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**ENERGY POLICIES AND INTERCONNECTION  
STANDARDS FOR ENERGY GENERATION  
DISTRIBUTED: GLOBAL STATUS, DEVELOPMENT  
TRENDS AND PERSPECTIVES IN PERU**

**POLÍTICAS ENERGÉTICAS Y NORMAS DE  
INTERCONEXIÓN PARA GENERACIÓN ENERGÉTICA: UNA  
REVISIÓN DE LA SITUACIÓN ACTUAL, TENDENCIAS Y  
PERSPECTIVAS EN EL PERÚ**

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## Energy Policies and Interconnection Standards for Energy generation Distributed: Global Status, Development Trends and Perspectives in Peru

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### ABSTRACT

Energy policies and interconnection standards play a key role in promoting and regulating distributed energy generation globally. The work should examine the current state of global interconnection policies and standards, emerging trends and their impact on clean energy adoption. Globally, energy policies for distributed generation typically focus on marketing renewable energy sources and improving energy efficiency. Many countries implement tax incentives, subsidies and support programs to stimulate the adoption of distributed generation technologies, such as solar panels and small wind systems. The rules of Interconnections often focus on establishing technical standards to ensure the security, stability and reliability of electrical grids, as well as facilitating the connection and seamless integration of distributed generation systems

**Keywords** : energy policies, distributed generation, renewable energy, tax incentives, interconnection standards

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# Políticas Energéticas y Normas de Interconexión para Generación Energética: una revisión de la Situación actual, Tendencias y Perspectivas en el Perú

## RESUMEN

Las políticas energéticas y las normas de interconexión desempeñan un papel fundamental en la promoción y regulación de la generación de energía distribuida a nivel mundial. El trabajo examina el estado actual de las políticas y normas de interconexión a nivel global, las tendencias emergentes y su impacto en la adopción de energías limpias. A nivel mundial, Mediante una revisión sistemática de los 199 artículos, las políticas energéticas para la generación distribuida suelen enfocarse en promover fuentes de energía renovable y mejorar la eficiencia energética. Muchos países implementan incentivos fiscales, subsidios y programas de apoyo para estimular la adopción de tecnologías de generación distribuida, como paneles solares y sistemas eólicos pequeños. Concluimos que la generación distribuida de energía renovable, especialmente la solar, es crucial para reducir la dependencia de combustibles fósiles y mitigar el daño ambiental. Países como México y Brasil están liderando este cambio. Sin embargo, en países como Perú, se enfrentan obstáculos políticos y estructurales que necesita políticas nacionales y locales coherentes y planes a largo plazo para atraer inversiones y fomentar el desarrollo de energías limpias. La cooperación entre los distintos niveles de gobierno y la participación de la sociedad son fundamentales para superar estas barreras y avanzar hacia un futuro energético más sostenible.

**Palabras clave:** políticas energéticas, generación distribuida, energías renovables, incentivos fiscales, normas de interconexión

