

Analysis of the carbon neutral standard and its implementation in a dental clinic in Ecuador: A Review of the Literature

Análise do padrão de carbono neutro e sua implementação em uma clínica odontológica do

Equador: Uma Revisão da Literatura

Análisis de la norma carbono neutro y su implementación en una clínica odontológica en el

Ecuador: Una Revisión de la Literatura

Received: 06/11/2023 | Revised: 06/22/2023 | Accepted: 06/23/2023 | Published: 06/27/2023

Cristina Stephany Prieto Veintimilla

ORCID: <https://orcid.org/0009-0009-7798-1955>

Universidad de Cuenca, Ecuador

E-mail: cristina.prietov@ucuenca.edu.ec

Bryam Andrés Bernal Merchán

ORCID: <https://orcid.org/0009-0009-2471-3930>

Universidad de Cuenca, Ecuador

E-mail: bryam.bernal98@ucuenca.edu.ec

Christian Geovanny Méndez Calle

ORCID: <https://orcid.org/0009-0008-5505-0212>

Universidad de Cuenca, Ecuador

E-mail: christian.mendezc@ucuenca.edu.ec

Salomé Tello López

ORCID: <https://orcid.org/0009-0007-1702-9271>

Universidad de Cuenca, Ecuador

E-mail: salome.tello@ucuenca.edu.ec

Manuel Estuardo Bravo Calderón

ORCID: <https://orcid.org/0000-0003-2968-1519>

Universidad de Cuenca, Ecuador

E-mail: estuardo.bravo@ucuenca.edu.ec

Abstract

Introduction: The carbon neutral standard, or also known as carbon neutral or “zero net emissions” standard, aims to balance the greenhouse gas emissions released into the atmosphere with the elimination or compensation of the same amount of emissions. In many countries, this standard has been implemented with certain policies and measures to move towards carbon neutrality in different international agreements. Said policies include actions such as the promotion of renewable energies, energy efficiency, use of renewable materials, etc. **Objective:** to determine the importance of Carbon Neutral model in dental clinics. **Materials and Methods:** In this article, a review of the literature about the Carbon Neutral Standard and its impact on Companies and Dentistry was carried out, using scientific articles and other research documents from the Scopus, Google Scholar, Scielo databases. and the website of the Ministry of the Environment of Ecuador. **Conclusion:** The carbon neutral standard promotes environmental awareness and responsibility in companies, reducing emissions, energy and water consumption, and also minimizing the consumption of single-use plastics. Dental offices can be polluting, but the implementation of reusable supplies benefits the environment and saves money. In Ecuador, carbon neutral certifications endorsed by the National Environmental Authority can be obtained.

Keywords: Carbon neutral; Carbon footprint; Neutrality; Environmental impact; Green company; Green dentistry.

Resumo

Introdução: O padrão carbono neutro, ou também conhecido como padrão carbono neutro ou “zero emissões líquidas”, visa equilibrar as emissões de gases de efeito estufa lançadas na atmosfera com a eliminação ou compensação da mesma quantidade de emissões. Em muitos países, esse padrão foi implementado com certas políticas e medidas para avançar para a neutralidade de carbono em diferentes acordos internacionais. Essas políticas incluem ações como a promoção de energias renováveis, eficiência energética, uso de materiais renováveis, etc. **Objetivo:** determinar a importância do modelo Carbono Neutro na clínica odontológica. **Materiais e Métodos:** Neste artigo foi realizada uma revisão da literatura sobre o Padrão Carbono Neutro e seu impacto nas Empresas e na Odontologia, utilizando artigos científicos e outros documentos de pesquisa das bases de dados Scopus, Google Acadêmico, Scielo e site da Ministério do Meio Ambiente do Equador. **Conclusão:** O padrão carbono neutro promove consciência e responsabilidade ambiental nas empresas, reduzindo emissões, consumo de energia e água, além de

minimizar o consumo de plásticos descartáveis. Os consultórios odontológicos podem ser poluentes, mas a implementação de suprimentos reutilizáveis beneficia o meio ambiente e economiza dinheiro. No Equador, podem ser obtidas as certificações de carbono neutro endossadas pela Autoridade Ambiental Nacional.

