

Energy Management and Environmental Responsibility in Organizations of the Health Sector of Barranquilla, Colombia

Gestión Energética y Responsabilidad Ambiental en Organizaciones del Sector Salud de Barranquilla, Colombia

Gestão Energética e Responsabilidade Ambiental em Organizações do Setor Saúde de Barranquilla, Colômbia.

Hugo Hernández-Palma^a; Dairo J. Novoa^b; Andrea Moreno-Ríos^{c*}

^a Universidad del Atlántico, Barranquilla, Colombia, Faculty of Economic Sciences; PhD Student in Project Management at Universidad Ean, Bogotá, Colombia, Carrera 30 Número 8-49, Puerto Colombia, Atlántico, Colombia. Email: hugohernandezp@mail.uniatlantico.edu.co. ORCID: <https://orcid.org/0000-0002-3873-0530>.

^b Universidad del Atlántico, Barranquilla, Colombia, Faculty of Economic Sciences; PhD Student in Project Management at Universidad Ean, Bogotá, Colombia, Carrera 30 Número 8-49, Puerto Colombia, Atlántico, Colombia. Email: daironovoa@mail.uniatlantico.edu.co. ORCID: <https://orcid.org/0000-0003-1164-8956>.

^c Universidad de Cartagena, Faculty of Pharmaceutical Chemistry, Campus Zaragocilla, Calle 30 # 39B-192, Cartagena, Colombia. Email: morenoriosandrea@gmail.com. ORCID: <https://orcid.org/0000-0002-5454-6784>

* Correspondencia del autor: Andrea Moreno-Ríos, Faculty of Pharmaceutical Chemistry, Universidad de Cartagena, Campus Zaragocilla, Calle 30 # 39B-192, Cartagena, Colombia. Email: morenoriosandrea@gmail.com. ORCID: <https://orcid.org/0000-0002-5454-6784>

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Abstract

This article seeks to identify key elements associated with energy management practices by health sector organizations in Barranquilla, Colombia, and to examine their influence on environmentally responsible behaviors within these institutions. A descriptive field study was conducted with a random sample of thirty-one (31) public and private Health Service Provider Institutions (IPS) in the city. The findings reveal that 80.65% of the organizations have established plans to optimize energy use, enforce policies for efficient energy consumption, and adopt energy-efficient technologies. Furthermore, 64.52% of the institutions implement energy consumption control metrics. In terms of environmental responsibility, 80.65% set environmental objectives, and 77.42% commit to the rational use of energy. These practices suggest a strong potential for these organizations to evolve into eco-efficient entities. However, strategic initiatives such as green construction projects are essential to achieve higher levels of eco-efficiency, thereby enhancing environmental well-being in the community and contributing to broader environmental preservation efforts of World Health Organization.

Resumen

Este artículo tiene como objetivo identificar los elementos clave asociados con las prácticas de gestión energética en organizaciones del sector salud en Barranquilla, Colombia, y examinar su influencia en los comportamientos ambientalmente responsables dentro de estas instituciones. Se realizó un estudio de campo descriptivo con una muestra aleatoria de treinta y una (31) Instituciones Prestadoras de Servicios de Salud (IPS) públicas y privadas en la ciudad. Los hallazgos revelan que el 80,65% de las organizaciones han establecido planes para optimizar el uso de la energía, implementar políticas para el consumo eficiente de energía y adoptar tecnologías energéticamente eficientes. Además, el 64,52% de las instituciones implementan métricas de control del consumo energético. En términos de responsabilidad ambiental, el 80,65% establece objetivos ambientales y el 77,42% se compromete con el uso racional de la energía. Estas prácticas sugieren un fuerte potencial para que estas organizaciones evolucionen hacia entidades ecoeficientes. Sin embargo, iniciativas estratégicas como proyectos de construcción verde son esenciales para alcanzar niveles más altos de ecoeficiencia, mejorando así el bienestar ambiental de la comunidad y contribuyendo a los esfuerzos más amplios de conservación ambiental de la Organización Mundial de la Salud.

