia prático e aplicável para que as empresas adotem práticas sustentáveis, contribuindo, em última instância, para um futuro mais verde para a indústria e para o planeta.

Palavras-chave: Sustentabilidade ambiental; Indústria farmacêutica; Medidas de redução de CO₂; *Backcasting*; *Backcasting* participativo; Análise multicritério; Indústria Farmacêutica.

Códigos JEL: Q56 (Environment and Development; Environment and Trade; Sustainability; Environmental Accounts and Accounting; Environmental Equity; Population Growth); L65 (Chemicals; Plastics; Rubber; Drugs; Biotechnology; Economic Regulation); M21 (Business Economics).

Abstract

Environmental sustainability has emerged as an urgent concern, demanding active engagement from businesses within the pharmaceutical industry to mitigate their substantial carbon footprint. This thesis aims to address this critical issue by examining the potential of implementing CO₂e reduction measures to promote sustainable practices within the pharmaceutical industry sector, particularly, at Perrigo Portugal. The research strives to identify a viable path for businesses, enabling the creation of effective action plans and assess their impact on reducing greenhouse gas emissions.

To achieve comprehensive insights, a mixed-methods approach was employed, integrating the use of several tools, including Backcasting, benchmarking and multicriteria analysis, always with the support of information collected through individual interviews and focus groups. Specifically, an in-depth analysis of the current CO₂ emission patterns within the pharmaceutical company Perrigo in Portugal, was conducted. By harnessing a combination of action research methodology with both participatory Backcasting tools and multicriteria analysis tools, a strong framework was developed. This facilitated the identification and development of several targeted actions to enhance the prevailing environmental landscape.

Throughout investigation, the significance of stakeholder engagement and collaboration in fostering sustainable transformation was evident. The findings underscored the significance of aligning business practices with environmental objectives, thereby paving the way for responsible and eco-friendly operations in the pharmaceutical sector.

In conclusion, this thesis provides valuable insights for advancing environmental sustainability in the pharmaceutical industry. By delving into the realm of CO₂e reduction strategies, we offer a practical and actionable roadmap for businesses to adopt sustainable practices, ultimately contributing to a greener future for the industry and the planet as a whole.

Keywords: Environmental sustainability; CO₂ reduction measures; Backcasting; Participatory Backcasting; Multicriteria analysis; Pharmaceutical Industry.

JEL Codes: Q56 (Environment and Development; Environment and Trade; Sustainability; Environmental Accounts and Accounting; Environmental Equity; Population Growth); L65 (Chemicals; Plastics; Rubber; Drugs; Biotechnology; Economic Regulation); M21 (Business Economics).

Glossary of Terms

AR – Action Research.

BCK – Backcasting.

CO₂ – Carbon Dioxide.

CO₂e – Carbon Dioxide Emissions.

CSCI – Consumer Self-Care International.

ERP – Enterprise Resource Planning.

GHG – Green House Gas Emission.

KPI – Key Performance Indicator.

MACBETH – Measuring Attractiveness by a Categorical Based Evaluation Technique.

MCA – Multi Criteria Analysis.

MCDA – Multi-Criteria Decision Analysis.

SKU – Stock Keeping Unit.

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Chapter I. Introduction

This chapter will introduce the problem and its context within the scope of the Lean & Green program, with a specific focus on Perrigo Portugal, a pharmaceutical company. To establish the significance of the project both in practical and academic terms, this section will provide an overview of the company's profile, a concise description of the problem and its context, as well as an outline of the program itself. Moreover, the chapter will define the research question and form the goals to be achieved. Finally, a summary of the project's structure will be provided.

1.1. Company Contextualization

Perrigo is a worldwide leader in self-care focused on consumers. The company's objective is to enhance people's lives with "Quality, Affordable Self-Care Products" that can be trusted everywhere. Boasting over 3,000 product formulations, Perrigo is a prominent provider of health and wellness solutions in key regions, including the US and Europe.

The Perrigo Business Model is divided into three segments: Consumer Self-Care Americas, Rx Pharmaceuticals, and Consumer Self-Care International. European countries fall under the Consumer Self-Care International (CSCI) segment. CSCI is responsible for developing, producing, marketing, and distributing brands in the natural health, vitamins, cough/cold, allergy, smoking cessation, personal care, derma-therapeutics, and lifestyle sectors. Many CSCI products are popular in their markets, including those of Perrigo Portugal.

Perrigo Portugal is a renowned brand in the Portuguese pharmaceutical industry. The company is a three-time winner of the *Prémio Almofariz*, which is one of the most respected honours in the Portuguese pharmaceutical sector. The company has both market-dominating products and globally recognised brands.

1.2. Problem Contextualization

In 1987, the United Nations Brundtland Commission defined sustainability as “*meeting the needs of the present without compromising the ability of future generations to meet their own needs.*”. Currently, around 140 developing countries are seeking solutions to address their development needs while facing the increasing threat of climate change, and it is imperative that action be taken.

A study conducted by Katie Murray (2020) found that the pharmaceutical industry generates approximately 48.55 tons of CO₂ emissions (CO₂e) equivalent per every \$1 million in revenue, a 55% higher emission rate compared to the automotive industry. Murray also noted

that the supply chains in the pharmaceutical industry are operating in an unsustainable manner. X4 Life news platform reported in 2022, that only 25 companies have consistently reported their Greenhouse Gas (GHG) emissions in the last five years, while the worldwide pharmaceutical sector consists of over 200 firms.

The pharmaceutical industry is heavily regulated, with all elements of the life cycle of pharmaceuticals, including patent applications, marketing approvals, commercial exploitation, and competition, being strictly controlled. Major players in the sector are subject to regulatory oversight. Lichtenberg and Virabhak (2013) explore the negative consequences of this in innovation, including sustainable innovation.

As a result of the lack of reporting, elevated amounts of emissions, and severe regulatory barriers, there is a tremendous challenge in the pharmaceutical business to adopt sustainable solutions with actual impact.

1.3. Project Contextualization– Lean & Green

As outlined in the Lean & Green Rule Book, the initiative is an environmental certification, that consists of a major European program for reducing GHG emission in logistics activities. The purpose is to establish a consistent report on CO₂e and to reduce them. The project's preferential focus is to meet the Paris Climate Conference (COP21) targets, aiming to achieve neutral carbon emissions by 2050.

The Lean & Green community is comprised of a diverse group of participants, who benefit from the platform of knowledge sharing and cooperation provided by the national hosts.

To be eligible for the Lean & Green Award, a participant must first submit their carbon footprint, which includes their current and past emissions from logistics, transportation, and warehousing. Based on this information, the participant develops a CO₂e reduction plan that must comply with specific Lean & Green criteria. Upon approval from an auditing company, the participant will receive the Lean & Green Award, which allows them to implement the measures and utilise the Lean & Green branding and marketing materials.

Progress and emissions reductions must be reported annually to the national host through a monitoring instrument. Once the reduction target is met, the participant undergoes an on-site audit of the measures in place. Upon passing the audit, the national host awards the participant the Lean & Green Star accreditation.

The problem at hand for Perrigo Portugal's is the certification Lean & Green Award certification. Hence, the program's opening phase – reporting emissions and constructing the plan of action. Which will be the focus of the present project.

1.4. Research Questions and Project Goals

The research questions at the heart of the current project are "*What is the current pattern of CO₂e by Perrigo?*" and "*What actions are necessary to achieve a 20% reduction in logistics-related CO₂e?*".

To address these questions, clear objectives must be established. The main objectives are to establish a comprehensive database of emissions and to create a robust and achievable reduction action plan. To achieve these goals, specific criteria must be met:

- Obtaining clean, comprehensive, and trustworthy data for the years 2018 and 2021 with the minimum of monthly coverage. The data should portray the record of all the shipments, along with relevant information about them; the estimation of fuel consumption in transportation, with the most precise and accurate values; and data in warehouse locations – the amount and type of electricity competition in the warehouse;
- A coherent analysis of the collected data that will disclose relevant insights into the environmental reality of the operations during the analysis period;
- Determination of relevant areas for possible reduction, with special focus on removing bottlenecks for sustainability, and risk of a rise in emissions in the years ahead;
- Development of a strong, bullet-proof, detailed, coherent, and feasible action plan on which all parties agree and are capable of working on.

1.5. Methodology

This project combines the Action Research framework proposed by Coghlan and Brannick (2014) with Backcasting. This fusion incorporates the tools Participative Backcasting and Multi-Criteria Analysis. The integration capitalizes on the flexibility of the frameworks mentioned, ensuring project success without compromising the core theoretical concepts.

To maintain the quality of project outputs, a systematic approach is employed, with each key stage undergoing a separate output cycle, distinct from immediate revision. Key activities in each stage are as follows: establishing the rationale behind the primary objectives and research direction; collaborative data collection, analysis, and the development of a strategic long-term vision; participatory on measures definition and employment of Multi-Criteria Analysis to identify necessary actions for achieving the envisioned future; and taking and evaluating action.

1.6. Project Structure

Chapter I, the Introduction, commences by contextualizing the organizational structure of the company. This is followed by an exploration of the problem context, and, subsequently, to the project's perspective, introducing the Lean & Green European Union project. This introduction serves as a smooth transition to Chapter II, which entails a comprehensive analysis of other cases involving Lean & Green participants. This section serves as a valuable source of insights drawn from analogous experiences.

Chapter III, the Literature Review, conducts an extensive examination of existing literature. Within this chapter, the intricate concept of strategic foresight is analysed and the methodology of Backcasting is explored, by looking into the practical application, diverse approaches, pertinent related work, tools, and evaluate the advantages and disadvantages of this framework.

Chapter IV, Methodology, introduces the approach of Action Research, defining its characteristics and elucidating the steps integral to an action research cycle. Additionally, it provides an overarching view of the selected methodology, which effectively merges Backcasting with Action Research, including Participatory Backcasting and Multi-Criteria Analysis tools.

Chapter V serves as the epicenter of research, housing the detailed case study. Each sub-chapter within this section examines various facets of the case study, starting with rigorous data gathering and its subsequent analysis. Then measures are defined while showcasing the practical application of the MACBETH software. Moreover, a comprehensive outline of future actions is provided.

The final chapter, Chapter VI, serves as a reflective and conclusive summary of our thesis journey. Here, the key findings and insights garnered throughout the research are consolidated. Drawing from this knowledge, recommendations are presented.

Chapter II. Background Analysis

The purpose of this chapter is to illuminate the strategies and approaches employed by relevant companies during their adoption of the Lean & Green Program. Additionally, it will explore whether methodologies and scientific tools were used in past studies. The selection of companies was based on industry and location, resulting in the inclusion of Award-winning companies in Portugal and a pharmaceutical company in Belgium's program.

This chapter holds a distinct position separate from other section due for several reasons. Firstly, being a research endeavour, its inclusion in the introduction is inappropriate, as the introduction typically outlines the research topic and its significance. Secondly, the chapter surpasses theoretical exploration by delving into real-world practices and decisions made by other companies during their adoption of the Lean & Green Program. Consequently, it doesn't align solely within the literature review, which primarily summarizes existing research and scholarly articles. Nevertheless, this chapter assumes a pivotal role as a foundational element for the subsequent literature review. By providing valuable insights into the implementation and methodologies employed by participants in the Lean & Green Program, it serves as a comparative framework for diverse approaches and outcomes.

The pharmaceutical company Takeda is a patient-focused and innovation-driven organization with a global network spanning more than 70 countries. Laurent Vanhoutte, Head of Supply Chain at Takeda, highlighted the company's approach to analysing the logistics of their finished products and finding sustainable solutions that reduce CO₂e.

Takeda's action plan included various measures, such as replacing a portion of finished product transport with more sustainable options, building a zero-carbon warehouse in Lessines, Belgium, using an "eco-combi" truck for transportation between Lessines and the main warehouse, replacing wooden pallets with reusable pallets made of 100% recycled plastic, optimizing waste disposal transport flows, and constructing a new waste storage building.

As a result of the measures, air shipments have been reduced by 21%, since 2018, on top of this a reduction of 1700 tons of CO₂e per year as achieved by centralizing in one warehouse, the new vehicle (eco-combi) allows for a 20% reduction in CO₂e alone, and the pallets change has enabled reuse of 11.000 pallets per year, which also reflects on the emissions generated.

Nestlé, a leading food and beverage manufacturer, operates in over 90 markets in Portugal through its various brands. Since the end of 2019, Nestlé Portugal have reduced their CO₂e by 20% with the help of the Lean & Green program. They focused their efforts in three areas: facilities, suppliers, and packaging.

The focus in the facilities was mainly on energy consumption, resulting in a 22% of energy savings and a 38% reduction in CO₂e; additionally, by the end of 2019, 100% of the energy purchased was renewable. Nestle adjusted their supplier criteria, resulting in 1051 local suppliers, in other words, 64% of suppliers are Portuguese. This measure led to a reduction of 51,3% of kilos of CO₂e per ton of product – obtained by optimising routes and reducing travel distances. In terms of packaging, 95% of the present packaging can be recycled or reused. The company reduced the amount of virgin plastic used in 2020 by 2.5 tons when compared to previous years.

SANTOSEVALE is a distribution, logistics, and transportation company that serves the Iberian market. The company received the Lean & Green certification in 2020. To reduce CO₂e, SANTOSEVALE uses gas-powered vehicles, route optimisation, and a predictive driving mobile application that can decrease emissions by up to 20%. The company has established a Training Academy to improve employee skills and foster innovation, thereby retaining valuable know-how within the organisation. To further increase and maintain reduction efforts, SANTOSEVALE is exploring the adoption of more efficient fossil fuel alternatives, such as electric vehicles, for its fleet.

None of the previous studies have specified the methodologies or research tools used. Moreover, there is limited information on the measures taken to achieve the 20% reduction in CO₂e and the results or conclusions drawn from those measures. Due to a lack of reporting on the focus subject matter, the researcher will investigate and develop their own methodology path.

Chapter III. Literature Review

Given the lack of specific methodologies or research tools mentioned in the studies reviewed in Chapter II, the current chapter will explore methodological concepts in relation to the previously described context and research questions. This literature review will be based on key concepts, such as: (3.1.) strategic foresight - normative and desirable futures; and (3.2.) Backcasting, with (3.2.2) Backcasting approaches, and (3.2.4) Backcasting tools and complementary methods.

3.1. Strategic Foresight

Studying the future requires embracing uncertainty and turning it into an opportunity for innovation (Rialland & Wold, 2009). Futurists differentiate between three types of futures: likely, possible, and normative or desirable (Amara, 1974, 1981; Bell, 1997). Different future tools serve specific purposes, such as exploring the possible, analysing the probable, or shaping the preferable. Commonly used tools for likely and possible future studies include forecasting, scenario planning, Delphi, road mapping, and mass collaboration (Masum et al., 2010; Rialland & Wold, 2009). For normative and desirable futures, tools include Backcasting, anticipatory thinking, simulation, and visioning.

The most cited tools for each type of future study are the Backcasting (referred to as BCK) and Forecasting techniques (Robison, 1982). Forecasting involves predicting the future based on current trends, while BCK creates a path for technology development based on future demands (Bibri, 2018). The core advantage of BCK is its ability to reduce the tendency for analysis results to become obsolete quickly (Robison, 1982). While the accuracy of a forecast determines its value, BCK should diverge to reveal the relative policy implications of alternative energy futures (Robison, 1982). Ultimately, choosing a specific future must be justified independently of the backcast itself when forecasting (Robison, 1982).

The choice between BCK and forecasting is more than just a matter of preference. According to Dreborg (1996, pp. 813-828), "*the two approaches stem from different views on scientific explanation in the social sciences, dating back to the antiques.*" they are also intended to solve different problems (Annex 1).

3.2. Backcasting

The origin of BCK dates to the 1970s, when Lovins (1976, 1977) proposed BCK as an alternative planning methodology for electricity supply and demand. Lovins argued that it would be beneficial to describe a desirable future or a range of desirable futures, and to assess

how such could be achieved, instead of focusing only on likely futures and projective forecasts. Following the development of several studies under the umbrella of the BCK approach.

3.2.1. Application and its' Rules

BCK is a strategic planning approach that is particularly well-suited for tackling complex problems that affect many sectors and levels of society. It is best employed when marginal changes within the existing order will not suffice and when the problem involves dominant trends that are often used as the basis for future projections. BCK is also useful when the problem is largely a matter of externalities and when there is sufficient time for deliberate choices to be made.

Dreborg (1996) also points out that BCK studies are intended to provide input to a multi-actor policy-forming process. The research is aimed at actors, and is critical, for the credibility of the results, for the studies to be conducted in institutional settings where change is important.

A BCK study requires novel approaches to address the issue at hand. Dreborg (1996), goes as far as saying that it is pointless to prescribe any formal methods. In his perspective, what matters is the outcome, and a solid understanding of the relevant aspects of society and technology is required. Focusing on the outcome, the author defends that a BCK study delivers alternative future images that have been thoroughly examined in terms of feasibility and consequences. Keeping in mind that the outcome of a BCK research is not meant to serve as the foundation for a single, major decision, nor is it a plan or blueprint, the results allow actors with different values and goals to form an opinion and view on the future.

Finally, it is essential to mention the need of a multidisciplinary team, since the studies cover such broad fields of knowledge.

3.2.2. Approaches

Four different BCK approaches are more extensively discussed on the selected papers from the literature review with a comprehensive description of a particular BCK approach or methodology (Annex 2). Thus, the four BCK approaches are:

The Backcasting approach as proposed by Robinson (1990)

Robinson (1990, p. 823) describes his approach as explicitly normative and design-oriented, with the goal of investigating the implications of various paths and the underlying values.

It starts by establishing objectives, goals, and describing current constraints for both the defined system and its external context, followed by the construction of future scenarios. Following, the scenarios must be assessed in terms of socioeconomic, technological, and feasibility, as well as policy implications. Iterative scenario development is required to avoid physical inconsistencies and to mitigate negative impacts. This results in a six-step operation.

The strategy does not specify who will set the criteria or how they will be determined. Participation of stakeholders is not included. There is no mention of specific methods, but various groups of methods can be applied, such as modelling, and scenario approaches.

The Natural Step Backcasting approach (Holmberg 1998, Natrass and Altomare 1999, Holmberg and Robèrt 2000)

Holmberg (1998) defines an approach for strategic sustainable planning in organisations.

The first step is to define relevant sustainability criteria for the organisation based on four principles: reducing resource usage; reducing emissions; protecting biodiversity and ecosystems; and using resources fairly and efficiently in compliance with the equity principle. The second step entails an examination of the firm's current situation, activities, and competencies, as well as the supply chains to which it belongs. This step makes it possible to identify bottlenecks in sustainability. The third step envisions future options with the help of employee involvement, for which creativity techniques are used. The future options and visions must be widely discussed within the organisation and may imply new activities. The last and fourth step, defines final strategies for moving from the present to the desired situation.

Even though Holmberg (1998) doesn't quite elaborate on specific methods, he does mention employee involvement, widespread discussion of the results, creativity techniques, training employees, and incorporating the results into the organisation's activities and policies.

The STD Backcasting approach as described by Weaver et al. (2000) and Aarts (2000)

BCK is conducted in three stages, according to Weaver et al. (2000, p. 76), framing, evaluating, and implementing.

The initial framing steps are designed to develop a long-term vision based on a strategic review of how a need might be met in the future. The evaluation process begins by exploring options and identifying bottlenecks. Selecting options and developing an action plan are intended to clarify the short-term actions required to realise that future, and can be viewed as a joint action, R&D, and policy agenda. Setting up cooperation agreements and carrying out the research agenda, dealing with implementation, facilitating stakeholder cooperation, and carrying out the action plan. The idea is that stakeholders involved in BCK projects establish

collaboration to enable the implementation of research and follow-up agendas. The method allows for iteration as well as forward and backward movement between two steps.

Aarts (2000) has given an overview of the methods used in the STD BCK approach, several methods for developing future visions are mentioned, such as stakeholder involvement, the Delphi method, and the relevance of visualisation and communication. She also mentions problem analysis, stakeholder analysis, as well as methods for organising and managing options derived from BCK analysis and future vision. Finally, Aarts (2000) emphasises the importance of methods for disseminating outcomes as well as follow-up agendas.

The Backcasting approach as applied in the SusHouse project, based on Vergragt (2005), Weaver et al. (2000), Quist (2007), and Green and Vergragt (2002)

The SusHouse project used a BCK approach to develop sustainable household strategies (Weaver et al., 2000). Basic assumptions include: the need to meet social needs twenty times more efficiently in terms of environmental impact by 2050; broad stakeholder participation; the development of normative future scenarios; taking follow-up and implementation into account.

The approach was broken down into seven steps. Each stage includes a stakeholder analysis that covers demand and supply sides, as well as research organisations, government agencies, and public interest groups. Selected stakeholders take part in creativity workshops to identify sustainable methods of future function fulfilment. The findings are used to create normative, or design-oriented, scenarios. These scenarios are evaluated based on environmental benefit, consumer acceptance, and economic credibility. The findings are discussed in a second workshop, which emphasis follow-up proposals, research plans, and policy recommendations.

BCK techniques are used in both series of workshops, for which a set of guiding questions is built (Quist, 2007). This approach uses participatory, analytical, design, management and communication methods. Also, iterative cycles are supported by the method, since scenarios can be adjusted after each assessment.

3.2.3. Related Work

Looking into BCK in the pharmaceutical industry and environment.

Korhonen and Granberg (2020) conducted a study on Sweden strategy to combat Covid-19. The nation applied the herd-immunity as its main strategy to combat the pandemic. The goal of the paper was to make a case, that alongside herd-immunity, Sweden was using the social science originated planning approach: the BCK. The researchers present the use of BCK only as an argument based on available data and authors' reasoning. A BCK exercise for the case of the Swedish economy is constructed.

During a workshop at the Lisbon Addictions Conference 2019, López-Pelayo et al. (2021) applied a BCK method to address challenges and achieve consensus in the required policies to develop a unit with the focus of standardisation of cannabis doses. The outcome of the BCK focused on policymaking, clinical and harm-reduction interventions, and consumer security in order to construct a regulatory unit focus on the cannabis use in the pharmaceutical and clinical environment.

Changes in the political, economic, demographic, social, and technological environments are becoming increasingly prevalent. Population aging and pressure on healthcare financing are expected to become major issues in the pharmaceutical and healthcare industries. As a result, new modalities such as antibody drugs, nucleic acid drugs, gene therapy, regenerative medicine, and cell therapy will certainly expand. All of these facts compelled Sumitomo Pharma Group to conduct a BCK exercise in order to better understand how to navigate these rapid changes and establish unconventional new business models. Sumitomo Pharma developed a new vision and the Mid-term Business Plan 2022 (fiscal 2018 to fiscal 2022) to address social issues in a changing healthcare environment over a five-year period beginning in fiscal 2018.

BCK studies in the sustainable field must also be explored.

The paper by Phdungsilp (2010) addresses a sustainable city planning project, Goteborg 2050, that uses BCK. The methodology used in the Project Goteborg 2050 consists of four steps. The first step aims to identify the problem and to make a description of the present situation, existing trends in the areas of focus are analysed. The second step is to choose criteria, goals, and limitations for the study. External factors that might affect the scenario, such as population and changes of lifestyle patterns, have been taken into consideration. The third step develops one or several alternative images of the future based on criteria and goals chosen in step two. This step is considered the core of the BCK study because it illustrates a solution to a major problem. The last step is to analyse the possibilities to reach the society described in the alternative images.

3.2.4. Tools and Complementary Methods

As explored over the literature, the BCK framework is highly versatile and flexible. Hence the tools and complementary methods used with this approach are based on the specific context (Bibri, 2018). Examining some tools frequently used and the setting to each they were applied: ***Multi Criteria Analysis (MCA)***

Soria-Lara and Banister (2018) studied a desired transport future for Andalusians by 2050, eliciting preferences and concerns from Andalusian society.

The study discusses the use of MCA techniques in transport policy studies and highlights the lack of attention given to combining MCA with transport scenario analysis, specifically the BCK approach. The researchers depart from the conventional approach of scenario analysis by employing the BCK methods to illustrate potential policies for achieving ambitious future targets related to climate change, pollution, and resources. The evaluation stage of the paths is subjected to MCA, allowing experts to discuss, rank, and evaluate policy packages.

Soria-Lara and Banister (2018) distinguished between bottom-up and top-down approaches in this context. Bottom-up approaches involve collective definition of sustainability impacts and goals by a group before applying MCA techniques, while top-down approaches begin with the research team defining the impacts and goals, determining the actors to be included in the MCA process accordingly. Overall, the research provides a comprehensive assessment of the BCK approach, utilising a collaborative methodology involving regional and local legislators. Through MCA, the study ranks the potential impacts of three different trajectories against a set of sustainability policy goals, specifically addressing the mitigation of climate impacts.

The paper by Vučijak et al. (2022) demonstrate the possibilities of using BCK with multicriteria analysis, to aid the creation and ranking of scenarios for solid waste management, specifically recycling options, using a pilot case study in Sarajevo, Bosnia and Herzegovina.

After creating several feasible paths using BCK methods, the most appropriate one is selected, according to the different criteria. This approach proven to create success in the area to waste management on the selection of the most favourable scenario. The BCK method considers environmental, technical, economic, and social criteria, and the MCA creates a ranking of paths. Together they offer accurate indicators that provide a snapshot of the current situation and can be used to plan actions.

Participative/Participatory BCK

When using participatory BCK, the focus is heavily on the stakeholder; it can be said that the research is stakeholder centred, since it is largely dependent and influenced by them.

Kanyama et al. (2008) reports the use of a BCK approach with local stakeholders in five European cities where several images of the future for household consumption in sustainable towns were formulated. The goal was to find ways to encourage local stakeholders to participate in long-term discussions about sustainability. A method based on workshops and back-office work was developed, and the results obtained are described and analysed here. The combined approach could be referred to as participatory BCK.

Sisto et al. (2018) also hold a participatory BCK approach. According to the researchers, stakeholder knowledge contributes to the design of policies that are better suited to serve the

needs of those involved. Furthermore, the BCK process has been shown to improve stakeholders' confidence while increasing their empowerment and allowing them to follow and keep track of the entire strategy definition process even when they were unable to attend the workshop. Other advantages of the suggested approach, highlighted in the case study, include: reduction of bounded rationality; prevention of certain issues being excluded; exploration of different claims about problems and their solutions; and orientation among involved stakeholders and policymakers to plan actions over time provided by the time.

Social Theory

Kiraly et al. (2013) raised the question of what types of social theories might be used to drive BCK. Based on various social theories, four models of society and social change were presented. The four models have theoretical implications for how the future is imagined and how the process of BCK influences this future. According to Kiraly, the underlying models on society are frequently unarticulated and un-reflected upon and excluding them when elaborating future studies will result in potential difficulties.

Road Mapping / Logical Tree

Okada et al. (2022) incorporate BCK (Backcasting) into a roadmap design framework, which involves four steps: preparation, vision development, pathway development, and postworkshop activities. The roadmap designers are responsible for Steps 1 and 4, while workshop participants handle Steps 2 and 3. The concept of BCK is integrated into the workshop phases. In Step 2, Okada et al. (2022) employs logic trees to generate ideas, and a storyline to establish the relationship between the ideas generated. Step 3 introduces a "four-arrow" template that bridges the vertical gap between market and technology, as well as the horizontal gap between vision and the present. This aligns market pull and technology push approaches, along with forecasting and BCK approaches. The selection of important paths in Step 3 leads to the formulation of a narrative storyline (Annex 3) that contributes to a clearer and more effective vision for the future.

3.2.5. Advantages and Disadvantages of Backcasting

According to Quist (2007), there are numerous differences and similarities between the various BCK approaches. All approaches include steps for developing future visions or (normative) scenarios, as well as steps for analysing the current situation. Moreover, all approaches discussed start with different assumptions. In terms of distinctions, both Robinson's approach and the TNS approach lack a separate BCK step. The term "Backcasting" is reserved

for the overall strategy. The SusHouse and STD approaches, on the other hand, include a distinct step. This would imply that the BCK step is methodologically underdeveloped.

Analytical and design methods are used in all approaches. Nevertheless, upon comparison, the TNS approach lacks a strong sense of analytical tactics. However, participatory methods can be found in all methods, except for Robinson's, which was not designed to be of participating nature.

Robinson's approach requires criteria for social and environmental desirability to be established outside of the analysis; this ensures that the problem is real and significant, but it can become a roadblock if new needs emerge in the ongoing analysis. The approach is goal, policy, design, and system driven. The approach strictly adheres to the BCK definition, leaving hardly any room for additional tools such as stakeholder participation.

TNS approach require a desire to reduce resource usage/emissions, protect biodiversity and ecosystems, or use resources more efficiently in accordance with the equity principle. When contrasted to others, this approach is extremely flexible; once the researcher has identified a sustainable issue, this approach can be combined with virtually any other tool. Finding a sustainable issue may be a barrier, as not all BCK is used with this particular issue.

Both the STD BCK and the SusHouse approach make the following assumptions: Factor 20; a time horizon of 40-50 years; stakeholder participation; follow-up; and social and technological changes. Under these approaches, stakeholder participation, social and technological changes, and follow-up will enrich the project. However, the assumptions of Factor 20 and a time horizon of 40-50 years may prevent a researcher from considering them.

The TNS, STD, and the SusHouse approach include steps dealing with operational aspects of implementation and follow-up, strategies, and agenda setting. Yet only the STD approach emphasises the importance of operational management and coordination.

3.3. Resume

BCK is a future study that aims to create desirable or normative future scenarios. It is becoming more popular due to its versatility in addressing complex issues and sustainable development.

BCK approaches serve as methodological frameworks for various techniques, although there is no standardised method. Participatory or interactive methods are commonly used in approaches such as TNS, STD, and SusHouse, which also emphasise agenda setting, strategy development, and follow-up. However, STD stands out for its focus on the specification of operational management, making it more suitable for projects related to supply chain, logistics, transportation, and operations.

This project is based on the BCK approach, so related discussions in the industry must be considered. The pharmaceutical industry has conducted several BCK studies. They ranged from drug development to policy formulation and understanding of economics. In addition, numerous papers on BCK applied to sustainability projects were discussed in all sections of the literature review. Despite extensive research, no studies of BCK in the pharmaceutical industry applied to sustainable projects were found. Subsequently there is a gap and the same is sketched in Figure 3.1. In addition to benefiting the company, the present work will contribute to the BCK literature review by filling the gap outlined.

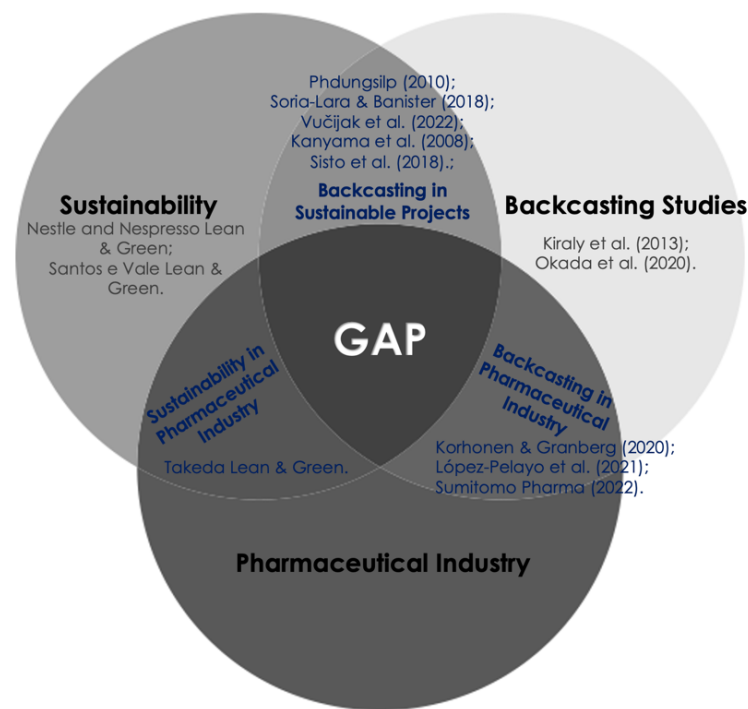


Figure 3. 1 - Gap found in Literature Review illustration.