Palavras-chave: Carbono neutro; Pegada de carbono; Neutralidade; Impacto ambiental; Empresa verde; Odontologia verde.

Resumen

Introducción: La norma carbono neutro, o también conocida como carbono neutral o norma “cero emisiones netas”, tiene como objetivo equilibrar las emisiones de gases de efecto invernadero liberadas a la atmósfera con la eliminación o compensación de la misma cantidad de emisiones. En muchos países, esta norma se ha implementado con ciertas políticas y medidas para avanzar hacia la neutralidad de carbono en diferentes acuerdos internacionales. Dichas políticas incluyen acciones como la promoción de energías renovables, la eficiencia energética, uso de materia renovable, etc. Objetivo: determinar la importancia del modelo Carbono Neutro en las clínicas dentales. Materiales y Métodos: En este artículo se realizó una revisión de la literatura acerca de la Norma Carbono Neutro y su impacto en las Empresas y en la Odontología, utilizando artículos científicos y demás documentos de investigación de las bases de datos Scopus, Google Scholar, Scielo y de la Web del Ministerio del Ambiente del Ecuador. Conclusión: La norma carbono neutro promueve la conciencia ambiental y responsabilidad en las empresas, reduciendo emisiones, consumo de energía y agua, minimizando también el consumo de plásticos de un solo uso. Los consultorios odontológicos pueden ser contaminantes, pero la implementación de insumos reutilizables beneficia al ambiente y permite ahorrar dinero. En Ecuador, se pueden obtener certificaciones de carbono neutro avaladas por la Autoridad Ambiental Nacional.

Palabras clave: Carbono neutro; Huella de carbono; Neutralidad; Impacto ambiental; Empresa verde; Odontología verde.

1. Introduction

Global concern about the detrimental effects of climate change has motivated organizations and institutions to deepen their understanding of greenhouse gasses and their dynamics. As a result, the carbon footprint has emerged as an internationally recognized indicator for understanding these dynamics. A complete understanding of the carbon footprint involves not only knowing it in all its dimensions, but also measuring and disclosing it as a key element in individual, corporate, regional or national decision-making processes. A consensus has been reached that knowing the carbon footprint helps to identify ways to control, reduce or mitigate greenhouse gas emissions and their environmental impact. The ultimate goal is that its importance in the trade of goods and services, as well as the benefits it brings to companies and the environment, will be increasingly recognized (Schneider & Samaniego, 2023).

Neutrality

Neutrality" is considered when a company has achieved a 100% reduction of its Greenhouse Gas (GHG) emissions. In Ecuador, this requirement is indispensable to obtain the "Green Dot" Certification - Carbon Neutral HCP or partial HCP. However, if a net zero value is not achieved, actions can be taken to reduce pollution and emissions or even actions that compensate for these reductions in their entirety (Arbaje & Pérez, 2020).

It is also worth defining the term "Carbon Neutral" or "CO₂ neutral", which corresponds to the state in which greenhouse gas emissions are totally zero, the objective being to stop promoting the accumulation of these in the earth's atmosphere and improve the climate situation (SUIA, 2014; Ministry of the Environment EC, 2021).

The Carbon Footprint is commonly defined as the amount of greenhouse gasses released into the atmosphere by human activities, such as the production and consumption of goods and services. The scope of this definition varies from a perspective that only contemplates direct CO₂ emissions to others that cover the entire life cycle of greenhouse gas emissions, including the extraction of raw materials, the production of the product and its transportation, and its final destination along with its respective packaging (Schneider & Samaniego, 2023).

Although the carbon footprint is increasingly well known, its definition has not yet been clearly defined, which has

hindered its adoption. This has led countries such as the United Kingdom, Germany, France and Japan to implement different initiatives to define its scope, accounting method and reporting model. For a complete definition of the carbon footprint, it is important to take into account the role played by consumers in purchasing decisions, as they may be responsible for a large part of the greenhouse gas emissions generated by the products or services they purchase. In current accounting models, emissions are attributed only to producers and transporters, so it is necessary to discern which of these should be considered at each stage of a product's life cycle, including those related to consumption and consumer behavior (Schneider & Samaniego, 2023; Ordoñez et al., 2018).