Resumo

Este artigo tem como objetivo identificar os elementos chave associados às práticas de gestão de energia por organizações do setor de saúde em Barranquilla, Colômbia, e examinar sua influência sobre comportamentos ambientalmente responsáveis dentro dessas instituições. Foi realizado um estudo de campo descritivo com uma amostra aleatória de trinta e uma (31) Instituições Prestadoras de Serviços de Saúde (IPS) públicas e privadas na cidade. Os resultados revelam que 80,65% das organizações estabeleceram planos para otimizar o uso de energia, implementar políticas para consumo eficiente de energia e adotar tecnologias energeticamente eficientes. Além disso, 64,52% das instituições implementam métricas de controle do consumo de energia. Em termos de responsabilidade ambiental, 80,65% estabelecem objetivos ambientais e 77,42% se comprometem com o uso racional da energia. Essas práticas sugerem um grande potencial para que essas organizações evoluam para entidades ecoeficientes. No entanto, iniciativas estratégicas como projetos de construção verde são essenciais para alcançar níveis mais elevados de ecoeficiência, melhorando assim o bem-estar ambiental da comunidade e contribuindo para os esforços mais amplos de preservação ambiental da Organização Mundial da Saúde.

1. Introduction

The energy model that currently prevails is fundamentally based on the use of fossil fuels (coal, oil, and gas), which is unsustainable for the development of humanity on this planet (Cañizares-Pentón et al., 2014). For this reason, a change is required in the modes of action of the different sectors of society that are supported by energy savings and an increase in energy efficiency that allows us to respond not only to the permanent increase in the exchange value of energy. itself, but also by the environmental deterioration caused by the increasing production and consumption of energy.

Now, to achieve the so-called energy efficiency in the context of organizations, Cañizares-Pentón et al., (2014) and Correa Soto et al., (2017) indicate that it is necessary to carry out management that is supported by the development and implementation of good consumption, operation and maintenance practices (energy management and technical-organizational measures) and the use of technologies based on high-efficiency equipment. , in remodeling of existing facilities or in new facilities that give organizational entities the ability to efficiently satisfy their energy needs.

Thus, in the environment of the organizational sectors that guide their management within the framework of energy efficiency are the health-providing entities in Colombia, which are called Health Service Provider Institutions (IPS). These institutions' main purpose is to provide medical services for consultation and hospitalization, contracted by the so-called Health Promotion Entities (EPS) (Law 100 of 1993, article 156 literal in the Republic of Colombia). The institutions, by the services they provide, are highly intensive in energy consumption, and as Martínez (2019) states, they are considerably sensitive to energy consumption issues, which is why they require the application of measures that lead to the optimization of the use of fossil fuels, which would lead to financial and environmental benefits.

In the same vein as described above, Setyowati et al (2013) point out that the health sector is a social actor that guarantees the well-being of the community it serves and cannot be a passive subject, much less when it is aware of the efforts made worldwide to increase and adjust health facilities. to models that have greater sustainability and efficiency in environmental matters. As health organizations insert themselves into this global trend, they are called "green hospitals." Due to what was previously stated, Camponogara et al, (2009) propose that there is a need to develop strategies to articulate the actions of the health sector with the environment since these are intrinsic conditions for the survival of human beings and are related to the specific spaces of human actions.

Likewise, by incorporating actions in companies in the health sector to transform them into energy efficient organizations, environmental responsibility actions would be carried out, directly or indirectly, which is conceived as a practice that arises from corporate ethical responsibility, which is defined as a business dimension in which economic, social and environmental guidelines are accommodated and is materialized through the voluntary commitment of companies with the development of society, the preservation of the environment from its social composition, a behavior responsible towards the people and social groups with whom it interacts, focusing its attention on the needs of the interest groups through certain strategies, the results of which must be measured, verified and communicated appropriately (Hernández et al., 2023).

