Model for evaluating the achievement of a circular economy for the grocery chain sector

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TABLE OF CONTENTS

9. REFERENCES AND BIBLIOGRAPHY

10. ANNEXES

1. ABSTRACT

Circular economy (CE) implies the gradual decouplization of the economic activity from the consumption and use of finite resources, as well as the eradication of waste from the system. CE is based upon 3 main principles: the elimination of waste and pollution, the maintenance of products and materials in use, and the regeneration of natural systems. The striking benefits that the CE provides, and the close relationship that grocery chain businesses establish with their customers, as compared to other more detached industries, makes this sector attractive for the study.

The objective of this paper is to propose a simple model that could help grocery chain companies monitor and evaluate the transition that their businesses are undergoing towards a CE. For the model, 7 variables and a set of sub-variables are identified -extracted mainly from financial, non financial and sustainable annual reports and corporate websites of 5 different grocery retail chains in the Spanish territory- as key dimensions for measuring the transition towards a CE in the grocery chain sector. Actions taken by the proposed supermarket chains are evaluated in a scale from 1 to 5, with the purpose of giving a final score that serves as powerful insight on the effectiveness of the actions taken by each grocery chain towards a CE.

The final aim is that this model can be extrapolated and used- both by internal or external parties- for the future evaluation and improvement of the grocery chain's transition towards a CE.

Keywords: Circular economy, grocery chain, climate change, environment, food waste, waste, sustainability, recycling, reusing, circularity indicators, KPI, circular economy model

2. THEORETICAL FRAMEWORK

For the execution of this work, a specialist bibliography has been used, including articles and academic papers, specific reports, and websites of various companies and institutions. The knowledge acquired through various subjects taken throughout the degree is also applied.

In relation to the main sources that have served as a base for the development of the model, a distinction should be made between primary sources -direct information collected at the point of sale of supermarkets- and secondary sources which could be discerned as follows:

Firstly, attention has been focused on the 2020 sustainability memories and 2020 non-financial annual reports of the Spanish 5 biggest retail chains in terms of market share, and also the most influential ones regarding CE -Mercadona, Eroski Group, Carrefour, Lidl, and DIA Group-. Information from their corporate websites has also been used. From these sources exact examples of actions implemented which contribute to a successful transition to a CE in the grocery chain sector are identified and extracted.

Furthermore, the previously mentioned information is complemented and verified with the literature concerning CE, its indicators, and application; for the obtention of a model that is as close to today's reality as possible, and measures with accuracy the success of the actions implemented by grocery chains towards a CE.

Concerning literature, these main sources chosen to serve as a base are:

Howard, M., Hopkinson, P. and Miemczyk, J., 2018. The regenerative supply chain: a framework for developing circular economy indicators. *International Journal of Production Research*, 57(23), pp.7300-7318.

Moraga, G., Huysveld, S., Mathieux, F., Blengini, G., Alaerts, L., & Van Acker, K. et al. (2019). Circular economy indicators: What do they measure?. *Resources, Conservation And Recycling*, *146*, 452-461. doi: 10.1016/j.resconrec.2019.03.045

These analyses are crucial in order to know which variables and indicators would be useful for creating a precise and useful CE model for the supermarkets.

3. METHODOLOGY

This work is structured as follows.

First, the concept of CE is explored in order to understand the underlying principles that the model is seeking for.

Next, the drivers and the barriers of the transition to a CE are studied, which allows for a contextualization of the concept in practical terms.

Then, the model is focused on understanding the grocery chain sector in Spain and how it relates to the concept of a CE.

In order to start building the model, an analysis of theoretical and implemented action plans by leading businesses is examined, alongside concrete actions that companies in the target sector are taking to achieve a CE. Here, the focus is set in the whole value chain, from the production level to what the customers do after having consumed the product. Once that is concluded, a set of relevant variables is extracted to indicate the level of success of a company in achieving a circular economy. These variables are divided into sub-variables, each quantified with a specific KPI.

Once the relevant variables are set, a finalized model for the evaluation of the successful achievement of a circular economy is presented, which is applied to the selected sample of companies (Mercadona, DIA Group, Eroski Group, Lidl and Carrefour). To perform such analysis, each sub-variable is given a score according to how each company performs at the specific KPI. A mean of these scores is calculated and then becomes the overall variable score, which in turn, is later used in the computation of the final score using the same mechanism.

Lastly, conclusions are extracted, which allows for a well-founded statement of which are the most relevant actions that a company in the target sector can take to come closer to a CE.

4. THE CIRCULAR ECONOMY APPLIED TO THE GROCERY CHAIN SECTOR

4.1. Introduction to the concept of circular economy

The origins of the concept of the CE can be traced back to the modern environmental movement of the 1960s and 1970s (Ekins et al., 2019). The main idea behind the coining of the term was to avoid industrial waste generation in the traditional sense. Under the view of those who formalized the idea, a new paradigm in production should come into force, one that creates a loop from the user back to the producer (Omar & El-Haggar, 2017). These ideas have been explored and developed further into the current main consensus definition of a CE (The Ellen MacArthur Foundation, 2021). This new conceptualization does not limit itself to a loop that involves customers but rather extends itself to energy efficiency, ideally to a level in which every output would be an input for some other productive process.

As defined by the Ellen MacArthur Foundation, a CE is understood from two distinct but related dimensions, which are known as "cycles" (The Ellen MacArthur Foundation, 2021). The first cycle is the biological one, in which residues from production are returned to nature after its use and the second one is a technical one, in which products and processes are designed in a way that minimizes resource usage. The combination of these two cycles allow us to land onto a specific general definition of the CE.

The CE is an economic model in which products and industrial assets are designed and produced so that the use of natural resources and waste generation are kept to a minimum. In a CE business strategies seek resource efficiency through the maximization of capacity usage and usable-life extension of products and assets, which incorporate recycling plans that can minimize waste production in favour of creating new, viable inputs for other production processes (European Investment Bank, 2020).

From this definition, a perfect CE would be an economy that maximizes efficiency at all times and for all stakeholders. Needless to say, such an economy is impossible at a practical level, at least at the current developmental level of civilization. It remains rather as a beacon of what, as a society, we should strive for if we decide that the ideals that such philosophy embodies are beneficial for us.

Companies can help society transition to an economy closer to the ideal of a CE model by taking relevant action in those areas that they have control over. Keeping in mind the ideas that

lie behind the CE, which have just been studied, allows for a more accurate identification of specific examples, which can be useful in the analysis of grocery chains.

4.2. Drivers and barriers to the achievement of a circular economy

a) Drivers

There are striking benefits from transitioning towards a CE in the grocery chain sector, not only for the supermarket chains themselves, but also at several other levels; consumer, environmental or even at a national and overarching economy level (Ellen MacArthur Foundation, 2013). For the purpose of the model, before inspecting the practices that grocery chains implement to achieve a CE model, it is crucial to understand which are the main reasons and forces favouring this transition.

Drivers, factors which effectively facilitate a CE, are categorized in two main subgroups, known as soft drivers and hard drivers. Soft drivers are considered to comprise all factors related to cultural, social and institutional matters, whereas hard drivers encompass technological and economic related factors (de Jesus & Mendonça, 2018).

a.1) Soft drivers

Along with soft drivers, social, legal and environmental factors are found.