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## INTRODUCTION

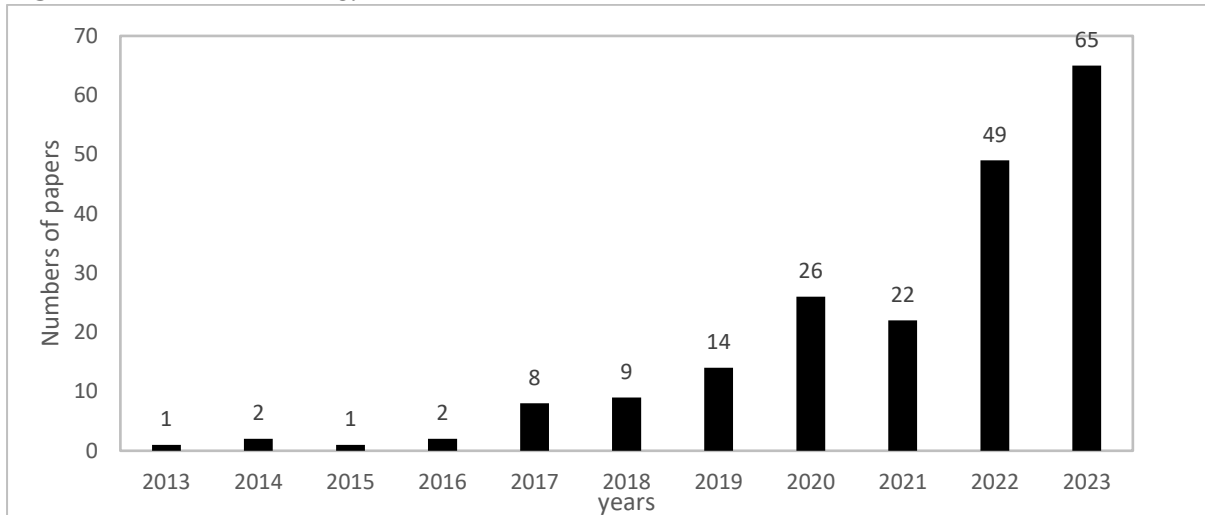
Energy is the engine of global economic and social development. In recent decades, the global energy matrix has undergone significant changes, driven by growing environmental awareness, technological advances and the search for more sustainable energy sources. In this article we seek to provide a detailed overview of the current state of global energy, as well as future trends and prospects. As well as highlighting the importance of energy policies and interconnection standards for distributed energy generation in the context of the transition towards a more sustainable energy matrix, according to (Eirin et al., 2022), the existence of public policies is highlighted. that promote investments in renewable energies because it is essential to achieve a successful transition. In addition, an electrical infrastructure capable of using variable renewable sources is required through highly specialized technical solutions, such as network stability and the essential conditions for electrifying transportation. Regarding interconnection standards, these are necessary to guarantee the connection of distributed generation systems to the electrical grid, which allows the injection of renewable energy into the grid and its distribution to consumers. In this sense, (Eirin et al., 2022) highlights the importance of having clear and stable standards that allow the connection of distributed generation systems to the electrical grid, as well as the regulation of the technical and economic aspects of injection. of renewable energy on the grid. Furthermore, it is highlighted that the existence of public policies that promote investments in renewable energies is essential to achieve a successful transition towards a more sustainable energy matrix. Therefore, the details of the need for clear and effective regulations to promote distributed generation will be described. In this regard (Farfan, 2020) mentions that regulation must encourage the connection of distributed generation systems to the electrical grid and guarantee that the owners of these systems receive a fair price for the energy they generate and sell to the grid. In addition, it is mentioned that regulation must encourage the adoption of renewable energy technologies and energy efficiency, and that it must be coherent and predictable to encourage investment in distributed generation systems. It is generally recognized that clear and effective regulations are essential to encourage distributed generation and the transition towards a more sustainable energy system.

## METODOLOGY

To shed light on Energy Policies and Interconnection Standards for Power Generation, we conducted a systematic literature review on the relationship between energy news and energy policy. This method adopts a systematic approach to research and presentation of related literature, making it explicit and reproducible. In this way, systematic literature review allows us to capture the debate on the link between Energy Policies and Interconnection Standards and Energy Generation, to then draw conclusions from the energy policy news literature and address related research gaps. In this article, we follow the methodological steps to acquire, select and analyze related studies. Based on these analyses, we draw implications for future research.

Article acquisition: keyword identification and article search, We use the Scopus database Redalyc and Scielo to identify relevant articles because it has a comprehensive collection of peer-reviewed articles. Our search covers peer-reviewed articles in English from 2022 to 2023 (November), a period of more than 2 years. We began the systematic review by identifying keywords and strings, (Table 1) extracted from the initial selection of related articles. We conducted our search on topics such as titles, abstracts and keywords and conducted our query in Scopus Redalyc and Scielo using asterisks as a wildcard character to capture word variations (e.g., searching on `energi *` to capture "energy" or "energetics"). The results illustrate the growing number of articles focused on Energy Policies and Interconnection Standards and Energy Generation; In fact, these items have increased almost fivefold over the past two years. Furthermore, the proportion of studies with a link especially on corporate financial performance increased to 30.4 percent between (2011-2020). Figure 1 reveals the growing interest in our research topic over the last decade, with 103 articles focused on energy policy , of which 65 (42%) were published between January 2019 and November 2020, demonstrating that interest recent remains high.

**Figure 1.** Evolution of Energy Policies new studies



This figure shows the evolution of energy policy studies over 10 years, and 2023 has mayor reserch in that field

evaluation and selection: In this part, we take a closer look at the main set of articles and review the articles by title, keyword and abstract. We eliminated articles in which the disclosures and ratings do not focus on energy policy and energy generation . This procedure resulted in the exclusion of 88 articles that did not fit the research criteria, reducing the number of relevant articles to 81.