There are more and more initiatives to include the issue of climate change in international trade agendas, which while generating restrictions, also creates opportunities for countries to adopt more efficient production processes with a lower carbon footprint. Some governments have already established and adopted measures related to this issue, such as carbon taxes, emissions trading programs and technical barriers that include energy efficiency requirements; however, it is important to emphasize that this may affect their trade relations with Latin American countries and other regions with incipient initiatives on these issues (Schneider & Samaniego, 2023).

In Ecuador, the carbon neutral standard (known as the Zero Carbon Project) is an initiative that seeks to measure, reduce and offset greenhouse gas emissions in companies and organizations in the country. This standard was created in 2011 and is administered by the Ministry of Environment and Water of Ecuador (Ordoñez León, 2012).

This review creates a compendium about the Carbon Neutral Standard within the Ecuadorian territory as well as internationally. The objective is to clarify the reason for the creation of such a standard, the benefits of its implementation and how the Green Company certification is achieved.

2. Methodology

This Narrative Review of the Literature of the Carbon Neutral Standard and its impact on companies and dentistry was carried out, using scientific articles and other research documents from the Scopus, PubMed, Google Scholar, Science Direct and Scielo databases and from the website of the Ministry of the Environment of Ecuador.

Literature Review

Health effects of environmental pollution.

Current high levels of pollution result not only in the climate change so evident today, but also in health. Social inequity does not allow all people to have access to clean and healthy resources, so a large percentage of the world's population is exposed to contaminated water, air and soil, thus, their risk of viral, bacterial or parasitic infections increases exponentially (PAHO, 2010). It is worth mentioning that cigarette smoke, metals commonly used in companies such as nickel and chromium (also used in dentistry) and ionizing radiation are very high risk agents for the development of carcinomas at the oral level and in other areas of the human body (Batista-Marrero et al., 2014).

This is why the climate crisis is considered a public health problem that directly affects the conditions and quality of life of people worldwide, and is also associated with socioeconomic and cultural factors.

Carbon Neutral Certification

To obtain Carbon Neutral certification, companies must carry out an inventory of greenhouse gas emissions and then take measures to reduce and offset their emissions through the acquisition of carbon credits or the implementation of mitigation projects. This standard is voluntary and seeks to encourage the adoption of sustainable practices in the country's business sector, promoting the transition to a greener, low-carbon economy. It is important to note that the carbon neutral

standard in Ecuador is part of a global effort to address climate change and the reduction of greenhouse gas emissions, and its implementation can contribute significantly to national and international efforts to combat global warming and protect the environment (Ordoñez León, 2012).

It is important to mention that environmental care initiatives have several main objectives, such as:

- The preservation, restoration and improvement of the environment.
- The preservation and protection of biodiversity, as well as the establishment and administration of natural protected areas.
- The sustainable use, preservation and restoration of soil, water and other natural resources.
- Prevention and control of air, water and soil pollution (Gutiérrez-Avila M. et al. 2022).

Ecuador Zero Carbon Program (PECC)

The Ecuador Zero Carbon Program is a project proposed by the Ministry of Environment, Water and Ecological Transition (MAATE) and presented in 2014, which acts as an instrument to encourage the reduction of emissions and environmental pollution (Arbaje & Pérez, 2020), (Ministerio del Ambiente EC, 2021). It proposes that companies that voluntarily comply with certain established requirements and responsibilities, to then be evaluated by the National Environmental Authority and awarded with different badges, for example:

- **Green Initiative Badge - HCP Quantification:** awarded to proponents that have quantified and reported the Product Carbon Footprint. This award is valid for 1 year and is granted only once.

- **Green Point Certification - HCP Reduction:** Awarded to proponents that implement mitigation actions to reduce HCP emissions. This certification is valid for 2 years.

- **Green Point Certification - Carbon Neutrality of HCP:** Awarded to proponents that quantify the HCP and carry out reduction and compensation actions until reaching a "zero" balance between emissions generated and compensated according to their HCPI.

In this way the product can be considered "carbon neutral". This certification is valid for 3 years (Arbaje and Pérez, 2020).