Regulations as well as governments have a crucial role in the incentivization of innovative initiatives and activities which favour the transition towards a CE in the grocery chain sector at the different levels of the economic activity (Frosch, 1992). Hand in hand with the legitimization of regulations, governments have the power and responsibility not only to promote a favourable environment for grocery chains to develop a CE, but also to provide a solid education on the matter, in order to foster awareness and increase participation on the issue (Ellen MacArthur Foundation, 2013). Accordingly, laws and regulations concerning packaging, pollution, waste, consumption and energy developed by governments drive change towards CE in the grocery chain sector (Ellen MacArthur Foundation, 2015).

Secondly, the positive consequences that a CE has on the environment and hence on society, impulses the existence of several social motivators. Consumers are experiencing a shift in their preferences as well as an increasing sensitivity towards environmental issues, as a result of global warming and climate change. Social movements, coupled with an increased demand for more sustainable alternatives, are putting increasing pressure on supermarkets to develop CE not only as part of their corporate social responsibility but also to adopt it in all areas of their economic activity. From the business perspective, reputational gains can be considered drivers of CE in the grocery chain sector (Mehmood, Ahmed, Viza, Bogush & Ayyub, 2021).

Furthermore, adopting a CE also has positive repercussions on public health, as water and air pollution are common causes of a significant amount of illnesses nowadays (Govindan & Hasanagic, 2018).

a.2) Hard drivers

Innovation and economic factors also help boost the transition towards a CE. Technology is crucial for change, consequently, innovations at the production and manufacturing level increase the quality and durability of materials, as well as the reuse opportunities; facilitating the closure of the loop of resources. Technological improvements also facilitate the design of more manageable life cycles and the improvement of the recycling systems, driving supermarket chains to strive for a CE (Jakhar, Mangla, Luthra & Kusi-Sarpong, 2019).

The benefits of a CE are extensive for the economy and market. Consumption of limited resources continues to increase, while the reuse of products has proven to save substantial amounts of assets, decrease the production of waste and also the demand for raw materials, contributing to the overall reduction of prices and price instability of the latter (Preston, 2012). Finally, a study provided by the European commission (2014) done with Cambridge econometric suggests the positive effects of a CE on net employment (Horbach, 2015).[1]

In conclusion, the increasing measures and regulations imposed by the Spanish government; -the ban of light and super light non-compostable plastic bags for instance (BOE, 2018) - along with the detrimental environmental consequences stemming from a linear economy, -overconsumption of resources, pollution, and climate change- are two of the most essential factors that drive supermarket chains towards the increasing adoption of policies and actions to strive for a CE in the grocery chain sector.

b) Barriers

Despite the numerous CE opportunities, some strong barriers must be overcome. Being aware of them is useful to understand the limits of the actions the supermarkets are implementing before starting with the model. Four categories of barriers can be determined.

Firstly, it is essential to make a remark on the **institutional and legal barriers**, which are based on poor environmental regulations and legal enforcement. Nowadays, there is a lack of strong environmental public policies and huge and efficient state aid would be key to giving incentives to start CE projects (Mehmood, Ahmed, Viza, Bogush & Ayyub, 2021). Moreover, a clearer tax policy concerning recycled products would be useful and would help in order to internalize the costs of using non-recycled materials (Mehmood, Ahmed, Viza, Bogush & Ayyub, 2021).

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[1] The model predicts approximately two million net additional jobs in the EU by 2030

Furthermore, some crucial problems come directly from poor institutional infrastructure, which favours continuation of the linear economy model, which leads to inconsistent messages and to obstructing laws that impede the development of the CE (Kirchherr et al., 2017).

Secondly, it is crucial to point out the **economic barriers** that describe the lack of economic feasibility of the creation and implementation of CE. The most robust economic barrier is the difference in prices between virgin and recycled materials. Recycling materials have much higher prices and low economic benefits in the short term. (Grafström & Aasma, 2021). The other crucial economic barrier is the high upfront investment costs for CE implementation due to the reversion of the supply chain, the adaptation of new technologies, the development costs, the renegotiation of contracts (Grafström & Aasma, 2021). Another point to highlight is the need for learning curves because in this type of huge investment what usually happens is that the first one in investing bears a lot of costs and losses and the rest start making profits, so nobody wants to be the first one if the incentives to do so are so low (Kirchherr et al., 2017).

Thirdly, some **technological and infrastructural barriers** appear when thinking about CE. The availability of the necessary technology is essential to implement it correctly. Moreover, to reach CE, it is crucial to design "product-life extension" or repair opportunities that require a high level of knowledge and are time-consuming (Grafström & Aasma, 2021). As technical alternatives improve, more material can be recovered and, therefore, the possibility for reusing is incremented, so a wide range of technologies must be promoted (De Jesus & Mendonça, 2017). Concerning the lack of infrastructural facilities, it is a fact that the current infrastructure is not facilitating the move to CE and the actual collection systems are insufficient (Grafström & Aasma, 2021).

Finally, some barriers linked to knowledge, skills, and consumer behaviour can be appreciated and grouped as **social and cultural barriers**. Some consumers are not willing to change to recycling and recycled products due to status-quo bias and lack of information, which is related to the thought of lower quality of the recycled products which ends in a reduction of the demand (Kirchherr et al., 2017). Another key barrier to consider is the conservative company culture. Some firms relate that CE is not taken into account in their strategy, mission, vision, values, and KPI (Grafström & Aasma, 2021). It is hard sometimes to change into a CE system because all the echelons of the supply chain must be circular. Some existing suppliers are quite conservative and are hard to convince to cooperate because they do not find it beneficial (Kirchherr et al., 2017).

After seeing the possible barriers that can occur and being aware of them, the models presented may help supermarkets to overcome these progressively by having an overview of the possible

actions and variables that are taken into account to reach a CE and not waste resources and time on useless ones. Besides this, the model is not searching to force supermarkets to reach a 100% CE because of the difficulties this can present. Finally, due to the necessity of huge investments and the company's cultural barriers, the model presented cannot be applied to small supermarkets.

4.3. Grocery chain sector and the circular economy

In the grocery chain sector, the traditional business model has proved to over-exploit resources and affect negatively the environment (Esposito, Sessa, Sica and Malandrino, 2020), that is why this sector has an increasing pressure to transition to CE by different agents, such as consumers and public institutions. Therefore, the model would focus on the changes expected from the grocery sector.

4.3.1. Overview of the agents involved in the grocery chain sector and its increasing trend to CE

Historically, supermarkets have followed a linear business (Steeneken and Ackley , 2012) which has caused problems such as resource scarcity, food loss, and waste generation as a worldwide pattern on the supply chain (Esposito, Sessa, Sica, and Malandrino, 2020). However, supermarkets are not the only ones responsible. Consumption patterns and habits of consumers have also played a key role in increasing climate impact and resource use (Mirza, 2016).

For this reason, the agriculture value chain has focused on food safety, production traceability, product quality, respect for the environment, and human resources. Thus, the production systems have started to move towards sustainable approaches (Mirza, 2016). Furthermore, the growing trend of sustainability for European consumers directly affects the food sector since it is partly responsible for greenhouse emissions and the use of water globally (Esposito, Sessa, Sica, and Malandrino, 2020).

One agent that has pushed the evolution to a CE is the United Nations by designing the Sustainable Development Goals. Different categories have been proposed as a guideline for transitioning to a CE (United Nations, 2021).