Closer examination of the introductions and data sections of the remaining 81 articles led to the exclusion of a further 35 articles. Fifteen of them measured the corporate social performance of energy generation companies through subjective rating. Another 16 articles examined were also excluded because they were published with a financial focus, therefore, they are not in line with our research approach. Finally, we read the remaining 46 articles carefully and in detail. After review, another 26 articles were excluded, leaving us with only 20. However, upon reading these articles, we discovered and added two previously undetected articles.

### **Analysis of reviewed articles**

Our search found 22 articles published in leading journals between 2015 and 2023 and focuses on the impact of Energy Policies and Interconnection Standards for Power Generation. From then on, interest in the topic increased. We review these items in a variety of dimensions. First, we examine the empirical setting of the articles. We then review the definitions of the Energy Policies and Energy Generation Standards news variable and identify the techniques used to derive and analyze the content of energy policies. Next, we discuss the research design and methodological frameworks of the articles (Table 4).



Finally, to present the big picture, we focus on the main findings. Due to the clear differences between the studies that investigate news on general and specific Energy Policies and Interconnection Standards for Energy Generation, we present the findings in two tables: general articles and specific studies.

## **RESULTS AND DISCUSSION**

### **Global Energy Policies**

Exploration of global energy policies that promote distributed generation and the transition to clean energy. The analysis of energy policies, as mentioned by (Farfan, 2020) , are energy policies that promote distributed generation and the transition to clean energy, usually including incentives for the installation of renewable energy systems, such as solar panels and wind turbines, and the implementation of energy storage technologies. They may also include regulations that encourage energy efficiency and the reduction of greenhouse gas emissions. Furthermore, these policies may require collaboration between governments, businesses and civil society to achieve an effective transition towards a more sustainable energy system. In addition (Ruth et al., 2014) indicates that nuclear energy offers the possibility of having abundant long-term supplies of heat and energy at prices that are not subject to the fluctuations in the prices of fossil fuels, and of producing Lower greenhouse gas emissions than alternative sources of fossil fuels.

Examples of leading countries in the implementation of energy policies favorable to distributed generation.

(Bocca & Ashraf, 2022) in their edition of the Energy Transition Index (ETI) shows, the 10 leading countries that have demonstrated strong performance and significant preparation to address the transition towards more sustainable energy systems are Sweden, Denmark, Norway, Finland, Switzerland, Iceland, France, Austria , Netherlands and Estonia. These nations stand out for their commitment to improving energy efficiency, promoting renewable energy, and implementing effective policies aimed at moving towards a low-carbon economy. These groups of countries have demonstrated solid performance in terms of the energy system and are well prepared to address the transition towards a more sustainable and diversified energy matrix. Its position in the ranking highlights its efforts in improving energy efficiency, developing renewable energy and adopting appropriate policies to move towards a low-carbon economy. These groups of countries have demonstrated solid performance in

terms of the energy system and are well prepared to address the transition towards a more sustainable and diversified energy matrix. Its position in the ranking highlights its efforts in improving energy efficiency, developing renewable energy and adopting appropriate policies to move towards a low-carbon economy. However, on the other hand, (Wang et al., 2022) says economies with weak environmental regulations allow companies and consumers to release more emissions and less use of clean energy.

In the ranking, Latin American countries occupy intermediate and low positions, depending on the case. In the first batch, up to the middle of the ranking, the one in the best position is Brazil (14th place), followed by Uruguay (23rd), Costa Rica (26th), Chile (30th), Paraguay (34th), Colombia (39), El Salvador (47), Panama (51) and Peru (53). Already at the bottom of the ranking, the Latin countries that are are Mexico (68), Bolivia (74), Ecuador (78), Argentina (85), Guatemala (87), Dominican Republic (93), Trinidad and Tobago (98), Honduras (100), Venezuela (103), Nicaragua (114) and Jamaica (115). Without a doubt, there is a long way to go in the region (Figure 1).