These certificates may be obtained by any natural or legal person, national or foreign, and by any private or mixed public company; however, obtaining one does not guarantee obtaining the others (Arbaje & Pérez, 2020).

Likewise, the Ministry of Environment presented the Ecuadorian Carbon Neutral Recognition, an incentive granted to public and private sector companies or even natural persons that produce a good or offer a service, stating that being Eco-Efficient corresponds to an added value for production and a benefit for the environment (Ministry of Environment A and. TE).

Among the indispensable requirements to obtain and renew the certification are:

- 1. Measurement and reporting:** to achieve carbon neutral status, it is necessary to measure and report the greenhouse gas emissions of an organization or activity. This can be done using different tools, such as the Greenhouse Gas Protocol (GHG Protocol).
- 2. Emissions reduction:** Once emissions have been measured and reported, it is important to implement measures to reduce them. This may include changes in energy consumption, resource efficiency and the implementation of cleaner technologies.
- 3. Offsetting emissions:** if it is not possible to reduce emissions completely, they can be offset by purchasing carbon credits or investing in emission reduction projects elsewhere.
- 4. Certification:** there are different certification programs that verify compliance with carbon neutral standards, such as Natural Capital Partners' "CarbonNeutral" program and Carbonfund.org's "CarbonFree" program.

5. Transparent communication: it is important for organizations striving to achieve carbon neutral status to transparently communicate their practices and results to demonstrate their commitment to sustainability and environmental responsibility (Arbaje and Pérez, 2020), (Ministry of Environment EC, 2021), (Ministry of Environment A and. TE).

Three specific points can be established more concretely to contribute to the control of the climate crisis within the company:

- 1. Prevention:** avoid the negative impact by modifying the factors harmful to the environment.
- 2. Correction:** to orientate to the elimination and modification of the alterations produced on the environmental factor.
- 3. Compensation:** implement a mechanism that contributes to the care and conservation of the ecosystem (Pino-Santillán, 2020).

It is important to keep in mind that these standards and certification programs may vary in their specific requirements and in the way they are applied in different countries and industry sectors. Therefore, it is advisable to research and select the standard or certification program that best suits the needs and objectives of the organization (Ministry of Environment EC, 2021).

Table 1 - Carbon Neutral Standards.

Standard	Description
GHG Protocol	It is a tool for measuring and reporting an organization's greenhouse gas emissions. It was developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD).
ISO 14064	It is an international standard that establishes requirements for the measurement, reporting and verification of greenhouse gas emissions. It is composed of three parts: specifications for the management of greenhouse gas inventories, specifications for the quantification, monitoring and reporting of emission reductions, and verification of emission reduction projects.
CarbonNeutral	It is a certification program that verifies an organization's reduction of greenhouse gas emissions and its commitment to sustainability. The program was developed by Natural Capital Partners.
CarbonFree	It is a certification program that verifies the neutralization of an organization's greenhouse gas emissions through the purchase of carbon credits. The program was developed by Carbonfund.org.
PAS 2060	This is a British public specification that sets out the requirements for demonstrating carbon neutrality. The standard includes guidance for measuring and reporting greenhouse gas emissions and for offsetting emissions through the purchase of carbon credits (6).

Ordoñez León YM. (2012). Obtaining Carbon Neutral Certification and its impact on Business Value Creation: Results of Real Cases. Repositorio Institucional de la Universidad Politécnica Salesiana. Available from: <http://dspace.ups.edu.ec/handle/123456789/2731>

This table gives the readers a resume of the most important standards considered in Carbon Neutrality and it helps to enrich their knowledge about the topic.

Benefits of following the Carbon Neutral Standard

For the Productive Sector

- Improves your corporate image and adds value and commercial preference.
- Attracts investors.
- Increases staff motivation.
- Increased efficiency with optimization of raw materials, energy consumption and waste generation.
- Economic benefits and tax benefits.
- Motivates the development of new technologies inspired by the Carbon Free initiative. (Ministry of Environment A y. TE).

For the Consumer

- Access to quality information on products and services purchased.
- Greater choice. (Ministry of the Environment A y. TE).