Supermarkets take these guidelines into account when setting goals related to their environmental actions (Herrara, 2021) and some of them are reflected in the definition of the variables of the model as the SDG.7 affordable and clean energy, SDG. 12 responsible consumption and production, SDG. 13 climate action, SDG. 14 life below water, SDG. 15 life on land and SDG. 17 partnerships for the goal (United Nations, 2021).

4.3.2. Food chain supermarkets in the Spanish market

As it is happening at a European level, Spanish supermarkets are causing damaging consequences: 3,5% of the fresh food that arrives in Spanish supermarkets' warehouses does not get to the sale stage due to different reasons, and 2,05% of them end up wasted (Aecoc, 2021). Moreover, according to Greenpeace, Spanish supermarkets have started to realize measures for reducing single-use plastics, but none have applied all these measures needed to eliminate them (GreenPeace, 2021).

However, the grocery chain market accounts for a significant part of the Spanish GDP. Furthermore, supermarkets and hypermarkets exceed by far sales levels compared to smaller groups, in 2020, the five biggest supermarkets in Spain had 49,6% of the market share of the grocery market. (Statista, 2021)

For the preceding reasons, the five Spanish supermarkets with the largest market share have been selected for being studied, and the sustainable strategies that they have followed are extrapolated into variables for the model.

The Spanish supermarkets selected and their respective market shares are (Statista, 2021):

1. Mercadona (24,5%)
2. Carrefour (8,4%)
3. Lidl (6,1%)
4. DIA Group (5,8%)
5. Eroski Group (4,8%)

5. ANALYSIS OF INDICATORS FOR CE MODELS AND ITS INTERPRETATION BY SUPERMARKETS

As stated, both literature about the most useful indicators to measure CE and the actions of the 5 supermarkets that are evaluated are used as a reference to create the variables of the model. Supermarket reports and corporate websites can involve some subjectivity. Being aware of this, it is crucial to contrast this information with other sources before creating the variables of the model.

5.1. Literary analysis

The literary analysis aims to know which variables are relevant and have impact in the path of acquiring CE.

These two papers have been used as a tool to complement the information given by the actions of the supermarkets:

Howard, M., Hopkinson, P. and Miemczyk, J., 2018. The regenerative supply chain: a framework for developing circular economy indicators. *International Journal of Production Research*, 57(23), pp.7300-7318.

Moraga, G., Huysveld, S., Mathieux, F., Blengini, G., Alaerts, L., & Van Acker, K. et al. (2019). Circular economy indicators: What do they measure?. *Resources, Conservation And Recycling*, *146*, 452-461. doi: 10.1016/j.resconrec.2019.03.045

Despite the possibility of existing macro, micro, and meso indicators, the model is focused on the micro part, which is more related to the supermarkets themselves; leaving the macro and meso constant as a way of simplifying the model.

These papers identify more complex indicators than the ones used in the model, but if the categories of variables they are presenting include the ones selected for the model, it can mean that good and relevant variables are being identified.

The model's variables have been based on the entire supply chain because it is essential to change all the echelons of the supply chain in order to develop a successful CE. From public company reports and company web-based sources, indicators concerning energy and water use, carbon emissions, water consumption, and waste management are required for a precise CE model (Howard, Hopkinson and Miemczyk, 2018). This has been used as a reference to create the model's variables about water management, waste and resource management, and energy efficiency.

To do a complete analysis of CE, products, components, and materials' indicators must be used and analysed deeply (Moraga et al., 2019). It is key to make sure that supermarkets are using recycling materials for their products and packaging and sustainability methods to process them. This has been used as a reference to create the model's variables about raw materials and packaging.

The variables stated above and the rest of the variables which are focused on logistics and communication are complemented and really developed with the actions taken by the supermarkets that are disclosed right below.

5.2. Actions taken by supermarkets to come closer to a CE model

An analysis of the main actions that bring a company closer to a CE model taken by a sample of 5 supermarket chains in Spain has been conducted. The details of such actions can be found in tables A1.1, A1.2, A1.3, A1.4 and A1.5 in Annex 1.

To perform the analysis, annual reports and other information located on each company's website has been used. The initial research has been classified in different categories, which have later informed the choice of variables. These actions have also played a role in the definition of sub-variables and their weighting scale, as are developed in the following section.

6. VARIABLES OF THE MODEL

6.1. Introduction

The model is designed taking into consideration information of limited scope. The analysis done of literature covers broadly applicable concepts. However, concerning the extracted information on the actions taken by supermarkets towards a CE; the scope covers a sample of the 5 most significant grocery chains regarding CE and the biggest in terms of market share in Spain. These supermarkets are Mercadona, Carrefour, Lidl, DIA Group and Eroski Group respectively.

After an in-depth analysis of the sustainable memories, corporate websites and non-financial annual reports of the five selected grocery chains; and an extensive research on the literature on both quantitative and qualitative micro indicators for the measurement of the success of achieving a CE; a set of 7 variables is selected for the designing of the model. Variables are the representation of qualitative and quantitative attributes (Waas et al., 2014). Each of the 7 identified variables is broken down into a group of sub-variables -recognized mainly from specific actions that supermarkets implement nowadays, but also from the literature- that serve both as qualitative and quantitative indicators for the scoring of the actions that grocery chains take towards a CE.

For consistency reasons, to measure the extent to which the actions implemented by supermarkets are effective for the achievement of a CE, each sub-variable is given a score in a scale from 1 to 5; being 1 not very effective and 5 very successful for the achievement of a CE in the specific area covered. Depending on the nature of the sub-variable -qualitative or

quantitative- and other aspects, tables of equivalence have been developed for the adaptation of the actual units of measurement to fit the 1 to 5 proposed score spectrum. Details about the meaning of the 1 to 5 scores in each variable can be found in Annex 2.

The different variables and sub variables in the analysis, are defined and structured as follows:

6.2. Raw materials

The first variable that has been identified consists in "Raw materials". This includes all inputs that constitute a fundamental part of a finalized product. Meat, cotton and fruits are all examples of raw materials. Given that all grocery chains buy their products as the first step of the value chain, it seems that this variable is a good place to start. The rational management of raw materials is a challenge for many supermarkets and it is essential for the achievement of CE.

This variable has been divided into distinct sub-variables to better assess the different categories or raw materials that a supermarket chain handles.

These sub-variables are fish, meat, eggs and fruits, vegetables and derived products. For fish, the chosen KPI is % of sustainably sourced fish/Total produce. Each 20% increase in the ratio equals an increase of 1 in punctuation. This is an accurate representation of how sustainable the overall fish sold by a particular grocery chain is. For meat, and eggs, the process is similar, with the exception that here the scoring works in a slightly different way, valuing marginally more an increase over 40%, which is considered as the baseline. Fruits, vegetables and derived products are controlled also by taking the percentage of sustainably sourced produce, which is found from data provided in the annual reports. The scoring system for these two sub-variables is the same as in meat and eggs.

There are some issues with collecting data to punctuate some sub-variables, as some grocery chains do not individualize information on sustainably sourced produce. In these cases, the sub-variable is not taken into account and the ranking factors the lack of information in. In some other cases, this issue is commonplace, such as with information regarding milk and non-edible plant-based products, which were considered as sub-variables but finally left out due to this reason.

6.3. Water management

Water usage is commonplace amongst the grocery chain sector, especially for those that sell textiles. Water is also used in production of other goods, such as processed foods or facility cleaning. By reducing usage or giving a second life to used water, a company contributes to improving the sustainability of its environment, which is why the variable is included in the

model. The variable water management aims to measure the control and movement of water to minimize the impacts in the environment.