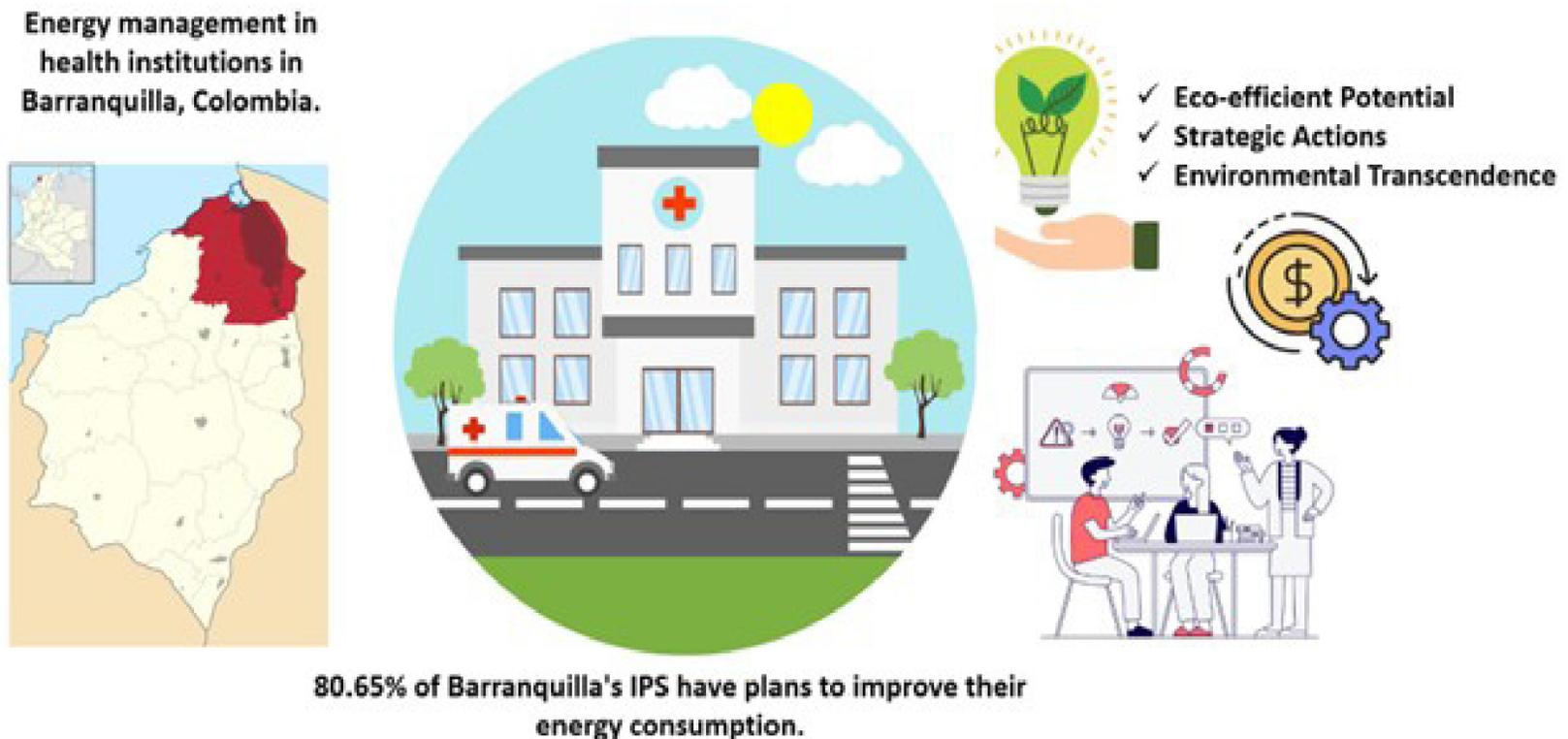
The practices and actions undertaken by companies for environmental protection are framed within the concept of a sustainable company, which emphasizes ethical environmental behaviors. These practices involve managing operational processes carefully, adopting appropriate technology to minimize negative environmental impacts, and upholding responsibility standards based on principles of social solidarity. Such an approach contrasts with the traditional business management model, where the primary motivation is financial gain, often without considering the general well-being or interests of society as a whole (Martínez et al., 2024; Romero, 2009).

Considering how relevant it is for organizations in the health sector to efficiently manage energy to carry out the different operational processes they execute, and also to take responsibility for the impact of their actions on the environment to provide human beings with a better quality of life that is sustainable over time, this article is presented which aims to identify the presence of some elements related to energy management carried out by organizations in the health sector of the city of Barranquilla - Colombia and the incidence of them in the environmentally responsible behavior that these institutions develop. It is important to mention that the current energy model, based fundamentally on the use of fossil fuels, shows unsustainability for human development worldwide. Given this reality, it is imperative to prioritize energy savings and increased energy efficiency (Hernández et al., 2024).

This study focuses on the health sector in Colombia, where institutions providing health services, highly intensive in energy consumption, need to implement measures that optimize the use of fossil fuels. The transition towards energy efficient organizations not only brings financial benefits, but also environmental ones, while reflecting a corporate responsibility towards social well-being and the preservation of the environment. This approach, which seeks to

harmonize business management with environmental sustainability, is crucial to guarantee a healthy and sustainable future for future generations.

