Región Científica

e-ISSN: 2954-6168
Región Científica. 2023. 2(1), 202334
doi: 10.58763/rc202334

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Prospects for energy transition in Latin America in the post-pandemic scenario

Perspectivas de la transición energética en Latinoamérica en el escenario pospandemia

Nachely Pérez Guedes[1], Alfredo Arufe Padrón[1]

ABSTRACT

In the context of post-pandemic recovery plans, several countries have glimpsed a window of opportunity to integrate robust strategies to combat climate change, aligning measures that support the transition to renewable energies. Latin America, a region endowed with significant clean energy potential, has experienced challenges exacerbated by the COVID-19 crisis, which has considerably impacted the implementation and optimization of these energies. This study sought to meticulously examine the process and challenges of energy transition in the post-pandemic scenario in Latin America, implementing a methodology that amalgamates qualitative and quantitative approaches. Through a theoretical and empirical exploration, it explored the prevailing energy dilemmas during the pandemic, identifying the main barriers and advantages intrinsic to the energy transition. Although investment in the region remains heavily weighted towards the non-renewable energy sector, Latin America has demonstrated tangible progress in energy transition. The analysis led to relevant recommendations for incorporating vital elements in government climate policies and identifying critical competencies for stakeholders, advocating for a more substantial commitment to energy sustainability in the region's future.

Keywords: Latin America, sustainable development, environmental impact, economic reactivation, energy resources, Covid-19.

JEL classification: O13, O18, Q42.

RESUMEN

En el contexto de los planes de recuperación pospandemia, varios países han vislumbrado una ventana de oportunidad para integrar estrategias robustas de combate al cambio climático, alineando medidas que respalden la transición hacia energías renovables. Latinoamérica, siendo una región dotada de un potencial significativo en materia de energías limpias, ha experimentado desafíos exacerbados por la crisis de la COVID-19, la cual ha incidido notablemente en la implementación y optimización de estas energías. El presente estudio buscó examinar meticulosamente el proceso y los desafíos de la transición energética en el escenario pospandémico en América Latina, implementando una metodología que amalgama enfoques cualitativos y cuantitativos. A través de una exploración teórica y empírica, se indagó en los dilemas energéticos prevalecientes durante la pandemia, identificando las principales barreras y ventajas intrínsecas a la transición energética. Aunque la inversión en la región sigue estando notablemente inclinada hacia el sector de las energías no renovables, Latinoamérica ha demostrado avances palpables en el ámbito de la transición energética. El análisis conllevó a recomendaciones pertinentes para la incorporación de elementos clave en las políticas climáticas gubernamentales, así como la identificación de competencias críticas para los actores involucrados, abogando por un compromiso más sólido hacia la sostenibilidad energética en el futuro de la región.

Palabras clave: América Latina, desarrollo sostenible, impacto ambiental, reactivación económica, recursos energéticos, Covid-19.

Clasificación JEL: O13, O18, Q42.

Received: 10-10-2022 **Revised:** 09-12-2023 **Accepted:** 15-12-2022 **Published:** 13-01-2023

Editor: Carlos Alberto Gómez Cano

[1] Instituto Superior de Relaciones Internacionales "Raúl Roa García". La Habana, Cuba.

Cite as: Pérez, N y Arufe, A. (2023). Perspectivas de la transición energética en Latinoamérica en el escenario pospandemia. *Región Científica*, 2(1), 202334. https://doi.org/10.58763/rc202334

INTRODUCTION

According to Grübler (1991), energy transition is the change in energy generation and management forms based on variables that differ from the strategies adopted regularly. This is not a new process (Pasman et al., 2023); other examples of the energy transition are the use of wood to create charcoal in the 19th century (Emodi et al., 2022) and then in the 20th century with the substitution of charcoal for oil as a non-renewable resource (Halttunen et al., 2023). The difference between the current transition and the previous ones is that it is based on the need to protect the planet from the danger

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posed by the global problem of climate change (Elshkaki, 2023; Li et al., 2023; Li et al., 2022; Schwab & Combariza, 2023).