Sadly, most chains provide little to no information regarding their water use, and when they do, the information is not directly comparable. For this reason, for water management, a single, overarching variable is considered, that evaluates the overall administration at a general level.

6.4. Packaging

Thirdly, the variable packaging aims to measure the actions taken by grocery chains regarding the composition of the materials which are directly related with the production, packing and storing of the products sold.

Aiming at covering with accuracy the dimensions related mainly to reusability, recyclability and the reduction of material waste 5 sub-variables are chosen. Firstly, the Material waste valorization rate is used to measure the percentage of the total material waste generated by supermarkets which is valorized, recycled or/and reused; crucial for the evaluation of the efforts made to close the loop of resources- one of the key objectives of CE (Camilleri, 2018)-. Concerning plastic bags, the number of sustainable alternatives offered by supermarkets is measured, as well as the percentage of the total material composition of checkout plastic bags which is recycled; essential aspects to consider in terms of making a smoother transition to a CE, especially for customers. Finally, the availability of compostable plastic bags in sections is measured, as well as the number of types of products[2] offered by grocery chains to buy in bulk to evaluate the commitment of grocery chains to promote the gradual increase of reusable ways of storing and transporting food.

6.5. Logistics

The variable logistics focuses on the actions taken by grocery chains related to the distribution, transportation and storing facilities of the products sold. Its main attention is drawn to the reduction of the environmental impact in terms of carbon emissions and increasing transportation efficiency. From the actions that supermarkets implement 4 sub-variables are identified as follows.

Firstly the percentage reduction in C02 emissions that come only from logistic activities is evaluated through the comparison of figures of 2019 and 2020. The second one evaluates

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[2] By type of products the following are hypothetical categories to distinguish (fruit, vegetables, nuts, meat, fish, rice, pasta, coffee, tea, olives, bread, patisserie)

whether the grocery chain has achieved at least one BREEAM certification[3] in one of its logistic centers; in order to measure sustainability in edification. Concerning efficiency in logistics, the extent to which supermarket chains are part of the Lean and Green Europe initiative[4] and have achieved the goals proposed in it -in terms of CO_2 emissions-; is key to measure the level of commitment and progress towards more efficient logistic facilities. Furthermore, the use of inverse logistics is measured in terms of used or not used, which gives some insight into the extent to which transportation efficiency is achieved.

6.6. Waste and resource management

This variable collects information on the preventive measures used by supermarkets to avoid food waste.

To evaluate prevention, two sub-variables are proposed. The first one is "Discounts for products that are near to their expiration date", measured by the percentage of discount offered to customers for those products that are going to expire and still can be sold. This variable is relevant because it assesses the involvement of supermarkets in preventing their products from ending up wasted.

The second sub-variable is "Measures to increase the efficiency of the maintenance of stock ", measured by the number of actions done to ensure that the stock is kept in good conditions longer and, to avoid having more food than necessary at the store.

To evaluate preventive and reactive measures, one last sub-variable is considered, "Certifications and collaborations", quantified by the number of collaborations with other entities and recognized certifications the supermarket has regarding the management and prevention of waste. Thus, the valuations made by these entities are considered reliable sources for evaluating the evolution to CE.

6.7. Energy efficiency

The variable energy efficiency encompasses all energy used for the general operations of the supermarket, including both renewable and non-renewable sources.

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[3] The BREEAM (Building Research Establishment Environmental Assessment Methodology) certificate is **an international method developed by BRE Global**, United Kingdom, which allows you to know and measure the exact degree of environmental sustainability of a building (Designable, 2020)

[4] Lean & Green is an international, cross-sectoral sustainability community whose aim is to support participants to reduce their CO2e emissions in logistics and transport over five phases whereby participants can aim at reaching the Paris COP21 climate goals. (Lean & Green, 2020)

The first sub-variable, Savings in electric consumption from one year to another, is measured by calculating the percentage of savings in electricity from one year to the following. Progress towards an EC following this variable would be making progressive reductions over the years.

The second sub-variable is Measures to improve energy efficiency at the store, which quantifies numerically according to the actions carried out to gain efficiency, which reduces the use of energy in stores.

To measure supermarkets' carbon emissions, the sub-variable "Reduction of the carbon footprint" is ranked by the percentage of change from one year to the following, as it is a measure used internationally (FootprintNetwork, 2021) to evaluate the evolution towards a CE.

Finally, the certifications for the use of energy granted by recognized entities are measured in the sub-variable "Certifications / Recognitions for their use of energy" quantified numerically.

6.8. Communication

The variable communication aims to measure the actions taken by grocery chains regarding the effectiveness of transmitting the information and actions concerning CE that have been done by the supermarkets.

Aiming at covering with accuracy all of the dimensions in which grocery chains exert effort for achieving a CE, 6 sub-variables are chosen. Firstly, the information in supermarkets, which is an essential indicator to achieve a good communication of their policies. It includes the establishment of recycling bins in the supermarkets, the informative posters through the corridors of the supermarket, and the informative labels in the packaging of the products. Then, efficient communication through the website, social networks, and the app. These three sub-variables measure the quantity of CE content, the level of relevance of the CE information, and the details of the next goals they are publishing in these channels, crucial for keeping consumers informed. Apart from this, a sub-variable about the level of listening of consumers' demands is taken into account concerning the number and quality of initiatives the supermarkets have to know which are the necessities of their customers concerning CE. Finally, it is relevant to consider the alliances, pacts, agreements, programs, and recognitions that are done to inform and promote CE, raise awareness, foster citizen participation and improve the company's image.

Table 1. Summary of variables and sub-variables. Own elaboration.

Name of the Variable	Summary of the Variable	Sub-variables
Raw materials	All inputs that constitute a fundamental part of a finalized product.	a) Fish b) Meat c) Eggs d) Fruits, vegetables and derived products
Water management	Control and movement of water to minimize the impacts in the environment.	
Packaging	Composition of the materials used for production, packing and storing of the products sold at the point of sale.	a) Material waste revalorization rate b) Composition of recycled plastic bags at checkout c) Availability of compostable plastic bags in sections d) Number of sustainable alternatives offered with respect to non-recyclable plastic bags e) Number of categories of products that are offered to be bought in bulk
Logistics	Distribution, transportation and storing facilities of the products sold.	a) Reduction in CO2 emissions from logistic activities as compared to the previous year b) Use of inverse logistics c) Participation in the Lean & Green agreement d) At least 1 BREEAM certification in logistic centers
Waste and resource management	Preventive measures to avoid food waste.	a) Discounts for products that are close to their expiration date (%) b) Measures for increasing the efficiency of stock, including automatization c) Certifications and collaborations
Energy efficiency	All energy use, both renewable and non-renewable, by the supermarkets at the store level.	a) Savings in electric consumption from one year to another b) Voluntary measures to improve energy efficiency c) Reduction of the carbon footprint d) Certification regarding energy use

Communication	Effectiveness of transmitting the information and actions concerning CE that have been done by the supermarkets.	a) Information in supermarkets b) Efficient communication through th website c) Efficient communication through social networks d) Efficient communication through the app e) Listen to consumer's demands f) Alliances, Pacts, Agreements Programs and Recognitions to inform and promote CE

(Source: Own)

7. APPLYING THE MODEL

After the study of the actions selected -taken by grocery chains towards achieving a CE- for the identification of the crucial dimensions measured in the model; it should be highlighted that those same actions taken by supermarkets chains have served for the evaluation and ranking of the five selected grocery chains (Mercadona, Carrefour, Lidl, DIA Group and Eroski Group).