Graphical abstract



2. Materials and methods

To achieve the objective proposed in this article, a descriptive study was carried out, which focuses on collecting data and information to highlight the most relevant characteristics that define the phenomenon being analyzed. Based on this, the information was approached from the quantitative method following the established type of study.

The population was made up of the Institutions (public and private) that provide Health Services in the city of Barranquilla - Colombia, which according to official data provided by the Superintendency of Health represent a total of thirty-four (34) organizations. Thus, under the study population, a sample was selected based on the simple random sampling technique (with 95% confidence and a 5% margin of error), which was made up of thirty-one (31) entities' health.

The primary source of information was made up of the managers or those responsible for the health entities under study to whom a data collection instrument (structured survey-type questionnaire) designed for the specific purposes of this study was applied. On the other hand, secondary sources corresponded to documents (scientific articles and reports) of relevance to the topic of study that contain valid and reliable information. To do this, the specialized search engine Scholar Google was used as a tool to search the main scientific databases (SciELO, Scopus, and Elsevier, among others).

3. Results and discussions

This section presents the analysis and discussion of the results obtained through the application of the data collection instrument designed for this study. The information is presented based on two main variables: Energy Management and Corporate Environmental Responsibility, which are supported at the end of this section in a strategic proposal that is formulated for the IPS that is the object of this research. This proposal will allow health service provider organizations located in Barranquilla – Colombia to be much more efficient in the performance of their energy management and responsible with the environmental environment in which they live.

Fernández et al., (2014) propose that energy management is a subsystem of business management that includes the administration and assurance activities of the management function that give the organization the ability to efficiently satisfy its energy needs. In this sense, the results derived from the application of the data collection instrument indicate, as observed in Table 1, that concerning the planning function, 80.65% of the senior management consulted express the presence of plans. linked to the improvement in energy consumption in the health institutions under study.

Regarding the existence of policies or action guides aimed at the rational and efficient use of energy, it is observed that a significant percentage (80.65%) of organizations have this type of business action instrument (Table 1).

Another core aspect of the energy management of the IPS is linked to the use of efficient technologies (equipment, tools, and devices) that allow the reduction of costs related to energy consumption in the different processes that are executed in them. In this sense, 80.65% of the managers of these organizations indicated that they have the presence of this type of technology, which shows that they make investments aimed at energy savings.

To control mechanisms for energy consumption, 64.52% of the managers interviewed indicate that they have indicators to control this type of consumption in their organizations (Table 1). Regarding the control of energy management, [Percebois \(2007\)](#) points out that like any other management system, it is done through indicators that constitute an important basis for comparison and monitoring to regulate and reduce energy losses in production processes and technically and economically evaluate the potential for reducing energy losses. Likewise, according to what was stated by [Pereira et al. \(2018\)](#) it is necessary to use different indicators to provide a complete evaluation of the energy consumption of a production process.

Table 1: Data on Energy Management.

Energy Management	Presence		Absence	
	Fr	%	Fr	%
The organization designs business plans to improve energy consumption.	25	80.65	6	19.35
The Institution has internal policies for the rational use of energy.	25	80.65	6	19.35
The IPS foresees the use of efficient technologies (equipment, tools, and devices) that allow the reduction of costs in energy consumption in the different operational processes.	25	80.65	6	19.35
In the organization, there are mechanisms (indicators) to control energy consumption.	20	64.52	11	35.48

Source: Authors' design

About Environmental Responsibility, the results presented in Table 2 show that the largest contingent of the health institutions under study (80.65%) formulate objectives linked to the environmental impact of their operations, and likewise, 77.42% of organizations denote the presence in the development of strategic management processes (formulation, execution, and evaluation of actions that will allow them to achieve the objectives related to environmental impact).

Likewise, 77.42% of the organizations consulted indicate through what their managers have expressed that they are committed, as expressed in their management philosophy, to the environment by promoting rational energy consumption (Table 2). Hence, according to the percentages described, we agree with the statements of [Zapata-Garza, et al \(2018\)](#) who affirm that to achieve transcendence to eco-efficient responsibility, the company will surely require adopting environmental sustainability values.

Table 2: Data on Social Responsibility.