There are indications that the energy management model, based on the use of non-renewable fuels (oil), is not sustainable and has influenced the planet's imbalance by causing the ozone layer's deterioration (Huang et al., 2021; Yuksel, 2012). This phenomenon has disrupted climate regimes and global food security (Śliwińska-Bartel et al., 2021; Tripathi et al., 2016). Mention should also be made of the daily increase in the number of people displaced by climate change. The global climate crisis has influenced increased concern among various sectors of society (Francisco et al., 2023; Khojasteh et al., 2022). This concern is strengthened by the inconsistency between the agreements signed by the states and the dimensions of humanity's problems. In this context, interest and studies related to energy transition have increased (Huang et al., 2023; Husu, 2022; Musango, 2022; Wang et al., 2022).

Thanks to the decline in global economic activity in the wake of the COVID-19 pandemic (Lavopa & Donnelly, 2023; Sheng et al., 2023), productive economic activity came to an abrupt halt worldwide, an element that considerably reduced carbon dioxide (CO2) emissions. This aspect is considered, at least in environmental terms, to be positive (Smith et al., 2021). A statistical report by the International Energy Agency (IEA) corroborates the above; this occurred due to the restrictions imposed to mitigate the health crisis and its influence on the mobility of people and on global production and service chains (International Energy Agency, 2020).

However, with the progressive control of the pandemic and the resumption of productive activity, CO2 emissions increased again. The resumption of CO2 emissions demonstrated that the sustainable context required at the international level (Sargison, 2023) may not only depend on abrupt shutdowns of production systems but that this growth, in a post-pandemic world, will require a change in production and in the way these systems plan (Chai et al., 2022), direct (Tan et al., 2023) and control (Masrur et al., 2023) energy consumption based on the substitution of non-renewable energy sources.

Despite the containment measures implemented to strengthen health systems and reduce the effects of the pandemic on economic activity and the population (Bollyky et al., 2023), data published by the International Monetary Fund (IMF) show a decrease in Gross Domestic Product (GDP) worldwide and in Latin America of 4.4% and 8.1%, respectively. As a result, countries have taken it upon themselves to develop strategies to address this situation at the tactical and operational levels. These plans represent a unique opportunity to commit to sustainable economies. In this context, the circular economy becomes relevant through the reuse of products and the optimization of production to boost the economy and sustainable development in a balanced way.

However, defining strategic policies for a sustainable development model for Latin America is emerging as a complex process (Antunes et al., 2021), requiring setting goals for transforming from a fossil fuel-based economy to a sustainable economy. This research aims to evaluate the energy transition process in Latin America by characterizing the post-pandemic energy scenario and identifying the obstacles and benefits of the energy transformation.

METHODS

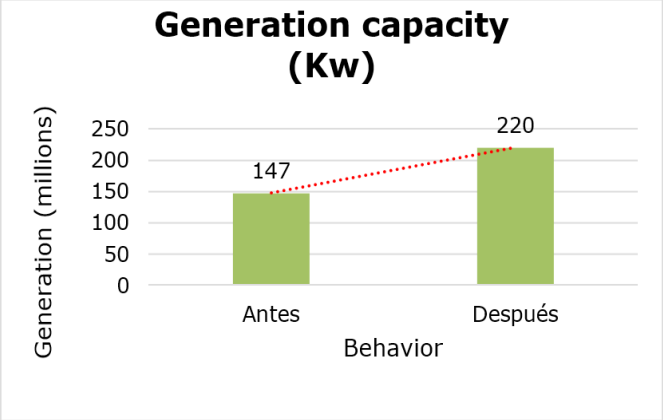
The research was developed under a mixed qualitative-quantitative methodology (Urbis et al., 2019), based on an exploratory study with the objective of analyzing the energy transition processes during Covid-19 in Latin America. Theoretical methods were used: historical - logical (which allowed predicting the behavior of the energy transition matrices in Latin America), analysis - synthesis, where the different government strategies for the development of renewable energies in the context of the pandemic were analyzed, the identification of strengths and weaknesses, as well as estimating the impact of these strategies on the population and development of nations.