**Figure 2.** Report on Promotion of an effective energy transition 2022

Rank	Country	ETI score (2014–2023)	2023 ETI score	SP <sup>1</sup> ('23)	TR <sup>2</sup> ('23)
1	Sweden		78.5	81.0	74.8
2	Denmark		76.1	73.7	79.8
3	Norway		73.7	77.3	68.3
4	Finland		72.8	68.9	78.6
5	Switzerland		72.4	75.7	67.4
6	Iceland		70.6	73.9	65.6
7	France		70.6	73.3	66.5
8	Austria		69.3	69.2	69.5
9	Netherlands		68.8	65.7	73.5
10	Estonia		68.2	74.2	59.2
11	Germany		67.5	64.6	71.9
12	United States		66.3	68.4	63.2
13	United Kingdom		66.2	67.7	64.0
14	Brazil		65.9	68.9	61.3
15	Portugal		65.8	66.7	64.5
16	Spain		65.0	65.1	64.7
17	China		64.9	65.0	64.8
18	Hungary		64.3	68.8	57.5
19	Canada		64.2	66.7	60.3
20	Luxembourg		64.2	61.5	68.2
21	Albania		63.7	71.6	51.8
22	New Zealand		63.7	68.2	56.9
23	Uruguay		63.6	71.5	51.8
24	Australia		63.6	63.1	64.3
25	Costa Rica		63.5	74.5	46.9

Note: SP means System Performance; TR means Preparation for Transition, the figure shows the ranking of countries with the highest ETI score



## Analysis of global initiatives and agreements to promote clean energy

In general, all countries in the world, whether developed like Germany, the United States and Russia; or the so-called Small States such as Denmark, Estonia and Iceland, and emerging countries such as Brazil, China, Colombia and Mexico need to develop an infrastructure that increasingly includes modern energies for their development and inclusion in the international arena, due to the high energy consumption of its populations today and even as a national energy security strategy and as part of its foreign policy and as a means of defense against the current international security environment. It is for this reason that the installation and use of Non-Conventional Energy Sources (FNCE), such as wind energy and photovoltaics, like any project carried out in a region, have associated environmental, social and economic impacts that They must be evaluated in order to make decisions such as the location of the project, the size of the facility, etc. In order to consider all the possible impacts of a project of this type, the impacts must be evaluated in the 3 main phases of its execution: construction, operation and dismantling? (Pasqualino et al., 2015) . The promotion of renewable energies has become the main instrument to achieve the climate and environmental objective in the world ( Yu et al., 2021)

### Worldwide Interconnection Standards

Description of the interconnection standards used globally to guarantee the connectivity and security of distributed generation systems (Figure 3).

**Figure 3.** Regulatory and non-regulatory policies

Regulatory policies						Non-regulatory policies			
For all stakeholders		In large scale installations		Applied to distributed generation		Access to decentralized renewable sources		For all project sizes	
Fees and certificates		FIT and FIP	auctions	FIT and FIP	Net metering and net billing	Legal provisions	Pricing policies	Financial and tax incentives	Voluntary programs

Figure 3 shows us how regulatory and non-regulatory policies are broken down into three levels.

Regarding the policy that can promote the use of renewable energies, it is possible to identify two types, namely, regulatory and non-regulatory (Eirin et al., 2022) :

- I. Regulatory: consists of achieving the objectives of the State through the use of regulations, laws and other instruments to obtain better economic and social results and; consequently, improving the lives of citizens and companies (OECD, s/f).
- II. Non-regulatory: They constitute financial and fiscal policies and instruments that facilitate investments in renewable energies and promote measures that encourage voluntary programs (IRENA, OECD/IEA and REN21, 2018).

Examples of relevant international regulations and standards. There are several relevant international regulations and standards in this area, we mention some (Farfan, 2020) : The Paris Agreement on climate change, which establishes global objectives to reduce greenhouse gas emissions and promote the transition towards a more energy-efficient system. sustainable. The ISO 50001 standard, which establishes a framework for energy management in organizations and promotes energy efficiency. The ISO 14001 standard, which establishes a framework for environmental management in organizations and encourages the adoption of renewable energy technologies and the reduction of greenhouse gas emissions. The European Union Renewable Energy Directive, which sets targets for renewable energy generation in the EU and encourages the adoption of renewable energy technologies. Japan's Renewable Energy Law, which sets targets for renewable energy generation in Japan and encourages the adoption of renewable energy technologies. For example (Osorio-Aravena et al., 2021) confirms that achieving a fully sustainable energy system in Chile by 2050 is technically feasible, and they also reveal that this scenario could be more profitable from 2035 onwards.

