

Calculate the carbon footprint of a company that provides prepared food in Guadalupe, Victoria, Durango, Mexico¹

*Cálculo de la huella de carbono de una empresa proveedora de comida preparada en
Guadalupe, Victoria, Durango, México*

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Abstract

This study aimed to calculate the carbon footprint of a prepared food supplier company (FSC) located in Guadalupe Victoria, Durango, Mexico. The methodology followed the UNE-EN ISO 14064-1:2019 standard and utilized the emissions calculator developed in the State of Mexico, considering direct emissions from the use of liquefied petroleum gas and diesel, as well as indirect emissions from electricity consumption. Data were collected through a direct interview with the business owner, and monthly energy inputs were evaluated. The results indicated a total emission of 0.802 tons of carbon dioxide equivalent (tCO₂e) per month. Although this value is below the thresholds for taxation in Mexican states with carbon legislation, a significant cumulative environmental impact is evident. Improvement measures are proposed, such as the use of efficient lighting, high energy-rated appliances, locally sourced ingredients, and food waste reduction. The study emphasizes the usefulness of carbon footprint assessment as a tool to promote sustainability in microenterprises within the food sector, supporting the achievement of the Sustainable Development Goals (SDGs) through more responsible operational practices.

Keywords: Carbon footprint, climate change, GHG emissions calculation, energy efficiency.

Resumen

El presente estudio tuvo como objetivo calcular la huella de carbono de una empresa proveedora de alimentos preparados (FSC) ubicada en Guadalupe Victoria, Durango, México. Se empleó la metodología de la norma UNE-EN ISO 14064-1:2019, apoyada en la calculadora de emisiones desarrollada en el Estado de México, considerando emisiones directas por uso de gas LP y diésel, así como emisiones indirectas por consumo de energía eléctrica. La recolección de datos se realizó mediante entrevista directa al propietario del establecimiento, y se evaluaron los insumos energéticos mensuales. Los resultados mostraron una emisión total de 0.802 toneladas de CO₂ equivalente (tCO₂e) por mes. Aunque esta cifra está por debajo de

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los umbrales para pago de impuestos en los estados que ya legislan esta materia, se evidencia un impacto ambiental acumulativo significativo. Se proponen medidas de mejora como el uso de iluminación eficiente, equipos con alta calificación energética, ingredientes locales y reducción del desperdicio de alimentos. La investigación destaca la utilidad del cálculo de huella de carbono como herramienta para promover la sostenibilidad en microempresas del sector alimentario, reforzando el cumplimiento de los Objetivos de Desarrollo Sostenible (ODS) mediante prácticas operativas más responsables.

Palabras clave: Huella de carbono, cambio climático, cálculo de emisiones de GEI, eficiencia energética.

Introduction

Global action against climate change is unavoidable and cannot be postponed. It is necessary for all countries to jointly and decisively reduce the emissions of greenhouse gases and compounds to prevent the effects from worsening (Secretaría de Gobernación, 2013). In 2015, the world committed, through the Paris Agreement, to limit the increase in the planet's global temperature to less than 2°C during this century, and even a group of countries, including Mexico, proposed limiting it. at 1.5°C. To achieve this global objective, each country established its goals for the year 2030 according to its possibilities (National Climate Change System, 2021).

In their analysis of the Paris Agreement and its goals of limiting global warming to 1.5°C and 2°C, Hänsel et al. (2020) explore the economic viability of these goals. It reveals that around 75% of experts favor optimal climate policies that align with the

2°C target, while a third support the more ambitious 1.5°C target. The study's findings demonstrate that the UN climate goals are presented as economically optimal options when scientific and economic updates are considered together. It highlights the crucial importance of adopting ambitious climate measures, not only for sustainability reasons but also for economic reasons.

General objective

Calculate the carbon footprint of a restaurant-type Food Supplier Company (FSC) located in Guadalupe, Victoria, Durango, by applying the UNE-EN ISO 14064-1 standard. At the same time, the development of remedial proposals that are considered by the organization in the medium term should be proposed.

Specific objectives

1. Identify FSC greenhouse gas emission sources.

2. Quantify the amounts of greenhouse gases during a monthly period.
3. Propose measures that reduce the amount of FSC CO₂e emissions.

Theoretical Framework

In Mexico, the General Law on Climate Change defines the National Inventory of Greenhouse Gas and Compound Emissions as the estimate of anthropogenic emissions by sources and absorption by sinks, including emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and black carbon in the period 1990-2015. Our country's most relevant gas is carbon dioxide, with 71% of emissions, followed by methane, with 21% (INECC, 2018).

