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**FINANCING MECHANISMS FOR CLIMATE
NEUTRALITY: A SYSTEMATIC REVIEW**

Project prior to obtaining a Bachelor's Degree in International
Studies

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To my wonderful mother and beloved grandmother,
whose patience, dedication, and countless contributions
have shaped me both personally and professionally.

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FINANCING MECHANISMS FOR CLIMATE NEUTRALITY: A SYSTEMATIC REVIEW

Abstract

Climate Change is a phenomenon that, as time goes by, becomes more and more complicated due to all the harmful effects it causes at the environmental level, greenhouse gases are therefore one of the main problems for Climate Change. Faced with this situation, climate neutrality is a long-term objective that seeks to solve the problems caused, seeking environmental relief that impacts the environment, so that it is conducive and appropriate. This is where various resource channeling instruments seek to solve by raising funds to generate improvements in various sustainable sectors that seek to reduce climate change and achieve a balance or a reduction of the impact generated, therefore, these act as a tool for actions aimed at Climate Neutrality.

Keywords: Climate Neutrality, Financing, Climate Change, Financial Resources, Environment.

MECANISMOS DE FINANCIAMIENTO PARA LA NEUTRALIDAD CLIMÁTICA: REVISIÓN SISTEMÁTICA

Resumen

El cambio climático es un fenómeno que a medida que transcurre el tiempo, se complica cada vez más debido a los efectos nocivos que se causan a nivel mundial. Por tanto, los gases de efecto invernadero son por ende, de los principales problemas para el cambio climático, ante esta situación, se requiere una neutralidad climática global, por lo cual, los instrumentos financieros juegan un rol indispensable para la canalización de recursos enfocados en mejoras en los diversos sectores que busquen reducir el cambio climático y lograr un equilibrio o su vez una reducción del impacto generado, por ende, estos actúan como una herramienta, destinada a acciones orientadas a la neutralidad climática. Para la investigación se ha utilizado una metodología PRISMA para que la información redactada se encuentre ordenada, en relación al tiempo y de calidad. A la vez, se ha evidenciado que la mayor parte de los resultados no presentan tasa, el sector con mayor índice de financiación es el público y los proyectos con mayor relevancia están direccionados a la energía. Por consecuencia, la neutralidad climática busca sostener los criterios medioambientales óptimos en favor de las medidas financieras encaminadas a los proyectos más relevantes en relación al sector

Palabras clave: Neutralidad Climática, Financiación, Cambio Climático, Recursos Financieros, Medio Ambiente.

Financing Mechanisms for Climate Neutrality: A Systematic Review

1. Introduction

Due to the major adverse effects of climate change and the magnitude of growth in emissions from all sectors, all regions and countries of the world need to achieve climate neutrality. Given the above, (Cristina Crespo Garay, n.d.) provides that climate neutrality seeks to ensure that net GHG emissions are balanced, proportional, or lower than those eliminated through climate action. At the same time, according to Lou et al. (2022) we live in a world affected by climate change, which has finite resources and requires global efforts to achieve a sustainable, low-carbon future. Likewise, the United Nations Development Programme (2023) mentions that climate change is identified as the most relevant challenge defining human development in the present generation, and in turn represents a significant threat to international efforts, therefore, current climate models project a global temperature increase between 1.4 and 5.8 degrees Celsius in the period 1990 to 2100, these projections are based on assumptions related to factors such as population growth and technological progress. In addition, the Intergovernmental Panel on Climate Change (2021) points out that climate change is undeniable and continues to advance, due to global greenhouse gas emissions that are currently at their highest level in the recorded history of mankind. It is here where it becomes essential to channel resources that allow feasibility around zero emissions, therefore, the various financing mechanisms according to the project to be carried out mean the guide to follow to achieve a sustainable and sustainable relationship with the environment and the planet. In addition, it is important to point out that these projects will also mitigate the damage caused previously and lay a fundamental foundation for the present and future of the strategic sectors in favor of nature and its care.

On the other hand, as the projects and proposals in the various sectors around the world are still highly polluting, ignoring the latent circumstances on earth, setting climate neutrality as an objective is a fundamental task of countries to combat damage and provide disastrous situations for all living beings and the ecosystem in general. However, if environmentally unfriendly projects continue to be articulated, the planetary integrity and the risk of life of all existing beings will be put at risk.

In this paper, we take a closer look at what climate neutrality really means and how it's being understood around the world. We explore the different financial tools available to support projects that align with neutrality goals and see how these have been put into practice. Along the way, we highlight the key players involved and offer a detailed, down-to-earth explanation to make this important topic easier to grasp. It should be noted that the methodology implemented was a PRISMA literature review that facilitates in an orderly, punctual, and quality criterion the veracity of authors presents and sources found for the subject matter worked on.

To wrap things up, the paper is laid out in a clear and organized way. It starts with a section that dives into the theoretical framework and state of the art, explaining the key concepts, the criteria involved, and the most trustworthy sources behind them. After that, it walks you through the methodology used for the proposed work. In addition to this, the most important results of the experiences collected in the form of a table and a brief explanation followed by the same, then the discussion by the authors about the results, characteristics around the climate neutrality and finally the conclusion at the end of this article that summarizes and integrates the author's point of view indicating their criteria and aspects found around the development of the same.

1.1 Objectives

1. To determine the criteria that support global Climate Neutrality.
2. To identify the financing instruments related to Climate Neutrality.

1.2 Theoretical Framework and Literature Review

Climate neutrality refers to the idea that net greenhouse gas emissions are balanced and are equal to, or lower than, those removed through the planet's natural absorption. In other words, it means that emissions are reduced through climate action (United Nations Climate Change, n.d.). Furthermore, it not only focuses on carbon dioxide but also on a range of harmful gases such as nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, among others. That is, all the harmful substances that humans, through their activities, are releasing into the atmosphere (National Geographic & Cristina Crespo Garay, n.d.). In turn, Agudelo-Herra (2023) mentions that climate neutrality is nothing more than an inquiry into reducing

the net emissions of greenhouse gases (GHG). Likewise, for Touza Lara & Escribano Francés (2022), climate neutrality refers to an economy based on net-zero greenhouse gas emissions.