How these standards promote system interoperability and energy efficiency. The international standards mentioned above, such as ISO 50001 and ISO 14001 (Farfán, 2020), promote system interoperability and energy efficiency by establishing a framework for energy management and environmental management in organizations. These standards establish requirements for the implementation of energy management and environmental management systems, which can help organizations improve energy efficiency and reduce greenhouse gas emissions. Additionally, these standards promote system interoperability by establishing requirements for the measurement and monitoring of energy and

greenhouse gas emissions. This can help organizations collect accurate data on their energy consumption and emissions, which can be useful in identifying opportunities for improvement and making informed decisions about the adoption of renewable energy technologies and energy efficiency. Overall, these international standards can help organizations improve system interoperability and energy efficiency by providing a framework for energy management and environmental management, establishing requirements for energy and emissions measurement and monitoring , and promote the adoption of renewable energy technologies and the reduction of greenhouse gas emissions.

### **Development Trends in Interconnection Policies and Standards:**

Exploration of emerging trends in energy policies, such as the inclusion of specific distributed generation and renewable energy objectives.

In general (Magoja, 2022) mentions that emerging trends in energy policies focus on the transition towards cleaner and renewable energy sources, energy efficiency and the reduction of greenhouse gas emissions. Some of the emerging trends in energy policies include:

1. **Renewable energy targets:** Many countries are setting ambitious targets to increase the proportion of renewable energy in their energy mix. For example, the European Union has set a goal of reaching 32% renewable energy by 2030. (Murphy et al., 2021) explains that a specific mix of technologies can be configured in various ways to achieve net economic gains. This suggests that technology combinations are not an important way to differentiate between various hybrid renewable energy systems.
2. **Distributed Generation:** Distributed generation refers to small-scale energy production, often through solar panels or wind turbines, rather than large power plants. Many countries are adopting policies to encourage distributed generation, such as tax incentives and feed-in tariffs.
3. **Energy Storage:** Energy storage is key to integrating intermittent renewable energy sources, such as solar and wind energy, into the electrical grid. Many countries are investing in energy storage technologies, such as batteries and thermal storage systems.

(Abo-Khalil et al., 2023) discusses the potential of hybrid energy storage systems (HESS) to improve the reliability, effectiveness and sustainability of energy storage systems, particularly in the context of energy source integration. renewable energy, electric vehicles and energy storage systems. HESS combines several energy storage technologies to maximize benefits and minimize drawbacks,

overcoming the limitations of individual methods. Different connectivity topologies (passive, active, semi-active ) and control solutions (traditional and intelligent) are explored , including filter-based control, droop control, sliding mode control and others. Controlling power flow between storage components and the grid is crucial to optimize HESS operation and ensure reliable performance. Challenges such as cost, network integration, scalability, environmental impact and security are highlighted, with recommendations to address these challenges through technological development, interdisciplinary cooperation, standardization and legislative support.

4. Electrification of transportation: The electrification of transportation, through electric vehicles and other electric means of transportation, is an emerging trend in energy policies. Many countries are setting targets to increase the proportion of electric vehicles on the roads and are investing in charging infrastructure. Although according to (Shah, 2022) the deployment of electric vehicles could contribute to the destabilization of the electrical grid, that is, it is a potential risk.

5. Energy efficiency: Energy efficiency is an important way to reduce energy consumption and greenhouse gas emissions. Many countries are adopting policies to improve energy efficiency in buildings, industries and transportation. (Tsemekidi Tzeiranaki et al., 2023) Indicates that the number of cars increases with GDP, this is possibly due to high levels of taxes on cars in conjunction with efficient public transport systems.

#### **Trends in the flexibility of interconnection standards to adapt to emerging technologies.**

Flexibility of interconnection standards is important to adapt to emerging technologies. In addition, it is mentioned that it is necessary to adapt the regulatory framework to promote the development of new value chains. In summary, the importance of having flexible interconnection standards and an adequate regulatory framework to promote the development of new technologies is highlighted (ECLAC- eLAC , 2022).