Based on this, the Mexican Legislation has decreed the adoption of production and consumption patterns by the public, social, and private sectors to move towards an economy with low carbon emissions (H. Congress of the Union, 2015). For this adoption, it is necessary to use economic instruments in the mitigation, adaptation, and reduction of vulnerability to climate change, encourage the protection, preservation, and restoration of the environment, and the

sustainable use of natural resources, in addition to generating economic benefits for those who implement them (H. Congress of the Union, 2015).

The Ministry of Environment and Natural Resources (SEMARNAT) and the German Cooperation for Sustainable Development Mexico (GIZ Mx) presented the Information System of the Transparency Agenda for Climate Actions at the Subnational Level (SIAT – Subnational), which will allow entities each year, federal authorities evaluate their progress in the implementation of measures to mitigate Greenhouse Gases (GHG) and adaptation to climate change, transparently and reliably (Secretary of the Environment and Natural Resources, 2022).

The purpose of calculating the carbon footprint of an FSC is to identify and quantify the amount of greenhouse gas emissions that are generated because of its operation, starting with the production of food, the energy used in the kitchen and the facilities, ending in the transport of products and waste management. With this information, strategies can be implemented to reduce emissions and improve the environmental sustainability of the establishment.

Corporations interested in optimizing

costs and enhancing sustainability find a valuable meeting point in integrating financial and environmental management. By prioritizing sustainable practices, such as waste minimization, they not only manage to increase their operational efficiency but simultaneously collaborate in mitigating their carbon footprint (Wang, et al., 2023; Filimonau, et al., 2023).

Waste minimization is one of the most efficient methods for reducing economic and environmental costs. By implementing strategies aimed at reducing the consumption of energy, supplies, and materials, organizations can generate significant savings in their operating expenses, given the consequent reduction in costs linked to the acquisition, storage, and management of waste (Milindi, et al., 2022; Juvan, et al., 2023; Hai, et al., 2023).

Optimizing costs is presented, in this context, as an essential competitive tactic, enabling corporations to propose sustainable solutions and services at prices that are attractive to a clientele with growing environmental awareness (Filimonau, et al., 2023).

Carbon footprint assessment stands out as an essential tool in this process. By

meticulously quantifying and analyzing this, companies can identify specific factors that can potentially reduce emissions and related costs (Cherukuri, et al., 2023).

The positions regarding calculating the carbon footprint in the food sector are diverse and often reach conclusions that seem opposite. On the one hand, some studies argue that food processing consumes a lot of energy and often influences the environment that is not identified and, therefore, cannot be assessed (Shabir et al., 2023).

In contrast, some others, such as Demeter et al. (2022), in which Wiedmann (2009) was cited, state that companies normally measure, report and manage their direct and indirect scope emissions because energy consumption and the use of public services on site are easy to monitor. Blanco (2016) and Filimonau (2016) point out that indirect emissions from the supply chain receive little attention since the carbon footprint caused by a company's suppliers is the largest and most difficult component to assess (Demeter, 2022).

Food processing, production, and consumption contain over 20% of anthropogenic greenhouse gas emissions. Each year, between 9.8 and 16.9 billion tons

of CO₂ are generated through the food supply chain, and this figure is expected to increase to 30% by 2050. (Shabir et al., 2023) These indirect emissions represent between 54% and 94% of emissions in the hospitality, food, commercial, retail, and recreational contexts (Sun, 2014, cited in Demeter, 2021).

Pigou (1920) is credited with the idea of collecting taxes with the main objective of removing negative externalities, such as GHG emissions associated with the use of certain commodities, which is why these taxes are known as Pigouvian taxes. (Shabir et al., 2023). With this background, environmental taxes have been implemented in some states of Mexico to tax the emission of greenhouse gases and pollutants; the cases of Zacatecas, Baja California, Tamaulipas, Querétaro, Yucatán, State of Mexico, Guanajuato, and Jalisco. In these states, the tax is collected through monthly statements that establish the amount of CO₂e emitted during the period under analysis, with rates ranging from \$43.00 MXN per ton of CO₂e emitted up to 5.6 UMA for each ton of CO₂e. (Legislative Branch of the State of Zacatecas, 2021; Congress of the State of Baja California, 2018; Legislative Branch of the State of Querétaro, 2022; Congress of the

State of Yucatán, 2021; Government of the State of Mexico, 2022; Congress of the State of Guanajuato, 2021). Another important aspect is that the Law was repealed in Tamaulipas in December 2022. In Jalisco, a consensus has not been reached due largely to the political environment in fiscal matters (Legislative Power of the Government of Tamaulipas, 2023; Plataforma Mexicana de Carbono, 2022).