To proceed, tools and approaches must be evaluated. BCK is a participatory approach that has been applied to a wide range of topics. As a result, stakeholder participation varies. This includes everything from expert to employee participation. This capability must be emphasised and thoroughly explored in the current project; consequently, participatory BCK must be considered. There has been less focus on combining MCA with BCK. However, MCA is proven to be a promising tool when business-as-usual forecasts are no longer appropriate, and policies must be evaluated in terms of long-term sustainability. This tool will also allow for more multi-actor participation in the design of BCK frameworks, including assessment against stakeholders' goals and objectives.

Keeping this in mind, the current work will employ the STD BCK approach, starting after the problem-framing and goal setting phase, supplemented by participatory BCK tools and multicriteria analysis (Annex 4).

Chapter IV. Methodology

This chapter aims to provide a comprehensive overview of action research as a methodology, highlighting its key features, characteristics, and applications. In addition, it will outline the steps involved in conducting action research in the present project, and the factors that should be taken into consideration to ensure its effectiveness. Ultimately, this chapter serves as a comprehensive guide for anyone seeking to understand the basics of action research and its potential as a powerful tool for bringing about positive change in practice.

The methodology of the present project will merge the AR framework presented by Coghlan and Brannick (2014), with the BCK – as explored on Chapter III. It will also incorporate the tools mentions in Chapter III, Participative BCK and MCA.

4.1. Action Research

Action research (AR) is a generic term, which covers many forms of action-oriented research.

According to Shani and Pasmore (1985), AR may be defined as a “*process in which applied behavioural science knowledge is integrated with existing organisational knowledge and applied to solve real organisational problems.*”, they add “*It is simultaneously concerned with (...) change in organisations (...) and adding to scientific knowledge. Finally, it is an evolving process that is undertaken in a spirit of collaboration (...)*” (p. 439).

Previously stated by Gilmore et al. (1986), “*Action research aims to contribute both to the practical concerns of people in a problematic situation and to further the goals of social science simultaneously. Thus, there is a dual commitment (...) to study a system and (...) to collaborate with members of the system in changing it in (...) a desirable direction.*” (p. 161).

A more recent view of Coghlan and Brannick (2014), highlights that action research is “*a collaborative, self-reflective, critical, and systematic inquiry or investigation of a problem or challenge facing an organisation, undertaken to improve the situation, as well as the understanding of it*” (p. 5).

The statements above focus on the characteristics that set AR apart.

4.1.1. AR Characteristics

Action research is a distinctive method for enhancing practice that comprises three essential elements: action, evaluation, and critical reflection. According to Koshy et al. (2010), it involves taking action, analysing it, and making changes based on the insights gained. Unlike

conventional research methods, action research requires active participation from researchers who work to improve the situation at hand (Gummesson, 2000).

The fundamental principle of action research is change. For this reason, researchers must have a solid understanding of organisational change dynamics to identify areas that require improvement (Coghlan & Brannick, 2014). Action research also prioritises reflection through the perspectives of participants (Koshy et al., 2010) and aims to develop a holistic understanding of the project, acknowledging its complexities and context-specific aspects (Pasmore, 2001).

This research method is collaborative and participatory, making it highly interactive (Koshy et al., 2010). While traditional data-gathering techniques such as interviews and surveys are frequently used in action research, it is important to ensure that the research is conducted within the ethical, normative, and value-based framework (Coghlan & Shani, 2005; Holian & Coghlan, 2013). For a perspective of operations management check the authors Coghlan (2001), Coghlan and Brannick (2014), and Coughlan and Coghlan (2002).

4.1.2. AR Cycle

AR is a cyclical process of self-reflection, typically consisting of four steps: plan, act, observe, and reflect (Annex 5). However, different authors provide slightly different models (Annexes 6-8). Yet, excessive reliance on a particular model could adversely affect the unique opportunity offered by the flexibility of AR. The Coghlan and Brannick (2014) model provides a flexible cycle that emphasises collaboration, active participation, and reflection. Numerous studies have shown its effectiveness in promoting improvement in various contexts (Annex 9).

Holian and Coghlan (2013) found that the Coghlan and Brannick model promotes change in healthcare organisations with its framework, which helps identify and address areas for improvement. Similarly, Coghlan and Shani (2005) found the model effective in promoting change in education by allowing teachers to reflect on their practices, identify areas for improvement, and enhancing student outcomes. Pasmore (2001) found that the model was successful in promoting innovation in many organisational environments, which allowed addressing complex issues and understanding contextual factors.

Overall, these studies provide strong evidence that the Coghlan and Brannick (2014) AR model is an outstanding approach for promoting change in various contexts. The model's participatory, collaborative, and reflective nature has been shown to be particularly effective in promoting change in healthcare organisations, and in addressing complex organisational issues.

4.2. Methodology Overview

In this project, the AR framework proposed by Coghlan and Brannick (2014) will be combined with the BCK framework discussed in Chapter III. Additionally, the frameworks will integrate the tools Participative BCK and MCA, as described in Chapter III.

It must be acknowledged that this merger is only possible due to the flexibility of the AR framework, and the adaptability of the chosen tools. Nevertheless, this methodology will ensure the success of the project, provide the reader a clear project's backbone, as well as not alter the theoretical concepts characteristics.

To ensure that key project outputs meet their own quality criteria, the steps will also be applied on each key stage as an output cycle that does not directly and immediately after it's revision. Data collection and analysis will arise a sub-cycle during the cycle's construction phase, as well as the measure defining phase (Annex 10).

A summarised view of the project backbone can be seen in Annex 11, while Figure 2 provides a detailed view.

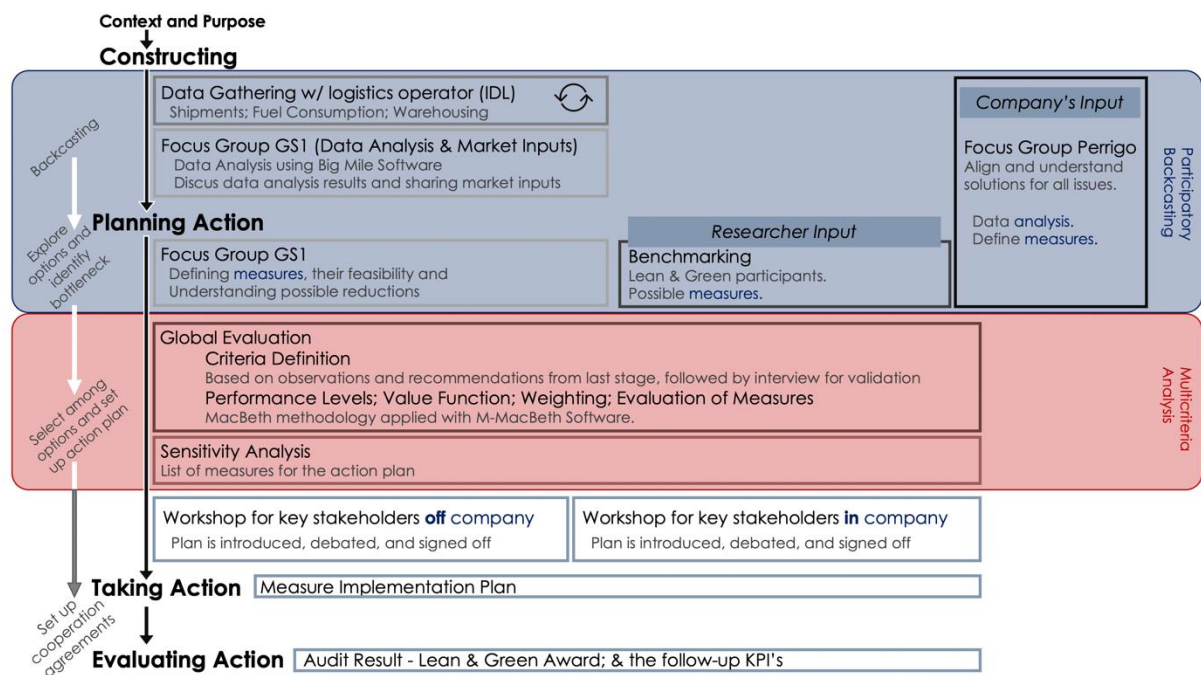


Figure 4. 1 - Detailed view of methodology

Resuming the activities meant to be developed in each stage: Step zero, known as 'context and purpose', involves defining the rationale behind the main goal and the research. In step one, referred to as 'constructing', the focus is on collecting and analysing data in a collaborative cycle. Moreover, this step involves constructing a long-term vision based on a strategic review. Step two, titled 'planning action', centres around defining measures in a participatory cyclical manner. This step also involves an exercise of MCA to identify and clarify the actions required

to achieve the envisioned future. Furthermore, it includes workshops to inform key stakeholders about the planned actions, their roles within it, and how they will be affected. Step three and four, 'taking action' and 'evaluating action', respectively, fall outside the scope of the project. However, step three entails the presentation of the audit conducted to the developed action plan, while step four signifies the decisive evaluation of its successful or unsuccessful passage. This serves to showcase the credibility of the product developed and brings the project to an end.

4.2.1. Step 0 – Context and Purpose

This corresponds to a pre-step aiming to serve as the foundation for the subsequent research. Koshy, Koshy and Wateman (2010) propose two questions to be answered in this stage: What is the rationale behind the core action?; What is the rationale behind the research?

As described in Chapter I, the central action is to create a plan to reduce CO₂e in Perrigo's logistics activities, and the rationale is a lack of sustainable action in the pharmaceutical industry, as described by Marray (2019), an absence of sustainability reporting, reported by X4 Life news platform in 2022, an enormous challenge due to regulatory and legal barriers of the sector, showed by Lichtenberg & Virabhak (2013).

The rationale for the research is in line with the rationale presented for the core action, with the addition of the gap identified in the literature concerning the lack of literature review using the BCK method in the pharmaceutical industry that focuses on sustainability issues.

4.2.2. Step 1 – Constructing

Constructing, as explained by Shani and Pasmore (1985), entails naming the issues, by carefully and thoroughly explaining the underlying theories, principles, or concepts that guide the actions or strategies to be implemented. This can be accomplished by focusing on collaboration, data gathering and data analysis.

Based on this, the construction phase will promote collaborative thinking through participatory BCK, in which the data will be collected and analysed, in a cyclical manner. The stakeholders involved are Perrigo's Supply Chain Team, the national host - GS1, and Perrigo's logistics operator, IDL.

Data gathering

To collect the necessary data in a structured way the national host provides to Perrigo with the data collecting templates that need to be filled out. Which was understood and communicated to IDL for them to fill in with the information over the defined period. Following this "step

zero," a cyclical process began, between data gathering and its analysis. With the intervention of the Focus Group Perrigo, IDL and GS1. IDL intervened in the collection, GS1 in the analysis, and Perrigo in both since they also serve as the connection between the sub-stages.

The cyclical process started with the operator collecting the data, promptly communicating any identified issues, and subsequently sharing the completed documents with Perrigo. This stakeholder then proceeds to conduct a swift analysis of the data, assessing whether the documents are fully completed, adhering to the correct formatting, preserving the overall data integrity, and with an appropriate structure. They will also analyse the integrity of the data.

If all these requirements are met, the data progresses to the next stage. However, if any of these requirements are not met, the company notifies IDL, who rectifies the errors or undertakes the necessary data collection anew.

Data analysis

The data analysis cycle is set into motion, manifesting as a collaborative framework akin to its preceding phase, excluding the participation of the logistics operator, who solely is informed of the outcomes. Consequently, the interactions considered were those between GS1 and Perrigo. This analysis employs the sophisticated Big Mile tool, which uses as input the data from the previous stage to generate emissions reports replete with multifaceted interpretations and representations.

Outlining the flow mentioned. GS1 focus group orchestrates the generation of reports, by subjecting the data to the Big Mile tool, before sharing the reports with the focus group Perrigo, this previous group makes comments based on knowhow and market inputs on the creditability of the results. Subsequently, both the comments and results are shared between focus groups culminating in a meeting to chart the course for future actions. Preceding the meeting, the focus group Perrigo conducts an additional analysis of credibility, rooted in their knowhow and the previous excel-based analysis. Within the meeting two outcomes are possible, the acceptance of the results as credible, thus moving on to the next stage, or one of the groups signals the identification of areas for improvement in terms of data collection. These improvements are subsequently communicated to IDL by Perrigo, and the cycle repeats. Should the former outcome materialise, the data analysis cycle concludes alongside the constructing stage cycle, propelling the project into the planning stage.

It is important to acknowledge that the data analysis serves as a catalyst for instigating the generation of measures, as it is a natural process and will move the project into the next stage. However, this analytical endeavour holds the potential to show stakeholders that more data needs to be gathered to draw more accurate conclusions, reverting the process to the previous

cycle. Consequently, data collection and analysis manifest as discrete cycles that seamlessly interweave within a broader construct, the constructing stage cycle.

4.2.3. Step 2 – Planning Action

The success of the previous stages culminates to the action planning. Key questions, as suggested by Beckhard and Harris (1987), encompass identifying necessary changes, required change types, timelines, necessary support, commitment-building strategies, and resistance management. Gilmore, Krantz and Ramirez (1986) recommend that the planning phase may conclude with a workshop for key stakeholders.

Using the participatory BCK tool, the project employs a collaborative approach to define measures and deepen understanding. Subsequently, a multi-criteria analysis tool is utilised to evaluate suggested initiatives. Criteria are developed, measured and weighted, and value functions for each criterion are defined using the MACBETH (Measuring Attractiveness by a Categorical Based Evaluation Technique) approach, applied with the M-MACBETH software. Sensitivity analysis guides the selection of measures for inclusion in the action plan. The finalised list of measures is presented, discussed, and officially endorsed by relevant stakeholders.

Definition of measures – Participatory BCK

Measures are identified through three main stages:

- i. First, the focus group with GS1 draws upon their knowledge and the successful trajectories of other Lean & Green participants to propose CO₂e reduction measures. Their contribution extends beyond suggestions, encompassing an assessment of feasibility and potential impacts.
- ii. Meanwhile, benchmarking serves as an invaluable tool, illuminating explored CO₂e reduction measures based on the examined case studies in Chapter II. This comprehensive analysis not only sheds light on the achievable reduction potential but also stresses the viability of measures.
- iii. Of utmost significance, the focus group with Perrigo afterwards plays a central role, actively engaging with outlined measures and offering evaluations of their feasibility. Perrigo plays an instrumental role in determining the ultimate feasibility of all measures.

This exercise will provide an extended list of CO₂e reduction measures, which will undergo a multicriteria analysis in the forthcoming stages. Moreover, all the reflections, distinct criteria, and differentiating factors associated with these measures will follow them.

Global evaluation

The MACBETH approach offers the advantage of eliciting weighting coefficients through interactions with stakeholders. During interviews, stakeholders provide qualitative judgments regarding the difference in attractiveness between various options. The MACBETH approach can be accomplished using the M-MACBETH software. This software streamlines the procedure, identifies judgment inconsistencies, and proposes alternatives for rectification. Additionally, it translates qualitative judgments on the MACBETH scale into numerical scores.

When the evaluation dimensions are assumed to be preferentially independent of each other and uncertainty is not formally incorporated into the model, the Additive Linear model is applicable. This model demonstrates how the values of options on each evaluation dimension can elicit relative weights. These weights are later used to construct a global score or utility function that fully describes the problem under consideration. So, the work devolved will use the MACBETH approach with the M-MACBETH software and an Additive Linear model.

As previously stated, the evaluation of measures unfolds organically within the dynamic atmosphere of the Focus Groups, fostering open discussions that promote deliberations. Each input presented during these discussions was recorded and subsequently incorporated, alongside other criteria derived from keen observations and project-specific characteristics, to form the comprehensive framework for the subsequent global evaluation stage.

To ensure the thorough inclusion of all identified criteria, a crucial interview session was arranged, bringing together the researcher and the Head of Supply Chain. This interview served multiple purposes, starting with an examination of the necessity of each criteria initially identified. Subsequently, the focus shifted towards identifying any potential gaps in the evaluation framework, seeking to ascertain if any additional criteria were required to adequately assess the effectiveness of the proposed reduction measures. These two steps are the Criteria Definition. The list generated from this step will be the one used in the evaluation phase.

In the global evaluation phase of the methodology using a MACBETH approach, several steps are involved to determine conclude the multicriteria analysis. The process begins with a second interview involving the same parties as the first interview, but with a different goal. This interview will first focus on defining Performance Levels, will follow with the definition of Value Function, and finish of with Weighting.

Starting with Performance Levels, a critical aspect that sets the foundation for subsequent analyses. Here, each criterion's different performance levels are identified and described,

contributing to a comprehensive understanding of the evaluation framework. This activity also involved defining the lower and upper reference for each criterion.

Following the establishment of Performance Levels, the methodology moves on to the definition of the Value Function. This step involves quantifying the subjective preferences and opinions of the stakeholders towards each criterion's performance levels. By employing a categorical-based evaluation technique, the Value Function accurately captures the stakeholders' perspectives, resulting in a nuanced and comprehensive representation of their preferences. For each pair of performance levels within a specific criterion, stakeholders are asked to compare and assess their preferences. The question may be framed as follows: "Between Performance Level A and Performance Level B, which one do you consider more preferable?". Stakeholders are then asked to determine if there is any significant difference in preference between the two performance levels being compared. The question may be phrased as: "Is your preference between Performance Level A and Performance Level B significantly different?". Stakeholders are prompted to quantify the magnitude of the difference in preference between the two performance levels. They may use a numerical scale to express the extent of their preference, such as: "On a scale of 1 to 7, how much do you prefer Performance Level A over Performance Level B?"

The final step in this global evaluation phase is the determination of Weighting. Through this process, the relative importance or significance of each criterion is ascertained, reflecting the stakeholders' prioritization of different aspects under consideration. The Weighting step plays a pivotal role in ensuring a fair and balanced assessment, enabling the multicriteria analysis to accurately represent the collective interests of the stakeholders involved. Stakeholders are asked to rank the criteria in order of importance, reflecting their relative significance in the decision-making process. The question may be presented as "Please rank the criteria based on their importance, with 1 being the most important and N being the least important.", as well as "If you could improve the measure in only one criterion, which criterion would you select?" and then, exclude this criteria and repeat the same question for the remaining criteria, until having all the criteria in order.

Sensibility Analysis

As part of the final stage of the MCA, a crucial sensitivity analysis is conducted by the researcher to further evaluate and refine the assessments of the CO₂e reduction measures. The MACBETH tool plays a vital role in this sensitivity analysis, enabling the assessment of how variations in criteria weights impact the overall rankings of the measures.

The sensitivity analysis serves to understand the extent to which uncertainty in the model's outputs can be attributed to the uncertainty of its multiple inputs. One way to achieve this, within the context of a multi-criteria decision analysis (MCDA) problem, is to modify the weights of the evaluation criteria and observe how the model's recommendations change accordingly. For this purpose, the previous interview mention continued, in which it is asked whether there are some adjustments to be made on the weights or value functions, and if it is the case, those adjustments are made, leading to a final ranking of the list of measures. Depending on the sensitivity of the results, the initial ranking of measures (before the adjustments) may stay the same or may change (in a more or less significant way).

Workshops

The workshops served as a vital platform for information dissemination, debates, and official sign-off the CO₂e reduction plan, engaging key stakeholders both within and outside the company. However, the internal and external stakeholders' workshops were held separately, this ensured the confidentiality of sensitive information, safeguarding the integrity of Perrigo and the Lean & Green Project.

The off-company workshop was specifically conducted with external entities, namely the logistics operator and the waste management operator. Each partner was assigned a separate workshop due to the distinct ways in which the project would impact them, resulting in different effects and implications.

Conversely, the in-company workshop brought together various parties within the organisation who were directly impacted by the project or held influential roles within it. This inclusive workshop served the dual purpose of informing and seeking official sign-off and support. Among the crucial participants were the Head of Supply Chain, the dedicated Supply Chain Team, the Head of the Sales Department, and the Managers responsible for each client division. Additionally, the Head of the Marketing Department and their team, along with the Head of Perrigo Portugal, played pivotal roles in the workshop proceedings.

By conducting separate workshops for each stakeholder group – Supply Chain, Sales, Marketing and the Head –, the workshops effectively optimised time and ensured a focused approach tailored to the unique needs and concerns of each crowd. This strategic division allowed for a comprehensive exploration of relevant measures while maintaining the utmost confidentiality of sensitive information and preserving the integrity of the project.

4.2.4. Step 3 – Taking Action

This stage entails making the desired changes and carrying out the plans in collaboration with key members of the organisation. Coughlan and Coughlan (2002) identify iterations, refined specifications, performance evaluations, and discussion documents form an integral component of this stage. However, Shani and Pasmore (1985) acknowledge that it is essential to recognise that the raw data generated during this process might not be inherently organised, posing concerns regarding data sufficiency and traceability.

While the actual physical implementation of the measures falls beyond the scope of this thesis, the description of how each measure will be implemented and the impact that it will generate, resides within the realm of the project's scope. Therefore, this step will focus on describing how each measure will be applied and how to ensure their traceability.

Information such as a detailed description of each measure, prevision dates for start and end of implementation, human resources and investments need, as well as predicted reductions, must be displayed. Followed by how it is planned to trace the performance of each measure and key decisions made that affect them.

4.2.5. Step 4 – Evaluating Action

Evaluation means appraising the new situation. Susman (1983) adds, that it is a system, not an act, characterised by a continuous flow of decisions, assessments, and measurements all aimed at achieving a successful outcome.

In the present project, the evaluation involves the definition of key performance indicators (KPIs) and the result of the mandatory audit conducted.

The KPIs selected to monitor and control the impact of CO₂e reduction measures are carefully tailored to each specific measure, with a minimum of one KPI assigned per measure. Additionally, an overarching KPI is included to assess the overall performance, enabling meaningful comparisons across different measures.

By utilizing this comprehensive set of KPIs, the effectiveness of each individual CO₂ reduction measure can be accurately evaluated. Moreover, the inclusion of an aggregate KPI facilitates a holistic assessment of the entire emission reduction strategy. This approach ensures a well-rounded analysis and enables informed decision-making, contributing to the successful implementation of sustainable practices.

Eligibility for the prestigious Lean & Green award requires a thorough audit, which involves a comprehensive evaluation of the meticulously crafted action plan. The first step entails transmitting the action plan to a selected audit firm. This firm carefully reviews the plan

and provides recommendations for further improvements. Once the suggested enhancements are incorporated, a final evaluation takes place, using predefined criteria and a scoring system. If Perrigo surpasses the predetermined minimum score, the company is presented with the award and empower to implement the proposed measures.

Nevertheless, it's important to note that the audit extends beyond the academic project and falls within the domain of the corporate project. However, with regards to the academic study, the outcome of this step holds paramount significance. A positive result ensures the credibility of the ongoing project, while a negative result necessitates repeating the AR cycle to rectify any issues and improve the plan.

Chapter V. Case Study

The present chapter aims to present the data obtained in the constructing and planning action phases described in the methodology, and to draw conclusions from it that will be applied in the implementation stage.

5.1. Constructing

5.1.1. Data Gathering

To calculate the CO₂e of Perrigo Portugal, several activities have been considered within the scope of the CO₂ baseline measurement. These functions are:

- Storage activity, which provides insight into the energy consumption of the operator, creating opportunities for emissions reduction in the warehouse area.
- Additionally, the outbound activities within the warehouse, these activities represent order flows, sample flows, and other product shipping flows, where there is room for process improvement and the potential for emissions reduction.
- Regarding transportation, the operator currently manages shipping entirely, with Perrigo holding no visibility or decision-making authority. Although the shipments are optimised by IDL, this optimisation is done among multiple clients, creating global optimisation but not guaranteeing it on a client level.

These activities include all processes of the core business, therefore the emissions will be well represented across the analytical dimensions: locations, fuel consumption, and shipments.

During the analysis, the years 2018 and 2021 were studied to identify potential emissions reductions. The year of 2018 was chosen due to its significance as the most recent pre-pandemic period and its alignment with the current trading volume, making it a representative timeframe for past emissions. As Perrigo joined the Lean & Green project in mid-2022, 2021 was selected as the reference year. This decision was strengthened by several factors, including its proximity to the current business volume, minimal disruptions caused by the pandemic, the availability of a comprehensive and easily accessible database, and the prompt collection of qualitative data.

The data collection procedure was carried out over two cycles to adhere to data analysis criteria. Each data point was collected independently to ensure accuracy and reliability.

5.1.1.1. First Cycle

Locations

To determine emissions in the warehouse area, it was necessary to collect data on the consumption of various energy sources, the collection fields considered are indicated on the

Table 5.1, analysing in detail the process of collection of the field above. The logistics operator provided the data on diesel consumption within the warehouse, purchases are segregated by warehouse, so the pharmaceutical warehouse's diesel consumption is separated from the consumption of the high-consumption warehouse. The consumption of diesel energy in the warehouse is primarily for backup generators, as it is crucial to ensure a continuous power supply due to the nature of the stored products. Regular tests are also conducted on the backup generators due to legal requirements.

During the data collection, a traceability issue regarding fuel consumption was identified. The impact of diesel on operations is low, and its maintenance is mandatory due to storage regulations. The operator doesn't see the need to record diesel consumption as it's limited. To calculate the impact, fuel purchases were considered. Although diesel emissions are outside the reduction scope, they are included in the overall emissions calculation. Real-time consumption data is not available, but efforts to acquire it were deemed unjustifiable. The total emissions from diesel are very low, less than one ton, and cannot be eliminated due to their necessity for storage best practices.

The data provided on green and grey energy consumption is derived from electricity invoices since the operator lacks specific strategic meters to measure energy usage for individual warehouses, machines/devices, and warehouse zones. The proportion of green energy consumption is notably low at 0.32%, while grey energy constitutes the overwhelming majority at 99.68% (100 - 0.32) – Annex 12. To calculate the overall energy consumption value, both green and grey, an adjustment factor of 80% was applied. This factor represents the pharmaceutical warehouse's specific energy consumption, determined by the operator through a benchmarking exercise.

Table 5. 1 - Data fields for the Location section.

<i>Data field Collected</i>	<i>Key Details</i>	<i>Data Source</i>	<i>Verification Method</i>
Green Energy (kWh)	Use by the lighting, various automation systems, material handling equipment, various machines for other operations, and the climate control and refrigeration systems.	Electricity Bill	Comparing it with the invoices from the logistics provider
Grey Energy (kWh)			
Diesel Consumption (liters)	Used exclusively to feed backup generator and pumping systems	History of Purchases	

Fuel consumption

The data encompassed monthly values for both services rendered by external providers and those provided by the logistics operator themselves, Table 5.2. shows in detail the data filed.

The formula employed took into account the transport vehicle as a Semi-Trailer Truck with a payload capacity of 12,000 kg, and an average fuel consumption of 37 liters per 100 km (as provided by the operator). Consequently, the formula utilised was:

$$\left(\frac{37}{12000} * Weight GR \right) * \frac{Distance}{100} \quad (1)$$

The calculation of distances considered the starting point of all shipments as the operator's warehouse, and the destination as the recipient, so the distances presented at the final point were considered. For weight, the sum of weights presented in the shipments sheet was considered.

Table 5. 2 - Data fields for the Fuel Consumption section.

<i>Data field Collected</i>	<i>Key Details</i>	<i>Data Source</i>	<i>Verification Method</i>
Vehicle type	The type primarily used by IDL	Assumptions made based on debates between Perrigo and IDL	Comparing it with the invoices from the logistics provider
Carrier	Considered to be the same, the logistics operator		
Vehicle ID/ License plate			
Period fuel consumption	Divided by months		
Fuel type	According with the specifications of the vehicle type, respectfully diesel		
Total amount of fuel	Calculated using the formula provided and in accordance with the previous information	Data from Shipments	

Shipments

The data in this field was obtained through the extraction of shipping documents from the system by the logistics operator. This dataset includes various information, namely the ones in the Table 5.3., Annex 13 show more detailed information.

Table 5. 3 - Data fields for the Shipments section.

<i>Data field Collected</i>	<i>Key Details</i>	<i>Data Source</i>	<i>Verification Method</i>
Assignment number	Unique code of contact between the ERPs	Shipping document	Comparing the information with the one in Perrigo's system
Carrier	Responsible for each shipment		
Vehicle ID/ License plate	license plate of the shipping vehicle		
Period fuel consumption	Divided by months		
Period energy consumption			
Date	Exact date of shipment		
Quantity (kg)	total weight of shipment		
Countrycode of origin	IDL address information		
Postal Code of origin			
Countrycode of destination	Specified of each customer		
Postal Code of destination			
Customer			
Free input	Considered distance for the shipment		

It is important to mention that the key shipment data is the weight and the distance, as variations in these data will significantly affect fuel consumption and consequently emissions. Additionally, the weight data will be considered as the indicator for transportation activities, and for relative reduction calculations, it will be measured in tons.

Improvements

In the location data analysis, it was observed that the collected values were higher than anticipated based on the amount charged, indicating the need for improvements in the data. The current data includes energy consumption for all IDL clients, which does not accurately reflect Perrigo's warehousing related CO₂e. To address this, it is essential in the next cycle to calculate and present the values that specifically represent Perrigo's energy consumption.

Regarding fuel consumption, the focus group at Perrigo found minimal divergences, but still, some corrections are necessary in the data. The current data only accounts for a single mode of transport primarily used by IDL for their own deliveries. However, external transportation services like Dismed and Torrestir handle shipments using different transport models. Dismed uses vans for shorter distances and loads, while Torrestir handles larger shipments with heavy trucks. To improve accuracy, the data should be adjusted to reflect the distinct monthly fuel consumption for each carrier in the upcoming cycle.

In terms of shipments, cross-referencing the Assignment number and Customer revealed a potential issue of duplication when inputting data into the BigMile tool. This highlights the importance of addressing any instances of duplicated information to ensure the integrity of emission calculations. Since customer requests often have a unique assignment number for tracking purposes, shipping loads are optimized, leading to challenges with duplicate distance entries inadvertently introduced into the "free input" column. In the next cycle, efforts should be made to address and rectify these duplicate kilometer entries to ensure precise and accurate analysis.

5.1.1.2. Second Cycle

Locations

In the pharma warehouse, there are multiple clients, and the distribution and control of warehouse allocation is based on pallets. Consequently, the pallet serves as the primary unit of measurement. In fact, the calculation of warehouse service fees relies on the average number of pallets handled per month.

To accurately determine the energy consumption specific to Perrigo, it is crucial to consider the occupancy unit, which, in this case, is the pallet. The tables on Annex 14, express the occupancy as a monthly percentage. This value is then divided by the maximum pallet capacity

of the warehouse during the analysis period. Until June 2020, the maximum capacity stood at 33,000 pallets, while from July 2020 onwards until the present, it has been recorded as 34,000 pallets.

Fuel consumption

Three distinct carriers were considered, each associated with different vehicles and parallel fuel consumption rates. Carrier IDL maintains all the same information as in the first cycle, therefore keeping the same formula presented previously.

Carrier Dismid utilises a van with a capacity of 1,500 kg and an average consumption rate of 10 liters per 100 km. The corresponding formula is:

$$\left(\frac{10}{1500} * Weight\ GR \right) * \frac{Distance}{100} \quad (2)$$

Lastly, Carrier TorresTir employs a heavy truck capable of carrying 8,000 kg and has an average fuel consumption rate of 22 liters per 100 km. The formula used for this carrier's fuel consumption calculation is:

$$\left(\frac{22}{8000} * Weight\ GR \right) * \frac{Distance}{100} \quad (3)$$

Shipments

In essence, the Big Mile tool primarily compares fuel consumption and shipments using license plate data. However, since the fuel consumption calculation was based on documents rather than license plates, adjustments were made to align the data with the tool's requirements.

Specifically, the presentation of distance was modified to address distinct scenarios: one vehicle ID has one shipment: consider the presented distance travelled – Annex 15; one vehicle ID has two or more shipments for the same postal code destination: consider the distance travelled only once – Annex 16; one vehicle ID has two or more shipments for two or more postal code destinations: consider the difference in distances travelled for each shipment – Annex 17.

Closing cycle

In summary, the location section incorporated the suggested improvements by applying the newly sourced percentage. The focus group at Perrigo ensured the reliability of the updated figures by cross-referencing them with the corresponding billing figures for each month, preserving the integrity of the revised data. Regarding fuel consumption, Perrigo's focus group compared the data with invoicing records from service invoices for the reference year, ensuring accuracy and validity. The shipment data showed no collisions in the Big Mile tool.