7.1. Quantitative scoring table

A table regarding the quantitative scoring of the supermarkets has been created in order to evaluate the different actions the supermarkets are doing from 1 to 5, being 1 not very effective and 5 very successful for the achievement of a CE in that specific area. Details about the meaning of the 1 to 5 scores in each variable can be found in Annex 2. Below each variable, the sub-variables are described and the arithmetic mean of each variable is computed taking into consideration the scores of each sub-variable.

Table 2. Quantitative scoring of the supermarkets sorted by the considered variables. Own elaboration with information about supermarkets' actions.[5]

	Mercadona	Carrefour	Lidl	DIA Group	Eroski Group
Raw materials	2,75	2,00	2,75	1,00	2,67
a) Fish	4	3	3	-	4
b) Meat	3	1	1	-	2
c) Eggs	3	3	4	-	2
e) Fruits, vegetables and derived products	1	1	3	1	-
Water management	2	3	5	N/A	4
Packaging	3,2	3,4	3,6	3,4	3
a) Material waste revalorization rate	4	4	4	4	3
b) Composition of recycled plastic bags at checkout	3	3	5	3	2
c) Availability of compostable plastic bags in sections	3	3	3	3	3
d) Number of sustainable alternatives offered with respect to non-recyclable plastic bags	4	4	3	4	4
e) Number of categories of products that are offered to be bought in bulk	2	3	3	3	3
Logistics	2,75	1,25	2,75	1,25	2
a) Reduction in C02 emissions from logistic activites as compared to the previous year	3	2	2	2	2
b) Use of inverse logistics	3	1	3	1	3
c) Participation in the Lean & green agreement	2	1	3	1	2
d) At least 1 BREEAM certification in logistic centers	3	1	3	1	1
Waste and resource management	1,67	3,33	3,33	2	3
a) Discounts for products that are close to their expiration date (%)	1	4	3	3	1
b) Measures for increasing the efficiency of stock, including automatization	3	2	4	2	4
c) Certifications and collaborations	1	4	3	1	4
Energy efficiency	2,5	2,75	2,25	2	3,75
a) Savings in electric consumption from one year to another	1	3	1	4	5
b) Voluntary measures to improve energy efficiency	3	3	3	1	3
c) Reduction of the carbon footprint	5	3	3	1	3
d) Certifications regarding energy use	1	2	2	2	4
Communication	2,17	3,33	2,50	1,67	4,17
a) Information in supermarkets (recycling bins, posters and labels)	2	4	4	1	5
b) Efficient communication through the website	2	1	4	2	4
c) Efficient communication through social networks	4	2	3	1	4
d) Efficient communication though the app	1	5	1	2	4
e) Listen to consumer's demands	1	4	2	1	5
f) Alliances, Pacts, Agreements Programs and Recognitions to inform and promote CE	3	4	1	3	3

(Source: Own)

The score sorted by variable and sub-variable for each grocery chain gives insight on how effort to achieve a CE is heterogeneously distributed through the different areas of action -variables- that are identified in the analysis. According to the investigation done, packaging is the variable with highest score overall, leading to think that it reflects the high effort exerted by grocery chains regarding this aspect.

7.2. Summary table

In table 3, an overview of the results of the analysis previously done is presented. The variables have been calculated by taking the mean of its sub-variables. Thus, the bottlenecks and strengths of each of the supermarkets analyzed can be appreciated. The scores are determined out of 5.

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[5] Regarding the sub-variable Savings in electric consumption from one year to another, in Lidl score data from 2018 to 2019 annual report due to lack of information in the newest annual report.

Table 3. Summary table of scores associated with each variable and grocery chain. Own elaboration with information about supermarkets' actions.

	Mercadona	Carrefour	Lidl	DIA Group	Eroski Group
Raw materials	2,75	2,00	2,75	1,00	2,67
Water management	2	3	5	N/A	4
Packaging	3,2	3,4	3,6	3,4	3
Logistics	2,75	1,25	2,75	1,25	2
Waste and resource management	1,67	3,33	3,33	2	3
Energy efficiency	2,5	2,75	2,25	2	3,75
Comunication	2,17	3,33	2,5	1,67	4,17
Overall score	**2,43**	**2,72**	**3,17**	**1,89**	**3,23**

(Source: Own)

7.3. Ranking

With regards to the overall score, Table 3 introduces the ranking displaying the 5 selected supermarkets ordered by the extent to which they have managed to achieve a CE through the actions they implemented in the past year (2020). The final score is determined in a scale out of 5 points, using the average of the variables presented in Table 2.

Table 4. Supermarket Ranking: actions done towards CE. Own elaboration with information about supermarkets' actions.

Position	Supermarket	Score
1 st	Eroski Group	3,23
2 nd	Lidl	3,17
3 rd	Carrefour	2,72
4 th	Mercadona	2,43
5 th	DIA Group	1,89

(Source: Own)

Eroski Group sits at the first position, benefited mainly by its strengths in communication and energy efficiency. That said, it can look for areas of improvement in its raw material and logistics management, to further improve its score.

A close second is Lidl, which has the best packaging and water management policies out of all the analyzed chains. By slightly improving its communication and energy efficiency strategies, it could overtake Eroski Group.

Carrefour has above average waste and resource management and doesn't do badly in packaging, but it's logistics, raw materials and water management all leave quite a lot to be desired, which is what brings its overall score down.

Mercadona does not excel in any category, although its raw material and packaging processes are not immediate areas of improvement. To improve its score, it should focus on improving water, waste and resource management.

The last place is held by DIA Group, which only presents a good score in the packaging department. Its other scores are below average and this is especially noticeable in raw materials, logistics and communication.

8. CONCLUSIONS

For the design of the model, as described through the course of this paper, a revision has been done of all the actions that the main 5 spanish grocery chains have, and are taking towards a CE. The information has been extracted from the 2020´s sustainable memories of supermarket chains, as well as -to a much lesser extent- from their websites. A thorough revision of the literature concerning CE, and most importantly, an analysis of what are considered to be -according to the literature- effective indicators for the assessment of the success of the measures implemented towards a CE, has been done. With the combination of the knowledge and information provided by the literature and supermarket chains concerning CE; a simple model covering 7 key dimensions for the transition towards a CE in the grocery chain sector is designed. The model has been applied to the same set of 5 Spanish supermarket chains from which the analyzed actions are extracted; obtaining results that suggest that the degree of maturity concerning CE is highest for the Eroski Group, followed by Lidl, Carrefour, Mercadona and Dia Group respectively.

8.1. Analysis of results and considerations

Looking more in detail to the scores received by each supermarket chain according to the different variables, several aspects should be highlighted:

Firstly, packaging is the area in which supermarket chains in general (making reference to the 5 analyzed) have scored higher, which leads to thinking that considerable effort is exerted by grocery chains to implement and/or communicate effectively the measures aimed towards closing the loop of resources, in this case material resources; and reducing material waste through the reuse and recycling of materials, especially conventional plastic.