In order to achieve climate neutrality, financing sources are necessary. According to the United Nations Development Programme – UNDP Climate Promise (2023) Financing for Climate Neutrality refers to the financial resources and instruments used to support the adoption of climate change measures. Financing is essential address climate change due to the large-scale investments needed to achieve the transition to a low-carbon global economy, as well as to help societies increase their resilience and adapt to the effects of climate change.

According to ParlAmericas (2019), the following financing instruments are the most commonly used to mobilize financial resources for projects aimed at climate neutrality: 1) **Climate/green bonds**: similar to a loan, used to finance projects addressing climate change, where the debt must be repaid within a specific period and at a determined interest rate. 2) **Co-financing**: joint financing between two parties working together to fund a climate change activity. 3) **Concessional loans**: loans characterized by longer repayment terms and lower interest rates. 4) **Debt swaps**: the sale of debt in foreign currency to an investor, or debt forgiveness by the creditor, in exchange for the debt relief to be invested in activities related to climate neutrality. 5) **Equity**: the residual value between the value of assets and the value of liabilities of an owned asset. 6) **Grants**: a sum of money given for activities related to climate neutrality that does not need to be repaid. 7) **Guarantee**: a promise to pay another's debt related to a climate neutrality activity in case of default. 8) **Insurance/risk management**: risk transfer mechanisms that provide resources for climate-related disasters and transfer the burden of losses to capital market investors. 9) **Non-concessional loan**: loans granted at market interest rates for activities related to climate neutrality. 10) **Payment for ecosystem services**: a formal financial transaction between two parties in which one pays for the ecosystem services provided by the other entity. It involves a commitment to support the conservation and expansion of ecosystems to continue supporting and obtaining the benefits/services that an ecosystem provides, focused on climate neutrality. 11) **Result-based climate financing**: funds disbursed by the donor or investor after the agreed emission reduction results are achieved and verified.

Therefore, to achieve climate neutrality, it is essential to strategically channel the key financing instruments that will emphasize the expected outcomes in environmental improvement.

1.2.1 Experience Across Europe

In studies based on business and financial sector scenarios toward climate neutrality, it is noted that the transition to net-zero emissions involves a series of key interrelated factors that work together with the aim of being environmentally friendly. Specifically, the European Union has implemented environmentally sustainable practices, as well as regulations and policies aimed at achieving climate neutrality; however, certain gaps remain. In terms of financing and economic models, there are transitional risks due to the high costs of clean technologies, as well as challenges in identifying and implementing projects that use eco-friendly technologies. There are also political and regulatory conditions that do not position climate neutrality as a fundamental axis of productive, commercial, or business models, nor as a core of consensual and decisive transition plans toward net-zero emissions. In Germany, there are climate change-related institutes working toward making the country climate neutral by 2045. Following the approval of the Federal Climate Change Act, eight climate neutrality scenarios were analyzed in Germany to identify key indicators for measuring the transition – such as regulatory standardization, transition planning, key technologies, energy demand, and carbon intensity. Consequently, in a key study that helps understand the aforementioned factors, it is shown that in Germany's construction sector, companies report the proportion of heating provided by renewable energy sources in each heatable housing unit. These homes must provide heating through renewable sources in order to achieve climate neutrality by 2045. In addition, the major challenges on the path to neutrality are categorized into: Transition risks: focusing on political and legal frameworks, market conditions, and economic risks. Physical Risks: including acute physical risks (e.g. damage to real state) and chronic physical risks (e.g. limited resource availability due to droughts). Finally, companies are setting climate neutrality targets to be achieved before 2045. Therefore, transition plans and reports, together with optimal financial measures, are critically important as instruments of comprehensive transparency in the management of portfolios and individual loans. These act as financing mechanisms for decarbonization and climate neutrality that also anticipate and mitigate financial risks (Ballesteros et al., 2023; Battiston et al., 2021; de Gooyert et al., 2024; European Parliament and the Council of the European Union, 2021; Ioshchikhes et al., 2024).

For this reason, within the construction sector, using both quantitative (surveys, data, assessments) and qualitative (key information) methodologies based on regional financial points, energy efficiency is highlighted as a fundamental pillar in the framework for achieving climate neutrality. This is due to its critical role in enabling structurally sustainable operations. Consequently, the analysis focuses on the urban residential sector

and general housing programs. Therefore, energy financing plans are required to meet specific standards and undergo evaluations in order for both municipalities and European regions to be eligible for grants. Among the evaluated programs, 60% provide financial support and subsidies, while 45% require structural improvements aimed at generating a positive environmental impact. In addition, governance and policies based on energy efficiency must be designed to avoid negative environmental impacts while offering financial incentives and support mechanisms (Della Valle et al., 2023; Economidou et al., 2024; Economidou & Bertoldi, 2014; Kılış et al., 2024; Nucci, 2024; Ulpiani & Vettters, 2023).