Among the empirical methods used were observation and data collection, which made it possible to identify energy-related problems during the pandemic. An analysis was also carried out of the different global summits that addressed energy-related issues, including: United Nations Development Program (UNDP), International Energy Agency (IEA), International Renewable Energy Agency (AIER), World Resources Institute (WRI), Inter-American Development Bank (IDB), Organización Internacional del Trabajo (OIT), Banco Mundial (BM).

RESULTS AND DISCUSSION

Latin America has a high potential for developing renewable energies due to its resource endowment (Ospina-Mateus et al., 2023). The IEA states that most of its energy consumption is generated with renewable resources, with values close to 60%. This element does not behave the same way worldwide, with average values of 25%. In recent years, renewable resources have grown exponentially in the region's generation capacity (Figure 1).

Figure 1.
Behavior of the use of renewable resources for generation in Latin America.



Source: International Energy Agency (2020).
Note: the figure appears in its original language.

The increase represents 67% of the overall installed capacity in the region; these data do not consider hydroelectric generation. The data provided by this agency also demonstrates the reduction of dependence on non-renewable sources, mainly fossil fuels, and the substantial increase in the contribution of renewable energies to the region's generation capacity (International Renewable Energy Agency, 2020).

Challenges for achieving the energy transition in a post-pandemic scenario.

The United Nations (2015), within its higher purposes, has stated:

- To ensure the maintenance of global temperature levels below 2°C concerning pre-industrial levels and to pursue efforts to limit this temperature increase to 1.5°C (...);
- Promote (...) development with low greenhouse gas emissions (...).

On the other hand, the United Nations Framework Convention on Climate Change (UNFCCC) of 1992 highlighted the principles of equality and shared responsibility for the differences in describing the realities of implementation (United Nations, 2015). The agreement has high ambitions regarding mitigation issues and ways of conceiving development. This is a sign of a consistent position with the need to face the transformations associated with climate change, which is why its implementation implies a change in managing production and consumption at the global level.

Sustainable economies have evolved and require the integration of various sectors of society: health, transportation, agriculture, production, and energy. In this sense, developing governments must create public policies to balance social conditions through energy transition (Castellini et al., 2022; La Viña et al., 2018). Both in Latin America and globally, two leading causes enhance the emission of greenhouse gases (Table 1).

Table 1.
Main causes of greenhouse gas emissions.

No.	Causes	Factors	Pollutant
1	Supply of electrical services	Electricity Heating Cooling Transportation	CO2
2	Food supply	Cattle Rice Synthetic fertilizers	Methane Nitrous oxide

Source: own elaboration.

Renewable energies are an essential pillar in the energy transition process (Abbas et al., 2023; Chen et al.,

2023) and are emerging as an alternative to reduce gas emissions into the atmosphere. Although this process has proven technically feasible and economically beneficial, awareness of various sectors and greater political will are still needed to put the global energy system on the path to sustainability (Werner & Lazaro, 2023).

At the international level, clean energy matrices should be considered in the efficient development of energy transitions (Nadaleti et al., 2022) through the efficient combination of different renewable and non-renewable sources. Countries' percentages of utilization of one source or another depend on political, economic-financial factors and the availability of natural resources. In Latin America, the energy transition is a challenge (Hampl, 2022), mainly for those that have more significant reserves of non-renewable resources (fossil fuels), and because government management focuses more on economic growth and stability in the face of the difficulties imposed by the crisis as a result of the pandemic (Pietrosemoli & Rodriguez, 2019).

In these transitions there is a high average level of management caused by uncertainty in aspects related to the fall in oil prices (Bouazizi et al., 2023), the demand for products (Izadpanahi et al., 2022), an element that imposes a challenge to supply chains (Sánchez et al., 2021) and the monetary policies imposed by the United States, as the leading actor in foreign investment in the region in energy and infrastructure issues.