On the other hand, lower scores for the 5 supermarket chains, in general, are found at the level of raw materials and logistics. Given the increasing incentives coming mainly from laws and the sustainable development goals trying to reduce the environmental impact of both logistics and the extraction of raw materials in the grocery chains sector; these data is found surprising. A plausible explanation considered is that less information is disclosed by supermarkets regarding the actions taken in the area of logistics and raw materials to achieve a CE. With this concern an alternative or complementary explanation is that the actual data reported in supermarkets' sustainable memories -or the way in which it was reported- differed considerably among the supermarket chains themselves, and was not directly comparable; making it impossible to develop a coherent criteria to assess the success of the different measures taken by supermarkets chain towards a CE.

Finally, two aspects ought to be remarked concerning the interpretation of the results. Taking into consideration the nature and source of the information used about the actions taken by supermarket chains towards a CE, several conclusions can be drawn for low scores: (1) that the supermarket chains in fact not taking course of action to transition towards a CE in the areas where scores are low, (2) that the supermarket chains in question are focusing its efforts on one or a few dimensions of the 7 ones being evaluated in the model; or (3) that the supermarket chains are successfully exerting effort to achieve a CE but are not effectively communicating all of the measures taken, and therefore that information has not been covered by the model.

8.2. Contribution of the work

After completing the analysis of the project, it is shown that the model can be used by enterprises in the grocery chain sector to get the keys of the achievement of CE or by external agents interested in this sector to get useful information to help them invest or continue developing studies about it.

From a sectoral point of view, this project can help supermarkets to know which are the most outstanding measurement indicators for achieving successful CE. Moreover, enterprises can be aware of the areas where they are placing more emphasis than others and have the clues in order to balance it by spending more resources on the ones where the score is low. Finally, the model can assist supermarkets to have a critical view on whether they really communicate all the actions they are taking on CE, as this model has been based on the information transmitted in the annual reports. In summary, the model aims to propose recommendations for the supermarkets to implement to get even closer to CE.

From the academic point of view, this work can serve to deepen studies that have to do with the grocery sector and the CE. As it is stated in section 8.3, there are some future lines of research for experts to continue developing. This model serves as an informative base for investors and specialists in this field to have references and keys about CE in the grocery chain sector.

8.3. Limitations, areas of improvement and future lines of research

The interpretation of the results provided by the model is to be done understanding that it has been constructed under several limitations that constrict the scope of the work.

The first and most important of these is the lack of information that most of the analyzed companies present, which has made it impossible to go more in depth in certain categories. This is relevant not only because of the sub-variables that have had to be eliminated, but also for those that have been included and for which no data has been found for a particular company, as is the case for many sub-variables of raw materials for Dia. An increased transparency would likely result in a more accurate score as more sub-variables could be considered, which would lead to a more informed final score.

Another limitation, which also has to do with transparency, is the possibility of not being able to compare scores yearly. This is due to the nature of the source of the data. If a company discontinues the practice of giving a particular piece of information that was used in the model before, the model will not be directly comparable and progress will be harder to track.

To overcome these issues, it is recommended that for further research and improvement of the model primary data is collected from interviews or from formal information requests directly targeted to the analyzed grocery chains.

As for future lines of research that the model opens, a logical next step would be to apply the model at an European level, although that presents some complex issues, such as the variance of legal frameworks and difficulty of comparable data available.

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10. ANNEXES

ANNEX 1 - Actions implemented by the 5 supermarkets

Mercadona

Table A1.1. Actions implemented by Mercadona - Own elaboration based on data from Mercadona 2020 Annual Report

Raw materials	Water management	Packaging	Logistics	Waste and resource management	Energy efficiency	Comunication
Screens every provider for sustainability practices	Uses certified raw materials that are produced using less water (Rainforest Alliance/UTZ, Bio, FairtTrade, RSPO)	Elimination of non recyclable plastic bags.	Decrease of 27% in CO2 emissions from logistic in 4 years	1% waste in weight of the final product	39,7 million kWh saved from 2019 to 2020	Pictograms in bags, recycling bins
Fishing and other animal produce comes from sustainable providers that hold multiple sustainability certificates	Has rain collecting mechanisms at 3 logistics plants	Offering of 3 sustainable alternatives to plastic bags at stores	Compliance with the standards of transparency and traceability of Lean & Green	Liquidation of fresh food and donation of food that can be used for consumption but not for sale.	78% of stores are more efficient by using LED and automatic lights, insultation and adapted air conditioning	"Cuidemos el planeta", new section in their web with information about sustainability
Products are tracked from origin to end		Replacement of non-recyclable plastic items	99% of their vehicle fleet complies with the Euro VId standard	17,000 tons of products were donated	600,000€ investment in 1,400 solar panel which saves 15% of electricity in 8 stores	Latest news in website's press room, some concerning sustainability
		Waste recycling rate of 79%	Use of natural gas (LNG) and (CNG) to fuel the fleet of vehicles	Store order system to follow sales in real time and deliver products	Creation of an urban garden on the roof of one of Toledo's store	Specific space to "Cuidemos el planeta" and sustainibility goals in social networks
		Offerring of a reusable plastic bags made between 50 to 70% of recycled plastic	The use of inverse logistics to maximize logistic trip efficiency.			Forms to make suggestions of CE actions
			Maximization of truck filling capacity, with a filling rate of 88%			"Economía Circular en Acción", project to show commitments for the EC
			Use of bifuel trucks for home delivery services			Agreement with UPF Barcelona School of Management for sustainability
			Use of solar panels as energy sources for their logistic centers.			
			Use of 100% recycled and reusable `box system to transport products. (Logifruit system)			

(Mercadona, 2020)

Carrefour

Table A1.2. Actions implemented by Carrefour - Own elaboration based on data from Carrefour 2020 Annual Report

Raw materials	Water management	Packaging	Logistics	Waste and resource management	Energy efficiency	Comunication
Has increased the share of seafood from responsible fishing (to 44%)	Has implemented water saving solutions such as rainwater harvesting and water-saving taps	Increasing the offering of products that consumers can buy in bulk	Compliance with Euro V or superior standards by 90% of their vehicle fleet.	Recycling management by clients at the store level (batteries, bulbs, electronic devices and clothes)	6% reduce in energy consumption (using regulated illumination, substituting no efficient equipment in climatization and cold storage, more automatization)	Recycling bins
Ensures animal well-being with its internal welfare policy that includes food and textile produce	All France sites will be 100% BREEAM certified by 2025	Possibility of bringing containers from home to store fruits, vegetables, fish and meat.	Use of natural gas to propel trucks and vehicles	Mobile application "Too good to go" in 466 stores, 60,700 packs saved, 151700 kg of CO2 saved	Reduction of carbon foodprint by 43,000 tons at the store level	"Carrefour Bio" label
Partakes in sustainable agriculture models by supporting producers that follow among others: crop rotation, exclusion of soilless plant production and cleaning up of chemical pesticides after use	Has reduced -3.4% water consumed per m^2 of sales area	IPS certificate for cardboard and paper packages.	Decrease in carbon emissions of 50,000Tons in 2020	Is part of Marcas Waste Warrior Community	Participates in the Earth Hour	"Bienestar Animal" label
Has increased its organic fresh vegetable and food produce	Has promoted the reduction of the use of pesticides that may contaminate fresh water	Increasing the amountof products to buy in bulk		50% discount in products near the end o their useful life	31 BREEAM certificates for the sustainability of the stores.	"Carrefour Soft Green" label
				Preferential consumption date has been extended in the Carrefour brand	SGS Qualicert certifications in all platforms	"Tax Responsible" label
				Sponsor of the AECOC brainstorming contest to stop food waste	Leed Platinum Certification in one platform	Sustainability specific tab in website, but with very poor information
				Project to sell less attractive vegetables in Andalucia, Levante and Extremadura.		Some punctual publications on social networks concerning CE
				Zero Waste Products: pastries form the day before are sold at a cheaper price (25% less)		App "ReciclaYa", scan the product to know how to recycle it and the app compensates you
				Development of gelatin with the excess of grape from local farmers		Committed Customer Club, engage consumers to get new CE actions
						Collaboration with "¿Quién es el jefe?", know consumer's preferences
						Reward of the executive director as the FSC National Forest Ambassador
						Creation of RSC trophies, to reward the best action to reduce plastics