The studies carried out by Wirsenius in 2011, Briggs in 2013, Edjabou and Smed also in 2013, Säll and Green in 2015, and Garcia-Muros in 2017 provide strong empirical evidence that taxes on food products based on their carbon footprint can lead to lower CO₂e emissions. Critics point out that the methodology used in this analysis is based on the AIDS demand model (almost ideal demand system) without considering the unobserved heterogeneity of households in the welfare estimates. The second criticism is that studies often only estimate a small number of food products (meat, meat, dairy, etc.), ignoring substitution effects between them (Dogde and Gil, 2018).

Literature review

For their part, in a study published in

2024, Waidelich et al. They broaden the perspective on the economic damages of climate change, transcending the traditional evaluation based solely on the average annual temperature. The authors incorporate temperature variability, precipitation patterns, and the frequency of extreme events into their analyses, using climate model projections and dose-effect response functions. This more comprehensive approach is absolutely relevant because it reveals more severe economic consequences, with global GDP losses reaching 10% for a temperature increase of +3 °C. Low-income countries, in particular, are disproportionately affected by these impacts.

Kotz et al. (2024) offer a worrying perspective on the subnational economic damages of climate change. Using data from more than 1,600 regions worldwide, the authors project a 19% reduction in global income over the next 26 years due to climate impacts, regardless of future emissions mitigation actions.

They state that regions at lower latitudes, with lower historical emissions and income levels, will experience the greatest economic damage. This regional disparity highlights communities' asymmetric vulnerability to

climate change impacts.

Another key aspect of the study is the conclusion that the committed costs of climate change, that is, the damages that are already inevitable due to past emissions, far exceed the costs of mitigation. This means that even if immediate action is taken to reduce emissions, regions worldwide are already facing the economic consequences of climate change.

In that same sense, Willner et al. (2021) explore the complex interplay between climate change, investment incentives, and optimal climate policies. The authors project an equally critical scenario: unmitigated climate change could reduce global economic income by 22% by the year 2100, with 40% of these losses attributable to impacts on economic growth.

In the national context, Estrada (2024) mentions that, at least temporarily, the threshold the country has imposed on itself as a limit has been exceeded, which is extremely dangerous. It should be noted that although the planet's temperature has increased around 1.2°C since the pre-industrial period, the increase has been more rapid in Mexico. Since the beginning of the last century, the temperature in the country has increased by

1.7°C, indicating that it has warmed more and at a faster rate than the global average, which will have economic and environmental consequences.

Current economic growth is closely linked to the type of energy used and greenhouse gas emissions. In Mexico, if the trajectory of global emissions is not changed, the accumulated damages in this century could be equivalent to losing between 85% and five times the current GDP. To put it in perspective, the pandemic caused a loss of 8% of GDP (Estrada, 2024). Furthermore, Mexican agriculture will also suffer severely, with current yield reductions between 5% and 20%, which could increase to 80% by the second half of the 21st century.

In 2012, CO₂ emissions in Mexico peaked and then declined, but in 2022, emissions broke historical records, reversing a decade in progress (Estrada, 2024). Given this and Mexico's vulnerability in agriculture, health, biodiversity, and economy, it is crucial to establish clear priorities and actions with triple helix innovation, which help mitigate climate change by adding joint efforts by the government, academia, companies, and society. We must move towards a sustainable, cleaner economy with circular processes,

taking advantage of the opportunities offered by new technologies to avoid the worst impacts of climate change and promote socioeconomic development. For this, carbon footprint measurement processes are important to establish improvement measures. This research adds to this joint effort by measuring CO₂ emissions for a prepared food supplier company (FSC) to propose improvement measures.

Methodology

The company provides prepared food services, specializing in typically Mexican food derived from pork, including carnitas and the Mexican dish called cochinita pibil. Food is cooked using traditional procedures over low and direct heat produced by liquefied petroleum gas (LP) and in large saucepans.