COVID-19 has affected the economy of Latin American countries (Arceo-Gomez et al., 2023); returning to regular economic terms implies a great sacrifice by governments to face gross debts and the reduction of Gross Domestic Product (GDP). In other words, the most indebted countries at the beginning of the pandemic have less capacity to respond (Lugo-Morin, 2022), for which fiscal spaces are an alternative for sustainable recovery.

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When Covid-19 appeared unexpectedly, multinational companies did not have a solid regulatory framework to cope with the situation and focused on reducing emissions of polluting gases (Uche et al., 2023; Wang et al., 2022). The current market organization impedes the change of the energy matrix, as there is a strong link between it and the predominant technological management models. In the case of public transport, it depends on logistics operators and the high cost of electric vehicles (Sangroni et al., 2021).

In general, the climate policies contained in the agenda of Latin American countries demand:

- Increase structured policies that guarantee an increasingly sustainable energy transition.
- Increase the commitment of the main governmental actors to fulfill the established climate agendas.
- Raise the population's knowledge level and include them as actors in the different environmental management processes.
- Increase spaces for debate on climate and energy transition issues.

Energy transition, a development opportunity

The region is well-positioned to transition to zero emissions (Werner & Lazaro, 2023). Clean energies in Latin America are much cheaper than those produced by thermal power plants and represent higher savings than in the rest of the world. However, it should be taken into account that countries with rapid economic growth and solid production systems based on the use of non-renewable resources such as coal and oil will show more excellent resistance to change due to the high costs of transitioning to the use of renewable resources, in addition to the need to maintain production capacities (Chu et al., 2023) and business competitiveness (Du et al., 2023).

Regarding environmental cost-benefit, the transitions are viable alternatives; in addition, the health benefits derived from the reduction in the use of fossil fuels must be considered (Roche et al., 2023; Yakub et al., 2022). Among the advances in the energy transition, renewable energy sources have been used as alternatives to electrify hard-to-reach and rural areas (Mazzone et al., 2021) and to substitute combustion transport with electric transport.

Among the benefits are the improvement of productivity and sustainable logistic chains and reducing adverse socioeconomic, health, and noise effects.

These benefits also go to the economic experiences in Latin American countries such as Peru, Chile, and Mexico, which generate solar and wind energy for average costs of 0.03 dollars/Kw/hours, as worldwide references among the lowest costs for any energy source in generation (International Renewable Energy Agency, 2020).

A summary of the recommendations of agencies, international institutions, and expert groups on the implementation of the energy transition in post-pandemic recovery plans highlights the following ideas:

1. Using carbon taxes is necessary to avoid a rebound effect after the pandemic.
2. It is essential to maintain investment in the energy sector and to ensure the progress of those projects in the renewable energy sector that may be delayed due to the pandemic.
3. Post-pandemic urban design should focus primarily on pedestrians and cyclists.

CONCLUSIONS

This research evaluated the development of the energy transition process in Latin America. Much of the investment in the region's countries flows towards the traditional energy sector since there is a large amount of gas, oil, and mining resources. However, the subcontinent has made significant progress in terms of transition.

Currently, the region's economic performance outlook is worrisome due to the slowdown imposed by the COVID-19 pandemic, falling supply, and rising commodity prices. In addition to the limitations of fiscal space, the nations of the area will have to face obstacles such as the absence of an adequate regulatory framework to integrate companies into emission reduction efforts. Finally, another challenge will be the creation of more inclusive climate agendas linked to energy transition plans.

Despite this context, there is still a need for an economic development plan for Latin American countries that considers renewable energies as part of its central axis. The energy transition process brings the region social, economic, and developmental benefits. These advantages are mainly due to the low cost of acquiring clean energy technologies. In addition, renewable energy is a solution for electrifying remote rural areas and poor populations.

The path towards energy transition must be gradual and under solid economic policies due to the impact of this indicator in Latin American countries. In turn, the results and conclusions of this research work, some recommendations are made available to the reader:

1. To continue studying the evolution of the Latin American energy scenario.
2. To study the conditions of each Latin American country in terms of energy resources to identify the particularities of this process.
3. To annually update national and regional studies on the availability of energy resources and the progress of the energy transition.