(Carrefour, 2020)

Lidl

Table A1.3. Actions implemented by Lidl - Own elaboration based on data from Lidl 2020 Annual Report

Raw materials	Water management	Packaging	Logistics	Waste and resource management	Energy efficiency	Comunication
Has vowed to remove some unsustainably sourced fresh produce by 2025 (such as eggs coming from caged hens)	Has a set plan for dealing with water use across 5 distinct product categories for better individualization of water use aross the supply chain	Total replacement of non-recyclable plastic clutery and similar	use of 100% renewable energy sources in their logistic platforms	Works with Zero Waste in all logistics platforms & Ceretified food waste management chain	100% use of renewable electricity	Informative logo on recyclabe or recycled packaging
Most of its fish products are ASC certified	Reduction in pesticide use to reduce water pollution (1/3 of maximum pesticide allowed by law)	Elimination of the Type A microplastics in their cosmetics, detergents and cleaning products	Achievement of the energy certification ISO 500001:2018	Optimization of orders and stock.	BREEAM & Green Energy certifications	Information on the packaging on sustainable measures that have been adopted
Its fish is packaged in a way that allows the consumer to trace its origin and whether ir comes from the sea or from aquaculture	Replace all cotton with sustainable produce by 2022 (cotton with GOTS, CMiA, Better Cotton Initiative or Fairtrade)	Elimination of non recyclable plastic bags at stores	Use of solar panels for the heating of the water in their logistic centers.	"Autodispo": automated system to determine the necessary quantities of goods needed (planned to be implemented in all stores by 2021)	Increase of efficiency in stores by 8% since 2017	Creation of slogan "Bien estoy con Lidl", inform about comercial startegy concerning CE
Has adopted GLOBAL.A.P standards			Use of LED technology light bulbs in logistic centers	Daily control of datees: 30% discount of food that is going to expire.	Photovoltaic surface of 106,101 m2	In the "Actualidad" section on the web, most are news about sustainability goals they achieve
Increase in organic fruits and vegetables sold			Use of natural gas as fuel source for vehicle fleet	Collaboration with Too Good To Go in Madrid, Participation in the week against food waste	LED lighting and water heat produced by solar panels	"Sustainable initiative" section on the web, talking about animal welfare and sustainable logistics
			Implementation of mega-trucks to increase product transportation efficiency.	Shrinkage control process at the store level	Carbon footprint: 188,583 tons in 2019 to 173,592 in 2020	Strong presence on social entworks, specially in Twitter, using interactive tools
			Use of inverse logistics to maximize efficiency	Donation: 70% of the stores collaborate with 40 local ONGs. 2,195,758 kg has been donated in 2020	ISO 50001 Certification	
			Achievement of the certification "Residuo cero" in all of their logistic platforms	Dry food is reutilized for animal feed		
				From the 1% of products not sold, 10,82% are donated, 38% of products are assigned to an authorized entity, 51,18% ends up eliminated		
				30% discount in products that are about to be expired*		

(Lidl, 2020)

DIA Group

Table A1.4. Actions implemented by DIA Group - Own elaboration based on data from Dia 2020 Annual Report

Raw materials	Water management	Packaging	Logistics	Waste and resource management	Energy efficiency	Comunication
Dia does not provide visible information regarding its sustainable practices in relation to its raw material use	Considers its water use "non-material" and, therefore doesn't report specifics on its consumption	Oferring of a reusable plastic bags made 70% of recycled plastic	Only businesses in Spain that was rewarded with an A by the Carbon Disclosure Project	117,747,963 kg of non-hazardous waste were generated and 1,22581838 kg in 2020	Punctuation A in Carbon Disclosure Project (only chain in Spain)	Webpage and app Dia where consumers are informed and can asses the CE policies
	According to the supermarket, it only uses water for cleaning facilities	Substitution of 100% of the plastic bags in sections with compostable plastic bags		58.77% is recycled, 0.56% is reused and 40.67% goes to landfill	Decrease in the use of renewable energy, from 35 million kWh in 2019 to 33,7 million kWh in 2020	Collaboration with AECOC to raise awareness
		Supply of all of their types of fruit to buy in bulk		Increase efficiency in orders through the management of stocks: reduce almost 2,000 tons of surplus in 2020	Decrease the electricity consumption thanks to the efficiency measures (by 7% compared to 2019)	Collaboration with partners that are useful to implement sustainbility strategies
		Recycle 59% of generated material waste generated		Price reduction in those products that are about to expire: 20% discount in meat 50% in dairy products	Carbon footprint: 628,463 tons of CO2 in 2019 and 626,964.1 tons in 2020	
		Reuse of 0,5% of the material waste generated		Donation of surpluses suitable to human consumption (543192 kg in 2020)		
				Reutilization of waste for animal feed.		

(Dia, 2020)

Eroski Group

Table A1.5. Actions implemented by Eroski Group - Own elaboration based on data from Eroski 2020 Annual Report

Raw materials	Water management	Packaging	Logistics	Waste and resource management	Energy efficiency	Comunication
Requires certain certificates from providers, but does not screen every provider individually	Has installed intelligent water trackers to minimize leaks and reuse grey water	Packaging is 14% recycled materials, or bioplastics	Achievement of the LEED Gold certification for their new logistic center in Barcelona	Promotion of fresh items close to expiration date (10% discount)	-25% of CO2 emissions planned.	Eroski BIO, Eroski Natur BIO and Eroski ECO label
Separates product categories with detailed sources for better tracking of their origin	Has a net positive water consumption - waste water generated balance	Packaging is 42% made of renewable materials	Local suppliers account for 59% of their total supplier	Zero Waste program: donation of food suitable for consumption but not for sale (20,000 tons of products)	Carbon footprint: 267,092 tons of CO2 (-9% compared to 2019)	Animal Welfare label
	Performs regular water quality controls at underground natural sites under its production centers	Reduction in 21% on the use of conventional plastic packaging for fresh products	Use of LED technology light bulbs for the illumination of their logistic centers.	Reutilization of products for flour and animal feed	Energy consumption: 730,081,450 kWh (-8% compared to 2019)	Coffee capsules bins
		Reduction in 20,37% of the amount of one use plastic bags offered.		Inorganic waste management: declared to ECOEMBES or ECOVIDRIO	37% of the energy used is renewable	Posters with essential sustainability information in supermarkets
				From the 47,168 tons of non-hazardous waste, 40,018 tons were recycled, 4,807 tons were recovered and 2,343 tons went to the landfill	1 store with the ISO 50001 energy certification 1 store with ISO 14001 certification Leed Gold Certification (logistics)	Posters with information about the eco-efficient shops
				Participation in LIFE CITRUSPACK project, NUTRACEUTICAL OMNIUM project, Robin Food project and	Optimization of lighting (LED) and automatzation control	CONSUMER Eroski, informative guide to get a sustainable life adressed to consumers
				More efficient cold installations to maintain the products	More efficiency in the cold installations and remote air conditioning	"Sustainbility and Health" tab in the website, showing commitments and actions on CE
				Begun to include facilities with self-consumption solutions based on solar panels		Specific part of sustainability in social networks
						App Eroski with sustainbility information, electronic ticket and products' scanner
						In 2020, more than 45 active listening initiatives to collect sugestions on CE
						21 Consumer Committees to define guidelines for improvements
						"Reactivate +", fostering adequate consumer habits
						Joint the European Week of Prevention of Waste 2020, the importance of reuse and recycle