On the other hand, according to Stoica et al. (2022), through a methodology based on the search for relevant and algorithmic information within the automotive sector, their study on the European Green Deal in the transportation industry examines how, in order to achieve climate neutrality, Europe sought to emphasize a substantial recovery in response to environmental crises and the consequences of various types of disasters for emission reduction. This led to the creation of the European Green Deal (EGD), aimed at reaching climate neutrality by 2050. Transportation is one of the most polluting sectors due to its high rate of CO₂ emissions into the Earth's atmosphere. Among the case studies, Germany is noted for its goal of reducing transport-related emissions by 40%, alongside financing a transition from fossil fuel combustion to liquid hydrogen alternatives. Meanwhile, Sweden identifies transportation as the third-largest source of pollution, and thus promotes sustainable transportation standards through electric combustion. Romania is implementing policies that encourage transitions to hybrid and electric vehicles through nationally funded subsidies. To achieve emission reductions, companies within the European automotive sector – particularly the RNM alliance (Renault, Nissan, Mitsubishi) – have emphasized financing directed toward the development of environmentally friendly technologies, software, and engines to achieve neutrality by 2050. The software implemented monitors variations in time and location of the environmental impact of vehicles in order to obtain metrics that address the identified problems and to expand this sustainable innovation globally. Through the EGD and €600 million in funding for the automotive sector, companies are aligning their production processes environmental care goals, thereby reducing their carbon footprint and steering their operations toward climate neutrality. As a result, climate neutrality entails a set of policies, plans, and initiatives that require both countries and companies – particularly within the transportation sector – to adopt green environmental solutions through appropriate programs, technologies, and transitional strategies aimed at net-zero emissions.

Regarding the energy sector, according to Lovas (2022) and Salazar Navarro (2024), the uncertainty within the European Union concerning the political and legal structuring required to achieve climate neutrality demands concrete actions aimed at synthesizing long-term sustainability. From a fiscal and financing perspective, sovereign green bonds are introduced specifically for green projects and public green debt. Through the Green Taxonomy linked to green bonds, the pressing need to contribute to environmental preservation is emphasized – even if on a small scale, it allows for gradual progress over time. In line with this, the study on Spain highlights the country's ambition to become the European hub for green projects as part of its emission reduction efforts. However, its regulatory framework and sustainability foundations remain limited. Therefore, Spain is expected to focus over time on initiatives that promote broader impact and long-term significance in future contexts. Additionally, with regard to the transformation of the energy system within the European Union, emphasis is placed on the use of natural resources for energy production. Consequently, to achieve climate neutrality, the adoption of renewable resources and the financing of zero-emission projects will be essential – supported by integrated policy frameworks that stress the overarching 2050 goal (Dębkowska et al., 2022; Jaroń & Borucka, 2024a; Noailly & Smeets, 2022). Furthermore, in the context of energy transition and economic transformation toward decarbonization and sustainable financing in Hungary, current projects are focused on significantly and efficiently contributing to the Hungarian economy's climate neutrality objectives. The transition aims to strengthen macroeconomic prospects and reduce energy imports by implementing sustainable national energy projects – thus enhancing Hungary's overall energy security. The financing process requires billions in investment to advance clean energy goals, which are a high priority given the country's wartime context. As a result, the need to secure both public and private funding becomes critical. To this end, strategies and policies have been formulated based on an open economy model that benefits the environment, in which banks and financial institutions are expected to play an intermediary role without compromising the climate neutrality objective (Lonescu et al., 2024; Kandrás, 2023; McKinsey & Company, 2022; Pahle et al., 2025).

Regarding the agricultural sector, studies related to climate neutrality based on both quantitative and qualitative analyses concerning carbon emissions synthesize the following. The agricultural sector faces a major discrepancy: on one hand, it is one of the largest contributors to global pollution through emissions; on the other, it is also a significant recipient of environmental contamination. The research shows that the global convergence toward decarbonization of the agricultural sector is a fundamental pillar in achieving climate neutrality. This has led to the creation of important institutions and organizations that promote a neutral

environment through various initiatives aimed at developing green financial mechanisms and projects within the sector. Analytically, a beta convergence study reveals that the global agricultural economy tends to behave inertially and with limited regulation in terms of climate neutrality, raising concerns about the feasibility of reaching net-zero emissions by 2050. In contrast, the European Union's agricultural economy demonstrates an accelerated and more regulated decarbonization scenario, showing a more evident convergent movement supported by regulatory frameworks and articulated policies that promote a more robust current toward climate change mitigation. Therefore, beta convergence models identify a group of high-emission countries – including India, Indonesia, Brazil, Pakistan, and Russia – that significantly contribute to divergence, as they show limited reductions in agricultural sector emissions. Additionally, China has succeeded in reducing its emissions and contributing to global convergence. These contrasts illustrate that a country's starting point in emission reduction matters less than its national economy's capacity to decarbonize in the context of climate neutrality. Thus, climate convergence in the agricultural sector depends on global agreements, digitalization, technological cooperation, and green financing. Digitalization enhances efficiency and sustainability; however, economic, technological, and regulatory inequalities and barriers persist. A common strategy and general solutions will enable more significant outcomes (Goecke & Hütther, 2016; Krysovatty et al., 2024; Leahy et al., 2020; Umar et al., 2023; J. Zhao et al., 2023).

1.2.2 Experience Across Asia

Japan, as part of its strategy toward low emissions, has adopted hydrogen as a sustainable and clean energy resource within its energy policies and strategies, as a means of protecting the environment. The country stands as a global leader in technological innovation in this area. Consequently, Japan has enacted financing measures aimed at the development of hydrogen-based technologies to provide highly sustainable solutions in pursuit of achieving climate neutrality by 2050 (Jaroń & Borucka, 2024b; Ministerio de Economía, 2014).

On the other hand, China, in its goal of decarbonizing to steer initiatives toward climate neutrality, has been working on an energy transition through innovation in clean technologies. Large industries manufacturing plants have begun aligning with this effort; however, the government has also taken the lead in developing governance structures and policies grounded in principles and practices focused on balancing emissions. As a result, China has unlocked significant potential and attention by leveraging technological resources and implementing funding measures for Artificial Intelligence (AI) projects, deploying its full analytical capacity across 30 provinces and municipalities to gather the maximum amount of data possible. However, the outcomes of AI usage present a dilemma. On one hand, AI can increase efficiency and energy savings, accelerate the transition to green energy, and introduce new paradigms for reducing urban pollution while also providing economic benefits. On the other hand, deploying AI in the industrial sector could lead to increased production, thereby raising energy consumption and CO₂ emissions. Therefore, to ensure true efficiency, China will need to build solid information frameworks that clarify the overall landscape, enabling a comprehensive and effective transition (Brahmi et al., 2023; Jaroń & Borucka, 2024b; Yang et al., 2023; Zhang et al., 2023; K. Zhao et al., 2024).