The calculator developed for this purpose in the state of Mexico was used to calculate the establishment's carbon footprint. It is based on the UNE-EN-14064-1:2019 standard, the Intergovernmental Group of Experts on Change Climate (IPCC) guidelines, and the previously mentioned national background.

Study limitations:

The study is conducted in a small restaurant-type food supplier company located in Guadalupe, Victoria, Durango. Calculation of the water or ecological footprint is not included; solid waste management is also excluded.

Limits to the report Direct:

Emissions derived from the combustion of LP gas for the operation of the restaurant and diesel for the operation of delivery equipment are considered. Indirect emissions from using electrical energy provided by Comisión Federal de Electricidad (CFE) are also considered. This paper is limited to studying carbon footprint emissions emitted into the atmosphere. There is no measurement of the water footprint nor study of waste management; this will be done in subsequent studies.

Identification of GHG emissions:

To identify the types of emissions generated by the FSC, an analysis is used in the establishment in which information was obtained through its owner, which revealed the types of fuels used, among which the following are distinguished:

Table 1. Identification of emissions by fuels used in the FSC.

Direct emissions
LP Gas
Diesel
Indirect Emissions
Electric power

Source: Own elaboration with information from the FSC analyzed.

Results Interpretation and Discussion

For the study, the direct and indirect emissions of the FSC are considered, described in Table 1, with which the calculator is fed to obtain the total emissions. The volume of demand for LP gas, diesel, and electric power is accounted for, and is determined based on a process of obtaining information through the owner, accounting for the amounts shown below:

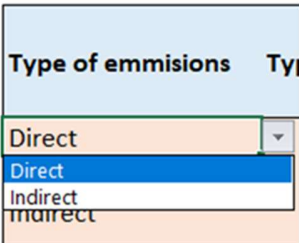
Table 2. The volume of fuels demanded by the establishment.

Fuel	Price / l	total/week \$	Liters/Weekly	liters/month	Equivalence in M ³
Diesel	22.11	750	33.921	136	0.136
Fuel	Price / l	Total/day \$	liters/day	liters/month	Equivalence M ³
LP Gas	11.85	75	6.329	190	0.190
Fuel	Price / kwh	Total/day \$	Kwh day	Kwh	Mwh
Electric power				258	0.258

Source: Own elaboration with information from the FSC analyzed.

To feed the calculator correctly, the amounts of Diesel and LP Gas are converted to Cubic Meters, resulting in 0.136 m3 and 0.190 m3, respectively, for a monthly period. A conversion to Megawatts/hour is made for energy consumption, obtaining 0.258 Mwh, with the same monthly periodicity. With this information, we proceed to fill in the calculator, which requests that the emission type be selected in the first instance, allowing us to choose between direct and indirect. For this exercise, there are two direct and one indirect.

Figure 1. Selection of emission type.



Source: Own elaboration based on the GHG calculator for the State of Mexico (2023).

Next, the type of industry is chosen directly. There are options: manufacturing industry, shops and services, and wastewater management. Regarding indirect emissions, only the Consumption of electrical energy is considered. In the example, businesses and

services are chosen for direct emissions and electricity consumption is used for indirect emissions.

Figure 2. Selection of industry type.

Type of industry	Fuel
Trade and services	
Manufacturing industry	
Trade and services	
Electricity consumption	

Source: Own elaboration based on the GHG calculator for the State of Mexico (2023).

The Fuel/Method is selected in the next column, and the options Diesel, Liquefied Petroleum Gas, and Electricity consumption are chosen, respectively. Likewise, the calculator launches the instructions for filling in these emissions, indicating which units the data must be entered.

Figure 3. Fuel, method, instructions, and activity data.

Fuels / Methods	Instructions	Activity Data (reporting period)
Diesel	Please enter the fuel consumption in cubic meters	0.136
Liquefied petroleum gas (LPG)	Please enter the fuel consumption in cubic meters	0.190
Electricity consumption	Please enter the megawatt-hours consumption	0.258

Source: Own elaboration based on the GHG calculator for the State of Mexico (2023).

As shown in Figure 3, the quantities calculated in Table 2 are placed in the Activity Data column, which amounts to 0.136 m3, 0.190 m3, and 0.258 Mwh for the fuels described in the column of the same name.

The calculator automatically breaks down the total CO2, CH4, and N2O emissions

arising from the operation of the economic entity in question. In this case, it is possible to verify that only CO2 is released from the three emissions types considered in the analysis.

Figure 4. Information for declaration and equivalent carbon dioxide emissions.