Environmental responsibility	Presence		Absence	
	Fr	%	Fr	%
The organization establishes within its strategic management performance objectives linked to environmental impact.	25	80.65	6	19.35
Within the management of the IPS, Environmental Responsibility strategies are formulated, executed, and evaluated.	24	77.42	7	22.58
The organization's management philosophy shows its environmental commitment in terms of rational energy consumption.	24	77.42	7	22.58

Source: Authors' design

In correspondence with the results presented in this section of the work, it can be inferred that the majority of the organizations under study try to incorporate, from practice, a pattern or behavior of organizational performance oriented towards eco-efficiency, which according to [González et al. \(2014\)](#) and [Zapata-Garza, et al \(2018\)](#) is a philosophy

of business action that allows evaluating the economic and environmental performance of an organization, through the determination of efficiency levels in the creation of value and the rational use of resources.

According to recent insights from the World Business Council for Sustainable Development (WBCSD, 2024), eco-efficiency in business remains pivotal to sustainable transformation, encompassing three main dimensions. First, the reduction of resource consumption focuses on minimizing energy, material, water, and land use, while promoting recycling and enhancing product durability. Second, the reduction of environmental impact emphasizes minimizing air emissions, water discharges, and waste, along with curtailing the spread of toxic substances, thereby supporting the sustainable use of renewable resources. Finally, enhancing product or service value aims to provide greater benefits to customers (such as functionality, flexibility, and durability) that satisfy needs with fewer materials and resources. This holistic approach to eco-efficiency reinforces WBCSD's commitment to achieving a sustainable world by 2050, aligning corporate strategies with environmental stewardship and social responsibility (WBCSD, 2024).

Under the previous approaches, a set of strategic options is presented below that will allow the organizations under study to improve their performance in terms of energy use, and consequently, will have a favorable impact on the practices and actions to the protection of the environment that they carry out.

4. Strategic Proposal supported by Energy Management and Environmental Responsibility of the IPS

Sustainability Strategy: According to [Dos Santos & Jabbour \(2013\)](#), health sector organizations as main providers of medical care can minimize the negative effects of their activities on the environment by applying the concept of sustainability through the following actions 1) Execution of green construction projects; 2) Improved energy efficiency; and 3) Implementation of environmental management systems, which are based on the establishment of a set of requirements for their execution, maintenance and continuous improvement of processes with the least investment of resources, in the shortest time and with the greatest effectiveness.

Strategy for Forming Work Teams with Environmental Awareness: As proposed by [Soo Wee & Quazi \(2005\)](#), the creation of green teams is necessary for the implementation of environmental projects that want to be developed in any type of organizations. To achieve this, it is essential to create and maintain ecological awareness in the employees of the institutions; However, the main difficulty of this type of strategy is maintaining the consciousness of the workers since as time passes, it experiences a common relaxation. Employee awareness is the main obstacle in adopting green practices. In this sense, the continuous reinforcement in workers of the organization's commitment to the environment and ecological problems constitutes a success factor for organizations ([Dos Santos & Jabbour 2013](#)).

Green Hospital Strategy: According to [Azmal et al. \(2014\)](#) and [Gil Morales, et al., \(2019\)](#) A green and healthy hospital is a healthcare facility that fosters well-being by consistently minimizing its environmental footprint, with the ultimate goal of eliminating its role in exacerbating health problems. A green and healthy hospital recognizes the relationship between human health and the environment, and demonstrates this through its management, strategy and operations. Green hospitals link local needs, environmental actions, and primary prevention methods through active participation in community and environmental health, health justice, and the green economy. Among the most important measures that hospital institutions must take to achieve this qualification are efficient use of energy, protection of the organization's resources, eliminating harmful factors, recycling, and making use of hospital items and goods that can be reused.

Strategy for Adoption of Green Management Practices: The adoption of green management practices falls into the main critical categories of success factors presented by [Zutshi, and Sohal \(2004\)](#), and can be used in any organization, regardless of its size, nature commercial or sector. In advanced green management practices focused on energy efficiency, the development of a plan for the rational use of energy stands out (for example: the replacement of light bulbs, and correct use of the air conditioning device, among others).