REFERENCES

Abbas, S., Saqib, N. y Shahzad, U. (2023). Global export flow of Chilean copper: The role of environmental innovation and renewable energy transition. Geoscience Frontiers, 101697. https://doi.org/10.1016/j.gsf.2023.101697

Agencia Internacional de la Energía. (2020). Short-Term Energy Outlook. International Energy Agency (IEA). https://www.eia.gov/outlooks/steo/

Antunes, W., Borsatto, R. y Souza-Esquerdo, V. (2021). Why is it so difficult to promote territorial development through public policies? The obstacles faced by a Brazilian experience. World Development Perspectives, 24, 100367. https://doi.org/10.1016/j.wdp.2021.100367

Arceo-Gomez, E., Campos-Vazquez, R., Esquivel, G., Alcaraz, E., Martínez, L. y López, N. (2023). The impact of COVID-19 infection on labor outcomes of Mexican formal workers. World Development Perspectives, 29, 100488. https://doi.org/10.1016/j.wdp.2023.100488

Bollyky, T., Castro, E., Aravkin, A., Bhangdia, K., Dalos, J., Hulland, E., Kiernan, S., Lastuka, A., McHugh, T., Ostroff, S., Zheng, P., Chaudhry, H., Ruggiero, E., Turilli, I., Adolph, C., Amlag, J., Bang-Jensen, B., Barber, R., Carter, A., Chang, C., Cogen, R., Collins, J., Dai, X., Dangel, W., Dapper, C., Deen, A., Eastus, A., Erickson, M., Fedosseeva, T., Flaxman, A., Fullman, N., Giles, J., Guo, G., Hay, S., He, J., Helak, M., Huntley, B., Iannucci, V., Kinzel, K., LeGrand, K., Magistro, B., Mokdad, A., Nassereldine, H., Ozten, Y., Pasovic, M., Pigott, D., Reiner, R., Reinke, G., Schumacher, A., Serieux, E., Spurlock, E., Troeger, C., Vo, A., Vos, T., Walcott, R., Yazdani, S., Murray, C. y Dieleman, J. (2023). Assessing COVID-19 pandemic policies and behaviours and their economic and educational trade-offs across US states from Jan 1, 2020, to July 31, 2022: an observational analysis. The Lancet, 401(10385), 1341-1360. https://doi.org/10.1016/S0140-6736(23)00461-0

Bouazizi, T., Guesmi, K., Galariotis, E. y Vigne, S. (2023). Crude oil prices in times of crisis: The role of Covid-19 and historical events. International Review of Financial Analysis, 102955. https://doi.org/10.1016/j.irfa.2023.102955

Castellini, G., Lucini, L., Rocchetti, G., Lorenzo, J. y Graffigna, G. (2022). Determinants of consumer acceptance of new technologies used to trace and certify sustainable food products: A mini-review on blockchain technology. Current Opinion in Environmental Science & Health, 30, 100403. https://doi.org/10.1016/j.coesh.2022.100403

Chai, J., Wu, H. y Hao, Y. (2022). Planned economic growth and controlled energy demand: How do regional growth targets affect energy consumption in China? Technological Forecasting and Social Change, 185, 122068. https://doi.org/10.1016/j.techfore.2022.122068

Chen, J., Luo, Q., Tu, Y., Ren, X. y Naderi, N. (2023). Renewable energy transition and metal consumption: Dynamic evolution analysis based on transnational data. Resources Policy, 85, 104037. https://doi.org/10.1016/j.resourpol.2023.104037

Chu, L., Doğan, B., Dung, H., Ghosh, S. y Alnafrah, I. (2023). A step towards ecological sustainability: How do productive capacity, green financial policy, and uncertainty matter? Focusing on different income level countries. Journal of Cleaner Production, 138846. https://doi.org/10.1016/j.jclepro.2023.138846

Du, J., Shen, Z., Song, M. y Zhang, L. (2023). Nexus between digital transformation and energy technology innovation: An empirical test of A-share listed enterprises. Energy Economics, 120, 106572. https://doi.org/10.1016/j.eneco.2023.106572