Information for reporting (greenhouse gas emissions in the reporting period)			Carbon Dioxide equivalent emissions (reporting period)			
CO2 Carbon Dioxide (tons)	CH4 Methane (tons)	N2O Nitrous Oxide (tons)	CO2→CO2e	CH4→CO2e	N2O→CO2e	Total CO2e (tons)
0.380	-	-	0.380	-	-	0.380
0.313	-	-	0.313	-	-	0.313
0.109	-	-	0.109	-	-	0.109
0.802	-	-	0.802	-	-	0.802

Source: Own elaboration based on the GHG calculator for the State of Mexico (2023).

As shown in Figure 4, the columns illuminated in orange refer to the amounts of CO₂, CH₄, and N₂O that the calculator automatically classifies, while the columns colored in gray, these three GHGs are transformed into tons of Carbon Dioxide. Equivalent Carbon (CO₂e), and finally, in the Total CO₂e (tons) column, the subtotals of each row are added, and in the bottom data, the sum of these sums. For the exercise carried out, a total of 0.802 tons of CO₂e

were obtained.

According to the emerging legislation of some states in Mexico, each business would be obliged to compensate, through monetary remuneration, the damage caused to the environment because of the negative externalities caused by the use and consumption of fossil fuels in the company.

Table 3. Cost of FSC GHG emissions.

Gas type	Total Emission (Direct and indirect by greenhouse gases (t/month))	CO2 Equivalency (Global Warming Power)	Total issue per month. (T CO ₂ e)	Cost per ton emitted. (\$)	Monthly total to pay. (\$)
CO ₂	0.802	1	0.802	43	34.486

Source: Own elaboration with information from the FSC analyzed.

Using the calculator, with data from the FSC, indicates a tax that, in cities where the legislation applies, would amount to \$34,486 per month, accumulating for \$413.83 per year, both amounts in Mexican pesos. Although the laws of several states in Mexico have begun to charge for the carbon footprint since 2022. In this research study, the calculations were made strategically, considering the entire life of the organization, which has been at the service of the Victorian community. for more than eleven years, accounting for \$4,690.10 Mexican pesos, which in a certain way shows us what the FSC would have to pay in theory for the 11 years of emissions; the latter was done to show what a small FSC could pay by GHG emissions throughout its useful life.

The industry comprises restaurant-type food supply companies, representing 12.2% of all businesses in the country, generating more than two million jobs. (INEGI, 2021) The food industry has traditionally contributed to guaranteeing food services, ensuring sanitary measures and regulatory compliance (for example, nutrition labeling), marketing, and profitability. More recently, an additional layer has been added to provide information and document progress toward a

sustainable food supply (Thoma et al., 2018). Integrating sustainable practices in this sector contributes to the planet's well-being and can represent significant economic advantages. By optimizing the use of resources, such as water and energy, restaurants can reduce their operating costs considerably. For example, efficient water management in food preparation and healthcare facilities can translate into lower bills. Similarly, by adopting energy efficiency technologies, electricity consumption and related emissions are reduced, leading to tangible savings in energy expenses (Christ, et al., 2017).

In contrast, the perspectives of Goodland (2009) and Pimentel (2003) argue that the persistence in the consumption of diets focused on meat products leads to a significant increase in the environmental footprint, relegating the consideration of economic factors to the background. In this sense, in a market increasingly aware of environmental problems, Companies that adopt green practices can position themselves favorably and attract a segment of consumers willing to pay a premium for sustainable products and services. In the long term, these practices can also result in tax incentives and

reductions in fees or taxes related to the carbon footprint (De Arce y Mahía, 2023; Van Der Ploeg, et al., 2022).

In the FSC study, the CO₂ emissions derived from its operation are concentrated using diesel as the main direct emission originated by the delivery equipment. Secondly, liquefied petroleum gas (LP) consumption comes from using stoves, burners, torches, and irons. In third place, the indirect emission derived from the consumption of electrical energy results from the use of household appliances, electric ovens, televisions, lights, fans, etc. The emphasis of the calculator is on the accurate conversion of tons of GHG into tons of equivalent carbon dioxide emitted.

The company's electricity consumption is related to the continuous and daily use of household appliances such as blenders, mixers, processors, grills, coffee makers, and food and beverage refrigerators.