In correspondence with the strategy, [Sanz-Calcedo et al. \(2011\)](#) propose the adoption of the following ecological management actions to achieve greater efficiency in the different processes that are developed in institutions in the health sector: 1) Lighting Systems, 2) Air Conditioning Systems, 3) Use of Renewable Energy, 4) Internal management. Additionally, this work includes 5) Efficient Operation of Motors and Biomedical Equipment:

Lighting Systems: luminaires are one of the most used elements in health sector facilities; although there are cases in which they are not well distributed or sized for said spaces. In this sense, some of the considerations to consider when intervening to achieve sustainable energy savings are proposed below 1) Define and check the lighting levels by area so that the areas where there is excess lighting. 2) Install low-consumption lamps or implement the use of LEDs. 3) Make the most of the lighting of spaces with natural light. 4) Use light colors on the walls since these can reflect up to 80% of the incident light. 5) Design electrical circuits that allow the separation of operating sectors following the proximity of the luminaires with natural light inputs. 6) Incorporate elements of automatic on and off the luminaires, using occupancy detectors or timers. 7) Increase lamp maintenance to eliminate dirt that minimizes their performance.

Air Conditioning Systems: in warm climates such as that of the Atlantic Coast (Barranquilla), air conditioning is essential for the well-being of the members that make up a hospital entity, either as patients or as members of the institution, hence it must be carried out. a large investment to guarantee the temperature levels necessary for this type of organization. The purpose is to optimize the required resources, through the implementation of the following measures: 1) Define the areas that can be sectored to make the air conditioning systems independent. 2) Use thermostats that facilitate temperature regulation of air conditioning systems. 3) Consider insulating roofs and covers and sealing doors and windows. 4) Installation of double windows with insulation and the use of solar radiation protection on the glass. 5) Use efficient air conditioning technologies that maximize performance with minimal energy consumption. 6) Incorporate intelligent control systems that allow temperature changes to be programmed about variations in the outside climate. 7) Ensure timely and frequent maintenance of thermostats and air conditioning equipment. 8) Certify the good condition of the insulation in the pipes and ducts, to avoid air leaks.

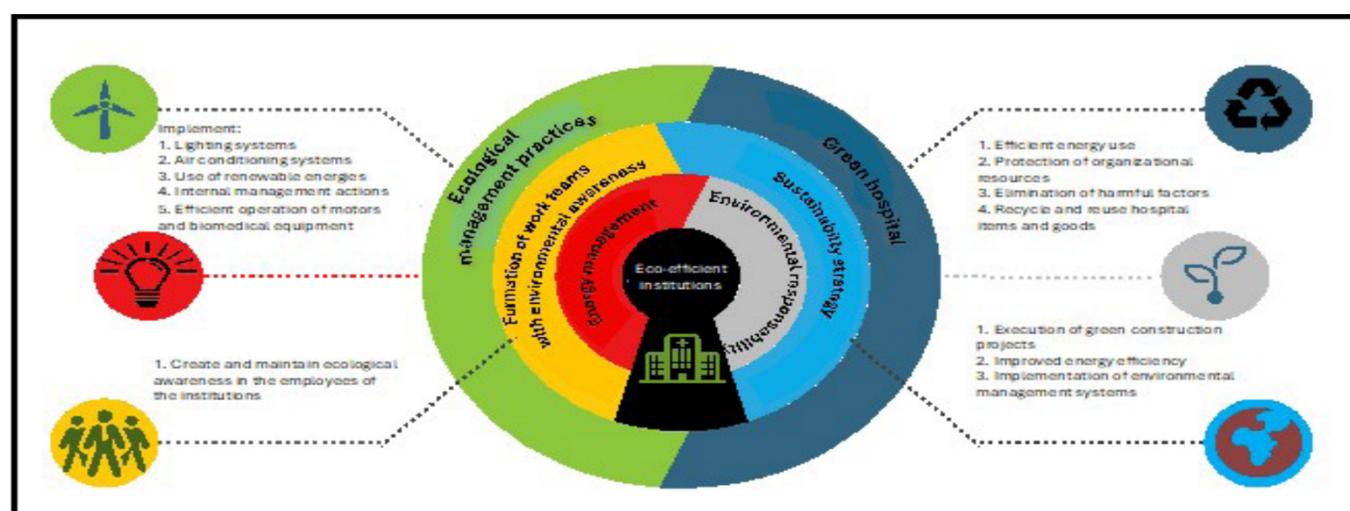
Use of Renewable Energy: the replacement of the use of conventional energy with renewable energy, since the latter, are more profitable in the medium and long term than traditional energy and are intrinsically associated with the concept of environmental sustainability (Novoa et al., 2020). In this sense, the use of photovoltaic solar energy is proposed, this is one of the types of alternative energy most used in the construction of sustainable buildings, given that its space and infrastructure requirements are minimal compared to other options. An autonomous photovoltaic system is responsible for converting energy from the sun into electrical energy, supplying it to a storage device that allows it to be used at any time of the day. Taking this into account, it is necessary to know expert personnel, not only to properly size and design the system but also to ensure its conservation and maintenance, since according to the nature of the activities carried out in a building and of the space available for its installation, so planning adjusted to its conditions must be carried out.