All essential data for calculating Perrigo's CO₂e has been gathered and thoroughly verified. With the current data in hand, the project can now proceed to the analysis phase, where further steps will be taken to identify and capitalize on opportunities for reducing emissions.

5.1.2. Data Analysis

The calculation of CO₂e for 2018 and 2021 was performed using the Big Mile tool, which adheres to the EN 16258 standard. This tool automatically calculates emissions based on input documents containing data collected in the previous phase. The tool considers specific emission factors, for Perrigo Portugal, the emission factors used are 3,262 kg of CO₂e for diesel and 0.524 kg CO₂e/kWh for grey energy, as indicated in Annex 18.

Upon comparing the data collected for the two years, the Table 5.4. demonstrates a reduction in total absolute CO₂e. However, there is a notable increase in relative emissions, indicating a decrease in efficiency in terms of transportation and warehouse emissions from 2018 to 2021. This can be attributed to the increase in the number of clients, despite a decrease of approximately 20% in shipments. It is important to note that the reduction of shipments did not correspond proportionately to a decrease of kilometres and weight, which only decreased by roughly 3%, as seen in Table 5.4..

Table 5. 4 - CO₂e and measuring figures over the years of analysis.

	<i>2018</i>	<i>2021</i>
<i>Number of clients (uni)</i>	<i>309</i>	<i>402</i>
<i>Total number of shipments (uni)</i>	<i>19.622</i>	<i>15.142</i>
<i>Total weight of shipments (ton)</i>	<i>933</i>	<i>915</i>
<i>CO₂ emissions (Absolut)</i>	<i>12.635</i>	<i>11.779</i>
<i>CO₂ emissions per ton (relative)</i>	<i>13,55</i>	<i>12,87</i>
<i>CO₂ emissions per ton per kilometer (relative)</i>	<i><u>0,0964</u></i>	<i>0,1203</i>
<i>TOTAL emissions (kg.CO₂.e)</i>	<i>130.074</i>	<i>123.281</i>

These findings highlight the need to focus in the year 2021 as a pivotal year for targeted improvements and further enhancements in efficiency levels.

Finally, Table 5.5. shows the emissions by areas, transportation and warehousing. Based on the analysis, it can be concluded that storage activities account for 90% of Perrigo's total emissions.

This finding highlights a significant opportunity for substantial emission reduction in this area. By focusing on warehousing emissions, Perrigo can effectively contribute to lowering its overall emissions and environmental impact.

Table 5. 5 - CO₂e and measuring figures by area of analysis.

<i>Absolut</i>	<i>2018</i>	<i>2021</i>
<i>Transport (kg. CO₂.e)</i>	12.635	11.779
<i>Warehousing (kg. CO₂.e)</i>	117.439	111.502
<i>TOTAL emissions (kg. CO₂.e)</i>	<i>130.074</i>	<i>123.281</i>
<i>Relative</i>	<i>2018</i>	<i>2021</i>
<i>Transport (kg. CO₂.e per ton)</i>	13,54	12,87
<i>Warehousing (kg. CO₂.e per ton)</i>	125,87	121,86
<i>TOTAL emissions per ton (kg. CO₂.e per ton)</i>	<i>139.41</i>	<i>134,73</i>

5.2. Planning Action

5.2.1. Definition of measures – Participatory BCK

Three key data gathering tools are used in the identification of CO₂e reduction measures. The focus group with GS1, benchmarking, and the focus group with Perrigo, form a comprehensive approach to propose and evaluate measures aimed at reducing CO₂e.

This collaborative effort results in an extended list of CO₂e reduction measures, with a focus on transportation and warehousing activities. Warehousing activities contribute significantly to emissions, representing 90% of total CO₂e, leading the focus groups to develop impactful measures in this area.

The focus groups emphasized the importance of balance between the quantity of measures and their feasibility and effectiveness. They recognized that implementing numerous measures would require substantial effort and investment in the future. The primary goal of the Lean & Green program is to reduce CO₂e while improving operations. Deviating from this objective might hinder the program's intended purpose, so maintaining a moderate number of measures ensures successful collaboration among stakeholders. The measures address key areas such as transportation efficiency, energy consumption, waste management, and sustainable practices in product and packaging development.

The transportation-related measures focus on optimising logistics operations, including sample load and distance and partnering with Lean & Green carriers. These measures aim to reduce unnecessary mileage and promote sustainable transportation options.

The proposed measures in the warehousing area involve implementing solar panels in the warehouse, reviewing minimum order values to optimise inventory management, and exploring power purchase agreements. By harnessing renewable energy sources, optimising inventory

levels, and ensure the source of energy used, Perrigo can significantly decrease CO₂e stemming from their warehousing operations.

Additionally, during the interview, the Head of Supply Chain identified that two measures, namely "Set Targets for the Quantity of Safety Stock" and "Change Return Process by Defining a Non-Return Fee", as supporting measures. These measures were determined to support the objective of maintaining warehouse volume constancy and enhancing warehouse utilisation efficiency, rather than focusing on CO₂e reduction directly. Consequently, these were categorised as supporting measures and considered as valuable contributions to the overall project, albeit not directly contributing to the present reduction plan

It is important to note that these measures are not exhaustive but represent a strategic selection that considers feasibility, potential impact, and stakeholder consensus. By focusing on a moderate number of measures, Perrigo can effectively drive change, promote collaboration, and ensure the successful implementation of the identified strategies. The identified measures include (Table 5.6.):

Table 5. 6 - List of identified measures.

Code	Measure	Description	Source
M.1	<i>Solar Panels in the Warehouse</i>	aims to leverage renewable energy sources to power warehouse operations	Focus group Perrigo
M.2	<i>Power Purchase Agreement</i>	implies a contract regarding the energy consumed by Perrigo at the logistics operator, where it will be stipulated that the energy consumed in the warehouse will come from solar panels or green grid energy	Focus group GS1
M.3	<i>Optimise Sample Load and Distance</i>	focuses on optimising the transportation of sample goods	Benchmarking (Santos e Vale)
M.4	<i>Review Minimum Order Value</i>	aims to optimise order fulfilment processes by reviewing and potentially adjusting the minimum order value requirement	Focus group Perrigo
M.5	<i>Get a Lean & Green Carrier for High-Volume Areas</i>	involves partnering with Lean & Green certified carriers for high-volume transportation activities	Focus group GS1
M.6	<i>Improve Waste Management</i>	focuses on enhancing waste management practices, including proper disposal	Benchmarking (Takeda)
M.7	<i>CHEP/LPR Pallets in the Supply Chain</i>	involves incorporating sustainable pallets, such as CHEP/LPR pallets, into the supply chain to promote circular economy principles	Benchmarking (Takeda)
M.8	<i>Incorporate Sustainable Principles in Product and Packaging Development</i>	integrating sustainable principles into product and packaging design, promoting eco-friendly materials	Focus group GS1
M.S1	<i>Set Targets for the Quantity of Safety Stock</i>	involves setting specific targets for safety stock levels	Benchmarking (Nestle)
M.S2	<i>Change Return Process by Defining a Non-Return Fee</i>	aims to optimise the return process by implementing a non-return fee, incentivising customers to reducing returns	Focus group Perrigo

This list was then inserted into the software as displayed in Annex 19. The forthcoming stages will involve a multicriteria analysis to evaluate each of these measures.

5.2.2. Global Evaluation

5.2.2.1. Criteria Definition

The present stage focuses on determining the criteria to be used to evaluate each of the measures proposed above.

The criteria were identified by the researcher, based on the project characteristics and aspect mention during focus group discussions, and the are was follows in Table 5.7..

Table 5. 7 - List of criteria to be considered for evaluation.

Criteria	Description	Source
<i>Predicted Reduction</i>	assesses the estimated reduction that can be achieved	Observation of project characteristics
<i>Time to Obtain Full Reduction</i>	looks into the duration required to implement the measure and realise its full potential for reducing	Focus group discussions
<i>Availability of Resources</i>	evaluates the availability of the necessary resources (financial, technical, human resources, etc.)	Focus group discussions
<i>Feasibility</i>	focuses on the viability of implementing the measure within the specific context of the Perrigo	Observation of project characteristics
<i>Effort Needed</i>	emphasizes on the level of effort, both in terms of labour and resources, required to implement and maintain	Focus group discussions
<i>Time to Fully Implement</i>	determines the time required to fully implement	Focus group discussions
<i>Lifetime</i>	stresses the expected longevity of the measure once implemented	Focus group discussions
<i>New Certification Needed</i>	meaning the requirement of obtaining new certifications or adhering to specific standards	Focus group discussions
<i>Direct Cost to Perrigo</i>	evaluates the potential direct financial cost associated with implementing and maintaining the measure within the budget of Perrigo	Observation of project characteristics
<i>In Accordance with Regulatory Aspects</i>	looks into the compliance of the measure with existing regulatory frameworks	Observation of project characteristics

Based on the interview with the Head of Supply Chain, it was concluded that all the criteria on the initial list were needed to assess the proposed measures. However, one new criterion was added to the list. The new addition focuses on the number of stakeholders affected since more stakeholders imply higher visibility of the project. The measure was recorded as: Number of Stakeholders Involved.

Additionally, it was also agreed that the criterion “In Accordance with Regulatory Aspects” was an exclusion criterion, thus resulting in the rejection of any measure that do not comply with this condition.

The final list of criteria is presented the one displayed in Table 5.8., and it was inserted into the software, as showed in Annex 20.

Table 5. 8 - Final list of criteria.

Code	Criteria
C.1	<i>Predicted Reduction</i>
C.2	<i>Time to Obtain Full Reduction</i>
C.3	<i>Availability of Resources</i>
C.4	<i>Feasibility</i>
C.5	<i>Effort Needed</i>
C.6	<i>Time to Fully Implement</i>
C.7	<i>Lifetime</i>
C.8	<i>Number of Stakeholders Involved</i>
C.9	<i>New Certification Needed</i>
C.10	<i>Direct Cost to Perrigo</i>
X	<i>In Accordance with Regulatory Aspects</i>

5.2.2.2. Performance Levels

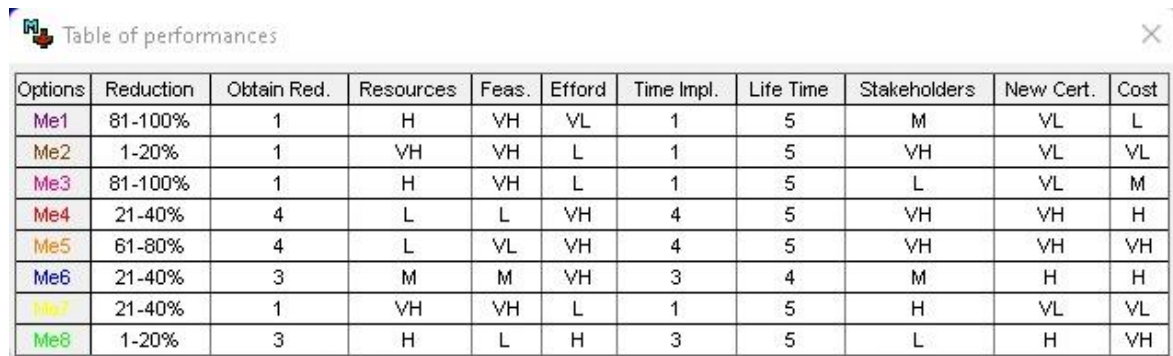
Succeeding, the work unfolded, as criteria after criteria was assessed, considering project-specific nuances. Focusing on the qualitative criteria, which are "Predicted Reduction", "Availability of Resources" and "Feasibility". Also the criterion "Effort Needed" and the trio of "Number of Stakeholders Involved", "New Certification Needed" and "Direct Cost to Perrigo" were considered (Annex 21). Within the realm of the quantitative criteria, the dimensions of time emerged, "Time to Obtain Full Reduction," "Time to Fully Implement," and "Lifetime" (Annex 22). The performance levels defined and the upper reference value, as well as the lower are as follows (Table 5.9.).

Table 5. 9 - Performance level of all the criteria, and the upper and lower references.

Criteria	Type	Scale					
C.1	<i>Qualitative</i>	100 – 81%	80-61%	60-41%	41-21%	20-1%	0%
C.2, C.6	<i>Quantitative</i>	1	2	3	4	5	
C.3, C.4	<i>Qualitative</i>	Very High	High	Moderate	Low	Very Low	
C.5	<i>Qualitative</i>	Very Low	Low	Moderate	High	Very High	
C.7	<i>Quantitative</i>	5	4	3	2	1	
C.8	<i>Qualitative</i>	Very High Amount	High Amount	Moderate Amount	Low Amount	Very Low Amount	
C.9, C.10	<i>Qualitative</i>	Very Low Amount	Low Amount	Moderate Amount	High Amount	Very High Amount	

During the second interview, the researcher and the Head of Supply Chain agreed that all considered options successfully met the exclusion criteria, especially "In Accordance with

Regulatory Aspects" (criterion X). Subsequently, all performance metrics were assigned to the input options, as shown in Figure 5.1.



Options	Reduction	Obtain Red.	Resources	Feas.	Efford	Time Impl.	Life Time	Stakeholders	New Cert.	Cost
Me1	81-100%	1	H	VH	VL	1	5	M	VL	L
Me2	1-20%	1	VH	VH	L	1	5	VH	VL	VL
Me3	81-100%	1	H	VH	L	1	5	L	VL	M
Me4	21-40%	4	L	L	VH	4	5	VH	VH	H
Me5	61-80%	4	L	VL	VH	4	5	VH	VH	VH
Me6	21-40%	3	M	M	VH	3	4	M	H	H
Me7	21-40%	1	VH	VH	L	1	5	H	VL	VL
Me8	1-20%	3	H	L	H	3	5	L	H	VH

Figure 5. 1 - Table of performances MACBETH.

5.2.2.3. Value Functions

Following these key steps, the interview in my thesis shifted its focus back to the criteria, delving into the process of making judgments for each criterion. A consistent process was followed for all criteria, using all the question defined in the methodology, starting with a comparison between the most attractive and least attractive performance levels. Subsequent comparisons with the least attractive level were then made until the final column of the matrix was completed. Any suggestions for adjustments from the software were carefully considered and incorporated. The suggested value function was then evaluated and adjusted, ultimately leading to the validation of the value function.

In this case, all judgments were included, as a higher number of judgments resulted in a more accurate and precise scale. Both parties unanimously agreed upon the validity of the value function, and no further adjustments were required, making the validation process seamless and unambiguous. To have a deep dive into the judgement of the criteria please refer to Annex 23.

5.2.2.4. Weighting

Having concluded these evaluations, the subsequent step entailed the determination of weights. The criteria were diligently ordered by importance following the protocol of questions presented in the chapter 4, followed by the completion of the judgment matrix, also following a specific protocol of questioning (also detailed on chapter 4). The final set of weights is presented in Annex 24.

During this process, the Head of Supply Chain astutely noted that "Predicted Reduction," "Feasibility," and "Direct Cost to Perrigo" held equal importance. Therefore, these three criteria occupied the topmost positions in the matrix, duly marked with "no" between them, to signify their equal importance. Following, "Time to Obtain Full Reduction" emerged as the next

important criterion, followed by "Effort". Next, "Availability of Resources" and "New Certification Needed", held the fourth position in terms of importance, and intriguingly, they were placed on an equal footing. The Head of Supply Chain articulated that certifications are a type of resource and that the company cannot obtain certifications without resources, these criteria were marked with "no" between them to indicate their equal significance. "Lifetime" assumed the next level of importance, while "Number of Stakeholders Involved" and "Time to Fully Implement" emerged as the least important criteria. However, they too shared equal importance, as neither was deemed less significant than the other.

Having established the first set of weights, the scale was validated, solidifying its accuracy.

5.2.2.5. Evaluating the Proposed Measures: Model Results

Subsequently, the global evaluation was performed with the Head of Supply Chain, leading to the results shown in Table 5.10. (see the M-MACBETH thermometer in Annex 25).

The outcome of the MCA is presented in Table 2, providing a comprehensive overview of the results achieved. For a more detailed breakdown of the results, please refer to Annexes 26 and 27. As a result, the top four measures, as indicated by their high scores, will be incorporated into the action plan, ensuring their prioritisation and implementation. Conversely, the options with lower scores will be identified as potential measures for future consideration and development. Nevertheless, to ensure the robustness and soundness of the decision-making process, a sensitivity analysis must be conducted. This analysis will allow to further explore the impact of variations in criteria weights on the rankings of the measures, providing a deeper understanding of their relative importance and allowing for a more informed and confident decision.

Table 5. 10 - Model result.

<i>Measure</i>	<i>Score</i>
Solar Panels in the Warehouse	92,34
Review Minimum Order Policy	87,87
Power Purchase Agreement	84,77
Optimise Sample Load and Distance	84,57
Get Lean & Green Carrier for High Volume Areas	38,83
Improve Waste Management	32,98
CHEP or LPR Pallets in the Supply Chain	28,88
Incorporate Sustainable Principals in Product and Packaging Development	28,45

5.2.3. Sensitivity Analysis

To ensure the reliability of the obtained results, a sensitivity analysis is crucial to explore the impact of changing criteria weights. The focus will be on the three most important criteria:

"Predicted Reduction," "Feasibility," and "Direct Cost to Perrigo," as outlined in detail in Annex 28. By prioritizing these specific criteria, we thoroughly evaluate the key factors significantly influencing the decision-making process. Analysing variations in their weights provides valuable insights into the overall rankings and preferences of the alternatives.

While changes in these criteria weights inherently affect the rest, this approach delves into the crucial aspects driving the decision. Understanding how variations in these influential criteria alter the decision outcomes leads to more informed and justified decisions aligned with our study's objectives. This analysis deepens our understanding of the decision model's robustness and enhances the decision-making process.

5.2.3.1. Sensitivity Analysis to Weights

Analysing the sensitivity of the results to changes of these criteria weights reveals interesting insights. When the weight of "Feasibility" increases, the scores of the top-ranking measures continue to rise, along with two of the lower-scoring measures. Although this change significantly improves the performance of some lower-scoring measures, it does not alter the final ranking, as there is no overlap between the top four and bottom four measures. On the other hand, when the weight of "Direct Cost to Perrigo" increases, the top measures do not intersect with the lower ones. However, most measures experience a decrease in score, and even one of the previously top-scoring measures falls below 50 out of 100.

Examining the "Predicted Reduction" criterion reveals that two of the top-scoring measures remain prominent. However, within this group of four measures, the scores of "Review Minimum Order Policy" and "Optimise Sample Load and Distance" experience a drastic decline. Although it may raise concerns that half of the previously top-ranked measures now fall among the lowest-scoring ones, it is important to note that the first intersection between lower and top measures occurs only at 54%, which is still above the halfway mark (consult Annex 28 to visualize this statement). Moreover, assigning such high weight to a single criterion within a group of ten is highly unlikely. While the level of reduction is of specific interest to this project, costs and effort have direct and immediate implications for the entire company.

5.2.3.2. Sensitivity Analysis to Value Functions

To further ensure the reliability of the results, adjustments were made to the scale of judgments within the criteria. Specifically, the value range of the intervals "61-80%" and "41-60%" was decreased, while the lower-scoring judgments were given higher values, while preserving the overall integrity of the scale (see Annex 29).

During the analysis, it became apparent that the lower-scoring measures consistently performed poorly in terms of time-related criteria, namely "Time to Obtain Full Reduction" and "Time to Fully Implement." Therefore, a sensitivity analysis was conducted on both criteria (see Annex 30 and 31). The analysis revealed that none of the lower-scoring measures intersected with the upper ones. To further investigate this, the value of the scale within the criteria was adjusted to maximise the values assigned to levels "4" and "3". However, even with these adjustments, the order of the measures remained unchanged.

Based on these findings, the researcher can have confidence in the results. The action plan will now be developed based on the conclusive outcomes, as presented in Annex 32.

5.2.4. Workshops

Workshops played a vital role in the CO₂e reduction action plan at Perrigo, providing a platform for information dissemination, and obtaining official sign-off from key stakeholders. To ensure the integrity of the project and maintain confidentiality, separate workshops were conducted for internal and external stakeholders.

The off-company workshop was held with external entities, including the logistics operator, IDL, and the waste management operator. Each partner had a dedicated workshop due to the distinct ways in which the project would impact them. During the workshop with IDL, a resume of the action plan was presented (Annex 33), and the measures "Solar Panels in the Warehouse" and "Power Purchase Agreement" were heavily focused on. The motivation was on outlining the measures, discussing the expected reduction and timelines, and laying out the compromises required from IDL. IDL responded positively and signed off on the measures, indicating their commitment to support the project.

Similarly, during the workshop with the waste management provider, the overall project was presented using the support of Annex 33, and the measure "Improve Waste Management" was discussed. Even though this measure is not one of the priority ones, it was necessary to conduct this workshop to show Perrigo's efforts in sustainability, and make sure that in the long-term this partner would contribute to the company's sustainable path. The provider presented potential solutions they could offer, and together they reached a compromise to change the way waste is managed in the future.

The in-company workshop brought together various parties within Perrigo who were directly impacted by the project or held influential roles. Participants included the Head of Supply Chain, the dedicated Supply Chain Team, the Head of the Sales Department, Managers responsible for client divisions, the Head of the Marketing Department, and the Head of Perrigo

Portugal. This inclusive workshop aimed to inform the participants, seek official sign-off, and gain their support for the proposed measures.

The workshop for the Supply Chain team focused on presenting all the measures, discussing the expected reduction and timelines, and outlining the compromises required from their side. For this the support of Annex 33 and the detailed view of the dashboard of the action plan (Annex 34) were essential. The employees responded positively to the measures and signed off on them, demonstrating their commitment to implementing the plan.

The workshop with the Marketing Department specifically focused on the measure "Optimise Sample Load and Distance". After presenting the overall Lean & Green project, the measure was introduced, and the expected reduction and timelines were discussed. The support used is seen in Annex 35. The employees from the Marketing Department liked the measure and signed off on it, showing their agreement and commitment.

In the Sales workshop, the measures "Review Minimum Order Value" and "Optimise Sample Load and Distance" were presented. Similar to the other workshops, the focus was on presenting the measures, discussing the expected reduction and timelines, and outlining the compromises required from the Sales Department, with the support of Annex 34 and Annex 35. The employees from the Sales Department expressed their support for the measures and signed off on them.

Finally, the workshop with the Head of Perrigo involved presenting the Lean & Green project as a whole, presenting all the measures, discussing the expected reduction and timelines, and laying out the compromises required from the head. Do to so the action plan was reviewed end to end, Annex 32. The Head of Perrigo liked the proposed measures and signed off on them, demonstrating their approval and commitment to the project.

With sign-off from all stakeholders, the project received approval to proceed to the next phase, which involved conducting an audit of the CO₂e reduction plan. This comprehensive workshop approach ensured that the unique needs and concerns of each stakeholder group were addressed, and their active participation and support were secured, laying a solid foundation for the successful implementation of the plan.

5.3. Taking Action

Each measure selected to be implemented based on the multicriteria analysis is presented below with a comprehensive summary table containing key information. This will be followed by a detailed specification of the measure and its predicted reductions, along with specific details pertaining to the reductions. Furthermore, the approach to tracking and evaluating the

effectiveness of each measure will be outlined in this section, concluding with a global evaluation resulting from the adoption of all the 4 measures.

5.3.1. Solar Panels in the Warehouse

IDL started the installation of solar panels in December 2022, and it was expected to be over by the first quarter of 2023. However, due to delays on delivery of raw materials and labour faced by the contracted installer, the installation was extended until the end of the second quarter of 2023. Once it's finished, the solar panels will start generating energy right away. The panels will be used exclusively for the pharma warehouse, given its high energy consumption.

Regarding the solar panel data, the planned implementation area covers approximately 40,000 m², with a total of 1,238 panels and 5 modules of 110 kW each, where each module has 545 Wp. The implementation of the solar panels is expected to bring a minimum reduction of 40% and a maximum reduction of 70% in energy purchases.

The calculation is made considering the worst-case scenario, which expects the start of energy production to be by the end of the second quarter and the reduction of energy purchases to be 40%. This means that the CO₂e reduction will also be 40% for the warehouse, as over 99% of the energy purchased is derived from grey energy. Therefore, the 40% reduction corresponds to a 36% reduction in the total emissions, as warehouse emissions account for 90% of the overall emissions. Also, in the first year of implementing the measure, with an impact for only 6 months, the total reduction will be 18%. In subsequent years, assuming there are no expansions or improvements, the annual reduction will be 36%.

Table 5.11. resumes the information discussed above.

Table 5. 11 - Solar panels in the warehouse detailed.

Area of reduction	Warehouse		
Starting Date	December 2022	Ending Date	June 2023
Start of Utilization: After the 3 rd trimester of 2023			
Responsible for Implementation	IDL		
Data Sources	Information provided by the logistics operator, which requested the information from the company responsible for installing the panels		
	Reference year data and justified assumptions		
Extra	There will be a minimum reduction of 40% in the purchase of energy, a maximum of 70%		
	At the most, the start of energy production will start at the end of the 2nd quarter of 2023, at least at the end of the 1st quarter of 2023		
KPIs	Production Efficiency		
	kWh of energy produced by solar panels		

5.3.2. Review Minimum Order Policy

The current minimum order value of 30 euros leads to inefficiencies in shipments, as some SKU's result in orders of only one unit. To add to the matter, back orders are also processed

without any minimum value restrictions. To address this issue, an analysis was conducted to determine the optimal base order value, where freight cost would represent approximately 1% of Gross Sales. The identified value was set at 500 euros as the minimum order amount.

The Sales department will be tasked with modifying the minimum order value and reevaluating the back order process. An important step in this process is to analyze a minimum order value that will be acceptable to customers. Negotiations with customers are expected throughout 2023 to set a new minimum value by the end of the year, to be implemented from 2024. The Supply department estimates the agreed-upon value will be 200 euros, as it aligns with the current minimum value in Perrigo Spain—a country with similar brands, strategies, and business volumes. Leading to a 50% reduction in orders and distances travelled and a 2% reduction in the net total.

To determine the reduction, the following steps are necessary: (1) remove shipment lines below the 200 euro minimum value; (2) apply a 50% reduction to fuel consumption; (3) use Big Mile to calculate the new transport emissions. The 50% reduction in fuel consumption is based on the 52% reduction in distances, with a small margin of error taken into account. The reduction in emissions in the transportation sector is expected to be 50%, which, considering that this sector contributes to 10% of the total emissions, would lead to a 5% reduction in overall emissions. Additionally, it is assumed that the measure will be applied to complete years, with the reduction being observed over the 12 months of the reference year.

Table 5.12. resumes the information discussed above.

Table 5. 12 - Review minimum order policy detailed.

Area of reduction	Transport		
Starting Date	March 2023	Ending Date	January 2024
Start of Utilization: 2024			
Responsible for Implementation	Perrigo's Supply Chain Department and Sales Department		
Involved Parties	Perrigo's Supply Chain Department and Sales Department		
Data Sources	Reference year data and justified assumptions		
KPIs	Freight Cost relative to Gross Sales (%)		

5.3.3. Power Purchase Agreement

The proposed measure revolves around a contract that governs the energy consumption of Perrigo at the logistics operator's facility. The contract will ensure that the energy utilized in the operator's warehouse is sourced either from solar panels or green energy supplied by the grid. This contract will outline its duration of validity and specify the minimum percentage of consumption that must be covered by the purchase of green energy. Furthermore, it will account

for the operator's investment in enhancing the efficiency of energy generated by the solar panels, thereby reducing the reliance on grid energy.

The initiation process involves gathering vital information for the contract, such as panel capacity and efficiency, and obtaining approvals from Perrigo Portugal's financial department, the General Manager, and IDL's corporate division. By installing strategic meters, real-time data on actual energy consumption in the pharma warehouse and various areas will be obtained, facilitating transparent and equitable negotiations. Additionally, discussions may be held to explore the implementation of further monitoring mechanisms.

Once all monitoring mechanisms, including the solar panels, are fully operational, the execution of the power purchase agreement will run concurrently with the existing contract between Perrigo Portugal and IDL.

Achieving a 100% reduction in grey energy consumption will correspondingly result in a 100% reduction in CO₂e within the warehouse, considering that over 99% of the energy purchased currently falls into this category. This substantial reduction will effectively lead to a 100% decrease in the overall emissions since warehouse emissions contribute to 90% of the company's total emissions. In the first year of implementing the measure, with an impact for only 6 months, the expected total reduction will be 45%. Subsequent years, assuming no expansions or enhancements to the panels, will witness a remarkable annual reduction of 90%.

Table 5.13. resumes the information discussed above.

Table 5. 13 - Power purchase agreement detailed.

Area of reduction	Warehouse		
Starting Date	January 2023	Ending Date	To be defined
Start of Utilization: 2 nd half of 2023 (assumption)			
Responsible for Implementation	Perrigo's Supply Chain Department		
Involved Parties	Perrigo Portugal, Supply Department; Logistic operator; Financial Department and General Manager at Perrigo		
Data Sources	Reference year data and justified assumptions		
Extra	It will be necessary to improve the monitoring of energy flow		
	There is no concrete information about what will be contracted		
KPIs	kWh of energy to the logistics operator		
	kWh of energy produced by solar panels		
	Number of pallets occupied		

5.3.4. Optimise Sample Load and Distance

The transportation of samples represents a significant inefficiency in emissions from 2018 to 2021. The lack of standardization in sample approval has led to low weight shipments over long distances, averaging 0.05 kilograms per kilometres.

To address this issue, a measure is proposed to optimize sample transportation. Initially, product samples will be sent to the office and promotional material warehouses. Sales representatives will incorporate samples into their current visits, and the rest of the team will handle deliveries during customer visits to the office. Samples for internal use will also be redirected to the office and warehouses for easy collection by employees.

The measure categorizes samples as "Internal use" and "Customers," with a second phase focusing on load optimization. Consolidating shipments through coordination will be facilitated using an Excel sheet for employees to specify their item quantities for periodic sample shipments. A small stock will be maintained at the office for client visits. Using the sample data from the reference year, the measure will reduce destinations from 164 to 22, and shipments from 311 to 67. This results in a 15% reduction in distances travelled, with shipments optimized from 68 kg per customer to 318 kg per customer.

Analysing overall shipment data, the reduction in the number of shipments is 1.61%, and in distances, it is 0.6%. Consequently, the measure will lead to a 1.61% reduction in emissions in the transportation sector, contributing to an overall 0.16% reduction in total emissions, considering this sector's 10% contribution.

Although the emission reduction may not be substantial, the measure will profoundly impact the teams' approach, fostering awareness and responsibility towards sustainability.

Table 5.14. resumes the information discussed above.

Table 5. 14 - Optimize sample load and distance detailed.

Area of reduction	Transport		
Starting Date	January 2023	Ending Date	February 2023
Start of Utilization: 2023 excluding January			
Responsible for Implementation	Perrigo's Supply Chain Department		
Involved Parties	Perrigo Portugal, Supply Department; Sales department; Marketing department; Trade Marketing Department		
Data Sources	Reference year data and justified assumptions		
KPIs	Number of sample shipments		
	Average sample weight		

5.3.5. Traceability of Measures

Given the presented reduction measures, effective monitoring and control are essential to ensure traceability of the reductions and actions taken. A collaborator from the Supply Department will be responsible for monitoring and control.

Each measure will have a dedicated document detailing the steps taken, results achieved, resources utilized, real performance against defined KPIs, and important notes. Monthly

meetings between the monitoring responsible and the Head of Supply, with optional participation from GS1, will review progress and plan future actions.

To support the monitoring methodology, the following control mechanisms will be implemented:

- **Solar Panels in the Warehouse:** Installation of meters at strategic locations and the use of software to track daily production data.
- **Power Purchase Agreement:** Use the meters for Solar Panels, along with monitoring the logistic operator's energy purchase invoices from the grid.
- **Optimize Sample Load and Distance:** Monthly control through extraction of sample documents from the system; daily control of sample flow approvals with status updates to relevant teams.
- **Review Minimum Order Policy:** Utilization of existing system blocks and monthly control through extraction of order documents (PRFs) from the system.