For the Environment

- Optimization of raw materials.
- Conserving and optimizing non-renewable natural resources.
- Reduction of greenhouse gas emissions.
- Harmony of production with the ecosystem.
- Incentivizes the implementation of environmental conservation activities (Ministry of the Environment A y. TE).

Environmental problems generated by dental clinics

- **Generation of hazardous waste:** dental offices generate a large amount of hazardous waste, such as needles, syringes, dental amalgam, radiographs, and chemicals, which can be harmful to the environment if not handled properly.

- **Water and energy consumption:** the use of medical equipment, such as air compressors, vacuum cleaners and lights, as well as the sterilization and cleaning of instruments, can consume large amounts of water and energy.

- **Noise pollution:** Dental procedures can generate high levels of noise, which can be disturbing for patients and people working in the office, as well as for nearby neighbors.

- **Greenhouse gas emissions:** The energy consumed by the equipment and the generation of hazardous waste can generate greenhouse gas emissions, contributing to climate change.

To mitigate these environmental issues, dental offices can adopt sustainable practices, such as proper hazardous waste management, water and energy conservation, use of green building materials and equipment, and educating patients about the importance of sustainability in health care.

Optimization and waste reduction strategies in dental clinics

The consequences of current environmental pollution and climate change have reached an irreversible level. However, it is still possible to stem the tide of damage and promote better living conditions to be enjoyed and maintained by future generations. (Omnia El Omrani et al., 2020).

Within the undergraduate and graduate dental curriculum, education about environmental care and resource optimization is very scarce, if not nonexistent, so the training of new cohorts of students is insufficient to meet this aspect of social responsibility. (Omnia El Omrani et al., 2020, 2020) So the first strategy to reduce emissions and generation of non-recyclable waste is to include the education and qualification of students in a sustainable dental service and health promotion, protecting not only the health of patients but also the environment, benefiting current and future generations. (Shaw, et al., 2021) This new implementation in the curriculum would take the name of "Planetary Health" and would implement the control of the environmental crisis in all the careers of Health Sciences and, therefore, its consequences on physical and mental health (Omnia El Omrani et al., 2020; Brady Bates, et al., 2023). Similarly, there is the proposal of Environmental Dentistry, an approach that "implements sustainable practices by keeping resource consumption in line with nature's economy and safeguarding the environment by virtue of eliminating or reducing waste." (Gutiérrez-Avila et al. 2022).

It is indisputably known that clinics dedicated to the dental area produce a large amount of waste on a daily basis and water pollution, the use of X-rays and high energy consumption are important aggravating factors for global warming. Like other health facilities, the amount of waste generated is due to the single-use materials and supplies used to provide greater

biosafety for patients, professionals and support staff. However, it is also important to intensify environmental care and promote more eco-friendly practices, so multiple strategies have been proposed and many others are under development to make dental activities "greener" and even sustainable (Sánchez-Trigos et al., 2022).

The FDA (American Dental Federation) proposes that by the year 2030, dental practices should urgently follow eco-friendly standards within their daily clinical activities, thus contributing to the preservation of life, health and supporting the green economy (Omnia El Omrani et al., 2020).

While the COVID-19 pandemic brought multiple changes in biosafety protocols-such as the massive use of single-use plastics and their subsequent incineration-they should be considered for reversal after the control of the health emergency, investing in alternative reusable or, failing that, biodegradable supplies to avoid emissions from their combustion upon disposal. (Țâncu, et al., 2023).

Similarly, the use of single-use materials that can be replaced by similar reusable ones, such as, for example, protective fields or bibs, can be considered. The disposable fields are made of cellulose, polyester and plastic, to make them resistant and waterproof, while the woven bibs also have a waterproof capacity and even greater resistance, with the difference that they can be used again when disinfected and with time and washing they will progressively lose their properties. There is also talk of sterilizable and therefore reusable instruments to avoid the consumption of single-use plastics, such as triple syringe tips and metallic suction cannulas, which would undergo a process of asepsis, disinfection and sterilization after each use. The use of these supplies would not only be much more sustainable as an "economic relief" for the clinic, but would also greatly reduce inorganic waste per patient. It is worth mentioning that any acquisition of reusable supplies should be considered based on the health and well-being of patients (Sánchez-Trigos et al., 2022).