Elshkaki, A. (2023). The implications of material and energy efficiencies for the climate change mitigation potential of global energy transition scenarios. Energy, 267, 126596. https://doi.org/10.1016/j.energy.2022.126596

Emodi, N., Haruna, E., Abdu, N., Aldana, S., Dioha, M. y Abraham-Dukuma, M. (2022). Urban and rural household energy transition in Sub-Saharan Africa: Does spatial heterogeneity reveal the direction of the transition? Energy Policy, 168, 113118. https://doi.org/10.1016/j.enpol.2022.113118

Francisco, É., Ignácio, P., Piolli, A. y Dal, M. (2023). Food-energy-water (FEW) nexus: Sustainable food production governance through system dynamics modeling. Journal of Cleaner Production, 386, 135825. https://doi.org/10.1016/j.jclepro.2022.135825

Grübler, A. (1991). Diffusion: Long-term patterns and discontinuities. Technological Forecasting and Social Change, 39(1-2), 159-180. https://doi.org/10.1016/0040-1625(91)90034-D

Halttunen, K., Slade, R. y Staffell, I. (2023). Diversify or die: Strategy options for oil majors in the sustainable energy transition. Energy Research & Social Science, 104, 103253. https://doi.org/10.1016/j.erss.2023.103253

Hampl, N. (2022). Equitable energy transition in Latin America and the Caribbean: Reducing inequity by building capacity. Renewable and Sustainable Energy Transition, 2, 100035. https://doi.org/10.1016/j.rset.2022.100035

Huang, M., He, W., Incecik, A., Cichon, A., Królczyk, G. y Li, Z. (2021). Renewable energy storage and sustainable design of hybrid energy powered ships: A case study. Journal of Energy Storage, 43, 103266. https://doi.org/10.1016/j.est.2021.103266

Huang, W.-C., Zhang, Q. y You, F. (2023). Impacts of battery energy storage technologies and renewable integration on the energy transition in the New York State. Advances in Applied Energy, 9, 100126. https://doi.org/10.1016/j.adapen.2023.100126

Husu, H.-M. (2022). Rethinking incumbency: Utilising Bourdieu's field, capital, and habitus to explain energy transitions. Energy Research & Social Science, 93, 102825. https://doi.org/10.1016/j.erss.2022.102825

International Renewable Energy Agency. (2020). Global Renewables Outlook: Energy transformation 2050. Agencia Internacional de Energías Renovables, Abu Dhabi. https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020

Izadpanahi, E., Downward, A., Arthanari, T. y Liu, Y. (2022). Robust optimization for energy transition planning in manufacturing firms: An integrated model addressing economic and environmental issues. Journal of Cleaner Production, 334, 130237. https://doi.org/10.1016/j.jclepro.2021.130237

Khojasteh, D., Davani, E., Shamsipour, A., Haghani, M. y Glamore, W. (2022). Climate change and COVID-19: Interdisciplinary perspectives from two global crises. Science of The Total Environment, 844, 157142. https://doi.org/10.1016/j.scitotenv.2022.157142

La Viña, A., Tan, J., Guanzon, T., Caleda, M. y Ang, L. (2018). Navigating a trilemma: Energy security, equity, and sustainability in the Philippines' low-carbon transition. Energy Research & Social Science, 35, 37-47. https://doi.org/10.1016/j.erss.2017.10.039

Lavopa, A. y Donnelly, C. (2023). Socioeconomic resilience during the COVID-19 pandemic. The role of industrial capabilities. Structural Change and Economic Dynamics, 67, 44-57. https://doi.org/10.1016/j.strueco.2023.06.004

Li, F., Zhang, J. y Li, X. (2023). Energy security dilemma and energy transition policy in the context of climate change: A perspective from China. Energy Policy, 181, 113624. https://doi.org/10.1016/j.enpol.2023.113624