The defined monitoring and control system will quickly identify any necessary adaptations to achieve objectives. The responsible monitoring and control personnel will lead the mitigation and adaptation plan's execution, with all adaptation moments recorded in the monitoring document. Communication within the company and with third parties will be managed by the monitoring and control personnel, using emails and meetings. The Perrigo Europe sustainability team will provide support as needed.

5.4. Evaluating Action

In order to evaluate the effectiveness of the measures implemented, a comprehensive set of KPIs has been developed. As outlined in Chapter 5.3, each measure is accompanied by a group of performance. The following section presents a breakdown of these KPIs, using the Table 5.15. to offer valuable insights into the specification of each one.

After reviewing the initial plan, the audit company identified some areas for improvement. Their feedback primarily revolved around the need for more detailed descriptions of activities within and outside the scope. Additionally, they suggested incorporating visual interpretations to enhance readability and allow for quicker comprehension by any reader.

Taking this feedback into consideration, the revision was diligently made, which took approximately three days to complete. The aim was to address the audit company's recommendations and ensure that the plan was more comprehensive and visually appealing.

Table 5. 15 - KPI detailed.

Measure	KPI	Description
<i>Solar Panel in the Warehouse</i>	Production Efficiency	Measures the average energy production efficiency of solar panels over a specific period. Helps understand the energy performance and supports decisions on potential expansion (%).
	kWh of Energy Produced by Solar Panels	Tracks the total kWh of energy produced by installed solar panels during a certain period (kWh).
<i>Power Purchase Agreement</i>	kWh of Energy Purchased by the Logistic Operator	Measures the total kWh of energy purchased by the logistic operator over a specific period. Helps understand the energy performance and compliance with the Power Purchase Agreement specifications (kWh).
	Number of Occupied Pallets	Counts the number of occupied pallets in the warehouse during a certain period. Provides information on volume and indicates when action is necessary to mitigate stock high growth (pallets).
<i>Optimize Sample Load and Distance</i>	Number of Sample Shipments	Tracks the total number of sample shipments during a specific period. Provides information on the optimization of distances covered (shipments).
<i>Review Minimum Order Policy</i>	Average Weight of Samples	Measures the average weight of samples shipped during a certain period. Provides insights into the optimization of shipment (kg).
	Freight Cost as a Percentage of Gross Sales	Calculates the ratio of transportation costs to the value of gross sales during a specific period. Provides insights into the impact of average value variation and the business sustainability (%).
<i>All Measures</i>	Weight Growth	Tracks the total weight of shipments during a specific period. Provides information on business volume and indicates the need for actions to support it (tons).

Upon completion of the revisions, the final version of the plan was presented to the audit company for their final review. The audit company thoroughly assessed the revised plan and final action plan and approved it with outstanding results. The plan received accolades for its thoroughness and adherence to the project's objectives.

While the approval was a moment of success, the audit company did provide a note for future reference. They emphasised the importance of maintaining traceability throughout the project and ensuring that all CO₂e reductions were accurately recorded and accounted for.

Chapter VI. Conclusion and Recommendations

In this research project, the central research questions focused on the current pattern of CO₂e emissions by Perrigo and the actions required to achieve a 20% reduction in logistics-related CO₂e. To address these questions, clear objectives were established, including the creation of a comprehensive emissions database and the development of a robust reduction action plan. The attainment of these goals was contingent upon meeting specific criteria, such as obtaining reliable data for 2018 and 2021, conducting a coherent data analysis, identifying areas for reduction, and formulating a feasible action plan.

During the construction phase, a cyclical approach was adopted to ensure the sufficiency and trustworthiness of the emissions data. The analysis revealed that 90% of emissions originated from warehouse activities, while transportation activities accounted for the remaining 10%. Despite an overall decrease in CO₂e (absolute) and CO₂e per ton (relative) from 2018 to 2021, there was an increase in CO₂e per ton per kilometre (relative), indicating inefficiency in certain operational aspects.

Addressing the second research question, the step planning action resulted in a prioritized list of four measures to implement over the next five years, with additional considerations of four measures for the future. These measures were collectively agreed upon during workshops with stakeholders. Achieving the 20% reduction target hinged on identifying measures that balance substantial emission cuts with cost and long-term viability and safety. The step taking action solidified the implementation plan, while the step evaluating action confirmed the project's value through a positive audit.

One significant challenge encountered during this in-company project was bridging the gap between theoretical concepts and practical work. The early stages presented opportunities for alignment, but the subsequent planning phase, proved more limiting and occasionally repetitive. This challenge is common in research projects conducted within real-world environments, where practical complexities may not always fit neatly within theoretical models. Moreover, in-company projects often encounter real-world complexities that are not always accounted for in theoretical models. These complexities may involve organizational hierarchies, existing processes, resource constraints, and differing priorities among stakeholders. As a result, researchers may have had to navigate these complexities while staying true to the project's sustainability goals.

To overcome this challenge, flexibility and adaptability were crucial. The researchers exercised critical thinking and problem-solving skills to tailor theoretical concepts to the

company's unique context. Refining the methodology and incorporating stakeholder feedback helped ensure a coherent and feasible action plan. Collaborating closely with all relevant parties enabled a better understanding of on-the-ground realities, allowing for adjustments that maintained alignment with sustainability goals.

The involvement of multiple stakeholders brought both opportunities and challenges. The logistics operator's competing priorities presented complexities in aligning their actions with sustainability objectives. Careful coordination and negotiation were necessary to find common ground and ensure progress. On the other hand, the collaboration with GS1, a valued partner, played a pivotal role in overcoming obstacles and enriching the project's approach with their expertise and guidance.

The research project's contributions extend to multiple dimensions, leaving a lasting impact on the program, the company, and the future of sustainability in the pharmaceutical industry. For the Lean & Green program itself, the emissions reduction plan will provide valuable insights and concrete strategies to promote sustainability within the program's framework. It serves as a roadmap for integrating environmentally responsible practices into companies, setting a precedent for future projects and initiatives. The knowledge and methodologies developed during this study can be applied as a blueprint for other projects within the program, fostering a culture of sustainability and responsible environmental stewardship.

Within the company, the impact is multi-faceted. First and foremost, the comprehensive emissions reduction plan directly addresses the company's carbon footprint, guiding it towards a more environmentally conscious and sustainable future. By identifying specific areas for reduction and providing a well-structured action plan, the company gains a competitive advantage in terms of sustainability, which can enhance its reputation and appeal to environmentally conscious stakeholders, investors, and customers. Furthermore, the collaboration with multiple stakeholders, has enhanced the company's ability to work in tandem with external partners to achieve shared sustainability objectives. This experience of successful collaboration can lay the groundwork for future partnerships and collaborations that align with the company's sustainable goals.

Additionally, the research project addresses a theoretical gap in sustainable studies within the pharmaceutical industry. By utilizing BCK methods, a novel approach in this context, the study demonstrates the potential for innovative solutions to sustainability challenges. The emissions reduction plan can serve as a benchmark for other pharmaceutical companies, influencing greener operations and advancing sustainability in the sector.

Considering the achievements and challenges encountered during this research project, several recommendations and opportunities for future work emerge. Firstly, it is advisable for Perrigo to rigorously implement the emissions reduction plan, continuously monitor progress, and regularly update stakeholders on achievements and challenges faced. Additionally, further research could delve into optimizing the identified measures and exploring additional innovative strategies to enhance sustainability. This could involve investigating emerging technologies, alternative energy sources, or even collaborative efforts with industry peers to address shared sustainability concerns. Moreover, extending the BCK methodology to other areas within the pharmaceutical sector presents a promising avenue for future research, with the potential to drive industry-wide sustainability initiatives. As we move forward, a continued commitment to sustainability and ongoing collaboration between academia, industry, and policymakers will be vital in achieving lasting positive change in the pharmaceutical industry's environmental footprint and fostering a more sustainable future.

In conclusion, this research project successfully identified the current emissions pattern of Perrigo and provided a well-founded plan for achieving a 20% reduction in logistics-related CO₂e. Despite the challenges faced during the study, the contributions made to both the industry and academia are valuable, furthering the pursuit of sustainability in the pharmaceutical world. The experience gained and the knowledge developed will undoubtedly leave a lasting impact on the company, the program, and the broader pharmaceutical industry, driving positive change towards a more sustainable future.

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Annexes

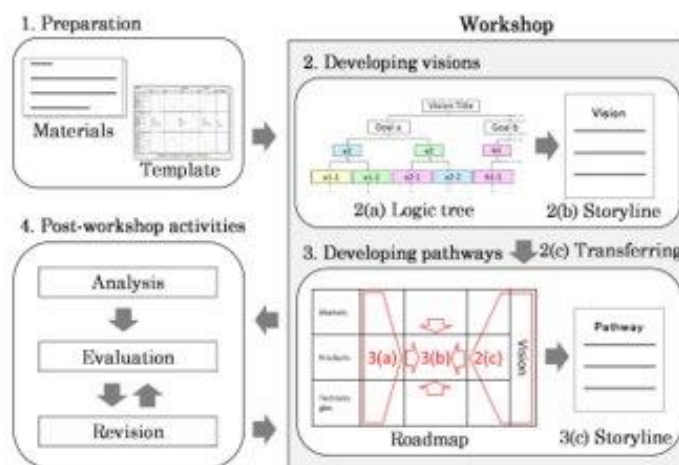
Annex 1 – Dreborg table of differences adapted

	Forecasting	Backcasting
Philosophical view	causality; determinism; context of justification;	causality & teleology; partial indeterminacy; = + context of discovery;
Perspective	dominant trends; likely futures; possible marginal adjustments; how to adapt to trends;	societal problem in need of solution; desirable futures; scope for human choice; strategic decisions; retain freedom of action;
Approach	extrapolate trends into the future; sensitivity analysis;	define interesting futures; analyse consequences, and conditions for these futures to materialise;
Method	various econometric models;	artial & conditional extrapolations highlighting interesting polarities and technological limits;
Techniques	various mathematical algorithms	-
Context	All issues; All time horizons; All scopes	Complex issues; Large time horizons; Scope must be wide enough to leave room to deliberate

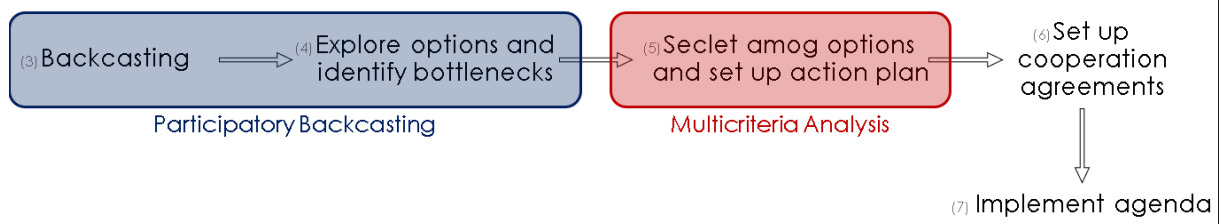
Annex 2 – Steps of the various Backcasting approaches

<i>Robinson</i>	<i>The Natural Step</i>	<i>STD</i>	<i>SusHouse project</i>	<i>Areas</i>
(1)Determine objectives	(1)Define a framework and criteria for sustainability	(1)Strategic problem orientation	(1)Problem orientation and function definition	Problem statement
(2) Specify goals, constraints and targets & describe present system and specify exogenous variables		(2)Develop sustainable future vision	-	Goal setting
(3)Describe present system and its material flows	(2)Describe the current situation in relation to that framework	-	(2)Stakeholder analysis and involvement (3)Stakeholder creativity workshop	Framing of current situation
(4)Specify exogenous variables and inputs	(3)Envisage a future sustainable situation	(3)Backcasting – set out alternative solutions		Future-oriented capability asserting
(5)Undertake scenario construction;	(4)Find strategies for sustainability	(4)Explore options and identify bottlenecks (5)Select among options & set up an action plan	(4)Scenario construction (5)Scenario assessments (6)Stakeholder Backcasting and strategy workshop	Scenario and Plan Building
(6)Undertake (scenario) impact analysis	-	(6)Set up cooperation agreements (7)Implement research agenda	(7)Realisation follow-up and implementation	Implementation Follow-up

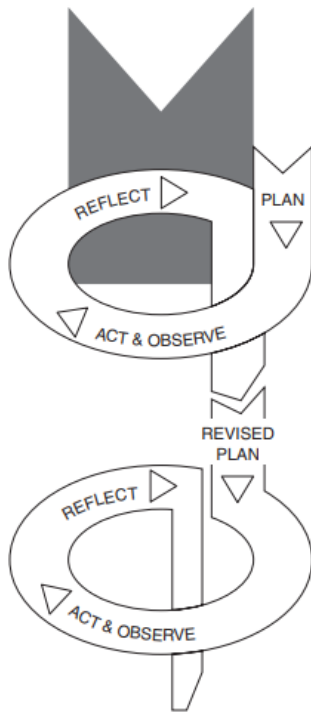
Annex 3 – Okada roadmap approach



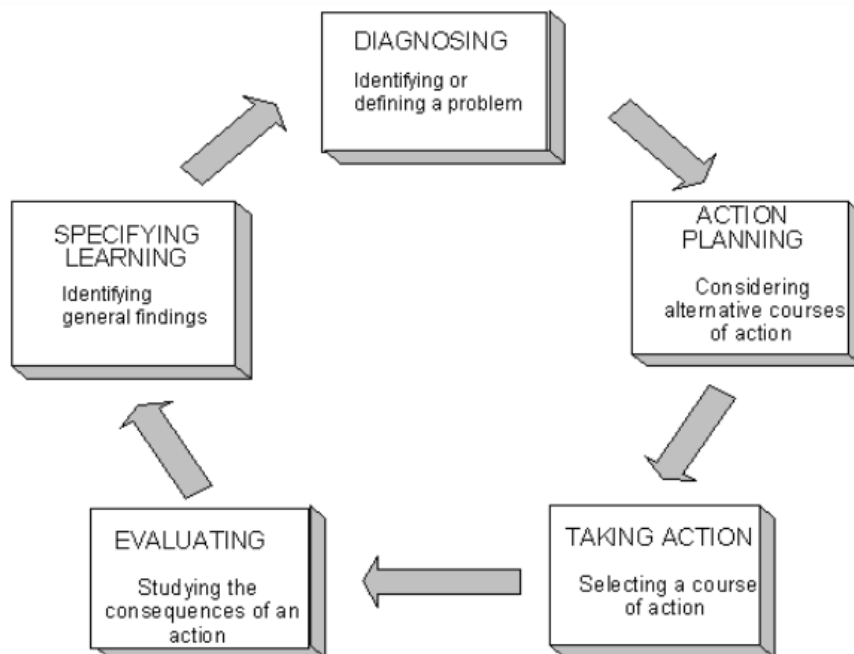
Annex 4 – Backcasting steps and tools



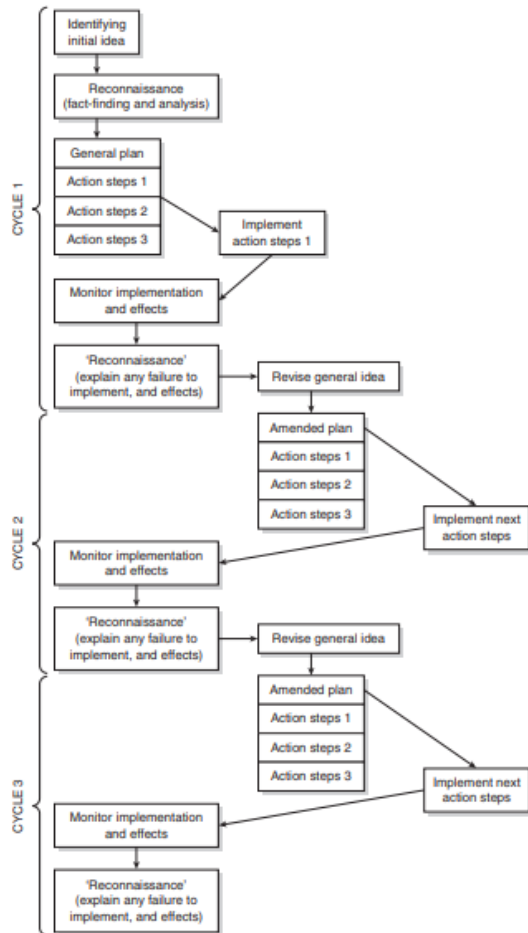
Annex 5 – Kemmis and McTaggart (2000: 595) participatory research



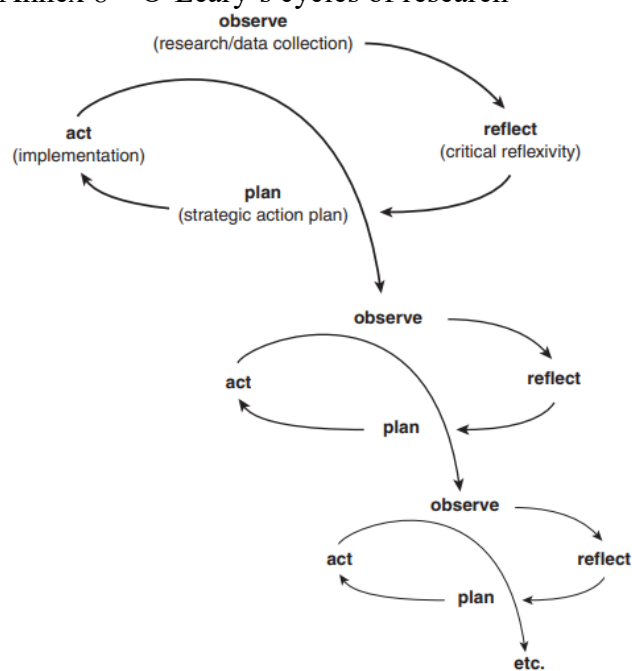
Annex 6 – Detailed Action Research Model (adapted from Susman 1983)



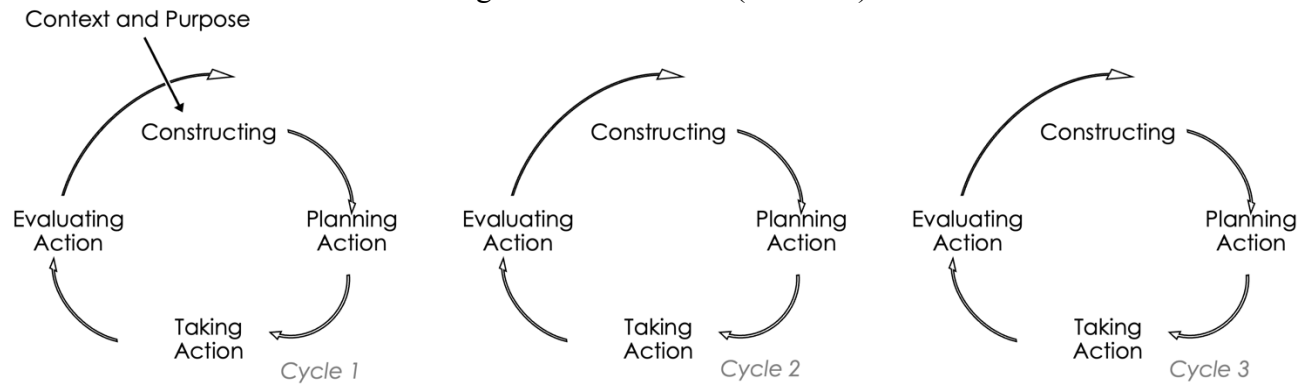
Annex 7 – Elliot’s action research model.



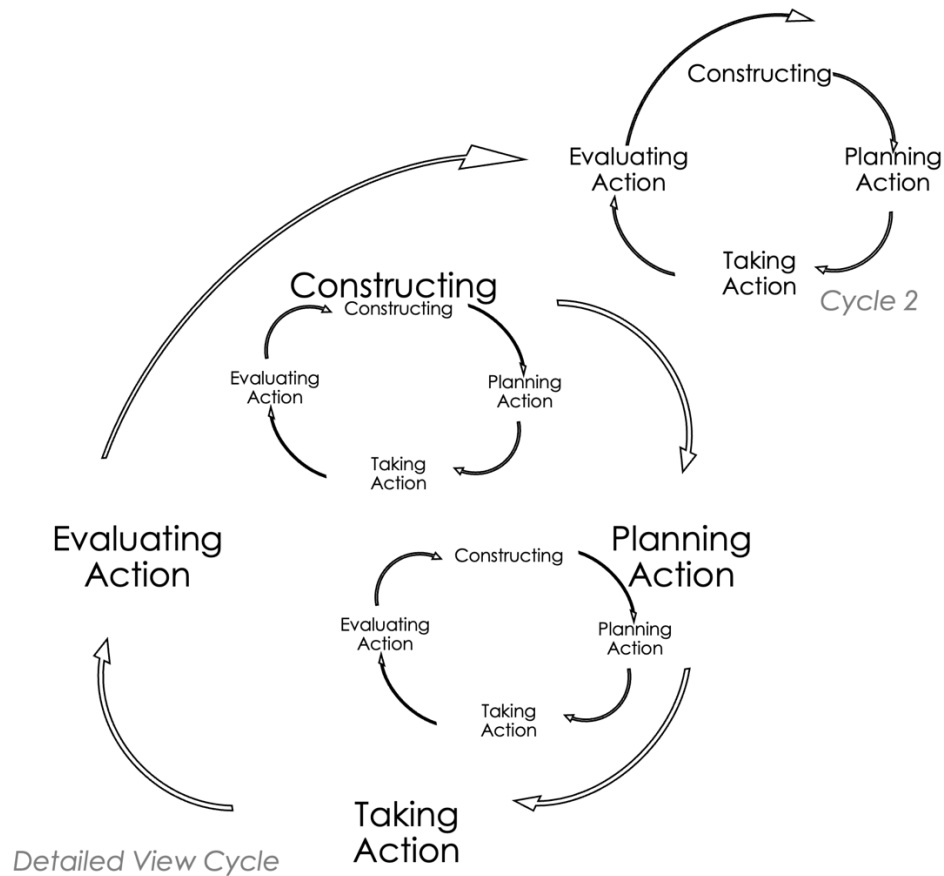
Annex 8 – O’Leary’s cycles of research



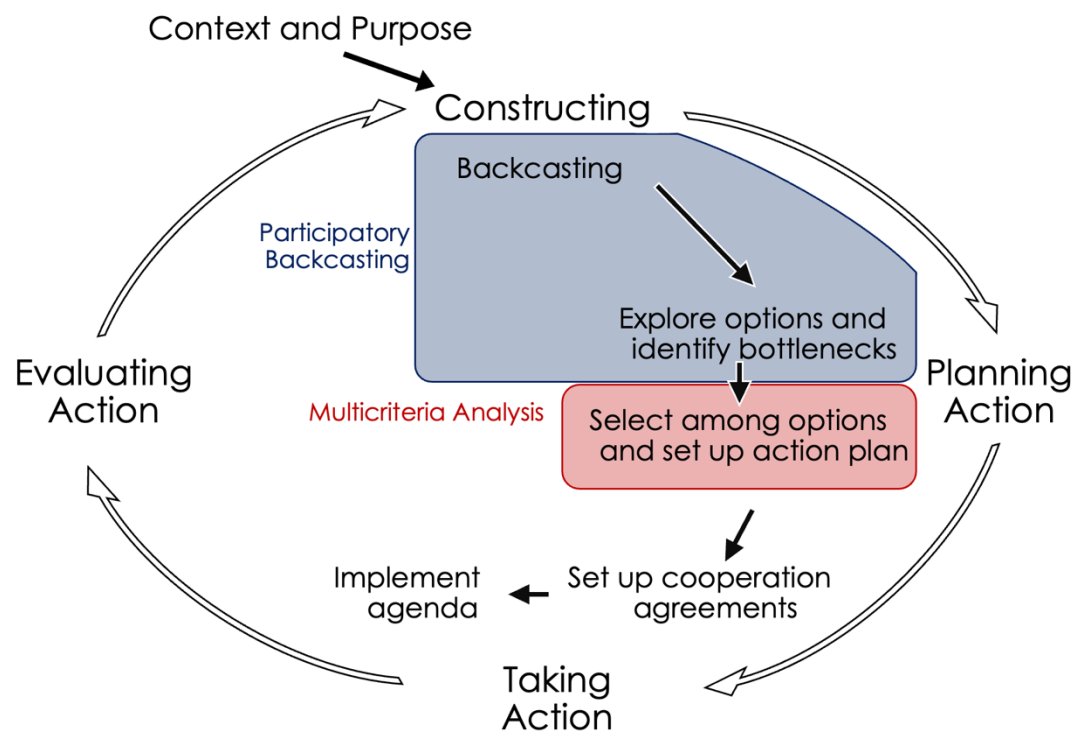
Annex 9 – Framework will on the Coghlan and Brannick (2014: 11)



Annex 10 – Final framework detailed view



Annex 11 – AR framework merged with BCK, highlighting the tools used in each stage



Annex 12 – Calculation of the ratio of green energy

Period	Energy Consumption	Green Energy Ratio
Janeiro		0,0031
Fevereiro		0,0031
Março		0,0031
Abril		0,0031
Maio		0,0031
Junho		0,0031
Julho		0,0035
Agosto		0,0035
Setembro		0,0035
Outubro		0,0029
Novembro		0,0029
Dezembro		0,0029
AVERAGE		0,32%

Annex 13 – Data fields Shipments

Assignment number	Carrier	Vehicle ID / License plate	Period fuel consumption	Period Energy Consumption	Date	Quantity (Kg)	Country code origin	Postal code origin	Country code destination	Postal code destination	Customer / Receiver (group)	Free input
-------------------	---------	----------------------------	-------------------------	---------------------------	------	---------------	---------------------	--------------------	--------------------------	-------------------------	-----------------------------	------------

- Assignment number of the shipment: This unique code serves as a means of communication between the logistics operator's ERP system and Perrigo's ERP system. It is automatically generated by Perrigo's ERP system.
- Carrier performing the shipment: As shipments involve the participation of three distinct parties, this field provides insights into the type of vehicle utilised and its corresponding fuel consumption for each specific shipment.
- Vehicle ID: This identifier corresponds to the license plate of the shipping vehicle, facilitating the tracking of shipments grouped within the same delivery. Given that a single license plate can be associated with multiple assignment numbers.
- Period of fuel/energy consumption: Signifying the month in which the shipment occurred, this field enables cross-referencing of fuel consumption.
- Date: Denoting the precise date of the shipment.
- Quantity (kg): Representing the total weight of shipment, this information is sourced from logistics data within the master data. The weight attributed to each order is determined by the logistic data of the items encompassed within that order, by multiplying the system weight of each SKU by its quantity and summing these values.
- Country of origin and Postal Code of origin: This field assume the same value, as only shipments originating from the logistics operator were considered for analysis.
- Country of destination and Postal Code of destination: This field are derived from the customer's address information.
- Customer: Indicating the name of the customer as specified in the shipping document.
- Free input: This field denotes the considered distance for the shipment. The information is obtained based on the optimal distance of shipping routes for various customers.

Annex 14 – Monthly occupancy rate of Perrigo in the logistics provider warehouse

Period Energy Consumption - 2018	% Perrigo
January	6,34%
February	6,95%
March	6,83%
April	6,32%
May	6,47%
June	6,60%
July	7,18%
August	7,04%
September	6,77%
October	6,38%
November	6,73%
December	6,51%

Period Energy Consumption - 2021	% Perrigo
January	6,85%
February	6,99%
March	7,69%
April	7,66%
May	7,50%
June	7,30%
July	7,68%
August	8,20%
September	9,46%
October	10,05%
November	11,13%
December	9,73%

Annex 15 – 1 vehicle ID has 1 shipment: consider the presented distance travelled

Assignment number	Carrier	Vehicle ID / License plate	Period fuel consumption	Period Energy Consumption	Date	Quantity (Kg)	Postal code origin	Postal code destination	Customer / Receiver (group)	Free input
PRF2021F5526	IDL	28681	maio	maio	2021-05-24	50,217	2050	3060	ITMP Alimentar, S.A.	193,353

Annex 16 – 1 vehicle ID has 2 or more shipments for the same postal code destination: consider the distance travelled only once

Assignment number	Carrier	Vehicle ID / License plate	Period fuel consumption	Period Energy Consumption	Date	Quantity (Kg)	Postal code origin	Postal code destination	Customer / Receiver (group)	Free input
PRF2021F48	IDL	1743655	janeiro	janeiro	2021-01-07	5,422	2050	4420	COOPROFAR	286,744
PRF2021F52	IDL	1743655	janeiro	janeiro	2021-01-07	50,612	2050	4420	COOPROFAR	0 286,744

Annex 17 –1 vehicle ID has 2 or more shipments for 2 or more postal code destinations:
consider the difference in distances travelled for each shipment

Assignment number	Carrier	Vehicle ID / License plate	Period fuel consumption	Period Energy Consumption	Date	Quantity (Kg)	Postal code origin	Postal code destination	Customer / Receiver (group)	Free input
PRF2021F69	IDL	1743867	janeiro	janeiro	2021-01-08	45,257	2050	2625	ALLIANCE HEALTHCARE, S.A.	18,15 2
PRF2021F70	IDL	1743867	janeiro	janeiro	2021-01-08	32,414	2050	2625	ALLIANCE HEALTHCARE, S.A.	0 18,15 2
PRF2021F71	IDL	1743867	janeiro	janeiro	2021-01-08	5,255	2050	2625	ALLIANCE HEALTHCARE, S.A.	0 18,15 2
PRF2021F72	IDL	1743867	janeiro	janeiro	2021-01-08	2,102	2050	2625	ALLIANCE HEALTHCARE, S.A.	0 18,15 2
PRF2021F74	IDL	1743867	janeiro	janeiro	2021-01-08	10,032	2050	2625	ALLIANCE HEALTHCARE, S.A.	0 18,15 2
PRF2021F75	IDL	1743867	janeiro	janeiro	2021-01-08	9,524	2050	2625	ALLIANCE HEALTHCARE, S.A.	0 18,15 2
PRF2021F94	IDL	1743867	janeiro	janeiro	2021-01-08	15,12	2050	2790	BOTELHO & RODRIGUES (LISBOA)	24 64,55 2
PRF2021F95	IDL	1743867	janeiro	janeiro	2021-01-08	8,856	2050	2790	BOTELHO & RODRIGUES (LISBOA)	0 64,55 2
PRF2021F96	IDL	1743867	janeiro	janeiro	2021-01-08	61,107	2050	2625	ALLIANCE HEALTHCARE, S.A.	0 18,15 2

Annex 18 – Emission factors considered by the tool table

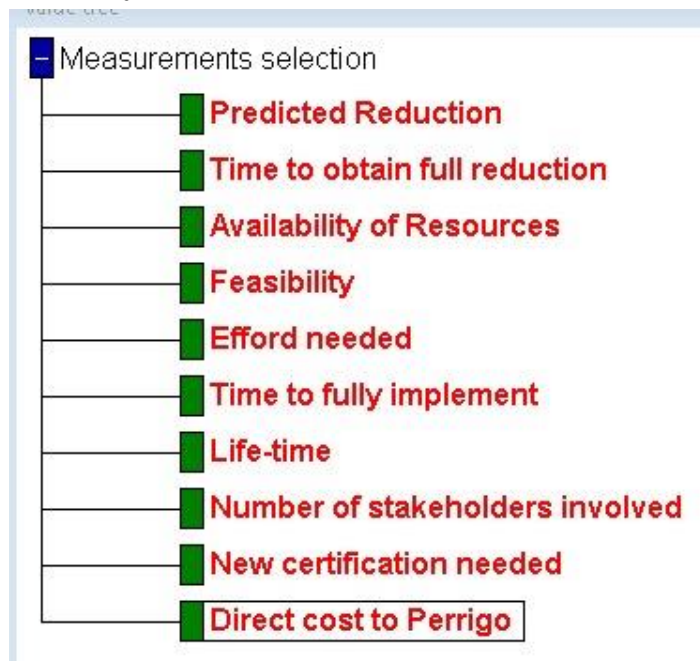
Fuel Type	KG CO2e
Diesel (liter)	3,262
Marine Diesel (liter)	3,436
LPG (Liter)	1,798
Bio-Ethanol (Liter)	0,558
LNG (KG)	3,651
HVO Bio-Diesel (Liter)	0,314
CNG (KG)	2,633
Kerosene (Liter)	3,202
Hydrogen (KG)	12,516
Hydrogen (Green) (KG)	1,092
Gasoline (Liter)	2,784
Bio-CNG (KG)	1,049