Water consumption on the premises is one of the main current expenses because sinks are used to wash dishes, glassware, cutlery, batteries, and table linen. In addition, food preparation demands a prolonged use of water for personal hand washing, food complement, and, in another important

proportion, the use of sanitary services by customers. However, it does not include the water footprint in this study and is left for further research.

Beyond nutritional importance, food intake also has a significant environmental impact, contributing to the greenhouse effect (Llanaj et al., 2018). Food systems contribute 19–29% of greenhouse gas (GHG) emissions, responsible for more than 70% of water use and 80% of human-caused deforestation (Vermeulen et al., 2012). Carbon dioxide (CO₂) emissions have frequently been applied to quantify the environmental impact of food production and consumption (FAO, 2022). (Cited in Costa and Bexiga, 2023). It is important to point out that, concerning tax obligations in terms of carbon footprint, the calculations obtained represent a hypothetical case since, in the State of Durango, no taxes are charged for carbon footprint emissions from companies. It is also important to mention that even in the states of Mexico, where the legislation is in force and is effectively executed, charging companies' carbon footprint emissions, only those companies that exceed one ton of CO₂e monthly are taxed.

Regarding the proposals that this research

suggests for reducing the carbon footprint of food supply companies (FSC), the following is found:

To improve the energy efficiency of the FSC, various actions can be carried out, such as:

- LED lighting should be used instead of incandescent or fluorescent lights, reducing energy consumption and decreasing waste generated.

- Install motion sensors in common areas, such as bathrooms or hallways, to reduce unnecessary light consumption.

- Use efficient kitchen appliances, such as stoves, ovens, and refrigerators with an energy rating of A or higher, which help save energy and reduce greenhouse gas emissions.

- Carry out regular maintenance on kitchen equipment, such as cleaning filters and checking for gas leaks, to ensure its proper functioning and avoid energy waste.

Regarding the use and consumption of local and sustainable ingredients, the following measures can be implemented:

- Purchase seasonal products grown in the region, reducing transportation costs and reducing the carbon footprint.

- Prefer organic or sustainably grown ingredients, which help preserve biodiversity and decrease exposure to toxic pesticides and fertilizers.

- Give priority to suppliers that work with sustainable practices and use recyclable packaging and materials.

- Promote local and sustainable products on the restaurant menu, raising awareness among customers and attracting consumers who value sustainability.

Finally, to minimize food waste, the following measures can be implemented:

- Establish a food waste measurement and monitoring system to identify critical areas and generate specific solutions.

- Train staff in food handling, storage, and preservation techniques to prevent spoilage and waste.

- Design menus with adequate portions that meet public demand, reducing the amount of wasted food.

- Establish alliances with organizations that work to recover food and donate items not used in the restaurant but still suitable for human consumption.

Conclusions

The world is threatened by global warming due to high greenhouse gas (GHG) emissions that have affected all planetary ecosystems. According to the latest report from the Intergovernmental Panel on Climate Change (IPCC), the main cause of global warming has been anthropogenic activities, which have occurred at an accelerated rate (95%) from the middle of the 20th century to the present. Given this, this research has the objective of collaborating with the generation of knowledge through the measurement of the carbon footprint of a food company to demonstrate that companies, no matter how large or small, must worry about their emissions so that through carbon footprint measurements they can create emissions reduction strategies and contribute to planetary sustainability, as a commitment for present and future generations. During the calculation of the carbon footprint of a food company in the city of Guadalupe, Victoria, the most important sources of emissions were identified during daily operations. These emissions turned out to be lower than the limits proposed by current laws in Mexico for paying punitive taxes; however, it is essential to consider the accumulated impact. The vast

majority of companies in Mexico are of comparable size to the case studied, which suggests that, if we take the data in aggregate values of all the micro and small food-producing companies, we would have alarming results in terms of the amount of emissions. Given this, we recommend aligning business operations with sustainable practices to minimize environmental damage, which could generate direct and indirect economic benefits. This research and its measurements were also useful to the owners of prepared food companies (EPA). On the one hand, companies learned about the monetary quantification of the sector's emissions, that in the situation of having to pay taxes for their emissions, they must become aware and carry out sustainable processes, as well as make the necessary changes to comply with the Sustainable Development Goals (SDGs) responsibly. Effectively reducing the carbon footprint would require a holistic approach and not be limited to government intervention alone. It must be a concerted effort by all stakeholders, including government, industry, and consumers. Besides being beneficial for the environment, these joint collaborations can open new business opportunities, encourage

innovation, and strengthen local economies.

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