Li, G., Luo, T. y Song, Y. (2022). Climate change mitigation efficiency of electric vehicle charging infrastructure in China: From the perspective of energy transition and circular economy. Resources, Conservation and Recycling, 179, 106048. https://doi.org/10.1016/j.resconrec.2021.106048

Lugo-Morin, D. (2022). Innovate or Perish: Food Policy Design in an Indigenous Context in a Post-Pandemic and Climate Adaptation Era. Journal of Open Innovation: Technology, Market, and Complexity, 8(1), 34. https://doi.org/10.3390/joitmc8010034

Masrur, A., Bailek, N., Abualigah, L., Bouchouicha, K., Kuriqi, A., Sharifi, A., Sareh, P., Al khatib, A., Mishra, P., Colak, I. y El-kenawy, E. (2023). Global control of electrical supply: A variational mode decomposition-aided deep learning model for energy consumption prediction. Energy Reports, 10, 2152-2165. https://doi.org/10.1016/j.egyr.2023.08.076

Mazzone, A., Cruz, T. y Bezerra, P. (2021). Firewood in the forest: Social practices, culture, and energy transitions in a remote village of the Brazilian Amazon. Energy Research & Social Science, 74, 101980. https://doi.org/10.1016/j.erss.2021.101980

Musango, J. (2022). Assessing gender and energy in urban household energy transitions in South Africa: A quantitative storytelling from Groenheuwel informal settlement. Energy Research & Social Science, 88, 102525. https://doi.org/10.1016/j.erss.2022.102525

Naciones Unidas. (2015). Acuerdo de París. Conferencia de las Partes 21er período de sesiones-Convención Marco sobre el Cambio Climático, FCCC/CP/2015/L.9. https://unfccc.int/resource/docs/2015/cop21/spa/l09s.pdf

Nadaleti, W., de Souza, E. y Lourenço, V.(2022). Green hydrogen-based pathways and alternatives: Towards the renewable energy transition in South America's regions–Part B. International Journal of Hydrogen Energy, 47(1), 1-15. https://doi.org/10.1016/j.ijhydene.2021.05.113

Ospina-Mateus, H., Marrugo-Salas, L., Castilla, L., Castellón, L., Cantillo, A., Bolivar, L., Salas-Navarro, K. y Zamora-Musa, R. (2023). Analysis in circular economy research in Latin America: A bibliometric review. Heliyon, 9(9), e19999. https://doi.org/10.1016/j.heliyon.2023.e19999

Pasman, H., Sripaul, E., Khan, F., & Fabiano, B. (2023). Energy transition technology comes with new process safety challenges and risks. Process Safety and Environmental Protection, 177, 765-794. https://doi.org/10.1016/j.psep.2023.07.036

Pietrosemoli, L. y Rodríguez-Monroy, C. (2019). The Venezuelan energy crisis: Renewable energies in the transition towards sustainability. Renewable and Sustainable Energy Reviews, 105, 415-426. https://doi.org/10.1016/j.rser.2019.02.014

Roche, L., Arendt, R., Bach, V. y Finkbeiner, M. (2023). The social impacts of resource extraction for the clean energy transition: A qualitative news media analysis. The Extractive Industries and Society, 13, 101213. https://doi.org/10.1016/j.exis.2023.101213

Sánchez, Y., Pérez, J., Sangroni, N., Cruz, C. y Medina, Y. (2021). Retos actuales de la logística y la cadena de suministro. Ingeniería Industrial, XLII(1), 1-12. https://rii.cujae.edu.cu/index.php/revistaind/article/download/1079/992

Sangroni, N., Medina, Y., Tápanes, E., Santos, O., Pérez, J. y Sánchez, Y. (2021). Principales modelos de gestión de calidad de vida urbana asociada al transporte. Ingeniería Industrial, XLII(3), 1-12. https://rii.cujae.edu.cu/index.php/revistaind/article/download/1116/1036/7844

Sargison, N. (2023). K-44 The global need for advances in the sustainable control of helminth parasites. Animal - science proceedings, 14(1), 39-40. https://doi.org/10.1016/j.anscip.2023.01.054