Grey energy: 0.524 kg CO2e / kWh

Annex 19 – Options MACBETH

Options			
-	+	Name	Short name
1		Solar Panels in the Warehouse	Me1
2		Optimize Sample Load and Distance	Me2
3		Power Purchase Agreement	Me3
4		CHEP or LPR Pallets in the Supply Chain	Me4
5		Incorporate Sustainable Principals in Product and Packaging Development	Me5
6		Get a Lean and Green Carrier for High Volume Areas	Me6
7		Review Minimum Order Value	Me7
8		Improve Waste Management	Me8
Add			Remove
Properties			Performances

Annex 20 – Value Tree MACBETH



Lean & Green Initiative action plan: The case of Perrigo Portugal

Properties of Direct cost to Perrigo

Name: Direct cost to Perrigo

Short name: Cost

Comments:

Basis for comparison:

☐ the options

☐ the options + 2 references

☒ qualitative performance levels:

☐ quantitative performance levels:

☒ criterion

Performance levels:

-	+	Qualitative level	Short
1		Very Low Amount	VL
2		Low Amount	L
3		Moderate Amount	M
4		High Amount	H
5		Very High Amount	VH

Annex 23 – Judgements of the criteria MACBETH

Predicted Reduction

	81-100%	61-80%	41-60%	21-40%	1-20%	0%	Current scale	
81-100%	no	moderate	strong	v. strong	v. strong	extreme	100.00	extreme
61-80%		no	strong	v. strong	v. strong	extreme	86.36	v. strong
41-60%			no	strong	v. strong	v. strong	63.64	strong
21-40%				no	strong	strong	40.91	moderate
1-20%					no	moderate	18.18	weak
0%						no	0.00	very weak
								no

Consistent judgements

Time to obtain full reduction

	1	2	3	4	5	Current scale	
1	no	weak	strong	v. strong	extreme	100.00	extreme
2		no	moderate	strong	v. strong	81.82	v. strong
3			no	moderate	strong	54.55	strong
4				no	moderate	27.27	moderate
5					no	0.00	weak
							very weak
							no

Consistent judgements

Availability of Resources

	VH	H	M	L	VL	Current scale	
VH	no	moderate	strong	strong	v. strong	100.00	extreme
H		no	moderate	strong	strong	76.92	v. strong
M			no	moderate	moderate	46.15	strong
L				no	moderate	23.08	moderate
VL					no	0.00	weak
							very weak
							no

Consistent judgements

Feasibility

	VH	H	M	L	VL	Current scale	
VH	no	strong	v. strong	extreme	extreme	100.00	extreme
H		no	strong	v. strong	extreme	73.33	v. strong
M			no	moderate	v. strong	46.67	strong
L				no	strong	26.67	moderate
VL					no	0.00	weak
							very weak
							no

Consistent judgements

Effort needed

	VL	L	M	H	VH	Current scale	
VL	no	weak	strong	v. strong	extreme	100	extreme
L		no	moderate	strong	v. strong	80	v. strong
M			no	moderate	strong	50	strong
H				no	weak	20	moderate
VH					no	0	weak
							very weak
							no

Consistent judgements

Lean & Green Initiative action plan: The case of Perrigo Portugal

Time to fully implement

	1	2	3	4	5	Current scale	extreme
1	no	very weak	weak	moderate	strong	100.00	v. strong
2		no	weak	moderate	moderate	85.71	strong
3			no	weak	moderate	57.14	moderate
4				no	weak	28.57	weak
5					no	0.00	very weak
							no

Consistent judgements

Life-time

	5	4	3	2	1	Current scale	extreme
5	no	very weak	moderate	strong	v. strong	100.0	v. strong
4		no	weak	moderate	strong	87.5	strong
3			no	moderate	moderate	62.5	moderate
2				no	weak	25.0	weak
1					no	0.0	very weak
							no

Consistent judgements

Number of stakeholders involved

	VH	H	M	L	VL	Current scale	extreme
VH	no	very weak	weak	moderate	strong	100.00	v. strong
H		no	weak	moderate	moderate	85.71	strong
M			no	weak	moderate	57.14	moderate
L				no	weak	28.57	weak
VL					no	0.00	very weak
							no

Consistent judgements

New certification needed

	VL	L	M	H	VH	Current scale	extreme
VL	no	weak	moderate	strong	v. strong	100.00	v. strong
L		no	moderate	strong	strong	81.82	strong
M			no	moderate	strong	54.55	moderate
H				no	moderate	27.27	weak
VH					no	0.00	very weak
							no

Consistent judgements

Direct cost to Perrigo

	VL	L	M	H	VH	Current scale	extreme
VL	no	strong	v. strong	extreme	extreme	100.00	v. strong
L		no	strong	v. strong	extreme	71.43	strong
M			no	moderate	v. strong	42.86	moderate
H				no	moderate	21.43	weak
VH					no	0.00	very weak
							no

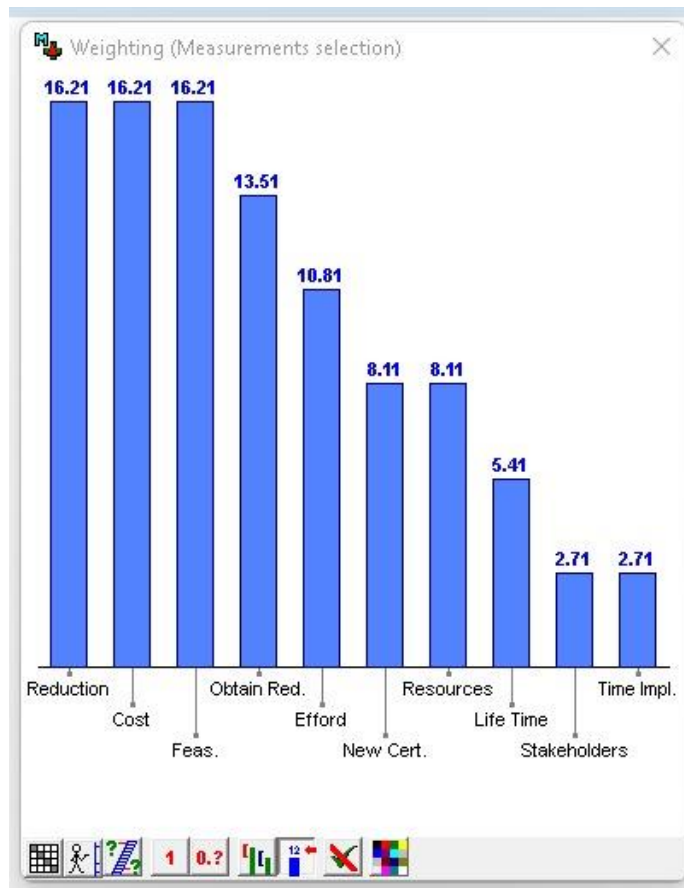
Consistent judgements

Annex 24 – Criteria Order of Importance and Validation MACBETH

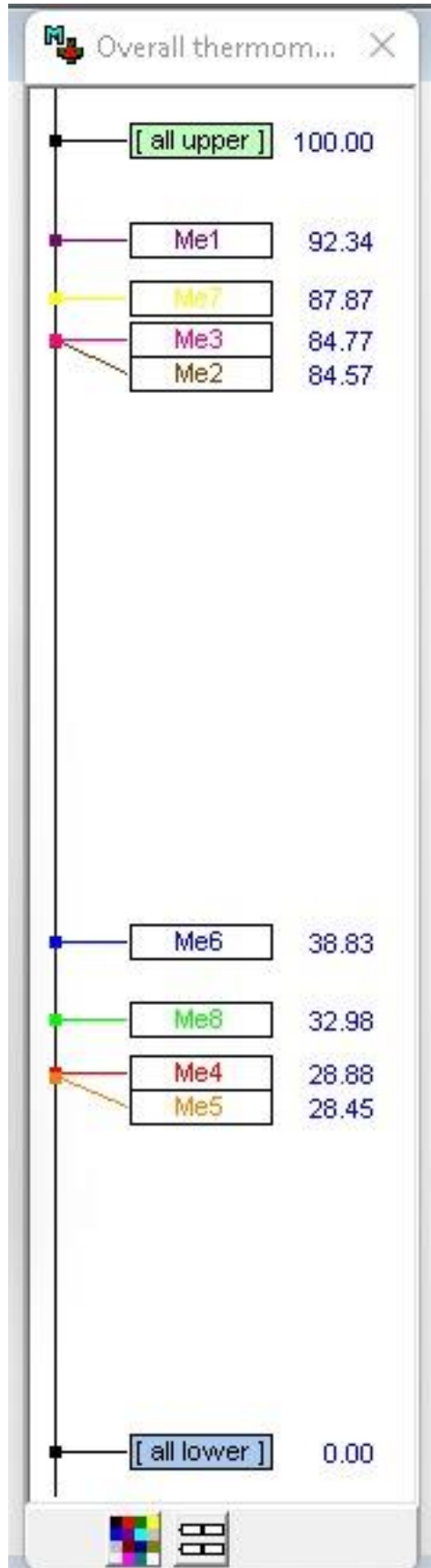
Weighting (Measurements selection)

	[Reduction]	[Cost]	[Feas.]	[Obtain Red.]	[Efford]	[New Cert.]	[Resources]	[Life Time]	[Stakeholders]	[Time Impl.]	[all lower]	Current scale	
[Reduction]	no	no	no	positive	positive	positive	positive	positive	positive	positive	positive	16.21	extreme
[Cost]	no	no	no	positive	positive	positive	positive	positive	positive	positive	positive	16.21	v. strong
[Feas.]	no	no	no	positive	positive	positive	positive	positive	positive	positive	positive	16.21	strong
[Obtain Red.]				no	positive	positive	positive	positive	positive	positive	positive	13.51	moderate
[Efford]					no	positive	positive	positive	positive	positive	positive	10.81	weak
[New Cert.]						no	no	positive	positive	positive	positive	8.11	very weak
[Resources]						no	no	positive	positive	positive	positive	8.11	no
[Life Time]								no	positive	positive	positive	5.41	
[Stakeholders]									no	no	positive	2.71	
[Time Impl.]										no	positive	2.71	
[all lower]											no	0.00	

Consistent judgements



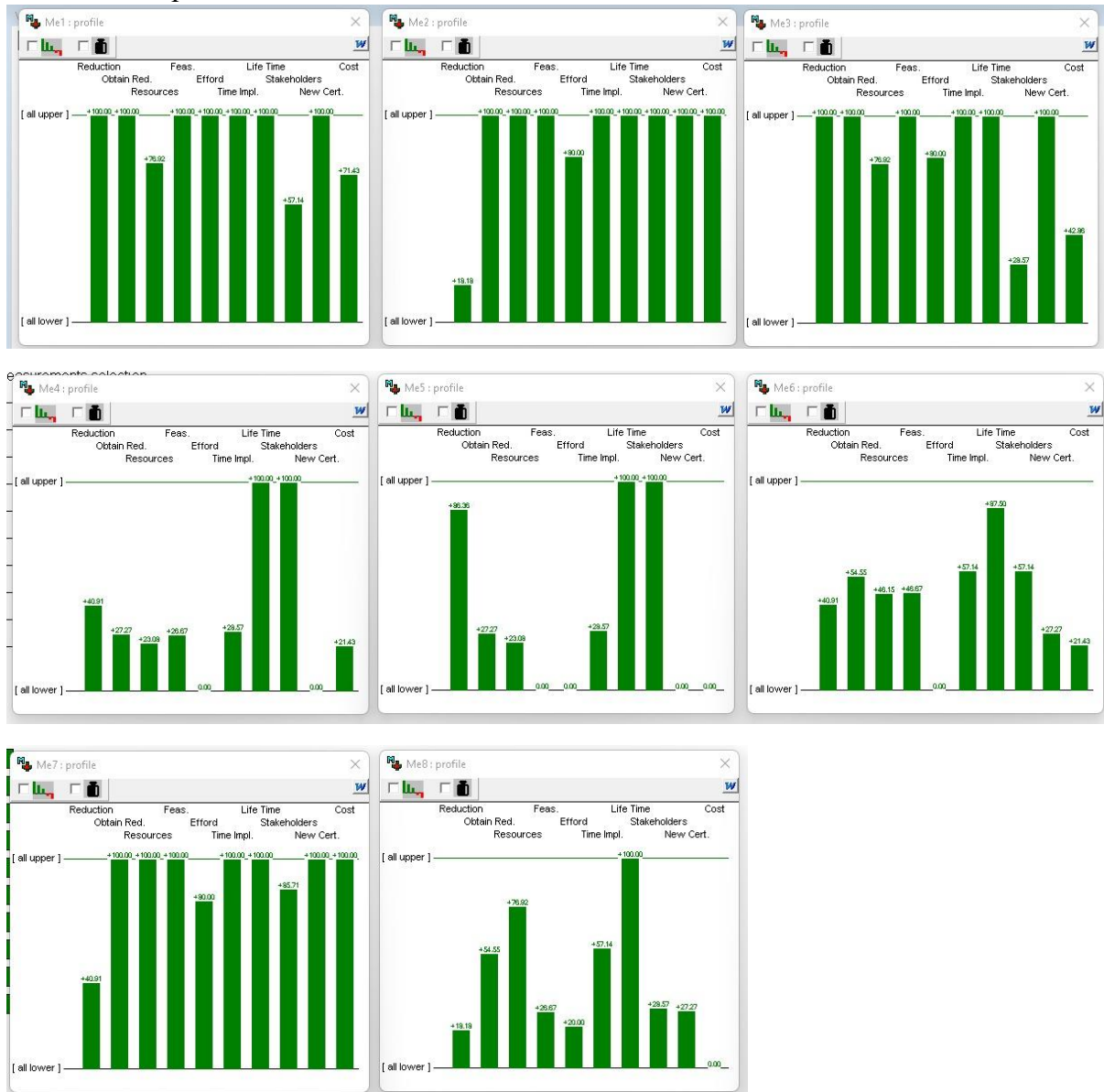
Annex 25 – Overall Thermometer MACBETH



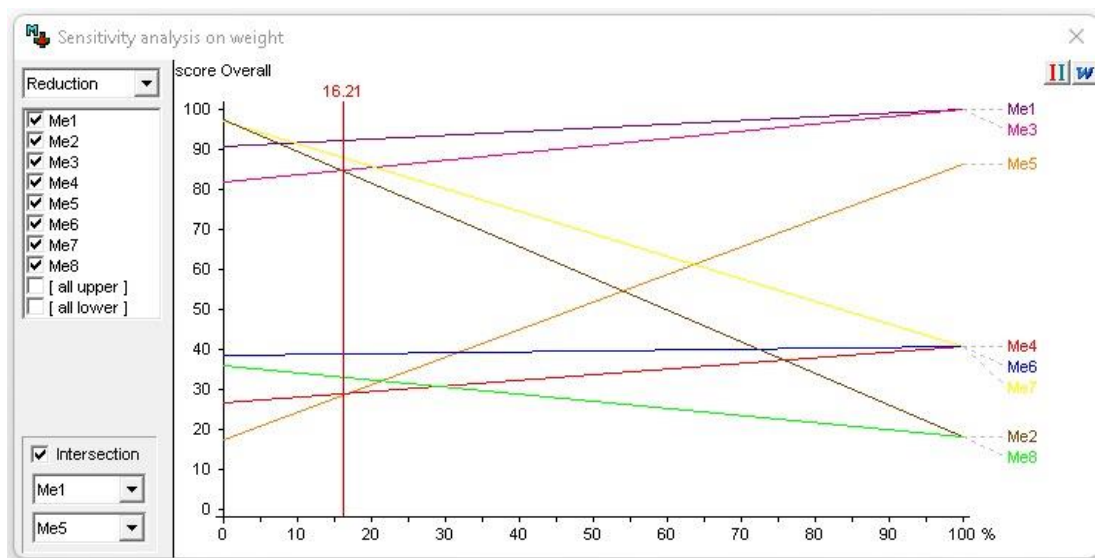
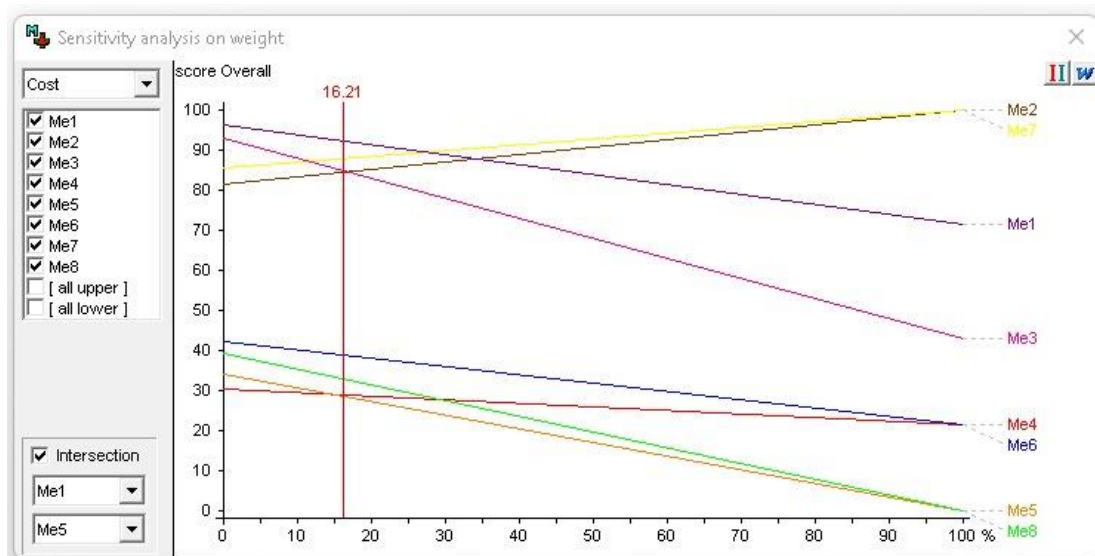
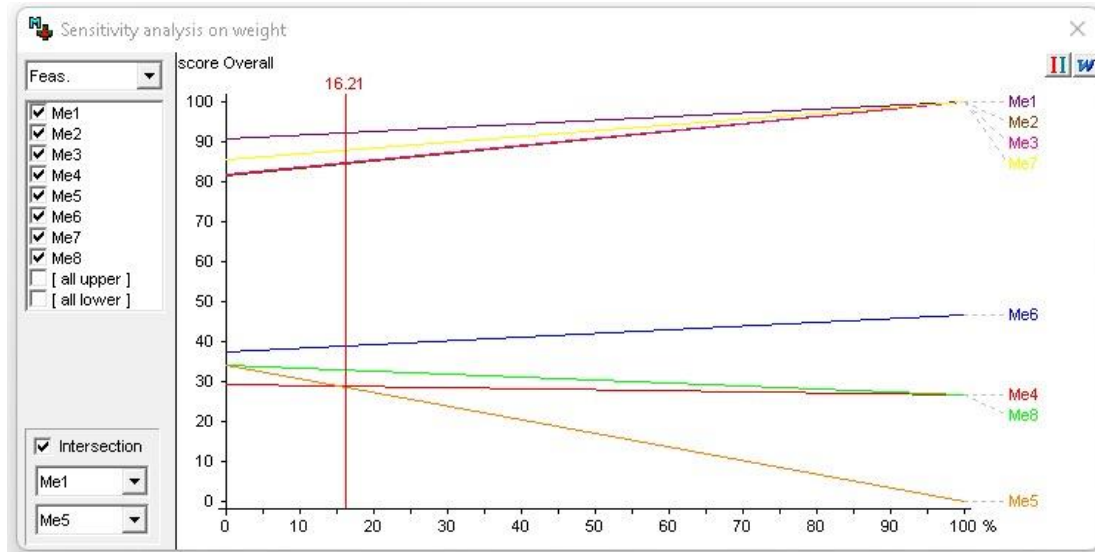
Annex 26 – Table of Scores MACBETH

Options	Overall	Reduction	Obtain Red.	Resources	Feas.	Efford	Time Impl.	Life Time	Stakeholders	New Cert.	Cost
[all upper]	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Me1	92.34	100.00	100.00	76.92	100.00	100.00	100.00	100.00	57.14	100.00	71.43
Me7	87.87	40.91	100.00	100.00	100.00	80.00	100.00	100.00	85.71	100.00	100.00
Me3	84.77	100.00	100.00	76.92	100.00	80.00	100.00	100.00	28.57	100.00	42.86
Me2	84.57	18.18	100.00	100.00	100.00	80.00	100.00	100.00	100.00	100.00	100.00
Me6	38.83	40.91	54.55	46.15	46.67	0.00	57.14	87.50	57.14	27.27	21.43
Me8	32.98	18.18	54.55	76.92	26.67	20.00	57.14	100.00	28.57	27.27	0.00
Me4	28.88	40.91	27.27	23.08	26.67	0.00	28.57	100.00	100.00	0.00	21.43
Me5	28.45	86.36	27.27	23.08	0.00	0.00	28.57	100.00	100.00	0.00	0.00
[all lower]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weights :		0.1621	0.1351	0.0811	0.1621	0.1081	0.0271	0.0541	0.0271	0.0811	0.1621

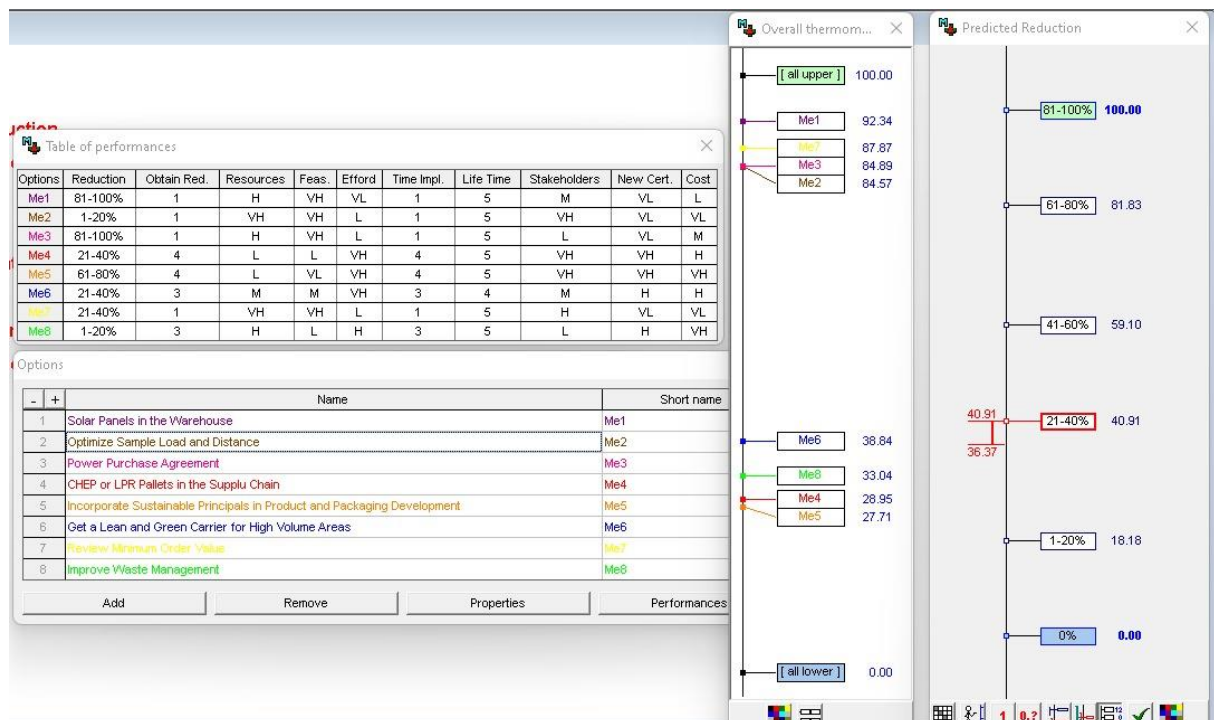
Annex 27 – Options Profile MACBETH



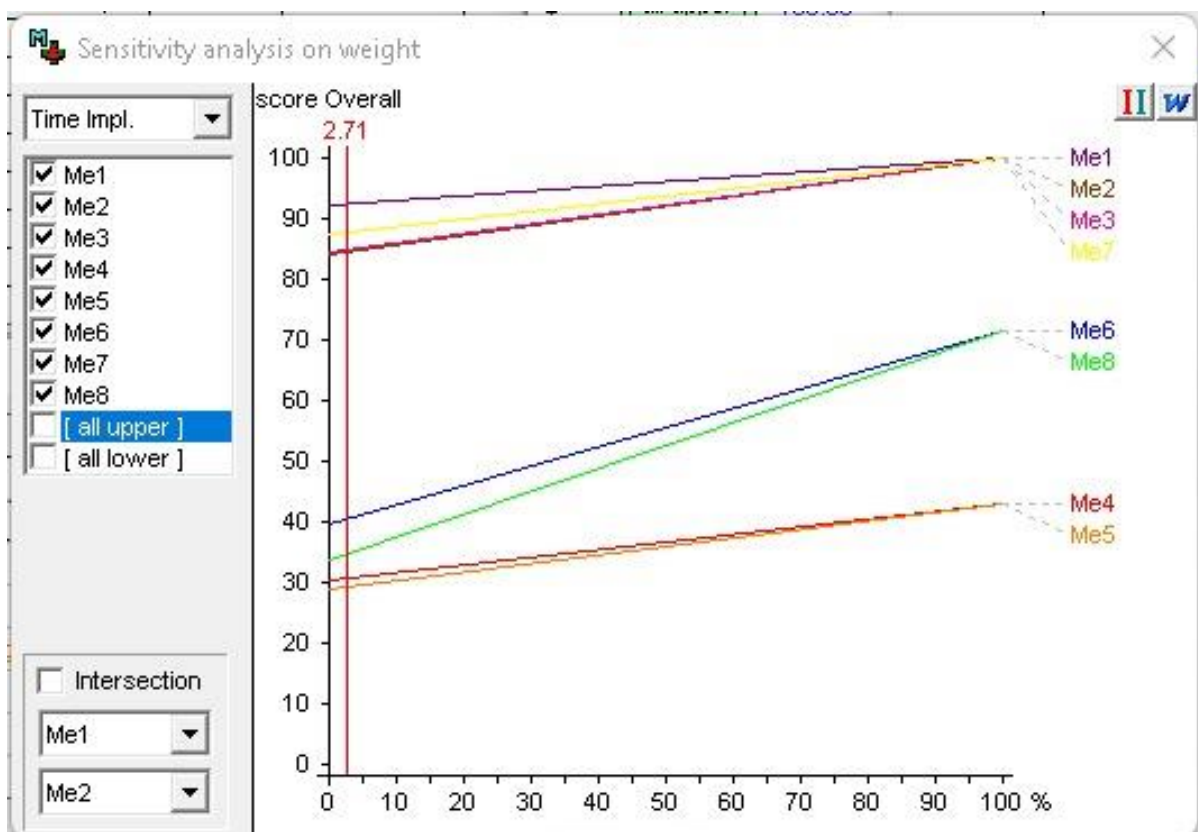
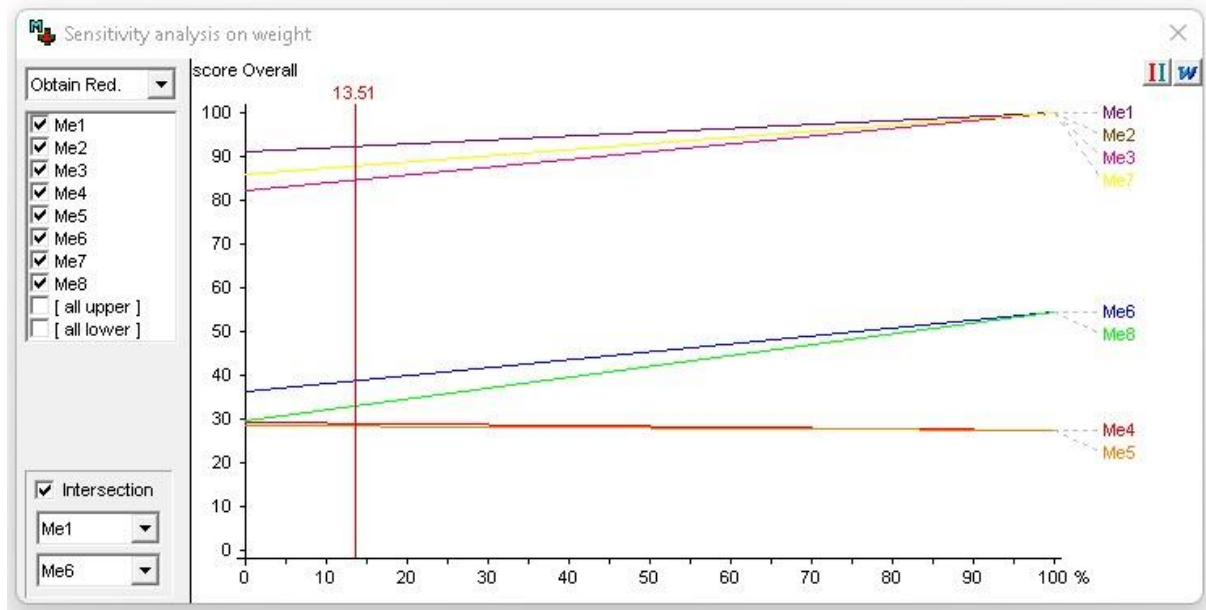
Annex 28 – Sensitivity analysis on Weight Top Criteria MACBETH



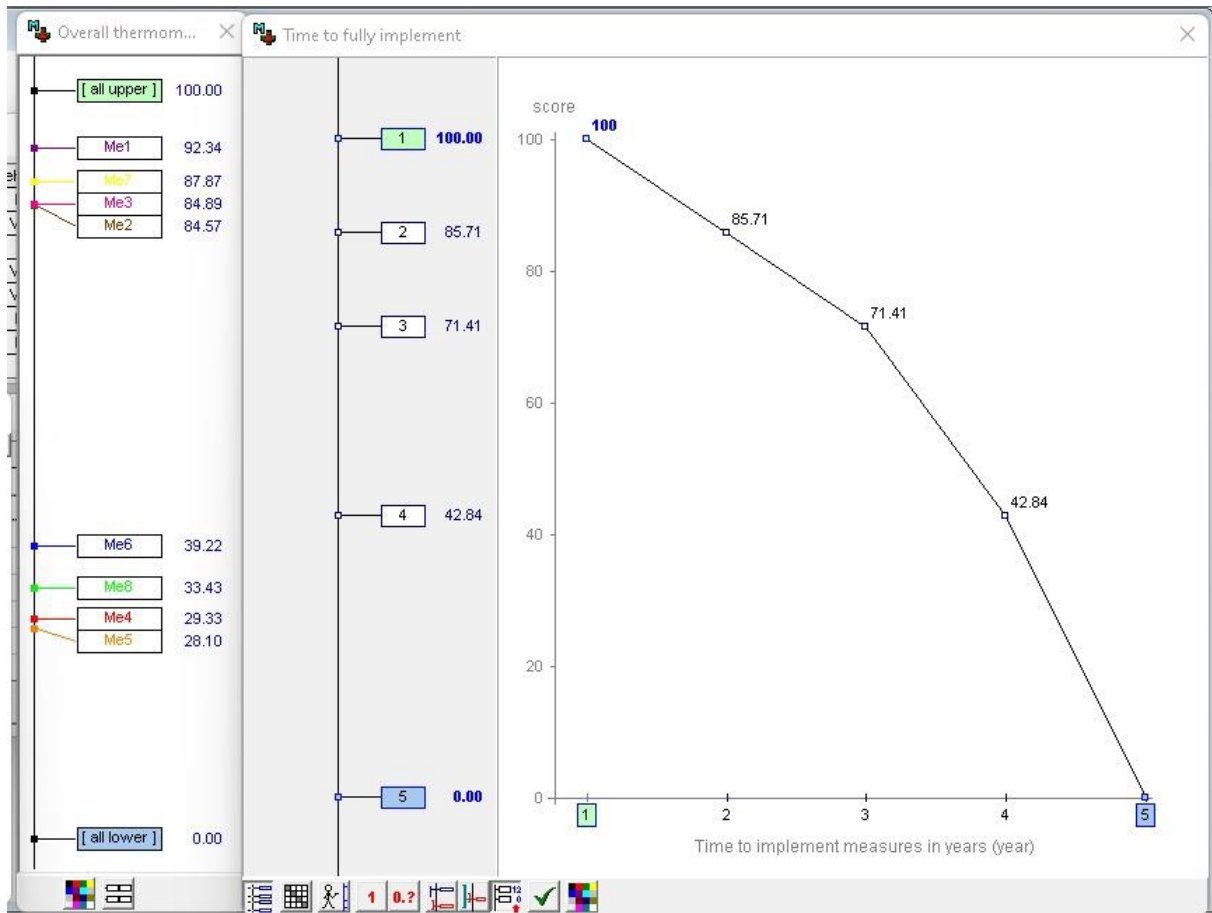
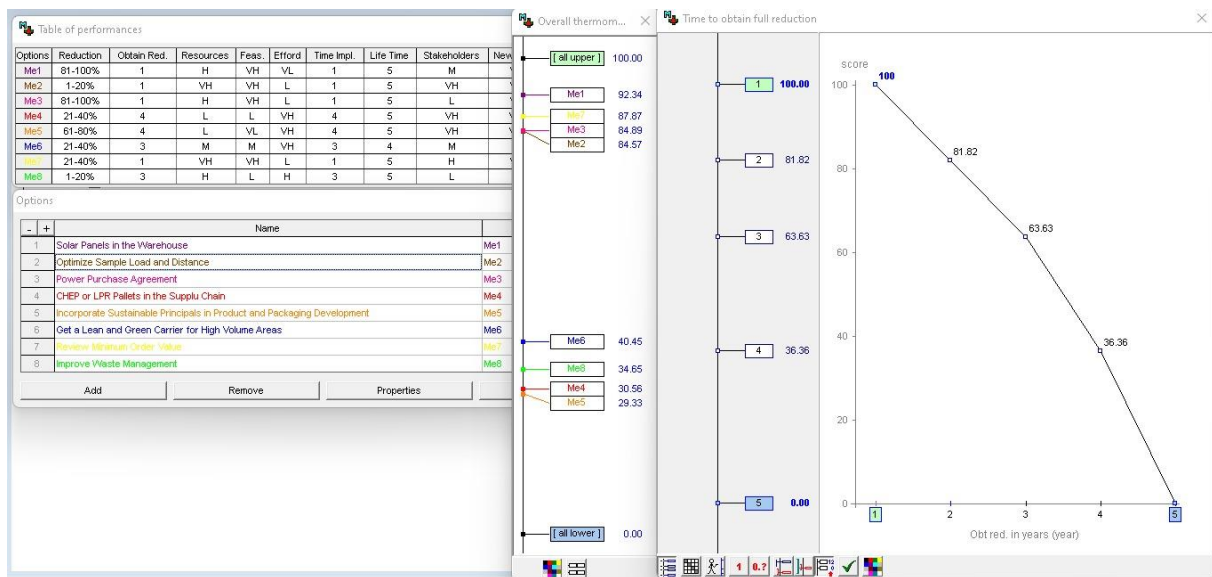
Annex 29 – Change of Value of Judgement Sensitivity Test on Predicted Reduction MACBETH



Annex 30 – Sensitivity analysis on Weight of Time to Implement and to Obtain Reduction MACBETH



Annex 31 – Change of Value of Judgement Sensitivity Test on Time to Implement and to Obtain Reduction MACBETH



Annex 32 – Plan of Action Lean & Green



Plan of Action LEAN&GREEN

1 Introduction

The present project is part of the Lean & Green program, and it focuses on a pharmaceutical company, Perrigo Portugal.