Likewise, the elimination of the use of dental amalgams is recommended because of the mercury contained in their composition, which is not only released during the degradation of the material in the human body, but also in the water and air as a product of their preparation (Gutiérrez-Avila, et al. 2022).

Dentists and dental clinic staff should have up-to-date knowledge and fully follow the waste classification guidelines, considering whether or not they are a biohazard. Similarly, when possible, they should reduce water and electricity consumption, for example, by turning off dental chairs, using moderate amounts of water when sanitizing spaces and instruments, etc (Sánchez-Trigos et al., 2022).

Currently, multiple restorative materials have been developed with many properties suitable for oral health, being considered much better than amalgams, used for many years in the past and even today by several professionals. The use of these new materials allows the professional a more respectful practice with the ecosystem and even with the patient. It is also important to talk about radiographs, which correspond to a high environmental risk and, by using physical radiographic films, generate a lot of non-renewable plastic waste and toxic and non-reusable liquid chemicals; that is why the use of digital systems such as digital sensors or radiovisiographs is recommended, which emit a smaller amount of radiation, do not generate waste and improve the storage of radiographic images (Sánchez-Trigos et al., 2022).

There are fabric alternatives for sterilization bags, which can be sanitized and reused. It is also recommended to use biodegradable plastics (also called bioplastics) made from polyhydroxyalkanoates, such as starches, cellulose or alginates, for waste storage, which degrade in less time and with certain treatment can be converted into compost (Sánchez-Trigos et al., 2022).

3. Results and Discussion

The Carbon Footprint, as indicated by Schneider, is defined as the amount of greenhouse gases emitted into the atmosphere by companies producing goods or those that provide services, also corresponds to a benefit to the consumer by the

variety of new product options that come to market. Therefore, the international Carbon Neutral initiative was created in order to relate international trade with the environmental issue, considering that emissions are not only the responsibility of producers and transporters, but also of the consumer, as indicated and agreed by Schneider and León; in addition, at the Ecuadorian level this production modality was implemented in 2014 with the Zero Carbon Ecuador Project, as indicated by the Ministry of Environment, Water and Ecological Transition of Ecuador (Ordoñez et al., 2018; Ministry of Environment EC, 2021; SUIA, 2014).

The concept of carbon neutral refers to the situation in which the same amount of carbon dioxide is emitted and leaked into the atmosphere, achieving an excellent zero emission balance, also known as zero carbon footprint, as indicated by Ordoñez León and the Ministry of Environment, Water and Ecological Transition of Ecuador (MAE) in agreement with Duch-Guillot (Ordoñez et al., 2018; Ministerio del Ambiente EC, 2021; Duch-Guillot, 2019).; likewise, the MAE stresses that the fact that companies achieve neutrality means that they have managed to cancel their emissions or that they have backed them up with carbon offset projects (Ministerio del Ambiente EC, 2021). This same entity establishes that this certificate can be granted to any company, whether public or private, or natural person that offers any product or service, as long as they comply with the established eco-efficiency conditions (Ministerio del ambiente A y. TE).

Ramirez-Garro mentions that the adoption of Carbon Neutral measures in the field of dentistry could generate favorable impacts for both the environment and public health, while improving the image and reputation of the industry (Ramirez and Chavarria, 2019). However, as Stocker rightly puts it, achieving carbon neutrality presents challenges, especially in terms of costs. The technologies and practices needed to reduce carbon emissions can be expensive, limiting the ability of many organizations and countries to invest in them (Stocker, 2023).

Despite this, Climate Partner © believes it is important to emphasize that achieving carbon neutrality is not only essential to avoid the worst consequences of climate change, but also offers benefits to communities and society at large, such as reduced environmental pollution and improvements in health, as well as driving sustainable economic growth and the creation of green jobs. Companies achieve a high level of credibility and have a significant positive impact on our climate when, in addition to offsetting their carbon emissions, they also adopt a transparent strategy that helps to avoid and reduce carbon emissions in their products and operations (Climate Partner, 2023).