Consequently, through a methodology based on six evaluation scenarios for climate neutrality, the importance of focal points enabling the reduction of emissions is emphasized. The study focused on this region of the world concludes decisively that climate action must follow three fundamental aspects: innovation, financing, and environmental performance. For the business production sector, alignment with these criteria is essential – criteria that are based on achieving significant environmental outcomes in terms of reducing the climate footprint, combined with economic returns on assets for companies investing in carbon footprint mitigation and reduction projects. Moreover, this must go hand in hand with innovation and efforts in technological development that will enable the region to meet its goal of achieving net-zero (Backes & Traverso, 2022; Fichter et al., 2023; Gebara & Laurent, 2023; Vaitiekuniene et al., 2024).

1.2.3. Experience Across Africa

According to a qualitative and quantitative analysis based on relevant information and evaluated through a set of criteria regarding the application of sustainability taxonomies to redirect capital flows in the context of South Africa, gaps and inconsistencies have been identified in the region due to a lack of knowledge and implementation of such frameworks in projects that promote sustainability and green growth. Therefore, the collected studies emphasize the impact and importance of properly registering these frameworks. As a result, governance will need to provide clarity and guidance on the use of taxonomy. The ideal scenario would be financial markets, where the diversity of instruments – such as green bonds listed on stock exchanges – makes investment attractive when focused on viable and sustainable projects. To achieve this, a coherent approach among all relevant governance actors is required. International forums such as the Sustainable Banking and Finance Networks (SBFN), sponsored by the IFC, and the G20 Sustainable Finance Working Group, facilitate cross-country exchanges on best practices in taxonomy implementation. Therefore, it becomes essential to

promote dissemination and awareness, as well as to introduce tax incentives for conscious investments, which will be crucial for adoption. On the other hand, taxonomy helps retain foreign capital and may also simplify development by drawing inspiration from the European Union's taxonomy framework (Ameli et al., 2020; Baker et al., 2014; Christophers, 2019; Cunha et al., 2021; Dumrose et al., 2022; Dusík & Bond, 2022; Hilbrich et al., 2024).

1.2.4. Experience Across Latin America

The digitalization model aimed at climate neutrality, through quantitative and qualitative analysis, highlights the importance of this objective for a sustainable economy. Digital infrastructure enhances ecological performance and provides solutions for both the business production sector and the governmental sphere. However, the transformation requires international financial support, particularly through green financing, which is essential for climate-related projects in developing countries. Climate funds, both public and private, foster innovation and sustainable development. The Green Climate Fund leads the equitable financing of sustainable projects, underlining the importance of geographical location and the role of donor entities. The European Union and the United States account for 67% of green projects and contribute 85% of global funding, while local initiatives are emerging to meet specific needs. The climate portfolio is distributed across four areas: Digitalization for Climate (35%), Financial and Business Capacity (44%), Community Empowerment (7%), and Ecosystem Development (14%). Digitalization is key to balancing emissions, providing digital tools that optimize business efficiency and ecological governance. Consequently, it facilitates access to climate information, enhances participation, and strengthens sustainable initiatives. With innovative financial operational mechanisms, it supports the green transition of companies, especially SMEs and micro-enterprises. To consolidate this model, it is crucial to strengthen digital integration, implement data-driven climate governance, and promote intersectoral cooperation, thereby ensuring resilient ecosystems and a sustainable economy (Caldwell & Larsen, 2021; Ke et al., 2022; Leal-Arcas et al., 2023; Maksymova, 2024).

Thus, Estrada-Chavira (2022) mentioned that the company '*Plataforma Mexicana de Carbono*' began its operational activities in 2013. This company, a subsidiary of the Mexican Stock Exchange Group *MéxiCO2*, created an environmental market through social and financial instruments. For example, Clean Energy Certificates (CELs), carbon credits, and the development of green, social, and sustainable bonds, which are significant for Mexico to meet its emissions reduction goals and fight climate change. As a result, *MéxiCO2* offers the market greenhouse gas reductions, carbon credit issuances, and certificates evaluated using international methods or protocols, such as the Gold Standard (GS), Verified Carbon Standard (VCS), Plan Vivo, and the Climate Action Reserve (CAR) from California, among others.

1.2.5. Experience Across the Rest of the Americas

Within the framework for achieving climate neutrality, the United States has focused on financing environmentally friendly projects, with hydrogen as a means of clean energy production. Major corporations and the American productive sector view this as a highly opportune solution to advance toward sustainability goals and emissions reduction. In terms of regulation and policy, the U.S. Department of Energy has developed a program called 'Hydrogen Shot,' which centers on the use of this non-polluting energy and aims to reduce its implementation costs. Additionally, another key step was the DOE's publication of the 'Foundational Science for Carbon-Neutral Hydrogen Technologies Program,' which highlights efficient water electrolysis for hydrogen production. These initiatives also project a growing U.S. demand for clean hydrogen, estimated to reach 10 million tons by 2030, 20 million by 2040, and 50 million by 2050 (Jaroń & Borucka, 2024a; Khabarov et al., 2019; Wang et al., 2024).

2. Methodology

For the present research, the applied methodology was a systematic literature review following the PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). This approach is characterized by its transparent documentation of the rationale behind the review and its results, following a series of steps that enable the identification, selection, evaluation, and synthesis of studies to facilitate their integration into the present work Page et al. (2021). Therefore, the articles included in this review were framed within a time window from 2018 to 2024, ensuring the consistency and relevance of the information presented.