In this chapter, a brief framing of the problem and its context, the motivation behind what lead the company to join the program will serve as a foundation to highlight the project's potential and relevance. The chapter will also present the goals and content of the present document. In this regard, the link between the program goals and criteria and the company goals will be establish.

Considering the income generated by the pharmaceutical industry, as calculated in 2019 study, the industry creates around 48.55 tonnes of CO₂ equivalent per \$1 million, 55% higher than the level of emissions from the automobile industry. To add to the fact, only 25 firms have regularly reported their greenhouse gas emissions over the last five years, considering that the worldwide pharmaceutical sector is made up of over 200 firms.

The pharmaceutical field is strictly regulated. From patent application to marketing approval, commercial exploitation, and competition, all elements of the life cycle of pharmaceuticals are controlled. All major players in the pharmaceutical sector are subject to regulatory oversight.

As a result of the lack of reporting, elevated amounts of emissions, and severe regulatory barriers, there is a tremendous challenge in the pharmaceutical business to adopt sustainable solutions with actual impact. This was the main motivation to why Perrigo Portugal what to lead the example and act in solving this enormous issue. To do so, the company is aware that the measures taken need to have actual impact and scale, therefore they must be disruptive. Making the main sustainable goals of Perrigo Portugal to be, “Regularly report”, “Put impactful and sustainable measure in to place in order to not operate in an unsustainable matter”, “Create concrete and measurable reductions in emissions, waste and consumption” and “Giving back to the environment”. Creating the Report, Rethink, Reduce and Return cycle.

The present document will present the action plan in the aim of the Lean & Green program. The goal of the plan is to put into words Perrigo’s compromise to what will be developed, achieved and maintained in 5 years to obtain at least a 20% reduction of greenhouse gases. Reporting quality will also be a goal of the present document, since it is such a vital bone of the project.

Regarding the content of the document. The measures will be explored, they classify themselves as, TBD (to-be-done) measures, measures that are key to obtain the reduction and that will take place as soon as possible, support measures, measures that have the roll of supporting TBD measures and making them more supportable over time, and future measures, measures that were defined on the bases of working toward net zero emissions. Therefore, they have different ranks of importance and needed detail. The document will also provide estimation of reductions, expected outputs, and reporting criteria. Creating a solid ground to start acting in the Lean & Green program aim.

2 Company framing

Perrigo is a consumer-focused self-care brand, it is operating in Portugal since 2014. Currently Perrigo Portugal is a well-known brand in the Portuguese pharmaceutical world, being one of the top five companies in self-medication Portuguese market.

Perrigo's value proposition is to offer consumers everywhere "Quality, Affordable Self-Care Products". With over 3.000 formulations, Perrigo is a prominent producer of health and wellness solutions; with branded and private labels accessible in the United States, Europe, and other key regions. Perrigo's portfolio includes brands in the natural health and vitamins, cough, cold, and allergy, smoking cessation, personal care and derma-therapeutics, and lifestyle sectors.

The company is established by 8 departments, each one was the Head of the Department, all the Head together with the General Manager compose the Lead Team. The departments are Finance; IT; Regulatory Affairs; Marketing; Supply; Sales; Trade Marketing; Human Resources.



Fig 1 – Perrigo's Organogram

The company logistic activities are divided in four main ventures Inbound, Warehousing, Outbound e Returns.



Figura 2 - Fluxo de Atividades desempenhadas pelo Departamento de Supply

Demand planning, supply planning e purchase are the main tasks within Inbound ventures.

Demand planning is based on forecasting and S&OP (sales and operation planning) activities. All the workflows within the function aim to ultimately meet market demand in the most sustainable way possible, avoiding stockouts and excess inventory that would lead to scrapping. Therefore, it involves coordination between departments, receiving market inputs, and analyzing product behavior. Its output is the forecast, which serves as the basis for purchasing decisions. Supply planning involves coordinating with suppliers regarding delivery times, minimum order quantities, and product data. Based on this information and the demand planning forecasts, purchases are planned and placed.

Inventory management, ensuring compliance with regulatory affairs, and product destruction are the main functions in Warehousing.

Once the goods ordered by the purchasing department arrive at the operator's warehouse, IDL will carry out the goods receipt process, which involves counting and verification. IDL then informs which items have arrived, their quantities, and batches, and any necessary adjustments are made. If the Receiving Operator identifies any non-



conformities with the transportation that affect the goods, they inform the Layout Department, which then informs Perrigo Portugal about the observed non-conformities. If the goods being unloaded show disorganization or signs of loss of integrity, the unloading is performed, the situation is communicated to Perrigo Portugal, and the problem is documented, if necessary, including photographic evidence. If the goods being unloaded show signs that the physical integrity of the staff operating the merchandise may be compromised, the unloading will only take place after authorization from the responsible section manager. Based on this information, it is the responsibility of the compliance department to approve the release of the batches for commercialization of the specified batch. If everything is in order, this step remains as the final step in the goods receipt process.

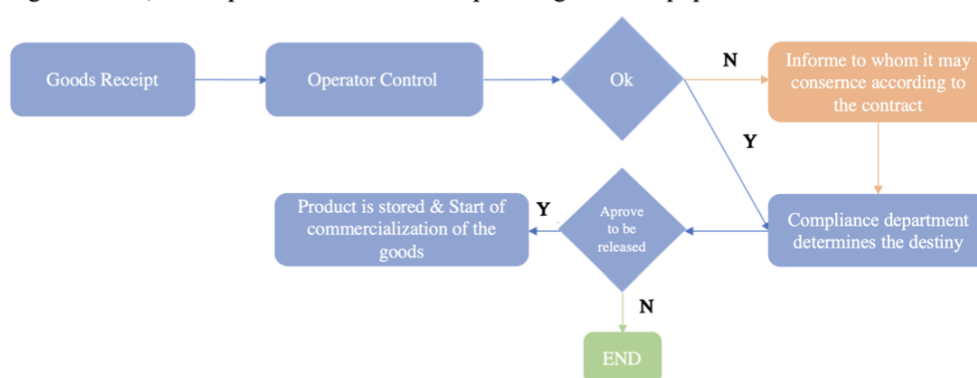


Figure 3 – Inbound Flow

The operator stores according to good practices, ensuring the correct storage and control of pharmaceutical products, observing special conditions and directives for the segregation of pharmaceutical products, as well as the proper recording of their location. Furthermore, the operator ensures that the locations are efficient and optimized. It is important to highlight that there are articles that are blocked and temporarily unavailable for sale. The reason for blocking may involve issues of expiration (products with less than 6 months of shelf life cannot be sold and will be segregated for destruction), quality issues, article handling issues, blocked for customers, or blocked due to returns.

Additionally, to reduce the risk of discrepancies between the operator's stock and Perrigo's stock, a weekly comparison is made between available products for sale.

Regarding disposal, it is done every 3 months. The Indaver group ensures the management of different types of waste generated by Perrigo Portugal. Currently, within the indicated period, Indaver collects a full trailer load from the operator's warehouse, and the current policy promotes the use of overlapping pallets whenever possible. Once in the possession of the waste manager, Medical Devices, Food Supplements, and Cosmetics undergo a physical-chemical treatment followed by disposal in a landfill located in Abrantes. Medicines and Aerosols/Pressurized Packaging are transported internationally to INDAVER NV in Belgium, where they are treated through incineration. The second type of treatment will produce energy that powers nearby factories.



To reduce the number of articles that are sent for scrapping or destruction, items that cannot be sold but are still in consumable condition (discontinued, loose units, etc.) are sent to the offices for internal use, for employees, or to the sales teams for promotional purposes.

Outbound activities include sample management, order management, the dispatch of orders and samples, and their delivery.

The customer places an order and sends it via EDI, through the 'my perrigo' platform or it can be entered into the system by a member of the Sales department. Then, the order goes through control procedures where it is checked if the customer has available credit and if the minimum order value (€30) is met. If any of these parameters are not met, the order is blocked and requires external approval (finance/supply chain team) to proceed. Once the necessary approval is obtained or if the parameters are met, the order document is transformed into a stock document according to the available stock, which is shared with the logistics operator. The picking is done using the "first expired, first out" (FEFO) rule, except for mass market customers due to expiration date agreements, and guides with allocated batches. Packaging is pursued, keeping in mind load optimization and always trying to optimize the packaging itself, using airbags in this process.

At this point, the stock document is transformed into an invoice, and the order will be accompanied by a copy of the invoice for the end customer. If it is found that the item is out of stock or there is insufficient stock to fulfill a line item of the order, the invoice document will indicate the missing line or adjust the quantities accordingly, and the missing product will not be charged to the customer.

It should be noted that the shipment of goods is optimized by the operator and the carrier, avoiding sending non-optimized loads.

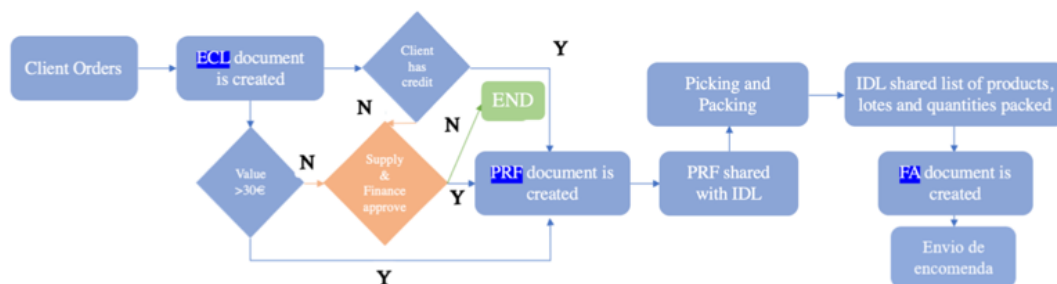


Figure 4 – Outbound Flow

Samples follow the same process as orders, starting with a request placed in the system, proceeding to a stock document, and being dispatched, with the addition of the labeling process between the picking and dispatch stages. Essentially, after the picking process is completed, the items are sent to the labeling area in the warehouse, where an individual label stating "Free Sample Not for Sale" is placed in the barcode area. Once the labeling is finished, the samples are packaged in the same location and proceed to dispatch, following the remaining process of an order. It is important to highlight that currently, the only restriction for orders is that they cannot include items that require multiples. In other words, certain items are sold in what we can call packs, where each pack contains a certain

number of multiples of the main SKU. To ensure that loose units are not sent and to avoid the need for scrapping, the inclusion of these items in samples is prohibited, reducing the possibility of not respecting the multiples. In conclusion, samples do not have a minimum value restriction or any other quantity and distance control restrictions.

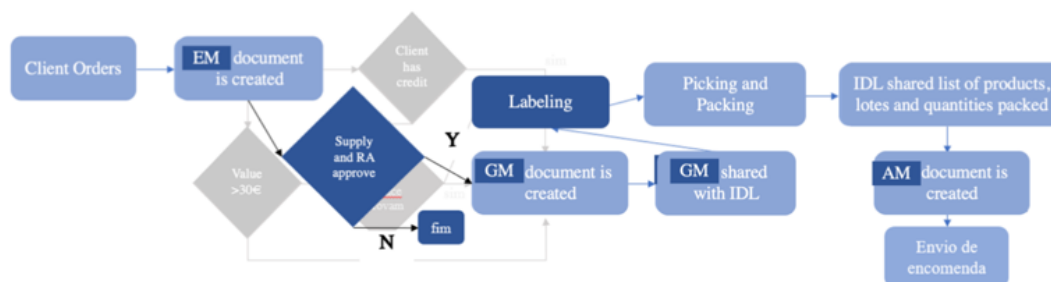


Figure 5 - Outbound Flow for Samples

Finally, Returns focus on returns management, customer management, and their entry into the warehouse. The remaining functions required for returns management are covered by Storage.

The workflow starts with the customer notifying that they have a return, providing necessary information, including the reason for the return. Based on this, the return is processed, and if approved by the sales team and other parties involved, it is accepted, and delivery or pickup can be arranged. If it is a return due to expiration, the customer is responsible for delivering it to the logistics operator. If it is for another reason, Perrigo Portugal is responsible for collecting it from the customer. Once at the operator, the returns go through a sorting process to confirm the item, quantity delivered/picked up, batch, and condition. All items that are in a sellable condition are reintegrated into the stock. However, returns of products that cannot be reintegrated into the stock due to expiration, quality, or damage are placed in a dedicated room and later destroyed. This dedicated room also contains returns that are pending for various reasons. For example, if excess items were delivered during sorting, they remain in the dedicated room until the matter is resolved. Additionally, there are items awaiting documentation to be reintegrated into the stock, such as customer temperature declaration and IDL serialization form.

Furthermore, to support the core business, promotional actions are carried out, most of which are subcontracted to a second logistics operator, Sermail. The operator has warehouses in Lisbon, Coimbra, and Porto, where Perrigo has dedicated pallets for customer managers. They collect promotional materials from these warehouses and distribute them to pharmacies, para-pharmacies, and customer wholesalers. In addition, Perrigo maintains its stock in the Lisbon warehouse. All of this represents an average of 50 to 80 pallets. It is important to note that this operation is standardized so that customer managers receive promotional materials a maximum of once a week if requested, and the shipping is coordinated among all parties to ensure transportation, movements, and stock are handled collectively.

Finally, it is important to highlight that all the described logistics activities undergo regular controls, mainly through status analyses. For example, returns undergo a biweekly analysis presented to Finance and Sales, as well as a monthly analysis presented to Regulatory Affairs and another monthly analysis presented to the logistics operator. Even promotional activities undergo status reports focusing on the expiration dates of items and sachets at the



operator, warehouse occupancy, and product rotation levels. Each control is tailored to the needs of the period and according to the parties who will have access to the information.

The main performance indicators of the operation are included in the Dashboard sent in the supporting documents. They are divided into indicators related to orders - number of orders, total order lines, total units ordered - complaints/incidents - number of incidents, total affected lines, total affected units - and finally, deliveries - delivery accuracy, outbound ratio, and shipments.

The physical supports for inbound logistics activities are the production factories of the products marketed by Perrigo Portugal and the means of transportation used to move the goods to Portugal. The destruction process in the storage activities currently utilizes the transportation means of Indaver, the landfill in Abrantes, and the incinerator in Belgium. Regarding the returns process, due to non-return fee agreements, the warehouses of some customers are indirectly used. However, it is important to note that all the mentioned means and facilities are not the responsibility of Perrigo Portugal, so all emissions generated will be the responsibility of the responsible parties. Furthermore, Sermail, the operator providing support for promotional materials, has three warehouses used by Perrigo, one in Lisbon - Vialonga, another in Porto, and another in Coimbra, and transportation between warehouses is ensured by the partner. However, as the mentioned objectives illustrate, emissions will be taken into account in the future, explicitly in the phase of the fifth star of the Lean & Green program.

Focusing on the infrastructures and means under the responsibility of Perrigo Portugal, that is, the structures, equipment, and transportation that directly contribute to emissions generation. The pharma warehouse subcontracted to ID Logistics at Rua dos Arneiros 2, Azambuja 2050, is the only warehouse used in the main logistics activities. Within the warehouse, Perrigo Portugal occupies a percentage of the temperature-controlled warehouse and a dedicated temperature-controlled room for returns. The transportation of goods and collection of returns are also ensured by IDL, which subcontracts Dismed or TorresTir Pharma, or handles it internally.

Infrastructure	Inbound, Warehousing & Outbound	IDL Pharma Warehouse
	Returns	IDL Pharma Warehouse or Wholesaler (Client)
	Destruction (Scrapping)	Landfill in Abrantes, Indaver, or Incinerator in Belgium, Indaver
	Promotional materials	3 Sermail Warehouses
Transport	Of products and collection of returns	IDL, Torrestir, Dismed/Medlog
	Returns	IDL, Torresti, Dismed/Medlog ou pelo cliente
	Destruction (Scrapping)	Indaver
	Promotional materials	Sermail
Human Resources	Perrigo	5 collaborators
	IDL	Varies with the workload
	Indaver	26 collaborators
	Sermail	Varies with the workload



All the processes mentioned as logistics activities are managed by the Supply Chain team of Perrigo Portugal, which consists of a Head of Supply, a Demand Planner, a Supply Planner, a Logistics Manager, and a Customer Service and Returns representative, totaling five people. The number of employees at the logistics operator varies greatly due to seasonal fluctuations that affect the workflow. However, globally, they have around 28,000 employees. The dedicated operator for promotional materials, Sermail, is also affected by seasonality. As for the partner Indaver, they have 26 employees in Portugal and nearly 2,000 (1,946) employees across Europe.

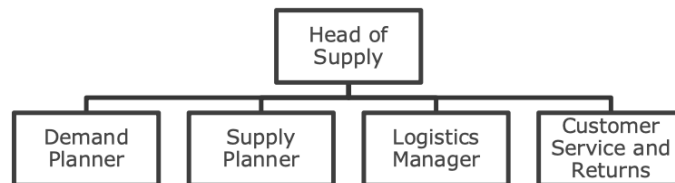


Figure 6 – Organization Chart of the Supply Chain Department

3 Scope

The activities under the CO2 baseline measurement are:

- Storage activity, including this activity will provide insight into the energy consumption of the operator, creating opportunities for emissions reduction in the warehouse area.
- Outbound activities in the warehouse (shipment of orders, samples, others), these activities represent order flows, sample flows, and other product shipping flows, where there is room for process improvement and the potential for emissions reduction in the transportation area.
- Goods transportation, currently the shipping is 100% managed by the operator and Perrigo has no visibility or decision-making power over it. Although there is information that the shipments are optimized, this optimization is done among multiple clients, creating global optimization but not guaranteeing it on a client-specific level. Perrigo sees an opportunity to synchronize order shipments between clients in the same region and initiate the practice of predefined weekly shipments, thus supporting global optimization and generating optimization at a micro level.

The activities that are excluded from the scope of reduction in the current action plan are:

- Emissions produced by Diesel will be excluded from the scope of reduction; however, they will be considered in the total emissions value for the warehouse and consequently in the overall emissions. The data used for calculation were fuel purchase data, as it was not possible to acquire more precise data on actual consumption due to the lack of control mechanisms in the warehouse. Nevertheless, it is not justifiable since Diesel usage is very limited, and the effort would not outweigh the pay-off. Considering the emission factor of Diesel used in the calculation, the total emissions are very low, amounting to less than one ton. These emissions cannot be eliminated as their usage is mostly related to generators required for proper warehousing practices.

Diesel Emission Factor	Diesel Emission
3,262	528,8572954
Total	111502
Total excluding Diesel	110973,14

The activities that are excluded from the scope of reduction and analysis in the current action plan are:

- Inbound activities in the warehouse will not be included as they are the responsibility of the producer until they reach the operator's warehouse. Given the number of suppliers, collecting data and implementing measures on a large scale at this initial stage would be quite complex. However, there is a desire to do so in the future, as expressed through the implementation of CHEP/LPR pallets throughout the supply chain and the incorporation of sustainability principles in product and packaging development. Currently, Perrigo Portugal has a total of nine suppliers creating inbound flows.



- Goods shipped to the islands: It is possible to gather information about the loads and distances, but no fuel consumption data can be collected due to the complexity of shipping, which involves various different modes of transportation and highly variable routes for each shipment. Furthermore, these shipments represent a low volume of business, generating only €636,020.61 net in 2021, which accounts for 2% of the total net value of €29,434,837.86 in 2021, and there were 518 shipping documents.
- Refrigerated gases: Since there is no record of replacements and refills of these gases that can be acquired in a timely manner, it is not possible to quantify their extent or impact. Therefore, they cannot be quantified for the current plan of action. However, it is an objective to include them in a future action plan.
- Returns or other product collections: Due to the instability of collection routes and frequent incidents that lead to line duplications, the quality of the data is believed to be lower than it actually is. In 2021, there were 859 collected returns, which represented 188,942 units of product and €238,905.66.
- Destruction emissions: Although it is possible to calculate the emissions from transportation, understanding the actual emission of the destruction itself is quite complex due to the current nature of the operation—mostly sending the product to landfills and large-scale incineration. Therefore, for the current plan, this action is out of scope, but it is an objective to include it in a future action plan. In 2021, 250,262 units were destroyed, representing a monetary value of €446,456.14, based on destruction documents.
- Promotional activities: These actions support the core business and represent a very low volume of emissions due to the standardization achieved in this operation. Currently, no CO2 measurement data can be collected. The average number of pallets between May and December 2021 was 254, but currently, the number is maintained between 70 and 130 pallets, as indicated by monthly analyses.

Period	< 1 m	> 1 m	> 3 m	> 6 m	> 12 m	Total
May_21	129	70	24	29	21	273
June_21	107	67	62	16	21	273
July_21	110	74	32	15	21	252
August_21	92	101	34	12	20	259
September_21	106	54	41	43	16	259
Outuber_21	96	40	65	29	13	243
November_21	111	47	41	25	7	231
December_21	92	58	41	42	7	239
Average						254



4 Goal of CO₂ emission reduction

The years used to understand the emissions trend were 2018 and 2021, with the most recent year, 2021, considered as the reference year. Considering that the reduction goal should be at least 20% of the emissions resulting from the activities within the scope (relative CO₂ reduction = CO₂ per KPI) and should be achieved within a maximum of five years, Perrigo Portugal sets the objective of reducing CO₂ emissions by 95.16% between 2022 and 2026, representing a reduction of 161,696.77 kg of CO₂ during that period. The reduction goal will be achieved through the implementation of various measures throughout the mentioned period, targeting different activities within the scope. Therefore, emissions in warehouse activities are projected to be reduced by 100%, accounting for 90% of the overall objective, while emissions in transportation activities are expected to be reduced by 51.61%, representing 5.16% of the overall objective.

No reductions were planned for 2022 as it was a preparatory year for entry into the program. The year 2023 will be the first year with reductions, although in this year, the projected reduction is 45.5% (77,849.11 kg of CO₂) as not all measures will be fully implemented and the measures that are implemented will not cover the entire year, as they will be implemented during specific periods. In the years 2024, 2025, and 2026, it is expected that all measures will be in operation, and therefore, these three years have a reduction target of 95.16%.

For more information on how this objective will be achieved and justifications for the values, refer to section 6, where the measures are presented, and section 9, the dashboard.



5 Base year CO₂ measurement

To calculate the CO₂ emissions of Perrigo Portugal, the activities mentioned within the scope were considered, which include all logistical processes of the core business. Therefore, the emissions from transportation and warehouse activities were calculated for the reference year.

Regarding the analyzed period, in order to detect any past emissions reductions, the years 2018 and 2021 were studied. The year 2018 was the last year recorded without the impacts of the pandemic, and among the years without COVID impact, it is the year that best approximates the currently traded volume. Therefore, it was selected to represent the past emissions period. Since the adherence to the Lean & Green project was made in mid-2022, the closest complete year to that date was considered as the reference year, and thus 2021 was chosen. Factors supporting this decision include: a year with business volume close to the current one, low pandemic impacts, a rich and easily accessible database, significant historical data and traceability to understand detected phenomena, and the possibility of quickly collecting qualitative data.

The calculation of CO₂ emissions was done using the Big Mile tool. This tool is based on the EN 16258 standard and automatically calculates emissions based on input documents containing data on energy consumption in the warehouse (used to determine emissions in the warehousing area) and fuel consumption in transportation, as well as shipments made during the analysis period (used to determine emissions in the transportation area).

The emission factors considered by the tool are provided, and the ones used in calculating the emissions for Perrigo Portugal are indicated in orange:

Fuel Type	KG CO ₂ e
Diesel (liter)	3,262
Marine Diesel (liter)	3,436
LPG (Liter)	1,798
Bio-Ethanol (Liter)	0,558
LNG (KG)	3,651
HVO Bio-Diesel (Liter)	0,314
CNG (KG)	2,633
Kerosene (Liter)	3,202
Hydrogen (KG)	12,516
Hydrogen (Green) (KG)	1,092
Gasoline (Liter)	2,784
Bio-CNG (KG)	1,049

0.524 kg CO₂e / kWh

Focusing on the characteristics of each type of data - shipments, fuel consumption, and locations.

Shipments

The data in this field was obtained through the extraction of shipping documents from the system by the logistics operator. The data includes information about:



- Assignment number of the shipment, which is the code used for communication between the logistics operator's ERP and Perrigo's ERP. This number is obtained through communication between Perrigo's ERP and the operator's ERP. The ERP automatically generates this number after an order is approved, as mentioned in the company's description.
- Carrier performing the shipment, as shipments vary among three different parties involved. The information in this field helps understand the type of vehicle and its fuel consumption for the specific shipment.
- Vehicle ID, indicating the license plate of the shipping vehicle, allowing to track which shipments were included in the same delivery since multiple assignment numbers can be assigned to a single license plate.
- Period of fuel/energy consumption, indicating the month of the shipment, enabling the cross-referencing of fuel consumption based on the month and the shipments.
- Date, the specific date of the shipment.
- Quantity (kg), indicating the total weight of items in the shipment. This information is obtained from logistics data in the master data. The weight considered per order is determined by the logistic data of the items included in the order. The weight of each SKU is known, as well as the SKUs and their quantities in each order. To determine the weight of the order, the system weight of each SKU is multiplied by the quantity and summed.
- Country of origin and Postal Code of origin, assumed to be the same as only shipments from the logistics operator to various destinations were considered. Pickup data was not integrated into this analysis, as mentioned in the scope.
- Country of destination and Postal Code of destination, based on the customer's address information to which the shipment is destined.
- Customer, indicating the customer's name on the shipping document, which is indicated either through the shipping entity or through manual changes made at the time of document creation.
- Free input, indicating the considered distance for the shipment. The information is obtained based on the optimal distance of shipping routes for various customers. The detailed analysis of the data presented in this field will be explained further. It is recommended to read the explanation and consult the documents with the considered formulas.

Assignment number	Carrier	Vehicle ID / License plate	Period fuel consumption	Period Energy Consumption	Date	Quantity (Kg)	Countrycode of origin	Postal code origin	Countrycode destination	Postal code destination	Customer / Receiver (group)	Free input
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The described data was verified through a comparison process between the data sent by the logistics operator and the data in the Perrigo system. In this comparison, the Assignment number and the Customer were cross-referenced. It is important to mention that the key shipment data is the weight and the distance traveled, as variations in these data will significantly affect fuel consumption and consequently emissions. Additionally, the weight data will be considered as the indicator for transportation activities, and for relative reduction calculations, it will be measured in tons.



Whenever a customer requests an order/sample/other, it is treated individually in the picking process. Therefore, it will have a unique assignment number that accompanies it to the destination. However, each assignment number is not sent individually. Shipping loads and shipments are optimized, and orders with destinations on the same routes, or even the same destination, are sent together.

This particularity has caused problems with duplicate kilometers, which were introduced in the "free input" column of the Perrigo Big Mile Attachment - DATA 2021. Essentially, the Big Mile tool compares consumption and shipments using license plates. However, the calculation of consumption was done based on the documents.

Therefore, to adapt the data to the tool, the presentation of kilometers was altered, focusing on 3 distinct cases:

- 1 vehicle ID has 1 shipment: consider the presented distance traveled.

Assignment number	Carrier	Vehicle ID / License plate	Period fuel consumption	Period Energy Consumption	Date	Quantity (Kg)	Postal code origin	Postal code destination	Customer / Receiver (group)	Free input
PRF2021F5526	IDL	28681	maio	maio	2021-05-24	50,217	2050	3060	ITMP Alimentar, S.A.	193,353

- 1 vehicle ID has 2 or more shipments for the same postal code destination: consider the distance traveled only once;

Assignment number	Carrier	Vehicle ID / License plate	Period fuel consumption	Period Energy Consumption	Date	Quantity (Kg)	Postal code origin	Postal code destination	Customer / Receiver (group)	Free input
PRF2021F48	IDL	1743655	janeiro	janeiro	2021-01-07	5,422	2050	4420	COOPROFAR	286,744
PRF2021F52	IDL	1743655	janeiro	janeiro	2021-01-07	50,612	2050	4420	COOPROFAR	0286,744

- 1 vehicle ID has 2 or more shipments for 2 or more postal code destinations: consider the difference in distances traveled for each shipment.