#### **How policies and regulations are evolving to address challenges such as the intermittency of renewable sources.**

In India, around 34,605 MW of wind power plants have been installed as of September 2018. In terms of wind energy conversion/utilisation, occupying the fourth position in the world indicates (Chaurasiya et al., 2019) . This shows that as the world population continues to grow, the world's need for energy

increases (Eirin et al., 2022) . To meet this growing demand, the transformation to renewable energy is essential. Regulatory frameworks are a powerful tool to drive this transformation.

Regulatory frameworks can provide incentives to promote the use of and investments in renewable energy. This may include subsidies, tax breaks or other forms of support, such as grants or preferential loan terms. These incentives can help reduce the cost of renewable energy and make it more attractive to businesses and consumers.

Regulatory frameworks can also be used to establish standards and guidelines for the use of renewable energy. This may include setting targets for the use of renewable energy, creating energy efficiency standards, and establishing rules for emissions reductions. These standards and guidelines can help ensure that renewable energy resources are used as efficiently and cost-effectively as possible.

Finally, regulatory frameworks can be used to encourage innovation in renewable energy technologies. This may include establishing regulations that require the use of new technologies, providing incentives for research and development, or creating standards for new energy sources. By encouraging new and innovative renewable energy technologies, these regulations can help reduce the cost of renewable energy and make it more accessible to businesses and consumers. For example (Burnett & Hefner, 2021) indicates North Carolina created its net metering policies early, to drive the growth of this industry.

In general, regulatory frameworks play a fundamental role in driving the transformation towards renewable energies. By providing incentives, setting standards, and encouraging innovation, regulatory frameworks can help make renewable energy more cost-effective and accessible. This is essential to ensure a sustainable energy future for the world.

### **Perspectives in Peru**

#### **Evaluation of the current state of energy policies and interconnection standards in Peru.**

In Peru, the Regulatory Framework for the promotion of electricity generation with non-conventional renewable energies is made up of the following regulations (Condor, 2021) :

- Legislative Decree No. 1002 (Published in the Official Gazette El Peruano in May 2008). Promotion of investment for the generation of electricity with the use of renewable energy sources,
- Legislative Decree No. 1058 (Published in the Official Gazette El Peruano in June 2008). That promotes investment in generation activity with water resources and other renewable resources.

- Regulation of electricity generation with renewable energies, approved by Supreme Decree No. 012 - 2011 - EM.
- Regulation for the promotion of electrical investment in areas not connected to the grid, approved by Supreme Decree No. 020 - 2013 - EM.
- The Legislative Decree that establishes the Special Regime for Early Recovery of the General Sales Tax, approved by Legislative Decree No. 973.

This regulatory framework declares the development of new electricity generation using renewable resources of national interest and public necessity and establishes incentives for the promotion of generation projects, such as priority for load dispatch, access to electrical transmission and distribution networks, tariffs . long-term stable (20 to 30 years) established by purchasing all the energy produced.

Additionally, it establishes the following guidelines:

- Participation of renewable energies in national electricity consumption in a target percentage that during the first 5 years is up to 5% (not including small hydroelectric plants).
- Priority to connect to transmission and distribution networks and payment of incremental costs generated by the use of transmission and distribution networks.
- Accelerated depreciation of assets over up to 5 years (at an annual rate of no more than 20%) for income tax purposes.

#### **Analysis of how Peruvian regulations encourage or limit distributed energy generation.**

In Peru, customers of the public electricity service, such as the residential, commercial and industrial sectors, have total dependence on the conventional electrical system to supply their energy needs; There is also a waste of renewable energy resources by these clients, due to the lack of promotion and implementation policies, especially for the generation of electricity for consumption.

The regulation of the use of electrical distribution and transmission networks for distributed generation is not considered in the Peruvian regulatory framework. Consequently, there is no promotion mechanism on the part of the state towards distributed generation that provides the respective legal security, as countries on our continent do. Identified barriers in terms of regulation:

- According to DS No. 012-2005-EM in its Article 1, it mentions the formation of the COES, whose text of the aforementioned decree indicates it verbatim.



- However, it belongs to the System's Economic Operation Committee and operates the cogeneration plant according to the COES economic dispatch program. It would be detrimental to cogeneration when electricity production, in most cases, is a consequence of meeting a thermal demand associated with a particular industry. This is the case of backpressure steam turbine cycles and gas turbines.