(Eroski, 2020)

ANNEX 2 - Quantitative criteria for evaluating the variables

Raw materials

a) Fish (% of sustainably sourced fish/Total produce)

1	2	3	4	5
0-20%	20-40%	40-60%	60-80%	80-100%

b) Meat (% of sustainable meat/Total produce)

1	2	3	4	5
0-40%	40-60%	60-75%	75-95%	95-100%

c) Eggs (% of sustainable eggs/Total produce)

1	2	3	4	5
0-40%	40-60%	60-75%	75-95%	95-100%

d) Fruits, vegetables and derived products (% of sustainably sourced produce /Total produce)

1	2	3	4	5
0-40%	40-60%	60-75%	75-95%	95-100%

Water management

1	2	3	4	5
Lack of a water management policy that is sustainable and sound or lack of effectivity of such policy	Has a water policy in place, but fails at implementing it or the effects of such strategy are not noticeable	Has a water policy in place that is effective but with clear inefficiencies that could be improved	Has a good water policy in place, but it has some room for improvement	Has a great water policy in place that is up to the current level of technological development

Packaging:

a) Material waste revalorization rate

1	2	3	4	5
0-40%	>40-50%	>50-70%	>70-85%	>85-100%

b) % of the composition of checkouts plastic bags that is recycled

1	2	3	4	5
0-40%	>40-60%	>60-75%	>75-95%	>95-100%

c) Availability of compostable plastic bags in sections[6]

1	3
Not available	Available

d) Number of sustainable alternatives offered with respect to non-recyclable plastic bags

1	2	3	4	5
1 alternative	2 alternatives	3 alternatives	4 alternatives	5 or more alternatives

e) Number of categories of products that are offered to be bought in bulk

1	2	3	4	5
0-3 categories	4-5 categories	6-7 categories	8-9 categories	10 or more categories

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[6]The criteria used for this score lies on the fact that compostable plastic bags are an improvement towards a CE, but better could be done by the substitution of compostable plastic bags for reusable ones- consequently scoring a 3 and not a 5, for instance-.

Logistics:

a) % of reduction in CO_2 emissions coming from logistic activities, with respect to the previous year (2019).

1	2	3	4	5
0-5%	5-10%	10-20%	20-50%	50-100%

b) The use of inverse logistics[7]

1	2
No	Yes

c) Owning of at least 1 BREEAM certification in logistic centers[8]

1	3
0 Certifications	At least 1 certification

d) Participation and achievements of the Lean & green agreement

1	2	3	4	5
part of the agreement	part of the agreement and 1 star achieved	part of the agreement and 2 stars achieved	part of the agreement and 3 stars achieved	part of the agreement and 4 or more stars achieved

Waste and resource management

a) Discount for products that are near to their expiration date (%)

1	2	3	4	5
0-15	15-30	30-45	45-60	>60

b) Measures to increase the efficiency of the maintenance of stock (nº)

1	2	3	4	5
0	1	2	3	=,>4

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[7] Given the lack of information about the efficiency of the inverse logistics used by each supermarket chain, only one dimension is measured (whether it is used or not); consequently a score of 3 out of 5 is given for those using inverse logistics, because with no further detail of its efficiency, scoring a 5 was considered to be overestimated.

[8] Given the lack of information about the exact number of BREEAM certifications owned by each supermarket chain, the chosen score criteria is based on the idea that having at least a BREEAM certification means a positive step towards a CE but cannot be rewarded with the highest punctuation as it is considered to be very far from the complete achievement of CE.

c) Certifications and Collaborations (nº)

1	2	3	4	5
0-1	2-3	4-5	6-7	>7

Energy efficiency

a) Savings in electric consumption from one year to another (%)

1	2	3	4	5
<0%-2%	>2-4%	>4%-6%	>6%-8%	>8%

b) Measures to improve energy efficiency at the store (nº)

1	2	3	4	5
0-2	3-4	5-6	7-8	>9

c) Reduction of the carbon footprint (%)

1	2	3	4	5
0%-4%	>4%-8%	>8%-10%	>10%-12%	>12%

d) Certification/recognitions for their use of energy (Nº)

1	2	3	4	5
0	1	2	3	>4

Communication:

a) Information in supermarkets (recycling bins, posters and labels)

1	2	3	4	5
Poor or inexistent info about CE practices	Info about few CE actions	Info about some CE practices	Info about most CE practices	Info about all CE practices

b) Efficient communication through the website

1	2	3	4	5
Poor or inexistent content about CE issues	Specific part for sustainability but not very useful information about actions	Specific part with useful info about actions OR how to promote good environmental practices	Specific part with useful information concerning actions OR how to promote good environmental practices	Specific part with useful and visible information concerning actions AND how to promote good environmental practices

c) Efficient communication through social networks

1	2	3	4	5
Poor or inexistent content about CE issues	Few information on social networks but only punctual posts	Specific parts on social networks for sustainability with some useful information on CE	Specific parts on social networks for sustainability with useful information about practices on CE and environmental information.	Specific parts on social networks for sustainability with useful content informing of the exact CE practices they are doing, next goals, environmental data and how to promote good environmental practices.

d) Efficient communication though the app

1	2	3	4	5
Poor or inexistent content about CE issues	Few information on CE and on environmental awareness in the app.	Some useful information on CE practices and/or consumer awareness in several parts of the app	Useful and visible content informing of the exact CE practices they are doing, how to promote good environmental practices OR some extras to enhance the experience.	Useful and visible content informing of the exact CE practices they are doing, how to promote good environmental practices AND some extras to enhance the experience.

e) Listen to consumer's demands

1	2	3	4	5
No or few ways of knowing consumers' preferences	Specific forms concerning CE in physical or online platforms.	Several ways of listening consumers' opinions concerning CE	Strong and effective listening initiatives to pay attention to consumers' preferences and suggestions concerning CE.	Interactive, strong, effective, and numerous listening initiatives to pay attention to consumer's preferences and suggestions concerning CE.

f) Alliances, Pacts, Agreements, Programs and Recognitions to inform and promote CE

1	2	3	4	5
No or few alliances, pacts, agreements, programs, and recognitions regarding CE	Some that are not so useful to well inform the consumers.	Some that can help in the communication of the supermarkets' practices.	Some are useful to raise awareness, foster citizen participation, inform on sustainability practices of the company OR improve greatly the company's image.	Many that are really useful to raise awareness, foster citizen participation, inform on CE practices of the company AND improve greatly the company's image.