Internal Management Actions: although the use of renewable energies and the efficient use of energy-consuming equipment become the focus of intervention in an energy-saving project, its users are a fundamental piece to ensure their proper functioning. In this way, it is important to invest efforts in training the personnel involved and in promoting awareness about rational energy consumption, encouraging interest in information, as well as the exercise of sustainable practices.

Efficient Operation of Motors and Biomedical Equipment: the proper functioning of the equipment used in the IPS is of great importance for the achievement of institutional objectives, since the survival of their patients may depend on them, however, this does not mean that set aside your attention and avoid your intervention to save energy. On the contrary, like all equipment dependent on electricity, these are susceptible to improvements in their operation, which leads to an increase in their performance without incurring energy losses. In this sense, it is proposed: 1) Develop timely preventive maintenance with the frequency proposed by the equipment manufacturer. 2) Carry out follow-ups to monitor the efficiency of the engines, especially those of larger size and great relevance for the institution. 3) Keep the control panels calibrated. 4) Prepare diagrams of electrical systems, as well as control tables with design points and expected operation.

As a contribution to this research, [Figure 1](#) is presented, which includes the strategic proposal described above and allows us to illustrate how its axis focuses on achieving the objective of converting these health entities into eco-efficient organizations in the context of management energy and corporate environmental responsibility of the IPS.

Fig.1: Strategic Proposal supported by Energy Management and Environmental Responsibility of the IPS.



Source: Authors' design.

5. Conclusions

The study analyzes energy management and environmental responsibility in health institutions in Barranquilla, Colombia. It was found that 80.65% of organizations have plans to improve energy consumption, and a similar percentage implements policies for the efficient use of energy. In addition, 80.65% use efficient technologies and 64.52% have indicators to control energy consumption. Regarding environmental responsibility, 80.65% establish environmental objectives, and 77.42% are committed to the rational use of energy.

The research carried out shows that the Health Provider Institutions (IPS) of Barranquilla – Colombia has enormous potential to become “Eco-efficient Organizations”. However, to achieve this purpose, they must overcome the limitations that they may have in the context of energy management and environmental responsibility that they carry out through the implementation of some strategic actions that derive from this study, namely: Sustainability Strategy, Formation of Work Teams with Environmental Awareness, Green Hospital and Adoption of Ecological Management Practices.

The implementation of this strategic proposal will allow the health institutions object of this study to transcend to achieve the preservation of the environment from the importance of the activity they carry out and with the resources that the same organizations possess.

6. Future perspectives

Looking ahead, the trajectory of energy management within the health sector reveals a pivotal shift towards sustainability and efficiency. With the current dominant energy model heavily reliant on fossil fuels, it becomes imperative to transition towards more sustainable practices. This necessitates a comprehensive approach encompassing not only energy savings and increased efficiency but also a fundamental restructuring of organizational processes. Moving forward, the integration of advanced technologies, coupled with meticulous management practices, will be essential for optimizing energy usage within health service provider institutions (IPS). As global initiatives continue to emphasize environmental stewardship and sustainability, the health sector must evolve to align with these objectives. The emergence of “green hospitals” underscores this evolution, emphasizing the imperative for health organizations to actively engage in environmental conservation efforts. Furthermore, as corporations within the health sector embrace energy efficiency initiatives, they concurrently embrace environmental responsibility as a core tenet of corporate ethics. This paradigm shift towards sustainability not only highlights the intrinsic link between organizational actions and environmental well-being but also means a broader societal commitment towards a more sustainable future.

Declaration of competing interests

The authors affirm that there are no conflicts of interest to disclose.

Author contributions

Hugo Hernández Palma: Original draft preparation; Andrea Liliana: Methodology, Data curation y Dairo J. Novoa: Writing and review & editing.

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