**Perspectives on how the adoption of more favorable policies and regulations could boost distributed generation in the country.**

The existing legal framework for Distributed Generation in Peru includes proposals (Ramos, 2020) , with the aim of being evaluated by those in charge of approving and implementing regulations on Distributed Generation in the country. Furthermore, it is highlighted that the gradual and scheduled penetration of Home Distributed Generation is recommended, and its implementation through pilot programs is suggested. Therefore, it is suggested that the adoption of more favorable policies and regulations could promote distributed generation in Peru, and proposals and recommendations are included for the implementation of regulations on Distributed Generation in the country.

The country has a commitment, born in the 2015 Treaty of Paris, to reduce its emissions; Therefore (Gamio Aita, 2018) , it must stop deforestation and accelerate a gradual change in the energy matrix, move efficiently towards clean energy and achieve decentralized sustainable growth. Governance and the ability to confront climate change are at stake: this is the urgency of a new energy policy. This effort must have strategic planning with short, medium and long term goals. Peru is building its own energy transition. Peru faces a great challenge. A society that seeks its development must manage with great care and prudence the renewable and non-renewable natural resources within its reach, as well as the human factor and the cultural and social aspects linked to the management of resources. A first step in this task is environmental literacy and strategic planning in the formulation of public policies to promote the sustainable growth of economic activities. In Peru there is a need to empower people and articulate social and economic public policies, building links in favor of a healthy environment and sustainable development.

## Challenges and Opportunities in Peru

Identification of current regulatory challenges in the Peruvian context, such as the harmonization of standards and adaptation to the intermittency of renewable sources.

The current regulatory challenges in the Peruvian context (Ramos, 2020) are related to the implementation of regulations on Distributed Generation and the impact of the Distributed Generation regulation project approved by the Ministry of Energy and Mines in 2018 on the energy market. Peruvian.

There are several measures (Farfan, 2020) , which are being taken to promote the production and use of renewable energy, such as hydroelectric, wind, solar and biomass energy. These measures include the promotion of alternative and renewable energy sources, the development of new biorefineries for the production of biofuels, bioproducts and biomass, tax incentives for the production of renewable energy, and the streamlining of licensing processes for hydroelectric plants. In addition, it is mentioned that the American Solar Energy Initiative (SAI) is working on the development of new solar energy technologies. On the other hand (Zolfaghari et al., 2022) indicates a main element in the realization of the smart grid is the hybrid alternating current and direct current microgrid.

According to (Condor, 2021), distributed generation in Peru faces challenges related to the lack of regulation and promotion by the state, but also presents opportunities related to the availability of renewable resources and the growing demand for energy. It is recommended to review the full document for more details on the challenges and opportunities of distributed generation in Peru.

Opportunities to overcome these challenges and foster a more robust and competitive distributed generation market.

(Niu et al., 2022) indicates that environmental variables hide the fact that most countries allocate capital inefficiently and that strong national policies are required to increase their efficiency in resource allocation. So distributed generation in Peru faces a series of challenges, including lack of regulation, interconnection problems, lack of financing, lack of awareness and technical problems. To overcome these challenges, it is necessary to establish a clear regulatory framework, improve electricity grid infrastructure, establish fiscal and financial incentives, and increase public awareness about the benefits of distributed generation.

## CONCLUSIONS

The distributed generation with clean renewable energy (green) of greatest importance today is photovoltaic energy, since through solar radiation we obtain the electrical energy required for the development of a country, thereby avoiding the deterioration of the environment. ; As an example, we have the countries Mexico and Brazil that have solar installations that are greatly displacing fossils such as coal and oil. Therefore, generating clean renewable energy will greatly contribute to minimizing the emission of CO<sub>2</sub> gases into the environment, which greatly harms, especially, the planet's ozone layer. To achieve efficient and effective development like Chile's, Peru must concentrate its efforts on better organizing the government and the sector. Our country has good natural conditions for NCRE, but the usual lobbies and lack of political will resist investment in clean energy. To this end, it is suggested that debates be held in the National Agreement and in the Congress of the Republic, to formulate long-term National Plans that are fulfilled, that provide confidence to investors in the new energy policies that will be oriented and finally respected. Likewise, subnational and regional policies are necessary in this sector, since the lack of strategic planning and adequate articulation and coordination between central, regional and local governments will reinforce economic centralism and the greater dependence of the regions, the economic resources and the thermal energy that today comes from Lima.

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