Stage 1. Review of Articles

As a first step, a review of articles was carried out using reliable information sources such as EBSCO, Web of Science, and Scopus. Initially, two search criteria were applied: 'climate neutrality,' and 'financing' in order to obtain the most accurate and relevant search results related to the topic of interest. The preliminary results were as follows: 236 articles from EBSCO, 109 articles from Web of Science, and 146 articles from

Scopus. It is worth noting that the research initially included only two databases – EBSCO and Web of Science – however, due to the limited number of results related to Latin America, Scopus was added in order to provide broader and more comprehensive coverage of information from the Latin American region.

Stage 2. Selection of Articles

Within the three databases selected for this study – EBSCO, Web of Science, and Scopus – the following results were obtained in a systematic and organized manner by incorporating additional information filtering criteria: time window, type of document (articles), and open access availability. Based on these filters, the following results were obtained: 236 articles in EBSCO, 68 articles in Web of Science, and 94 articles in Scopus. Although the selected time window for the articles ranged from 2018 to 2024, three articles published prior to this period were included due to the high quality and relevance of their content, which provided valuable insights to complement more recent studies on the topic. Additionally, the keywords used in the search process were: climate neutrality and financing. Finally, the articles selected for this research were published in both English and Spanish.

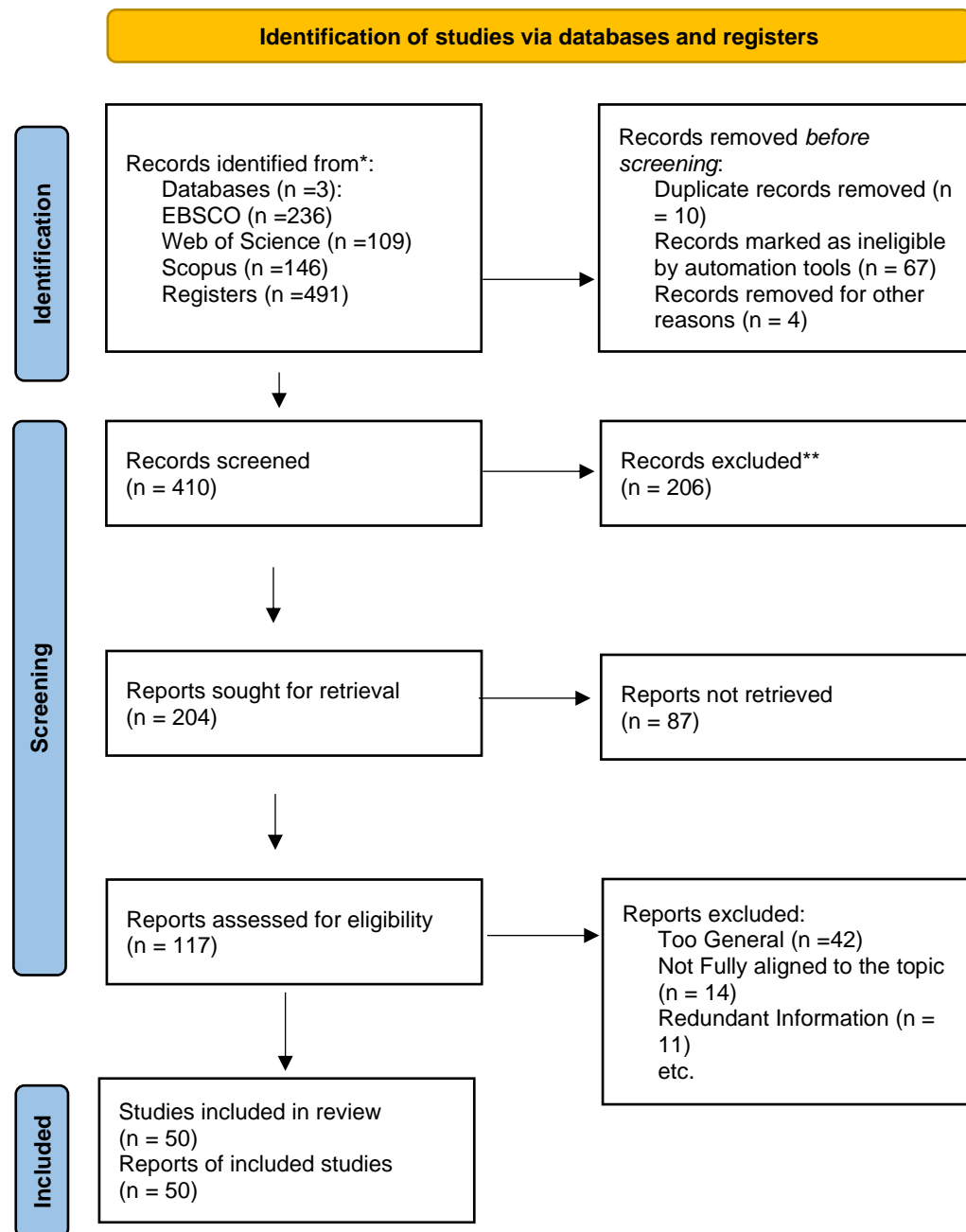
Stage 3. Limitation of Articles and Exclusion Criteria

Among the limitations encountered in the article selection process, 10 duplicates were identified, 67 articles were excluded for lacking thematic eligibility, and 4 additional articles were found not to be directly related to the core topics of climate neutrality and financing. Furthermore, 206 articles were removed after an in-depth reading, as they were not essential to the subject due to a lack of relevant or precise information. Additionally, 87 documents were excluded for more general reasons, such as redundancy, being outside the established time frame, or lacking specific information relevant to the area under investigation.

Stage 4. Article Eligibility

Finally, through the aforementioned selection processes, a total of 50 articles were identified and utilized for the development of the present research.