It should be recognized that dental clinics are an entity that produces a large amount of waste and gases, due to all the biosafety protocols, cleaning, sterilization, supplies and single-use materials; as well as noise pollution from turbines, ultrasound and other machinery used daily, as indicated by Sanchez and cola (Sanchez-Trigos et al., 2022). However, Arbaje-Escovar proposes a series of recommendations to convert the dental office into a Green Dental Office, such as using more reusable implements such as sterilization drapes, impermeable fields instead of disposable bibs, suction and triple metallic sterilizable syringe tips, among others. Similarly, the use of radiovisiographs and digital imaging should be considered to avoid the use of physical radiographic films and developing liquids, which are extremely aggressive chemicals for health and for the preservation of the environment. Regarding energy saving, dental chairs, lights and electrical outlets that are not essential at the moment should be turned off and disconnected to avoid unnecessary consumption of electricity (Arbaje & Pérez, 2020).

4. Conclusion

- The Carbon Neutral Standard promotes environmental awareness and responsibility within companies, proposing strategies to reduce gas emissions, overconsumption of energy and water, and minimize the consumption of single-use plastics, among others.

- The Carbon Neutral certification program brings together multiple requirements to be met in order to classify a company as "green", such as measuring greenhouse gas emissions, reducing them or, failing that, offsetting them.

- In Ecuador, certification is achieved through compliance with various requirements, which is no different from other countries. Three different certifications can be obtained and endorsed by the National Environmental Authority and can be renewed if the Carbon Neutral protocol is followed.

- Although it may not seem a very threatening enterprise, dental offices are often major environmental polluters, with high consumption of plastic, water, energy and gaseous emissions generated by the equipment.

- The acquisition of reusable supplies such as polyester bibs, suction cannulas and triple metallic syringes, reusable sterilization covers, result in a great environmental benefit due to the reduction in the consumption of single-use plastics.

- The use of radiovisiographs in the dental office corresponds not only to a great reduction in exposure to ionizing radiation, but also to toxic chemicals (developer liquids) and a reduction in the generation of non-recyclable plastic waste. Also, working time decreases and comfort for the patient and the professional increases.

- The implementation of the Carbon Neutral Standard in the dental practice translates into economic benefits and added value, since by acquiring reusable supplies and using digital systems it is possible to reduce expenses, invest them in the purchase of new products and technologies and even, by being classified as a green company, it would automatically be more striking among the competition.

It is suggested for future researches and reviews to look for more information about Carbon Neutrality and requirements for its certification in international community.