Assignment number	Carrier	Vehicle ID / License plate	Period fuel consumption	Period Energy Consumption	Date	Quantity (Kg)	Postal code origin	Postal code destination	Customer / Receiver (group)	Free input
PRF2021F69	IDL	1743867	janeiro	janeiro	2021-01-08	45,257	2050	2625	ALLIANCE HEALTHCARE, S.A.	18,152
PRF2021F70	IDL	1743867	janeiro	janeiro	2021-01-08	32,414	2050	2625	ALLIANCE HEALTHCARE, S.A.	018,152
PRF2021F71	IDL	1743867	janeiro	janeiro	2021-01-08	5,255	2050	2625	ALLIANCE HEALTHCARE, S.A.	018,152
PRF2021F72	IDL	1743867	janeiro	janeiro	2021-01-08	2,102	2050	2625	ALLIANCE HEALTHCARE, S.A.	018,152
PRF2021F74	IDL	1743867	janeiro	janeiro	2021-01-08	10,032	2050	2625	ALLIANCE HEALTHCARE, S.A.	018,152
PRF2021F75	IDL	1743867	janeiro	janeiro	2021-01-08	9,524	2050	2625	ALLIANCE HEALTHCARE, S.A.	018,152
PRF2021F94	IDL	1743867	janeiro	janeiro	2021-01-08	15,12	2050	2790	BOTELHO & RODRIGUES (LISBOA)	2464,553
PRF2021F95	IDL	1743867	janeiro	janeiro	2021-01-08	8,856	2050	2790	BOTELHO & RODRIGUES (LISBOA)	064,553
PRF2021F96	IDL	1743867	janeiro	janeiro	2021-01-08	61,107	2050	2625	ALLIANCE HEALTHCARE, S.A.	018,152

Fuel consumption

For the calculation of values to be entered in this field, some calculations and assumptions were made. In summary: The calculation of distances considered the starting point of all shipments as the operator's warehouse, and the destination as the formal recipient, so the distances presented at the final point were considered.

For weight, the sum of weights presented in the shipments sheet was considered.



Three different carriers were assumed, for which three different types of vehicles and consequently three distinct fuel consumption rates were considered.

- Carrier IDL

Consider Semi-Trailer Truck with a payload of 12,000 kg and an average fuel consumption of 37 liters per 100 km (values provided by the operator)

Formulas used - $((37/12000) * \text{Weight GR}) * (\text{Distance}/100)$

- Carrier Dismed

Consider Van with a payload of 1,500 kg and an average fuel consumption of 10 liters per 100 km (values provided by the operator)

Formulas used - $((10/1500) * \text{Weight GR}) * (\text{Distance}/100)$

- Carrier TorresTir

Consider Heavy Truck with a payload of 8,000 kg and an average fuel consumption of 22 liters per 100 km (values provided by the operator)

Formulas used - $((22/8000) * \text{Weight GR}) * (\text{Distance}/100)$

The data used for the described calculation was obtained from the logistics operator, who sourced the information from their own fleet and other carriers they use for shipments. These data were verified by comparing the values with the invoicing in this field in the service invoices of the reference year. For more information on this verification method, please refer to *.

Furthermore, due to the large number of license plates, it is currently not possible to calculate fuel consumption per license plate. Therefore, for the sake of consistency in the tool, it was assumed that the carriers represent the license plates.

Locations

To determine emissions in the warehouse area, it was necessary to collect data on the consumption of various energy sources. The data on diesel consumption in the warehouse were obtained from the logistics operator. However, during the data collection process, a traceability issue with diesel consumption was identified. As stated in the scope, the impact of diesel on the operation is very low, and its maintenance is mandatory due to good warehousing practices required by law. Therefore, the operator does not see the need to make efforts to record its consumption. To calculate the impact of diesel, internal fuel purchases were considered. This decision is supported by the fact that the operator assured that diesel is only purchased for the warehouse when the tanks need to be refilled. Additionally, diesel purchases are segregated by warehouse, so the pharmaceutical warehouse's diesel consumption is separated from the consumption of the high-consumption warehouse.



The consumption of diesel energy in the warehouse is primarily for backup generators, as it is crucial to ensure a continuous power supply due to the nature of the stored products. Regular tests are also conducted on the backup generators due to legal requirements.

Although diesel emissions in the warehouse are outside the scope, they will still be considered in the calculation. Unlike other aspects, these emissions are excluded from reduction efforts due to their impossibility of reduction.

The logistics operator provided data on green and gray energy consumption based on electricity invoices. Since the operator has a general energy meter and is not properly equipped with strategic meters to determine energy consumption per warehouse, per machine/device, and per warehouse zone, it was necessary to extract the overall consumption data from the infrastructure based on the billing. The invoices ensure the most accurate data on energy consumption given the circumstances, and it is also possible to determine the distribution of consumption between the two types of energy, green and gray. The ratio of green energy consumption is quite low at 0.32%, while the ratio of gray energy is 99.68% (100-0.32).

Period	Energy Consumption	Green Energy Ratio
Janeiro		0,0031
Fevereiro		0,0031
Março		0,0031
Abril		0,0031
Maio		0,0031
Junho		0,0031
Julho		0,0035
Agosto		0,0035
Setembro		0,0035
Outubro		0,0029
Novembro		0,0029
Dezembro		0,0029
AVERAGE		0,32%

The energy consumption value (gray and green) obtained from the logistics operator's electricity invoices was multiplied by a percentage of 80%. This adjustment was made because these invoices include the energy consumed in both warehouses of the operator - the high-consumption warehouse and the pharma warehouse. The pharma warehouse is a significant consumer of energy due to the need for constant temperature control and the presence of refrigeration chambers. The operator conducted benchmarking within the group to determine the mentioned percentage consumed by the pharma warehouse. Although the specific details were not shared by the operator, this value is considered for all energy consumption allocations, including in the billing process.

The electrical energy consumption occurs throughout the facility, including the lighting, various automation systems, material handling equipment such as forklifts, pallet jacks, and lifts used to reach higher shelves, as well



as various machines for tasks such as filling airbags and other operations, and the climate control and refrigeration systems.

In the pharma warehouse, there are multiple clients, and the distribution and control of warehouse allocation are based on pallets. Therefore, the unit of measurement considered within the warehouse is precisely the pallet. In fact, warehouse service fees are calculated based on the average number of pallets per month.

Regarding the energy consumption value of the pharma warehouse, it is necessary to determine the consumption specific to Perrigo Portugal. This will be done using the occupancy unit, which is the pallet. The occupancy is expressed as a percentage in the provided tables, which were given by the logistics operator. The operator considered the average number of pallets occupied by Perrigo on a monthly basis, the same number used for billing purposes for the respective month, and divided it by the maximum pallet capacity of the warehouse during the analysis period. Until June 2020, the maximum capacity was 33,000 pallets, and from July 2020 onwards until the present, it has been 34,000 pallets. These capacity values were provided by the logistics operator when questioned about the maximum capacity of the pharma warehouse.

Period Energy Consumption - 2018	% Perrigo
January	6,34%
February	6,95%
March	6,83%
April	6,32%
May	6,47%
June	6,60%
July	7,18%
August	7,04%
September	6,77%
October	6,38%
November	6,73%
December	6,51%

Period Energy Consumption - 2021	% Perrigo
January	6,85%
February	6,99%
March	7,69%
April	7,66%
May	7,50%
June	7,30%
July	7,68%
August	8,20%
September	9,46%
October	10,05%
November	11,13%
December	9,73%

In conclusion, the number of occupied pallets is the key data in warehouse activities, as variations in this data will have a significant impact on Perrigo's energy consumption in the warehouse and, consequently, emissions. Therefore, the pallet unit will be considered as the indicative data for warehouse activities, and for relative reduction calculations, this data will be considered in the unit of tons.

The number of pallets in the warehouse as of December 31, 2021, was 2,517 pallets. The number of pallets in the warehouse as of December 31, 2022, was 2,026 pallets. These figures were provided by the logistics operator when asked about Perrigo's occupancy of the pharma warehouse in the years 2021 and 2022.

The data used for the described calculation was obtained by the logistics operator through the aforementioned process. These data were verified by comparing the values with the invoicing in the service invoices of the reference year. For more information on this verification method, please refer to *.



Comparing the two years of data collection, according to the table below, there is indeed a reduction in total absolute CO₂ emissions. However, there is a clear increase in relative emissions, indicating that the efficiency in terms of transportation and warehouse emissions has decreased from 2018 to 2021. This can be explained by the increase in the number of clients, while the number of shipments decreased by approximately 20%. However, the number of kilometers and weight did not follow this reduction, decreasing by approximately 3%. This opens the door to a program aimed at improving the current scenario and increasing the mentioned efficiency, further proving that 2021 should be the focus year.

	2018	2021
<i>Number of clients (uni)</i>	309	402
<i>Total number of shipments (uni)</i>	19.622	15.142
<i>Total weight of shipments (ton)</i>	933	915
<i>CO₂ emissions (Absolut)</i>	12.635	11.779
<i>CO₂ emissions per ton (relative)</i>	13,55	12,87
<i>CO₂ emissions per ton per kilometer (relative)</i>	<u>0,0964</u>	0,1203
<i>TOTAL emissions (kg.CO₂.e)</i>	130.074	123.281

Finally, dividing the emissions by process type (transportation and storage):

<i>Absolut</i>	2018	2021
<i>Transport (kg.CO₂.e)</i>	12.635	11.779
<i>Warehousing (kg.CO₂.e)</i>	117.439	111.502
<i>TOTAL emissions (kg.CO₂.e)</i>	130.074	123.281
<i>Relative</i>	2018	2021
<i>Transport (kg.CO₂.e per ton)</i>	13,54	12,87
<i>Warehousing (kg.CO₂.e per ton)</i>	125,87	121,86
<i>TOTAL emissions per ton (kg.CO₂.e per ton)</i>	139.41	134,73

Based on this data, it is possible to determine that storage accounts for 90% of Perrigo's emissions.

* Reiterating the complete process, after the necessary data is collected and processed according to the described procedures, they are inputted into the Big Mile templates and used for emissions reporting. These reports are considered the basis for emissions measurement and undergo a verification process conducted by Perrigo Portugal. The results and distribution percentages are compared with the invoicing provided by the logistics operator for the reference year.

Since detailed invoices are accessible, this comparison process ensures that the consumption distribution is realistically represented.

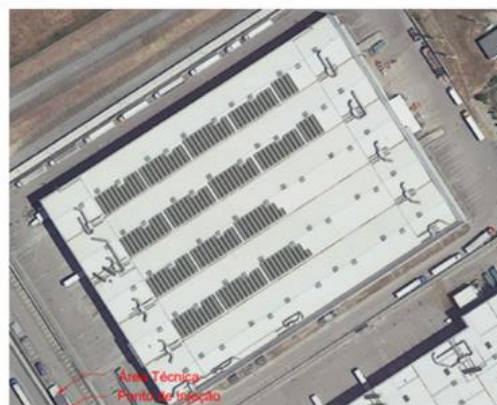
6 Reduction measures

TBD (TO-BE-DONE) MEASURES

Me1. Solar Panels in the Warehouse

Code	Me1		
Name	Solar Panels in the Warehouse		
Area of reduction	Warehouse		
Starting Date (Implementation)	dez/22	Ending Date (Implementation)	31/06/2023
First Utilization Period: Post the end of the second quarter of 2023.			
Responsible for Implementation	Operador Logístico		
Investment	n.a.	Human Resources needed	Panel installation operators; Operators responsible for monitoring
Measurement Factor	kWhs	Are there reductions?	No
Data Source	Information provided by the logistics operator, who requested the information from the company responsible for installing the panels.		
	Data from the reference year and justified assumptions.		
Extra	There will be a minimum reduction of 40% in energy purchasing and a maximum reduction of 70%.		
	Energy production is expected to start at the end of the second quarter of 2023 at the latest, and at the end of the first quarter of 2023 at the earliest.		
KPI's	Production Efficiency		
	kWh of energy produced by the solar panels."		

The logistics operator started installing solar panels in December 2022, and in the best-case scenario, it will be completed in the first quarter of 2023. However, due to difficulties such as delays in the delivery of raw materials and labor issues faced by the contracted installer, which are beyond the operator's control, in the worst-case scenario, it will be completed by the end of the second quarter of 2023. Once the panel installation is completed, energy production will commence. Initially, the solar panels will be implemented and used exclusively by the pharma warehouse due to its high energy consumption. Only after the completion of this project will the operator consider further expansions. However, as shown in the image, there is room for future expansions.



Regarding the data on the solar panels, an estimated coverage area of approximately 40,000m² is planned for implementation, which totals 1,238 panels. There will be 5 modules of 110kW, with each module having 545 Wp. In terms of energy procurement, these panels will bring a minimum reduction of 40% in energy purchases



and a maximum reduction of 70%. Here are some additional details about the characteristics of the panels and the installation:

Marca	Risen Energy
Modelo	RSM110-8-530M-555M
Potência de Pico (STC*)	545 W
Corrente no MPP (STC)	17,22 A
Tensão no MPP (STC)	31,66 V
Corrente de CC (STC)	18,23 A
Tensão de CA (STC)	38,02
Rendimento (STC)	20,9 %
Dimensões	2,384 m x 1,096 m x 0,035 m
Peso	29,0 kg

*Irradiância – 1 kW/m²; Temperatura do módulo – 25 °C; Massa de ar – 1,5

Instalação 1		
Tipo de Instalação		UPAC
Nº de Módulos		1238
Potência dos Módulos		545 Wp
Potência de Pico		674,71 kWp
Potência Nominal		550 kWn
Nº de Inversores		5
Inversor 1	Potência Nominal	110 Kw
	Nº de Strings	12
	Nº de Módulos por String	21 (9), 20 (3)
Inversor 2	Potência Nominal	110 Kw
	Nº de Strings	12
	Nº de Módulos por String	21 (6), 20 (6)
Inversor 3	Potência Nominal	110 Kw
	Nº de Strings	12
	Nº de Módulos por String	21 (3), 20 (9)
Inversor 4	Potência Nominal	110 Kw
	Nº de Strings	12
	Nº de Módulos por String	21 (10), 20 (2)
Inversor 5	Potência Nominal	110 Kw
	Nº de Strings	12
	Nº de Módulos por String	21 (10), 20 (2)

All the information mentioned was provided by the logistics operator, based on contractual data with the company responsible for the panel installation.

Based on the provided information, the start of energy production at the end of the second quarter will be considered for calculating the reduction, and this production will result in a 40% decrease in energy purchases.

Total reduction in energy purchases	40%
Impact on area reduction (full year)	40%
Impact on total reduction (full year)	36%

Full year	12	months
Implementation year	6	months
Reduction in implementation year	18%	

The 40% reduction in energy purchases will effectively lead to a 40% reduction in CO₂ emissions in the warehouse, as over 99% of the purchased energy is grey energy. In turn, this 40% reduction represents a 36% reduction in the total emissions value, as warehouse emissions account for 90% of the overall emissions.



Considering that in the first year of implementation, the measure will only have an impact for 6 months, the total reduction in the first year will be 18%. In the subsequent years, assuming no expansions of installed area or panel improvements are made, the reduction will be 36% for a full year.

Applying these reductions to the baseline CO₂ measurement, we obtain:

		2021	2022	2023	2024	2025	2026
		Base year CO ₂	Goal	Goal	Goal	Goal	Goal
Total emission reduction	kg de CO ₂	123281,00	123281,00	101090,42	78899,84	78899,84	78899,84
Total emission reduction in the area	kg de CO ₂	111502,00	111502,00	89201,60	66901,20	66901,20	66901,20
Absolut reduction	kg de CO ₂	-	0,00	22190,58	44381,16	44381,16	44381,16
Share in the total relative reduction*	%	0,00%	0,00%	18%	36%	36%	36%
Share in the total relative reduction*	%	0,00%	0,00%	20%	40%	40%	40%

Me2. Power Purchase Agreement

Code	Me2		
Name	Power Purchase Agreement		
Area of reduction	Warehouse		
Starting Date (implementation)	jan/23	Ending Date (implementation)	To be determined, the expectation is still in 2023. In the worst case, mid-year
First Period of Use: Assumed second half of 2023			
Responsible for Implementation	Perrigo Portugal, Supply Chain Department		
Parties	Perrigo Portugal, Supply Chain Department; IDL; Finance Department and Perrigo's General Manager		
Investement	To be determined	Human Resources Needed	Legal teams from IDL and Perrigo; Perrigo's Account Manager at IDL; among others (yet to be determined)
Mesurement Factor	Pallet	Are there reductions?	No
Data Source	Data from the reference year and justified assumptions		
	-		
Extra	Improved monitoring of energy flow will be necessary		
	We do not yet have specific information on what will be contracted		
KPI's	kWh of energy to the logistics operator		
	kW h of energy produced by solar panels		
	Number of occupied pallets		



The measure is based on a contract regarding the energy consumed by Perrigo at the logistics operator, where it will be stipulated that the energy consumed in the operator's warehouse will come from solar panels or green grid energy. Therefore, IDL must generate solar energy or purchase sufficient green energy to cover Perrigo's usage, taking into account a margin of error. In return, Perrigo will pay a higher amount for a defined period. To ensure that the contract is fair and upheld, mechanisms will be put in place to monitor consumption and determine precise values for its commencement. These will also be used for Me1 control.

Additionally, the contract should specify the duration of its validity, as well as an honorable commitment to selling the minimum percentage of consumption. Furthermore, the operator should invest in increasing the efficiency capacity of energy produced by solar panels in order to reduce reliance on grid energy.

It will start with the collection of necessary information for the contract, such as the capacity and efficiency of the solar panels, and obtaining approvals from Perrigo Portugal's finance department and General Manager, as well as from IDL's corporate department. Additionally, meters will be installed in strategic locations to gather real-time data, allowing for a better understanding of the actual energy consumption in the pharma warehouse and its different areas, creating a fair basis for negotiation. The possibility of installing other monitoring mechanisms is still under discussion.

Based on all the collected data, information, and approvals, the contract will be established in parallel with the current contract between Perrigo Portugal and IDL. Once all the necessary monitoring mechanisms, including the solar panels, are operational, the power purchase agreement will commence. The estimated start date is the end of the first quarter of 2023.

Total reduction in energy purchases	100%
Impact on area reduction (full year)	100%
Impact on total reduction (full year)	90%

A 100% reduction in grey energy consumption will effectively result in a 100% reduction in CO2 emissions in the warehouse, as over 99% of the purchased energy is grey energy. This represents a 100% reduction in the total emissions, as warehouse emissions account for 90% of the total.

Full year	12	months
Implementation year	6	months
Reduction in implementation year	45%	

Considering that in the first year of implementation, the measure will only impact 6 months, the total reduction in the first year will be 45%. In the subsequent years - assuming no expansion of installed area or panel improvements - the reduction will be a full year's worth, amounting to 90%.



Applying these reductions to the CO₂ measurement in year zero, we obtain:

		2021	2022	2023	2024	2025	2026
		Base year CO ₂	Goal	Goal	Goal	Goal	Goal
Total emission reduction	kg de CO ₂	123281,00	123281,00	67804,55	12328,10	12328,10	12328,10
Total emission reduction in the area	kg de CO ₂	111502,00	111502,00	55751,00	0,00	0,00	0,00
Absolut reduction	kg de CO ₂	-	0,00	55476,45	110952,90	110952,90	110952,90
Share in the total relative reduction*	%	0,00%	0,00%	45%	90%	90%	90%
Share in the total relative reduction*	%	0,00%	0,00%	50%	100%	100%	100%

Me3. Review **Sample** procedures– optimize cargo; optimize miles

Code	Me3		
Name	Review Sample procedures– optimize cargo; optimize miles		
Area of reduction	Transport		
Starting Date (implementation)	jan/23	Ending Date (implementation)	fev/23
First Period of Use: 2023, excluding January			
Responsible of Implementation	Perrigo Portugal, Supply Chain Department		
Parties	Perrigo Portugal, Supply Chain Department; Sales Department; Marketing Department; Trade Marketing Department.		
Investment	0	Human Resources needed	1 person from the Supply Chain Department
Measurement factor	Shipment weight (kg); Shipment Distance (km)	Are there reductions?	No
Data Source	Data from the reference year and justified assumptions.		
Extra	-		
KPI's	Number of sample shipments		
	Average sample weight		

Currently, samples represent long distances and low loads, contributing to the efficiency issue of emissions observed from 2018 to 2021. This problem is exacerbated by the lack of standardization in the approval or issuance process for samples, resulting in situations where shipments have an average of 0.05 kilograms per kilometer.

As can be seen in the table below, which represents an analysis of sample distribution using shipment data extracted from the system for the reference year of 2021, the worst efficiency situations occur in shipments to customers and internal sample shipments.

	N*	Quantity (Kg)	Distance (km)	kg/km	Cost (trans e adm)	4,8
"Academia"	20	328,191	245,825	1,34	3,60	
Client	197	6164,433	5215,223	1,18	4,06	
"Armazenista"	33	4815,456	1858,562	2,59	1,85	
Auchan	7	12,302	41,309	0,30 !!	16,12	
colgate	1	2,616	2,455	1,07	4,50	
"Farmácia"	18	113,507	941,224	0,12 !!	39,80	
"Grupo"	2	13,336	164,842	0,08 !!	59,33	
Hospital	3	153,689	21,139	7,27	0,66	
ITMP	1	0,731	15,06	0,05 !!	98,89	
Others	95	1002,477	1985,537	0,50 !!	9,51	
PD	14	11,47	51,073	0,22 !!	21,37	
sonae	19	20,054	68,189	0,29 !!	16,32	
Wells	4	18,795	65,833	0,29 !!	16,81	
Hotel	8	1488,757	373,745	3,98	1,21	
Internal use	34	287,476	888,164	0,32 !!	14,83	
"Voluntariado"	23	9724,27	166,187	58,51	0,08	
Sermail	15	2530,786	181,52	13,94	0,34	
Perrigo	14	721,208	205,674	3,51	1,37	
AVG €/kg					3,64	General
AVG €/kg					18,04	Detailed

The measure initially involves optimizing the distances traveled by samples. In practical terms, samples of products will be sent to the office and promotional materials warehouses, and it will be the responsibility of the sales representatives to include them in their current visits. The rest of the sales team will handle the delivery when clients visit the office, which is quite common at present. Additionally, samples for internal use that were previously sent to Perrigo employees will now be sent to the office and promotional materials warehouses, and it will be the responsibility of the employees to collect them.

Specifically, the measure involves transferring "Internal use" to Sermail and the Office, as well as to "Clients".



	N*	Quantity (Kg)	Distance (km)	kg/km		Cost (trans e adm)	4,8
"Academia"	20	328,191	245,825	1,34		3,60	
Client	0	0	0	-			
Hotel	8	1488,757	373,745	3,98		1,21	
Internal use	0	0	0	-			
"Voluntariado"	23	9724,27	166,187	58,51		0,08	
Sermail	122	6741,66785	2964,82	17,01	25,3 km	0,28	
Perrigo	138	2962,23515	6898,974	13,55	53,7 km	0,35	
					AVG €/kg	1,10	General

In a second phase, shipment loads will be optimized. Since shipments will be consolidated, there is the possibility of coordinating them. For this purpose, an Excel spreadsheet will be created where employees can enter the quantity they wish to order for each item, and periodic shipments of samples will be made. Additionally, a small stock will be maintained in the office to provide samples to visiting clients and to cover urgent situations.

This measure, focusing solely on sample data and considering the reference year, would reduce the number of destinations from 164 to 22. With a high level of optimization, the number of shipments would decrease from 311 to 67. In terms of distances traveled, there would be a reduction of approximately 15%, and the shipments sent would be optimized from an average of 68kg per client to 318kg per client.

Samples	2021	foreseen	reduction	
78,46%	311	67	244	- Number of shipments
14,75%	12491,56	10649,55	1842,01	- Distance
	68,31	317,09	(248,78)	+ Kilos per client

Analyzing these data in light of the total shipment data, the reduction in the number of shipments is 1.61%, and the reduction in distances is 0.6%. Within these reductions, the reduction relative to shipments will be considered, as optimizations will be made in terms of distances and loads. Therefore, if the reduction factor based on distance were selected, it would not reflect the value of the savings resulting from load optimization.

TOTAL	2021	foreseen	reduction	
1,61%	15142	14898	244	- Number of shipments
0,61%	300113,68	298271,7	1842,01	- Distance
1,6%	considering x of emissions for y of shipments		121294,4352	this will be considered
0,6%	considering x of emissions for z of kilometers		122524,3373	



Impact on area reduction (full year)	1,61%
Impact on total reduction (full year)	0,16%

Full year	12	months
Implementation year	11	months
Reduction in implementation year	0,15%	

Considering the reduction in shipments, the emission reduction in the transportation area will be 1.61%, which, considering that this area represents 10% of total emissions, corresponds to a reduction of 0.16%.

Furthermore, considering that in the first year of implementation, the first month will not have the effect of the measure, only 11 months of reduction in 2023 are considered. In the following years, a reduction is expected for all 12 months based on the reference year.

Although the weight of the reduction is not drastic, it directly affects the working methods of teams, creating awareness about the issue and a sense of responsibility.

		2021	2022	2023	2024	2025	2026
		Base year CO ₂	Goal	Goal	Goal	Goal	Goal
Total emission reduction	kg de CO ₂	123281,00	123281,00	123098,90	123082,34	123082,34	123082,34
Total emission reduction in the area	kg de CO ₂	11779,00	11779,00	11605,01	11589,19	11589,19	11589,19
Absolut reduction	kg de CO ₂	-	0,00	182,10	198,66	198,66	198,66
Share in the total relative reduction*	%	0,00%	0,00%	0,15%	0,16%	0,16%	0,16%
Share in the total relative reduction*	%	0,00%	0,00%	1,48%	1,61%	1,61%	1,61%



Me4. Review Minimum Order Value

Code	Me4		
Name	Review Minimum Order Value		
Area of reduction	Transport		
Starting Date (implementation)	mar/23	Ending Date (implementation)	jan/24
First Period of Use: January of 2024			
Responsible of Implementation	Perrigo Portugal, Supply Chain and Sales Department		
Parties	Perrigo Portugal, Supply Chain and Sales Department		
Investment	0	Human Resources needed	-
Fator de Medição	Peso do Envio (kg); Distância por Envio (km)	Já há reduções?	Não
Measurement factor	Data from the reference year and justified assumptions		
	-		
Extra	-		
KPI's	Freight Cost relative to Gross Sales (%)		

Currently, the minimum order value is 30 euros, which opens the door to inefficient shipments since certain SKUs reach that value with just one unit. However, whenever there is a back order (BO) - an order sent when the stock of a previously requested item returns to stock - it is processed without any minimum value restrictions.

Therefore, an analysis was conducted to determine the optimal base order value, that is, the value from which the freight cost would represent approximately 1% of the Gross Sales. The determined value was a minimum order of 500 euros. All the data for this analysis can be found in the supporting document 'Minimum Value,' which was sourced from the extracted system data.

Sum of Valor Gross Margin 1 Number Month Y Real	Sum of Custo Picking	Peso	Custo Shipping	Margin Freight	Sum of Valor NET 1 Number Month Y Real	Interim	Shrimp
405,98 €	0,17 €	1,794	3,85 €	401,02 €	524,58 €	100,00	2%

Total Shipments '21	14749	
Total Shipments <=200eur	7449	51%
Total Shipments >200eur	7300	49%
Total '21	#####	
Total <=200eur	602236,92	2%
Total >200eur	27214801	98%
Total Weight '21	882876	
Total Weight <=200eur	31314,93	4%
Total Weight >200eur	851561,1	96%
Total Distance '21	2432487	
Total Distance <=200eur	1267497	52%
Total Distance >200eur	1164989	48%

Therefore, the sales department was challenged to modify the minimum order value and change the process of handling BOs (back orders) - either by applying the minimum value to BOs or by integrating BOs into the customer's subsequent orders.

Currently, the Sales department is in the process of analyzing what will be the minimum order value that will be accepted by the customer. It is estimated that negotiations and necessary analyses will be carried out with customers throughout the year 2023 so that by the end of the year, a new minimum value is defined and implemented starting in 2024. The Supply department estimates that the agreed-upon value will be 200



euros as the minimum order value, as it is the current minimum value in Spain, a country with similar brands, strategy, and business volumes. According to the table below, which is based on shipment data from the year under analysis, this value would represent a 50% decrease in the number of orders sent and distances traveled. At the same time, considering that customers would not reallocate orders with values greater than 200 euros but simply stopped placing them, it would result in a 2% reduction in net total. Therefore, it is a fair starting point.

Analyzing in terms of reductions, based on the information in the analysis table, it is possible to determine that both the number of guides and the number of kilometers traveled decrease by the same percentage. However, the total weight transported does not reflect the same order of reduction. However, this reduction in weight will not be considered because the assumption, once again, is not that orders are eliminated but rather that customers reallocate orders to create higher order values. Therefore, the indicated weight reduction will not be observed.

To determine the reduction, it is necessary to: (1) remove from the shipments lines that do not meet the minimum value of 200 euros; (2) multiply the fuel consumption by 50%; (3) input the modified Excel file into Big Mile and determine the new emissions in transportation. The fuel reduction considered is 50%, as the reduction in distances is 52%. Considering a small margin of error, a value of 50% was used. Looking at the formulas: $((37/12000)\text{Weight GR})(\text{Distance}/100) \Rightarrow ((37/12000)\text{Weight GR})(\text{Distance} \cdot 0.5/100) = ((37/12000)\text{Weight GR})(\text{Distance}/100) \cdot 0.5 = ((37/12000)\text{Weight GR})(\text{Distance}/100) \cdot 0.5 = \text{calculation formula} \cdot 50\%$. In turn, the reduction is exactly in the same 50% scale observed throughout the analysis.

<i>Transporte Emissions Before (kgCO₂e)</i>	11779	
<i>Transporte Emissions After (kgCO₂e)</i>	5889	50%

Impact in area	50,00%
Impact in total	5,00%

Full year	12	meses
Year of Implementation	12	meses
Impact in year of reduction	5,00%	

Considering the reduction in emissions in the transportation area to be 50%, which, considering that this area represents 10% of the total emissions, represents a 5% reduction. Furthermore, it was considered that starting from the first year of implementation, and in the following years, the measure would affect complete years. Therefore, the projected reduction is for the 12 months over the reference year.



		2021	2022	2023	2024	2025	2026
		Base year CO ₂	Goal	Goal	Goal	Goal	Goal
Total emission reduction	kg de CO ₂	123281,00	123281,00	123281,00	117116,95	117116,95	117116,95
Total emission reduction in the area	kg de CO ₂	11779,00	11779,00	11779,00	5889,50	5889,50	5889,50
Absolut reduction	kg de CO ₂	-	0,00	0,00	6164,05	6164,05	6164,05
Share in the total relative reduction*	%	0,00%	0,00%	0,00%	5,00%	5,00%	5,00%
Share in the total relative reduction*	%	0,00%	0,00%	0,00%	50,00%	50,00%	50,00%



SUPPORT MEASURES

Su1. Establish a target for the quantity of **safety stock**

This measure is used for projection purposes and will not be introduced as a reduction line but rather considered under the "Size of warehouse area" line in the dashboard. Currently, the measure is already being implemented, and some stock is shared with Spain. However, it is relevant to include it in the list to ensure commitment to it since it is an internal objective of Perrigo Portugal.

Year			2021	2022	2023	2024	2025	2026
		Unit	Base Year CO ₂	Goal	Goal	Goal	Goal	Goal
Size of Goods flow	Volume within range	Weight (ton)	915	1187,064	1222,676	1259,356	1297,137	1336,051
Size of warehouse		Pallets (uni)	2517	2026	2026	2026	2026	2026

Su2. Change Returns Process - **Non-Return Fee**

Returns due to expiration dates exhibit significant seasonality, caused by expiration dates approaching, high variation in the number and quantity of returns, as well as substantial liquidity variations due to credits.

The non-return fee focuses on eliminating returns due to expiration dates. This action would reduce operator instability, decrease the number of incidents, increase process speed, and, above all, eliminate the need for a dedicated returns room at the operator's facility.

With this measure, the warehouse space occupied by pending items would be reduced, as well as the number of units sent directly by Perrigo for destruction. Therefore, it is a support measure for reducing the space occupied due to energy consumption in the warehouse and will later also contribute to the path towards achieving net zero emissions.

The support measures will assist in maintaining a consistent warehouse volume and bring greater efficiency to warehouse utilization. They are not intended to create reductions.



FUTURE MEASURES

Fu1. Lean & Green/Sustainable Transporter for High-Volume Areas

For selected customers, schedule distribution and utilize a Lean & Green distribution method to deliver orders based on optimized routes.