Figure 1
Prisma Flow Diagram



Resource: Adapted from Page et al. 2021

3. Results

As the pathways of Climate Neutrality Financing Mechanisms have been addressed, the following results have been gathered from various regions across the globe, categorized by sectors to which contributions have been made, in order to synthesize the most concise and relevant information:

Table 1.
Results

Transportation Sector											
Financier	Amount	Destination	Project	Country	Year	Authors	Objective	Financial Instrument	Interest Rate	Deadline	Conditions
Public and Private	7 thousand dollars	Conglomerate of companies in the technological construction and mobility sector.	The Catenary-Pantograph System (PAC)	Germany and Switzerland	2022	Stoica et al	To reduce air pollution and greenhouse gases produced by the Transport sector in Europe.	Incentives and Funds to alleviate the climate issues of this century.	0%	9 years	Transition from Gas to Electric Motorizations.
Energy Sector											
Financier	Amount	Destination	Project	Country	Year	Authors	Objective	Financial Instrument	Interest Rate	Deadline	Conditions
European Union	78 thousand million dollars	Energy Fiscal Directive	Energy Fiscal Directive	European Union	2022	Lovas, D	Achieving Climate Neutrality through Proper Management of the Energy Sector.	Fund	0%	10-year extended deadline	Mandatory Economic Contribution for All State Parties. Direct incentives for private investment in the clean energy sector and favorable regulations.
Public and Private	8 thousand 890 million dollars	Public Sectors (CityHalls) and the Private Sector (Enterprises)	MNB Preferred Green Capital Requirements Program	Hungary	2020	Kandrács, C	Promote a responsible energy transition.	Green Incentives, Loans	0%	2 years	
Organization for the Development of New Energy Technologies of Japan	1 thousand 326 million dollars	Green Investment Fund	Production of Green Hydrogen	Japan	2021	Yang et al	Hydrogen production from renewable energy sources, a hydrogen energy supply chain, coupling, and the synergistic development of hydrogen energy with lignite.	Fund	0%	Partially by 2030 and net zero neutrality by 2050	Achieving three million tons annually by 2030 and twenty million tons by 2050 in reductions.
The United States Government	1 thousand million dollars	Production of Liquid Hydrogen	Hydrogen Shot Program, the goal is to reduce the cost of clean hydrogen by 80%	The USA	2023	Jaron et al	Hydrogen Shot Program, whose goal is to reduce the cost of clean hydrogen by 80%.	N/A	0%	Partially by 2030 and carbon neutrality by 2050	Ensure global leadership in key hydrogen technologies.
Financial Sector											
Financier	Amount	Destination	Project	Country	Year	Authors	Objective	Financial Instrument	Interest Rate	Deadline	Conditions
International Financial Corporation (IFC)	N/A	Direction of the International Financial Corporation (IFC)	Taxonomy for sustainable activities	South Africa	2022	Hilbrich et al	Substantially contribute to an environmental objective, not cause harm to the environmental objectives included in	Green Incentives	0%	N/A	Proper management of economic resources in the taxonomy for eco-friendly projects.

the GFT, and ensure minimum social safeguards.

Real State – Construction Sector											
Financier	Amount	Destination	Project	Country	Year	Authors	Objective	Financial Instrument	Interest Rate	Deadline	Conditions
EU Cohesion Policy Funds	26 thousand 966 million dollars	National Investment Programs in Eco-friendly Constructions	«Low Carbon Emission Economy for Energy Efficiency in Residential and Public Buildings	Estonia, Croatia, Lithuania, Luxembourg, Latvia, Malta, Romania, Slovakia	2014	Economidou et al	Investments in energy efficiency in buildings.	Fund	0%	6 years	Achieve neutrality by 2030 in the sector.
Agricultural Sector											
Financier	Amount	Destination	Project	Country	Year	Authors	Objective	Financial Instrument	Interest Rate	Deadline	Conditions
European Union	48 thousand million dollars	Purchase of resources such as unmanned aerial vehicles, milking robots, driverless tractors, automated harvesting systems, etc.	Controlled Environment Agriculture Program	European Union	2024	Krysovaty et al	Optimize performance and maintain ideal conditions for crop growth.	Not mentioned	N/A	6 years	Achieve Climate Neutrality by 2030.

Note: N/A: NOT MENTIONED

Below is a more detailed presentation of the results shown in Table 1, along with similar projects related to the sector subdivided by regions:

3.1 Detailed results related to the Transportation Sector

As shown in Table 1 in Europe, the pantograph catenary system will allow the technology-driven intelligent road networks the possibility of capturing energy through the movement of vehicles by sensors, it is worth mentioning that it does not have a financial cost due to the great importance of promoting resources in favor of climate mitigation and damage to nature. Among the smaller projects of this sector directed to climate neutrality is the RNM Alliance (Renault, Nissan, and Mitsubishi) where these automotive factories are seeking to reduce climate damage caused by the emission of gases due to the motorization used in their units, this is why, This is why the alliance aims to achieve net emissions by 2050 through a technological mechanism that allows to accurately quantify the environmental damage in multimodal transport and at the same time with a change of electrified combustion that would be implemented in new vehicles produced by the brands in more than 18 European countries and its expansion in its headquarters with presence in other continents to strengthen its proposal.

3.2 Detailed results related to the Energy Sector

The European Union has been immersed in the need to comprehensively regulate fiscal and technical management because the countries that comprise it have different points of view and individual directions that have been a factor of multiple conflicting scenarios in the energy taxonomy, therefore, as shown in Table 1 of results in favor of this sector, they seek through (Fit for 55) to achieve climate neutrality with the Climate Fund, which would eliminate this climate imbalance. Also, another result within Europe specifically in Hungary, the public sector is not solid enough to finance alone the ecological transition, so private participation is required as a means of incentive through sustainable financial products. The Central Bank (MNB) has implemented strategies such as the Green Program and the Green Monetary Strategy to encourage green loans, sustainable bonds, and ESG funds. Since 2020, state and corporate green bonds have been issued, increasing green financing.