References

- Arbaje-Escovar, I. & Pérez-Mota, F. (2020). *Use of eco-friendly options in dental clinics for the reduction of the environmental impact of disposable materials*. Universidad Iberoamericana (UNIBE). <https://repositorio.unibe.edu.do/jspui/handle/123456789/265>
- Batista Marrero, K., Niño Peña, A. & Martínez Cañete, M. (2014). *Role of environmental factors in the occurrence of oral cancer*. *Correo Científico Médico*. 18(3), 516-521. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1560-43812014000300014&lng=es&tlng=es
- Brady Bates, O., Walsh, A. & Stanistreet, D. (2023). *Factors influencing the integration of planetary health topics into undergraduate medical education in Ireland: a qualitative study of medical educator perspectives*. *BMJ open*. 13(1), e067544. <https://doi.org/10.1136/bmjopen-2022-067544>
- Climate Partner. (2023) *Carbon Neutral*. <https://www.climatepartner.com/es/carbono-neutro>
- Duch-Guillot J. (2019). *What is carbon neutrality and how to achieve it by 2050: News: European Parliament. Directorate-General for Communication*. <https://www.europarl.europa.eu/news/es/headlines/society/20190926STO62270/que-es-la-neutralidad-de-carbono-y-como-alcanzarla-para-2050>
- Gutiérrez-Ávila, M. D., & Rosales-García, J. C. (2022). *Sustainable consumption of plastics in dental offices in Toluca 2022* (Universidad Autónoma del Estado de México, Mexico). <http://ri.uaemex.mx/handle/20.500.11799/137113>
- Ministry of Environment A y. TE. *Climate Change - Carbon Neutral - What is Carbon Neutral*. Ministerio del Ambiente, Agua y Transición Ecológica.Gob.Ec. http://suia.ambiente.gob.ec/?page_id=772
- Ministry of Environment A y. TE. *MAE officially presented the Ecuadorian Environmental Carbon Neutral Recognition*. <https://www.ambiente.gob.ec/mae-presento-oficialmente-el-reconocimiento-ecuatoriano-ambiental-carbono-neutral/>
- Ministry of Environment EC (2021). *Norma técnica alcance a Producto del Programa Ecuador Carbono Cero*. <https://www.ambiente.gob.ec/wp-content/uploads/downloads/2021/08/NT-PECC-PRODUCTO.pdf>
- Omnia El Omrani, Alaa Dafallah, Blanca Paniello Castillo, Bianca Quintella Ribeiro Corrêa Amaro, Sanjana Taneja, Marouane Amzil, Md. Refat Uz-Zaman Sajib & Tarek Ezzine (2020) *Envisioning planetary health in every medical curriculum: An international medical student organization's perspective*, *Medical Teacher*, 42:10, 1107-1111, 10.1080/0142159X.2020.1796949.
- Ordoñez Leon, Y. M., Freire Moran, J. F., Carrera Jimenez, J. A., Morales Navas, M. E., & Cabezas Garcia, F. G. (2018). *Application of Carbon Neutral Certification in Ecuadorian Companies: Eco-efficiency and Profitability Evaluation*. <https://pure.ups.edu.ec/en/publications/aplicaci%C3%B3n-de-las-certificaci%C3%B3n-carbono-neutro-en-las-empresas-ecu>
- Ordoñez León Y. M. (2012). *Obtaining Carbon Neutral Certification and its impact on Business Value Creation: Results of Real Cases*. Repositorio Institucional de la Universidad Politécnica Salesiana. <http://dspace.ups.edu.ec/handle/123456789/2731>
- Panamerican Health Organization. (2010). *Environment and health*. <https://www.paho.org/hq/dmdocuments/2010/Sanemiento-Capitulo1.pdf>
- Pino-Santillán, M. T. (2020). *Implementation of sustainable environmental practices in Ecuadorian companies and their economic impact*. <https://core.ac.uk/download/pdf/486912035.pdf>

- Ramírez-Garro M. A., & Chavarría Calvo M. A. (2019). *Analysis on carbon neutrality and technical difficulties for the implementation of a green dental clinic*. *Odontología Vital*, 1(30), 73-8. 10.59334/rov.v1i30.140.
- Schneider, H. and Samaniego, J. (2023). *The Carbon Footprint in the Production, Distribution and Consumption of Goods and Services*, ECLAC. <https://www.cepal.org/es/publicaciones/3753-la-huella-carbono-la-produccion-distribucion-consumo-bienes-servicios>
- Shaw, E., Walpole, S., McLean, M., Álvarez-Nieto, C., Barna, S., Bazin, K., & Woollard, R. (2021). *AMEE Consensus Statement: Planetary health and education for sustainable healthcare*. *Medical Teacher*, 43(3), 272-286. 10.1080/0142159X.2020.1860207.
- Stocker T. (2023). *What is carbon neutrality and how to achieve it?* <https://www.carbonneutralplus.com/que-es-la-carbono-neutralidad/>
- Sánchez-Trigos V, Ramírez-Ortiz C. L, Casadiegos-Duarte Y, & Parra-Serrano. J. F. (2022). *Environmentally friendly dentistry educational program in oral rehabilitation at Universidad Santo Tomás. Universidad Santo Tomás*. <https://repository.usta.edu.co/bitstream/handle/11634/48041/2022S%C3%A1nchezValentina..pdf?sequence=6&isAllowed=y#:~:text=La%20pr%C3%A1ctica%20odontol%20odontol%20C3%B3gica%20genera%20un,wasting%20de%20recursos%20naturales%20y>
- Țâncu, A. M. C., Didilescu, A. C., Pantea, M., Sfeatcu, R., & Imre, M. (2023). *Aspects Regarding Sustainability among Private Dental Practitioners from Bucharest, Romania: A Pilot Study*. *Healthcare (Basel, Switzerland)*, 11(9), 1326. <https://doi.org/10.3390/healthcare11091326>
<https://doi.org/10.3390/healthcare11091326>