Schwab, J. y Combariza, N. (2023). The discursive blinkers of climate change: Energy transition as a wicked problem. The Extractive Industries and Society, 15, 101319. https://doi.org/10.1016/j.exis.2023.101319

Sheng, H., Dai, X. y He, C. (2023). Gone with the epidemic? The spatial effects of the Covid-19 on global investment network. Applied Geography, 156, 102978. https://doi.org/10.1016/j.apgeog.2023.102978

Śliwińska-Bartel, M., Burns, D. y Elliott, C. (2021). Rice fraud a global problem: A review of analytical tools to detect species, country of origin and adulterations. Trends in Food Science & Technology, 116, 36-46. https://doi.org/10.1016/j.tifs.2021.06.042

Smith, L., Tarui, N. y Yamagata, T. (2021). Assessing the impact of COVID-19 on global fossil fuel consumption and CO2 emissions. Energy Economics, 97, 105170. https://doi.org/10.1016/j.eneco.2021.105170.

Tan, Q., Yasmeen, H., Ali, S., Ismail, H. y Zameer, H. (2023). Fintech development, renewable energy consumption, government effectiveness and management of natural resources along the belt and road countries. Resources Policy, 80, 103251. https://doi.org/10.1016/j.resourpol.2022.103251

Tripathi, A., Tripathi, D., Chauhan, D., Kumar, N. y Singh, G. (2016). Paradigms of climate change impacts on some major food sources of the world: A review on current knowledge and future prospects. Agriculture, Ecosystems & Environment, 216, 356-373. https://doi.org/10.1016/j.agee.2015.09.034

Uche, E., Ngepah, N. y Cifuentes-Faura, J. (2023). Upholding the green agenda of COP27 through publicly funded R&D on energy efficiencies, renewables, nuclear and power storage technologies. Technology in Society, 75, 102380. https://doi.org/10.1016/j.techsoc.2023.102380

Urbis, A., Povilanskas, R. y Newton, A. (2019). Valuation of aesthetic ecosystem services of protected coastal dunes and forests. Ocean & Coastal Management, 179, 104832. https://doi.org/10.1016/j.ocecoaman.2019.104832

Wang, L., Dilanchiev, A. y Haseeb, M. (2022). The environmental regulation and policy assessment effect on the road to green recovery transformation. Economic Analysis and Policy, 76, 914-929. https://doi.org/10.1016/j.eap.2022.10.006

Wang, S., Sun, L. e Iqbal, S. (2022). Green financing role on renewable energy dependence and energy transition in E7 economies. Renewable Energy, 200, 1561-1572. https://doi.org/10.1016/j.renene.2022.10.067

Werner, D. y Lazaro, L. (2023). The policy dimension of energy transition: The Brazilian case in promoting renewable energies (2000–2022). Energy Policy, 175, 113480. https://doi.org/10.1016/j.enpol.2023.113480

Yakub, A., Same, N., Owolabi, A., Nsafon, B., Suh, D. y Huh, J.-S. (2022). Optimizing the performance of hybrid renewable energy systems to accelerate a sustainable energy transition in Nigeria: A case study of a rural healthcare centre in Kano. Energy Strategy Reviews, 43, 100906. https://doi.org/10.1016/j.esr.2022.100906

Yuksel, I. (2012). Global warming and environmental benefits of hydroelectric for sustainable energy in Turkey. Renewable and Sustainable Energy Reviews, 16(6), 3816-3825. https://doi.org/10.1016/j.rser.2012.03.028

FINANCING
No external financing.

CONFLICT OF INTEREST STATEMENT
The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION
Conceptualization: Nachely Pérez Guedes and Alfredo Arufe Padrón.
Formal analysis: Nachely Pérez Guedes and Alfredo Arufe Padrón.
Research: Nachely Pérez Guedes and Alfredo Arufe Padrón.
Methodology: Nachely Pérez Guedes and Alfredo Arufe Padrón.
Writing - original draft: Nachely Pérez Guedes and Alfredo Arufe Padrón.
Writing - revision and editing: Nachely Pérez Guedes and Alfredo Arufe Padrón.