On the Asian continent, specifically in Japan, to mitigate the harmful effects of energy capture and production, the use of electrolytic water technology to produce green hydrogen has been pursued due to the geographical advantage of being surrounded by water. This, in turn, presents a wide scale of hydrogen production technologies that are beneficial from renewable energy and large-scale electrolyzer technology developments. This facilitates its clean energy transition in favor of the nation and the world at large while not mentioning any fees. The more detailed project is shown in Table 1.

The United States has, in parallel with the Asian sector, opted for sustainable hydrogen innovations as shown in Table 1, for the energy transition. The financial instrument is not mentioned as the total investment is made by the U.S. government itself.

3.3 Detailed results related to Real State – the Construction Sector

The European Union has been hard at work focusing on economic and financial solutions that facilitate the implementation of environmentally friendly buildings, where it has created a European Commission that actively promotes energy efficiency at the regional level through its Cohesion Fund (CF) and European Regional Development Fund (ERDF). The analysis of 176 action plans with a 2030 target submitted by August 2019 by CF signatories in the EU-27, covering around 11 million inhabitants, included 1060 financial instruments targeting the building sector. These comprise instruments deployed at various levels of governance, including energy supplier regimes that are implemented at the national level in each nation. Thus, to facilitate the implementation of these actions, no interest rate is added to increase investment.

3.4 Detailed results related to the Agricultural Sector

The agricultural sector is one of the major strategic polluting sectors. Therefore, the European Union has been working with technological solutions that provide innovations that provide non-polluting improvements through sustainable projects, as shown in Table 1. In this aspect, the investment in environmentally friendly resources will serve to guarantee zero neutrality until 2030, likewise, there is no mention of the financial instrument used or the rate in the mentioned Sector.

3.5 Detailed results related to the Financial Sector

With European corporations still showing some uncertainty due to investment risk and focus on transitional environmental measures, it is mentioned that changes in operations towards cleaner actions and environmental care premiums are highly costly. In the context of using climate change scenarios at the corporate level, risk management and transition are two separate areas. Risk management examines transitional effects and changes in legislation as well as political conditions, such as prioritizing climate neutrality, on the company and how it can strengthen its resilience to them. Risk management also analyzes the physical effects of climate change, such as droughts and heat waves, on the company. In risk management, companies can use scenarios to investigate the future risks and opportunities of the transition to climate neutrality that can financially and strategically affect an industry, the company, or the business model. This makes it easier for factories to weigh investments and helps banks, investors, and financial market regulators to assess portfolios and their risks. In turn, South Africa has implemented an initiative for the proper management of the economic taxonomy linked to eco-friendly projects; no rate or timeframe is mentioned.

It is important to mention that in Latin America, there are no relevant results in question due to the urgency of information and at the same time of implementation. Therefore, in order to present quality results, the most clear and important has been exposed.

4. Discussion

Something that should be highlighted in relation to the conglomerate of results in Table 1, is the high costs involved in the transitions in each of the sectors in favor of climate neutrality in each project and the characteristics of the same. That's why it's so important to offer basic opportunities and guidance, making sure that the resources collected are used effectively and in line with each situation's specific needs. At the same time, most of the climate neutrality projects in all regions of the world regardless of the sector in which they are located, have sought the strategy that emissions be reduced significantly by 2030. However, due to the scope and complexities of the same, the countries have stipulated the year 2050 at the latest that should be completely neutral in premium of an improvement in the quality of life, production, construction, and industry, among others, to achieve a friendly and healthy world in a cross-cutting manner.

Throughout this study, it has become evident that climate-neutral financing mechanisms act in a concrete way to direct all resources to the projects that have the greatest positive impact on the environment. For example, Economidou et al. (2024) and Krysovatty et al (2024) even though they are in different projects and sectors, the first is for construction and the other for the agricultural sector. The financier from which they obtain the funds is the European Union, i.e. a public financier, where the amounts allocated to the projects total billions of dollars aimed at mitigation and impact caused in the territories. However, Hilbritch et al (2024) explains there are other types of financiers, such as the International Finance Corporation, which is a private source, in turn Yang et al (2023) mentions one source of funding is the semi-governmental, which is the Japan New Energy Technology Development Organization, therefore, you can find drastic differences coming from the zero-emission funding.

On the other hand, Yang et al (2023) and Jarón & Borucka (2024) agree that innovation within the energy sector, fundamentally in Hydrogen as a pillar of projects aimed at neutrality is of great help in these cases for Japan and the United States, in these cases the sources of financing are public and present a rate of 0% these in favor of an emancipation of opportunities and innovations on the way to zero emissions. On the contrary, Lovas (2022) and Salazar Navarro (2024) note that the European Union allocates 78 times the amount of financing for the administration of its energy matrix. A similar aspect shared among the authors is that the financing rate is 0%, with the public sector acting as the primary financier. Furthermore, much of the funding is projected for 2030, although there are differences and uncertainties regarding the specific terms and timelines. On the other hand, Kandrács (2023) stands out widely concerning the project term of 2 years, currently, this is operational and completed in comparison with the rest of the energy sector projects were on a par with the financial instruments evidenced by the rest of the authors of the energy sector is the one that adds the loan as an additional mechanism, at the same time the financier is public-private.

Krysovatty et al (2024) present within the agricultural sector a public financing of high amounts as is the European Union, a characteristic shared with Leahy et al (2020) and Umar et al (2023) where the main rationale is based on public financing for zero emissions in projects that seek to guarantee an environmentally friendly implication based on sustainability.