Fu2. Waste Management

Eliminate product destruction in landfills and seek solutions such as energy-producing incineration or incineration with the reuse of ashes in concrete.

Fu3. Implementation of CHEP/LPR pallets throughout the supply chain.

Incorporate sustainability principles in product and packaging development Modify product shapes to achieve more efficient volumes and logistical advantages, moving from cylinders to cubes and rectangles, for example. Additionally, explore the elimination of blister packaging and adoption of bottles

These measures represent commitments and long-term goals of the Supply department. Therefore, it is not possible to calculate the reduction they will bring to the current plan, and they are not planned for implementation within the indicated timeframe of the current action plan.

7 Key Performance Indicators (KPI)

The chosen KPIs to monitor and control the effect of the measures to reduce CO2 emissions are described in the following table:

Code	Name	Explanation	Units
KPI - Me1.1	Production Efficiency	What is the average energy efficiency produced by solar panels over a certain period of time. Its variation will help understand the energy behavior of the period and will support decisions regarding amplification or not.	%
KPI - Me1/2.2	kWh of energy produced by the solar panels	How many kWh of energy are produced by the installed solar panels over a certain period of time. Its variation will allow understanding the energy behavior of the period and will support decisions regarding amplification or not. It will also be crucial for monitoring whether the specifications of the Power Purchase Agreement (PPA) are being met or not.	kWh
KPI - Me2.1	kWh of energy purchased by IDL	How many kWh of energy are purchased within a certain period of time.	kWh
KPI - Me2.3	Number of pallets occupied	Number of pallets occupied in the warehouse within a certain period of time, with a focus on variations in the value. It will provide information about the volume per period and indicate when stock reduction actions are necessary to mitigate undesirable stock growth.	pallet
KPI - Me3.1	Number of samples shipped	Number of sample shipments within a certain period of time, with a focus on variations in the value. It will provide information on compliance with distance optimization.	Uni (shipments)
KPI - Me3.2	Average weight of samples	Weight of samples shipped within a certain period of time, with a focus on variations in the value. It will provide information on compliance with load optimization.	kg
KPI - Me4.1	Freight Cost compared with Gross Sales	Ratio of transportation costs to the gross sales value for a certain period. It will provide insights into the impact of average value variation and the business's sustainability.	%
KPI - Total.1	Weight growth	Total weight shipped within a certain period of time, with a focus on variations in the value. It will provide information about the business volume per period and indicate when actions to support it are necessary.	ton

Lean & Green Initiative action plan: The case of Perrigo Portugal



The expected growth and the way each KPI was calculated are as follows:

Sinopse de KPI								
Year		2021	2022	2023	2024	2025	2026	
KPI	Unidade	Base Value	Goal	Goal	Goal	Goal	Goal	
KPI - Me1.1	Production Efficiency (%)	0	0	20,9	20,9	20,9	20,9	Yield indicated by supplier data
KPI - Me1/2.2	kWh of energy produced by the solar panels (kWh)	0	0	4048,26	8096,52	8096,52	8096,52	
KPI - Me2.1	kWh of energy purchased by IDL (kWh)	212854,68	276144,39	354204,27	451426,03	577555,48	741187,97	Peak production x Number of months of production Considering the energy consumed in the reference year by the occupied pallets, minus the value of energy produced by the panels
KPI - Me2.3	Number of pallets occupied (pallets)	2517	2026	2026	2026	2026	2026	Dashboard Data
KPI - Me3.1	Number of samples shipped (n#)	311	88,76384465	91,42675999	94,16956279	96,99464967	99,90448916	Considering the number of shipments in the reference year by the occupied pallets, minus the estimated reduction
KPI - Me3.2	Avegare weight of samples (kg)	68,31	273,24	273,24	273,24	273,24	273,24	Considering the weight of the shipments, there will be a fourfold increase
KPI - Me4.1	Freight Cost compared with Gross Sales (%)	26%	26%	26%	4%	4%	4%	Values consulted in the Valor minimo document
KPI - Total.1	Weight growth (ton)	915	1187,063985	1222,675905	1259,356182	1297,136867	1336,050973	Dashboard Data



8 Traceability

Given the presented measures and reduction objectives, they require monitoring and control to ensure the traceability of the reductions and actions taken.

The person responsible for monitoring and control will be an employee from the Supply Department, due to the nature and focus of the project. Rita Matos, the current Logistics Manager, will fulfill this role.

To have a record of the actions and their outcomes, a document will be created where each measure includes the planning, KPIs, and reduction objectives. It should also include the actual steps taken, the results obtained, the resources used, the actual performance according to the defined KPIs, and important notes. This document will also allow documenting the actual progress compared to the planned progress on the dashboard. The frequency of filling in this document will vary since the monitoring of the actions is not periodic. However, a monthly meeting should be held between the monitoring responsible and the head of supply, with optional participation from GS1, where progress is discussed and future actions are planned.

Furthermore, the data sources used for the report should align with the sources used to initially define the measures. In other words, the sources mentioned for each measure should be reported and justified if new sources are added.

To support monitoring of the methodology, control mechanisms will be implemented, which are as follows:

- Me1 – Installation of counters in strategic locations; Implementation of supporting software that allows monitoring and recording of data on daily production.
- Me2 – Utilization of the counters mentioned in Me1, as well as the software; Control of energy purchase invoices from the power grid by the logistics operator.
- Me3 – Monthly control through the extraction of sample documents from the system; Daily control in the approval of sample flows; Sending status updates, when relevant, to the teams involved in the sample request.
- Me4 – Through the existing system blocks; Monthly control through the extraction of order documents from the system (PRFs).

Based on the defined monitoring and control system, any necessary adaptations to ensure the fulfillment of objectives will be quickly detected. These adaptations will be led by the monitoring and control responsible, who will outline the risk mitigation/adaptation plan and ensure its execution. Additionally, moments of adaptation will be recorded in the monitoring document.

Communication within the company and with third parties will be carried out by the monitoring and control responsible, who will use emails and meetings for this purpose. It should be mentioned that within Perrigo Europe, there is a sustainability team that should provide support to the monitoring and control responsible whenever necessary.



In the case of involving business partners, their monitoring should be carried out through meetings and email exchanges, which will be documented in the monitoring document. Regarding the involvement of other departments within the company, the monitoring will be done in the same manner, but with less formality. The same methods will be used to receive reports and information from third parties.

Throughout the monitoring and control process, intervals and deviations in the KPIs should be taken into account.



9 *Dashboard*

The measurement of zero CO₂ and associated reduction for all the document, as well as the measures explained in section 6, can be found below.

All emissions reduction calculations were performed based on the reference year, as well as the calculation of variations in warehouse and shipment volumes. However, the calculation of variations in business volume, weight, and pallets was done for the year 2022, as it is now possible to have real information on its behavior. It is important to explain that the variation in volume from 2021 to 2022 is due to a complete return to normalcy. In 2021, Perrigo's business was still greatly affected by the pandemic, as it was a year of recovery. Therefore, the calculation of business volumes up to 2022 represents actual values, while from 2023 onwards, they represent the company's objectives based on the information from 2022.

It is projected that the volume of transported cargo will grow by 3% each year. The company's objective is to keep the warehouse volume static throughout the analysis period.

The analysis of this dashboard should be complemented with the Excel document, as it provides the calculations performed, including assumptions made, and detailed information on reductions per measure.

Lean & Green Initiative action plan: The case of Perrigo Portugal



Dashboard Lean&Green – Perrigo									
Year			2021	2022	2023	2024	2025	2026	
Description	Description	Unit of Measure	Base year CO ₂	Goal	Goal	Goal	Goal	Goal	Explanation
Size of the goods flow	In-Scope Volume	Wight (ton)	915	1187,064	1222,676	1259,356	1297,137	1336,051	Weight shipped in tons
Area of the warehouse		Pallets (unit)	2517	2026	2026	2026	2026	2026	Number of occupied pallets in the warehouse
CO ₂ Emissions TOTAL	Absolut reduction	ton de CO ₂	123,281	123,281	67,622	5,965	5,965	5,965	Total scope emissions in tons
	Share in the total relative reduction*	kg de CO ₂ /ton	12,87	9,92	9,63	9,35	9,08	8,82	Subdivision linked to a unit of transport volume (ton)
		kg de CO ₂ /pallet	44,30	55,04	55,04	55,04	55,04	55,04	Subdivision linked to a unit of storage volume (ton)
	Absolut reduction	%	0,00%	0,00%	45,15%	95,16%	95,16%	95,16%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
	Share in the total relative reduction*	kg de CO ₂	-	0,00	77849,13	161696,77	161696,77	161696,77	Total extrapolated reduction in kg of CO ₂ regarding the zero CO ₂ measurement
	CO ₂ Emissions	kg de CO ₂	123281	123281,00	67622,45	5965,39	5965,39	5965,39	Given the observed/estimated reduction, what will be the emission forecast for the plan period

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Me 1	Absolut reduction	kg of CO ₂	-	0,00	22190,58	44381,16	44381,16	44381,16	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
	Share in the total relative reduction*	%	0%	0%	18%	36%	36%	36%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
Solar Panels	Absolut reduction	kg of CO ₂	-	0,00	55476,45	110952,90	110952,90	110952,90	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
	Share in the total relative reduction*	%	0,00	0,00	45%	90%	90%	90%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
Power Purchase Agreement	Absolut reduction	kg of CO ₂	-	0,00	182,10	198,66	198,66	198,66	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
	Share in the total relative reduction*	%	0,00	0,00	0,15%	0,16%	0,16%	0,16%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
Me 3	Absolut reduction	kg of CO ₂	-	0,00	0,00	6164,05	6164,05	6164,05	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
	Share in the total relative reduction*	%	0,00	0,00	0,00%	5,00%	5,00%	5,00%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
Samples	Absolut reduction	kg of CO ₂	-	0,00	0,00	0,00	0,00	0,00	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
	Share in the total relative reduction*	%	0,00	0,00	0,00%	5,00%	5,00%	5,00%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
Me 4	Absolut reduction	kg of CO ₂	-	0,00	0,00	0,00	0,00	0,00	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
	Share in the total relative reduction*	%	0,00	0,00	0,00%	5,00%	5,00%	5,00%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
Minimum order value	Absolut reduction	kg of CO ₂	-	0,00	0,00	0,00	0,00	0,00	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
	Share in the total relative reduction*	%	0,00	0,00	0,00%	5,00%	5,00%	5,00%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement

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CO₂ Emissions BY AREA	Absolut reduction WAREHOUSE	kg of CO ₂	-	111502,00	89201,60	66901,20	66901,20	66901,20	Total reduction in CO2 emissions in kilograms achieved by measures in the WAREHOUSE area
	Share in the total relative reduction WAREHOUSE	%	0%	0%	50%	100%	100%	100%	Total extrapolated reduction in CO2 emissions in percentage achieved by measures in the WAREHOUSE area
	Absolut reduction TRANSPORT	kg of CO ₂	-	23558,00	23384,01	17478,69	17478,69	17478,69	Total reduction in CO2 emissions in kilograms achieved by measures in the TRANSPORT area
	Share in the total relative reduction TRANSPORT	%	0%	0%	1,48%	51,61%	51,61%	51,61%	Total extrapolated reduction in CO2 emissions in percentage achieved by measures in the TRANSPORT area



10 Anex

Guide of the support documents:

- Support documents of the base year 2021
 - The document which start with “Analysis” contain the data analysis made by the Big Mile tool. They are referred to every time the is the meation of the CO₂ emission in the year of 2021 or 2018.
 - The document “DADOS TOTAIS DE ARMAZÉM (...)” indicates the consumption of the pharmaceutical warehouse of the logistics operator, including the consumption of all clients.
 - The document which start with “FORMULAS Perrigo (...)” contains the formulas applied to the data mentioned in the CO₂ measurement chapter in the reference year for Shipments.
 - The document “KPIs Perrigo 2021” supports the analysis of performance indicators in Chapter 2 - Company Framing
 - The document which start with “Perrigo Big Mile (...)” These are the documents that were used as input in the Big Mile tool.
 - The document “rácio green energy Big Mile_2021” represents the calculation regarding the ratio of energy types consumed

Name	Status
Analysis Report - EN-GS1Portugal-001-20...	✓
Analysis Report - EN-GS1Portugal-001-20...	✓
DADOS TOTAIS DE ARMAZÉM Big Mile_2...	✓
FORMULAS Perrigo 2018 - Dados (kg e k...	✓
FORMULAS Perrigo 2021 - Dados (kg e k...	✓
KPIs Perrigo 2021	✓
Perrigo Big Mile - DADOS 2018 - FINAIS 2...	✓
Perrigo Big Mile - DADOS 2021 -FINAIS 2...	✓
rácio green energy Big Mile_2021	✓

- Support document for the Plan of Action
 - The document “7 – KPI’s” are the calculations supporting Section 7.
 - The document “9 – Dashboard” are the calculations supporting Section 9.
 - The document “Check Valor das Ilhas”, “Dados de Apoio Sermail”, “Analise Devoluções 2021 vs 2022 (...)” e “quantificação de Devoluções 2021”, represent the data used to quantify out-of-scope information. The data related to returns presented throughout the document comes from the last two documents.
 - “Informação Paletes Armazém”, “RE Dados % de Armazém (...)” e “RE CSR IDL Perrigo (...)” are the email exchanges from which a significant portion of the information provided by the logistics operator originates.



Name	Status
7 - KPIs	✓
9 - Dashboard	✓
Analise Devoluções 2021 vs 2022 - Sem e ...	✓
Check Valores das Ilhas	✓
Check Valores das Ilhas	✓
Dados de Apoio Sermail	✗
Informação Paletes em Armazém	✓
Quantificação de Devoluções 2021	✓
RE CSR IDL Perrigo Iniciativa LeanGreen	✓
RE Dados % de Armazém - Lean Green	✓

- Support document for Me3

- The document “Analise Amostras 2021 vs Reduções” represents all the analysis conducted and presented in the description of the measure. Furthermore, the data used for calculating the measure's reduction is derived from this document.

Name	Status
Analise Amostras 2021 vs Reduções	✓

- Support document for Me4

- The document “Analise Valor de Encomenda 2021” these calculations were performed to determine the variations in net value, shipments, weight, and distances that would occur with the removal of orders ≥ 200 euros
- The document “Dados logístico de Envio 2022” allows quantifying all the shipment values for the year 2022.
- The documents “Me4 redução (...)” e “Me4 – Analysis Report” are exactly the input document in the Big Mile tool and the results of the analysis, assuming the scenario where shipments ≥ 200 euros were removed.
- The document “Valor Mínimo” Supports all the percentages presented in relation to this, both in the body of the text and in the KPIs.

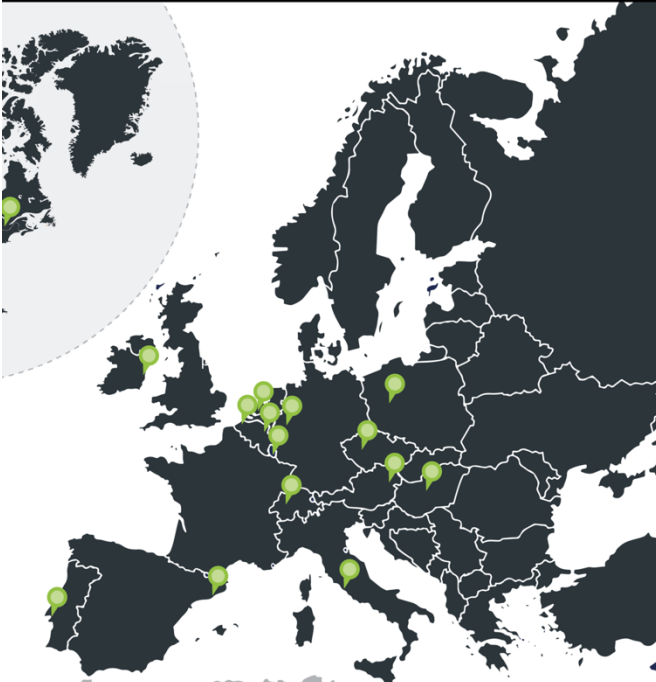
Name	Status
Analise Valor de Encomenda 2021	✓
Analise Valor de Encomenda 2021	✓
Dados logisitco de Envio 2022	✓
Me 4 reduções - Perrigo Big Mile - DADO...	✓
Me4 - Analysis Report - EN-GS1Portugal-...	✓
Valor Minimo	✓



- Support document for Waste Management
 - The documents “Destruição 2018” e “Destruição 2021”, represent the quantification of data outside the scope of Waste Management.

Name	Status
 Destruição_2018	
 Destruição_2021	

Annex 33 – General Slideshow Used to Present the Project in the Workshops



Lean & Green
Perrigo
Portugal
CO2 emission reduction

LEAN & GREEN 

The slide features a map of Europe with several green location pins indicating various countries. To the right of the map, the text 'Lean & Green Perrigo Portugal CO2 emission reduction' is displayed. Below this text is the 'LEAN & GREEN' logo, which consists of the text 'LEAN & GREEN' followed by a circular icon containing a stylized green leaf and the words 'LEAN & GREEN'.

Slide 1

What is Lean & Green?

- Is an environmental certification
- The biggest European initiative for the reduction of Green House Gases in the logistics activities
- The aim is the goals defined in the Paris Climate Conference (COP21)



Neutral emissions of carbon by 2050

- Limit the temperature increase of 2°C was global average;
- Analyze the contribution of each country to the reduction of GHG
- Give climate funding to developing countries



Slide 2

Lean & Green Program



1st Phase

1. Each participant must carry out a reference CO2e measurement of its current greenhouse gas emissions.
2. Based on this, draw up a realistic and feasible action plan is created.
Which – alongside the CO2e calculation – contains specific measures for reducing its greenhouse gas emissions by at least 20%.
1. The action plan is reviewed by the national host or an external auditing party.
2. Once a participant successfully passes the review, it receives the Lean & Green Award.

Slide 3

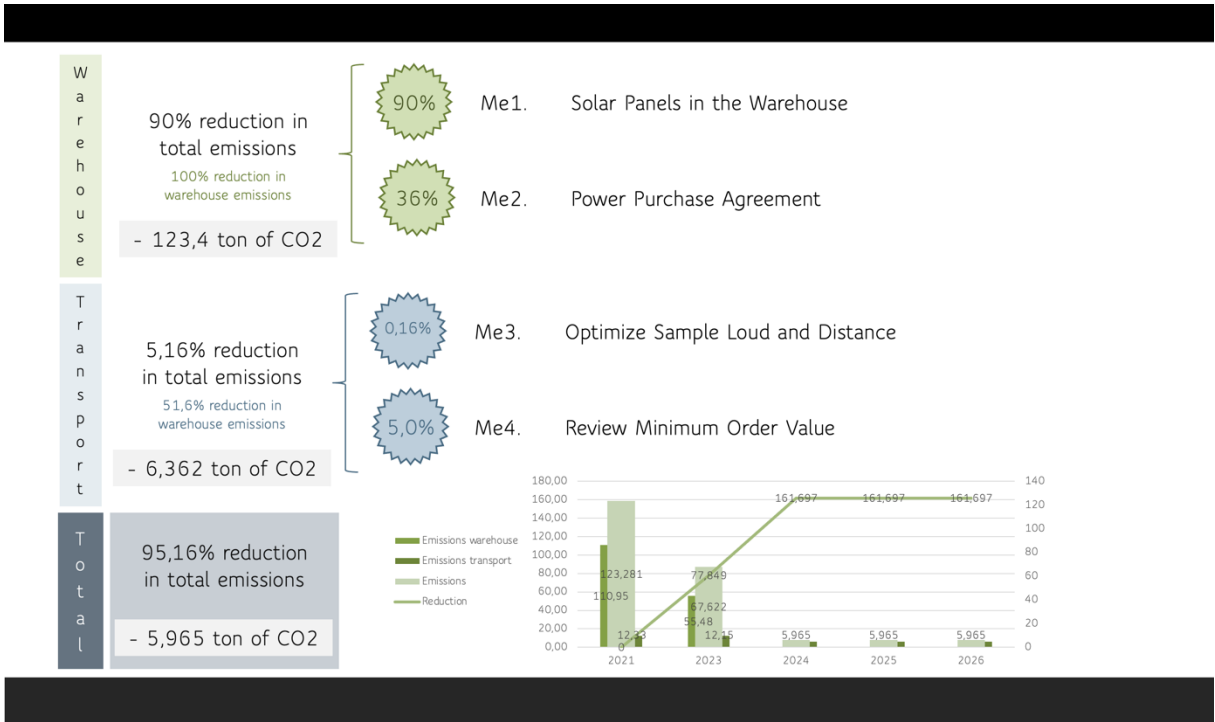
Lean & Green Program



2nd Phase

1. Project progress and the resulting reduction of greenhouse gas emissions must be reported to the national host, once a year using a monitoring tool.
2. As soon as the participant has achieved its reduction target, the auditor will carry out an on-site audit of the measures implemented.
3. Once the participant has successfully passed this audit, the national host will award it with the **Lean & Green Star certification**.

Slide 4



Slide 5

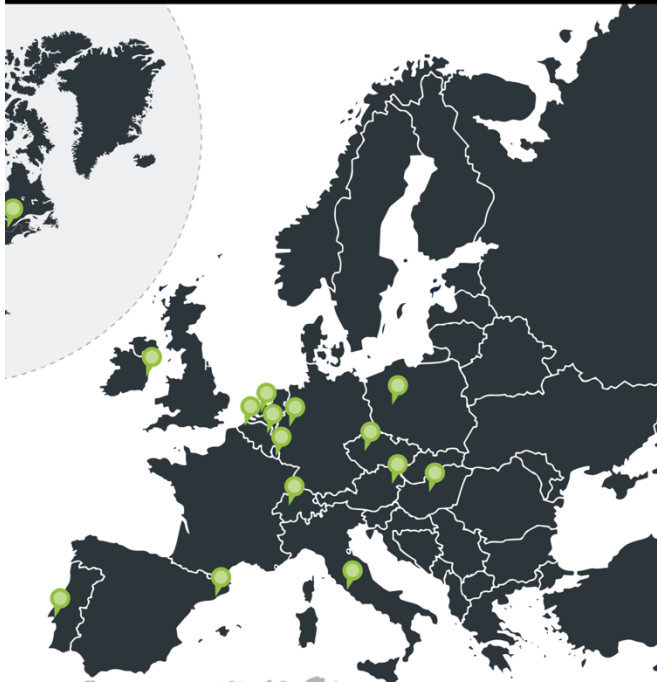


Slide 6

Annex 34 – Dashboard Lean & Green

Dashboard Lean&Green – Perrigo									
Year			2021	2022	2023	2024	2025	2026	Explanation
Description	Description	Unit of Measure	Base year CO ₂	Goal	Goal	Goal	Goal	Goal	
Size of the goods flow	In-Scope Volume	Wight (ton)	915	1187,064	1222,676	1259,356	1297,137	1336,051	Weight shipped in tons
Area of the warehouse		Pallets (unit)	2517	2026	2026	2026	2026	2026	Number of occupied pallets in the warehouse
CO ₂ Emissions TOTAL	Absolut reduction	ton de CO ₂	123,281	123,281	67,622	5,965	5,965	5,965	Total scope emissions in tons
	Share in the total relative reduction*	kg de CO ₂ /ton	12,87	9,92	9,63	9,35	9,08	8,82	Subdivision linked to a unit of transport volume (ton)
		kg de CO ₂ /pallet	44,30	55,04	55,04	55,04	55,04	55,04	Subdivision linked to a unit of storage volume (ton)
	Absolut reduction	%	0,00%	0,00%	45,15%	95,16%	95,16%	95,16%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
	Share in the total relative reduction*	kg de CO ₂	-	0,00	77849,13	161696,77	161696,77	161696,77	Total extrapolated reduction in kg of CO ₂ regarding the zero CO ₂ measurement
	CO ₂ Emissions	kg de CO ₂	123281	123281,00	67622,45	5965,39	5965,39	5965,39	Given the observed/estimated reduction, what will be the emission forecast for the plan period
Me 1	Absolut reduction	kg of CO ₂	-	0,00	22190,58	44381,16	44381,16	44381,16	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
Solar Panels	Share in the total relative reduction*	%	0%	0%	18%	36%	36%	36%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
Me 2	Absolut reduction	kg of CO ₂	-	0,00	55476,45	110952,90	110952,90	110952,90	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
Power Purchase Agreement	Share in the total relative reduction*	%	0,00	0,00	45%	90%	90%	90%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
Me 3	Absolut reduction	kg of CO ₂	-	0,00	182,10	198,66	198,66	198,66	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
Samples	Share in the total relative reduction*	%	0,00	0,00	0,15%	0,16%	0,16%	0,16%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
Me 4	Absolut reduction	kg of CO ₂	-	0,00	0,00	6164,05	6164,05	6164,05	Reduction achieved/expected in tons/kg of CO ₂ , in relation to the zero value, attributable to specific measures
Minimum order value	Share in the total relative reduction*	%	0,00	0,00	0,00%	5,00%	5,00%	5,00%	The year of zero CO ₂ emissions is year 0 (2021); for the following year, specify the reduction (in %) regarding the zero CO ₂ measurement
CO ₂ Emissions BY AREA	Absolut reduction WAREHOUSE	kg of CO ₂	-	111502,00	89201,60	66901,20	66901,20	66901,20	Total reduction in CO ₂ emissions in kilograms achieved by measures in the WAREHOUSE area
	Share in the total relative reduction WAREHOUSE	%	0%	0%	50%	100%	100%	100%	Total extrapolated reduction in CO ₂ emissions in percentage achieved by measures in the WAREHOUSE area
	Absolut reduction TRANSPORT	kg of CO ₂	-	23558,00	23384,01	17478,69	17478,69	17478,69	Total reduction in CO ₂ emissions in kilograms achieved by measures in the TRANSPORT area
	Share in the total relative reduction TRANSPORT	%	0%	0%	1,48%	51,61%	51,61%	51,61%	Total extrapolated reduction in CO ₂ emissions in percentage achieved by measures in the TRANSPORT area

Annex 35 – Sample Focused Slideshow Used to Present the Project in the Workshops (in Portuguese)



Me3. Rever
processo das
Amostras
otimizar cargas e distâncias

LEAN & GREEN 

Slide 1

O que é o Lean & Green?

- Is an environmental certification
- The biggest European initiative for the reduction of Green House Gases in the logistics activities
- The aim is the goals defined in the Paris Climate Conference (COP21)



Neutral emissions of carbon by 2050

- Limit the temperature increase of 2°C was global average;
- Analyze the contribution of each country to the reduction of GHG
- Give climate funding to developing countries



Slide 2

Programa Lean & Green



1st Phase

1. Each participant must carry out a reference CO2e measurement of its current greenhouse gas emissions.
2. Based on this, draw up a realistic and feasible action plan is created.

Which – alongside the CO2e calculation – contains specific measures for reducing its greenhouse gas emissions by at least 20%.

1. The action plan is reviewed by the national host or an external auditing party.
2. Once a participant successfully passes the review, it receives the Lean & Green Award.

Slide 3

Plano de Ação

Me1. Painéis Solares no Operador Logístico

Me2. Power Purchase Agreement

Me3. Rever processo das **Amostras** – otimizar cargas; otimizar distâncias

Me4. Rever processo de **Encomendas** – Restrições de valor mínimo de encomenda

Su1. Estabelecer target na quantidade de stock de segurança

Su2. Alterar processo das Devoluções – fee não devolução

Slide 4

Me3. Rever processo das Amostras

	N*	Quantity (Kg)	Distancia (km)	kg/km		Custo (trans e adm)
Academia	20	328,191	245,825	1,34		3,60
Cliente	197	6164,433	5215,223	1,18		4,06
Armazenista	33	4815,456	1858,562	2,59		1,85
Auchan	7	12,302	41,309	0,30	Urgentell	16,12
colgate	1	2,616	2,455	1,07		4,50
Farmácia	18	113,507	941,224	0,12	Urgentell	39,80
Grupo	2	13,336	164,842	0,08	Urgentell	59,33
Hospital	3	153,689	21,139	7,27		0,66
ITMP	1	0,731	15,06	0,05	Urgentell	98,89
Outro	95	1002,477	1985,537	0,50	Urgentell	9,51
PD	14	11,47	51,073	0,22	Urgentell	21,37
sonae	19	20,054	68,189	0,29	Urgentell	16,32
Wells	4	18,795	65,833	0,29	Urgentell	16,81
Hotel	8	1488,757	373,745	3,98		1,21
Internal use	34	287,476	888,164	0,32	Urgentell	14,83
Voluntariado	23	9724,27	166,187	58,51		0,08
Sermail	15	2530,786	181,52	13,94		0,34
Perrigo	14	721,208	205,674	3,51		1,37
AVG €/kg						3,64 Geral
AVG €/kg						18,04 Detalhe

Existem **três** grandes problemas

- Falta de centralização
- Envios de amostras não são constantes
- Envios de amostras não são coordenados

Envio de amostras para uso interno e para clientes para Escritório ou Sermail

Implementação do excel

Slide 5

Me3. Rever processo das Amostras

AMOSTRAS CLIENTES

Será enviado para o escritório e para os armazéns da Sermail amostras de produtos e será então de a responsabilidade dos vendedores incluir as mesmas nas visitas já feitas atualmente, e da restante equipa de entrega das mesmas quando os clientes se deslocam ao escritório, algo bastante comum atualmente.

Caso não seja possível, deverão concentrar os envios, um exemplo é, se querem enviar produto para várias pessoas dentro de um cliente, deve ser enviado todo o produto numa guia só, e depois o cliente faz a distribuição.

Envio de amostras para uso interno e para clientes para Escritório ou Sermail

AMOSTRAS USO INTERNO

Serão agora enviadas para o escritório e para os armazéns da Sermail, e será da responsabilidade dos mesmos recolhê-las.

Especificando, a medida tem como base passar "Internal use" para a Sermail e Escritório, tal como os "Clientes".

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Me3. Rever processo das Amostras

AMOSTRAS CLIENTES / INTERNAL USE

Serão otimizadas as cargas de envio. Visto que os envios estarão concentrados, existe então a possibilidade criar coordenação.

Para isto será criado um **excel** onde os **colaboradores** inserem a **quantidade** que desejam encomendar de cada artigo e **periodicamente** o **envio de uma amostra** será feito.

Ainda, será construído um **pequeno stock em escritório** para entregar a clientes quando visitam e para cobrir situações de urgência.

Implementação do excel

Slide 7

Me3. Rever processo das Amostras

AMOSTRAS	2021	previsto	redução	
78,46%	311	67	244	Redução no número de shipments
14,75%	12491,56	10649,55	1842,01	Redução distancias
	68,31	317,09	(248,78)	Aumento nos kilos por cliente

Impacto na redução da area (ano completo)	1,61%
Impacto na redução total (ano completo)	0,16%

Ano completo	12	meses
Ano de implementação	11	meses
Redução em ano de impl.	0,15%	

Envio de amostras para uso interno e para clientes para Escritório ou Sermail

Implementação do excel

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Redução total - Dashboard

Ano			2021	2022	2023	2024	2025	2026
Descrição	Descrição	Unidade	Medição zero de CO ₂	Objetivo	Objetivo	Objetivo	Objetivo	Objetivo
Tamanho de fluxo de mercadorias	Volume dentro do alcance	Peso (ton)	915	1187,064	1222,676	1259,356	1297,137	1336,051
Tamanho de área de armazém		Paletes (uni)	2517	2026	2026	2026	2026	2026
Emissões de CO ₂ TOTAL	Redução absoluta	ton de CO ₂	123,281	123,281	67,622	5,965	5,965	5,965
	Quota na redução relativa total*	kg de CO ₂ /ton	12,87	9,92	9,63	9,35	9,08	8,82
		kg de CO ₂ /paleta	44,30	55,04	55,04	55,04	55,04	55,04
	Redução absoluta	%	0,00%	0,00%	45,15%	95,16%	95,16%	95,16%
	Quota na redução relativa total*	kg de CO ₂	-	0,00	77849,13	161696,77	161696,77	161696,77
	Emissão de CO2	kg de CO ₂	123281	123281,00	67622,45	5965,39	5965,39	5965,39



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Questões?
Obrigada pela atenção

LEAN & GREEN 

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