On the other hand, Yang et al (2023) and Zhao et al (2024) in the Asian region to achieve climate neutrality in strategic sectors, the region has set a condition premium of the use of clean technology in the direction of digitization projects based on these guidelines to follow, on the contrary, Ionescu et al (2024) and Pahle et al (2025) emphasize the importance of establishing conditional frameworks for projects in general, even when technological innovations are involved.

Although the financial instruments for climate neutrality can be varied and can even be some at a time, several authors have shared the bond as the alternative to capture resources for various projects, among them are Lovas (2022), Baker et al (2014) and Ameli et al (2020). These instruments have been implemented as a way to achieve neutrality in their projects.

Leal-Arcas (2023) and Maksymova (2024) agree with Battison et al (2021) regarding innovative financial and operational mechanisms, support the green transition of companies such as green bonds that seek to minimize the harmless financial impact for contractual sustainable measures of the financial scope focused on neutrality.

5. Conclusion

Based on the results presented, the financing mechanisms in the direction of climate neutrality work in the same way in the different regions of the world; however, it is about the sectors where the manner of implementation of these instruments can be evidenced based on the project they are seeking to solve. Although achieving zero emissions is a constant struggle and work, in many of the projects mentioned in Table 1. the results clearly and concisely reflect the way of working and the route to achieving them within the necessary timeframe and conditions.

In terms of regulations, fiscal situations, regulatory policies, and social environments in various countries, there is a lack of precise regulatory bases and implementation roadmaps. This may depend on the current relevance of climate neutrality. On the other hand, most sustainable projects work hand in hand with environmental protection and pollution reduction. Therefore, appropriate instruments and national frameworks tailored to each country's unique political context should be established to facilitate their effective planning and successful implementation.

Now, within the region with more projects and cases of implementation around zero emissions is the European Union. This is largely due to its environmental commitment and form of compensation for the damages emitted before an action, which is why they have allocated time objectives and large amounts of money. The sector that has been most related and channeled through financing instruments has been the energy sector because being strategic and at the same time, a major pollutant for energy production is where Europe has developed technologies, resources, and means capable of guaranteeing a clean energy transition and facilitation. A key project shown in Table 1 is the creation of an energy fiscal management system to manage clean energy projects aimed at neutrality, which can be an example of implementation in other regions of the world to simplify progress and administration.

On the other hand, in the energy sector, we see promising projects using hydrogen as a clean energy source, especially in Asia, with Japan leading the way. Similarly, in North America, particularly in the United States, there is strong collaboration between the public and private sectors, which is significantly boosting the energy supply chain.

At the same time, within the transportation sector, the expectation of searching for clean motorization has become relevant for the automotive manufacturing sector, with the use of technology through sensors adapted to roads that channel energy through vehicle movement. At the same time, alliances between Asian companies such as Mitsubishi and Nissan with European companies such as Renault are looking for electric motorization for their units and marketing them worldwide. This will lead to a large part of the transportation market migrating to clean transitions. As a result, the United States is on the road to implementation.

As part of achieving climate neutrality, the construction sector is immersed in strategies at the European level with sustainable construction programs. Although this sector is highly costly in its operation, Europe has achieved great achievements and optimal technologies that should be taken as a form of implementation in all regions and parts of the world, because its environmental management has managed to be carbon neutral, which facilitates real estate development in any sector.

On the other hand, the agricultural and financial sectors haven't developed as much. Europe, however, is making real progress with environmentally friendly projects, especially thanks to technological advances aimed at climate neutrality. This kind of effort is something every country and region should take on, particularly in agriculture, since it's one of the most polluting sectors. Based on what was mentioned by the Authors and Projects of the various sectors found in the results, the following can be evidenced: achieving climate neutrality in any sector is highly costly due to the large number of resources, knowledge, and transcendental aspects that it requires, therefore, some regions in certain sectors are financially limited to work on projects that provide and are environmentally friendly. As can be seen in the table of results, the most used instrument for the projects is the funds, which as a great characteristic of these is to gather all public, private, or mixed investment resources, which is complex for countries or regions that are economically limited. As it

is visible, Latin America, Africa, and the rest of America do not present transcendental projects of climate neutrality due to the lack of resources, knowledge, and time pressure because it is still a modern aspect that requires a time of employment. This means that at the same time, the environment is not being fully worked for these regions of the planet.

Although many of the countries, based on the projects they manage, stipulate deadlines and individual and precise conditions, they may be in a dilemma due to a series of factors such as project size, delimitation of the work plan, structuring of execution, trial and error evaluations and a series of characteristics that may cause a delay or failure to meet deadlines.

It is important to mention that all the projects presented in the results do not present a rate, because they are prioritizing the interest of seeking projects that benefit the countries to achieve emission reductions, their commitment to the environment and nature, and their international relevance in the sustainable management of their implementations in general, as shown in Table 1.

As a key point at a general level, we must take the following into account: the advancement, management, and resources available in developed regions — along with their high level of knowledge and easy access to instruments — allow them to carry out projects in a more feasible, efficient, and well-managed way. That is why generating alliances between sectors and regions at a global level can not only be beneficial for the planet and climate neutrality, but at the same time, it would generate coexistent forms of collaboration through retribution in certain areas. Within the financing through fee-free instruments, investment with large residuals, improvements of the environmental condition at the project site, adaptability, and knowledge generated from the projects. All this is in favor of a better global condition and an effective way to reach full climate neutrality.

It should be noted that the study had limitations in terms of information in certain regions of the planet, such as Africa and specifically in Latin America, which do not provide sufficient data, results, and scarcity of relevant information, largely causally due to the implication of contemporary periods of the booming climate neutrality and at the same time due to the high costs of implementation.

Finally, this work could help show how different projects have impacted the environment over time, across regions and sectors. It could also highlight areas where research and action are still missing. These places will be critical for understanding how much progress is truly being made in the global fight against pollution and the damage being done to the planet.

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