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The missionary helix: reconfiguring the institutional model of innovation from the perspective of the entrepreneurial state.

The missionary helix: reconfiguring the institutional model of innovation under the entrepreneurial state perspective

The missionary helix: reconfiguring the institutional model of innovation from the perspective of the entrepreneurial State

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ABSTRACT: This article proposes a theoretical rearticulation of the Triple Helix model, integrating it with the premises of the Entrepreneurial State. It argues that the classic configuration of collaboration between University, Industry, and Government lacks strategic directionality, resulting in incremental innovations and the private capture of public risks. Through a qualitative and integrative analysis, the work outlines the Missionary Helix, an institutional arrangement in which the State acts as a first-resort investor, the University operates within Pasteur's Quadrant, and Industry submits to a symbiotic risk-reward nexus.

It can be concluded that overcoming contemporary challenges requires a social pact that recognizes innovation as a collective and focused effort.

Keywords: Innovation. Triple Helix. Entrepreneurial State. Directionality. Risk-Reward Nexus.

ABSTRACT: This paper proposes a theoretical rearticulation of the Triple Helix model by integrating it with the premises of the Entrepreneurial State. It is argued that the classic configuration of collaboration among University, Industry, and Government lacks strategic direction, resulting in incremental innovation and the private capture of public risks. Through a qualitative and integrative analysis, this study designs the Missionary Helix, an institutional arrangement in which the State acts as an investor of first resort, the University operates within Pasteur's Quadrant, and Industry adheres to a symbiotic risk-reward nexus. The study concludes that overcoming contemporary challenges requires a social pact that recognizes innovation as a collective and directional effort, ensuring that the fruits of technological progress are shared by the society that bore the initial uncertainty.

Keywords: Innovation. Triple Helix. Entrepreneurial State. Directionality. Risk-Reward Nexus.

1. INTRODUCTION

The architecture of contemporary innovation policies remains, to a large extent, trapped in the dogma of correcting market failures. From this neoclassical perspective, the The state is relegated to a reactive role, intervening only to mitigate externalities or to to provide public goods that the private sector neglects. However, as Mazzucato demonstrates (2014), this view ignores the historical evidence that the most disruptive technologies of the last The century saw the emergence of state investments that embraced radical uncertainty, when capital The private sector proved to be absent.

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The Triple Helix model, originally proposed by Etzkowitz and Leydesdorff. (2000), represented an advance in describing the dynamics of overlap between the spheres. institutional. However, the evolution to the balanced model (Helix III) generated a an equivalence that, in practice, stripped the strategic leadership system. The central problem The problem lies in the lack of direction: without a clear mission, the propeller spins around interests. fragmented and financialized innovation.

This article proposes a reconfiguration of this model, called the Missionary Helix. The objective is to demonstrate how the integration of Mariana Mazzucato's theory into the dynamics of The Triple Helix model can generate an ecosystem capable of facing major challenges. To that end, the The study combines a theoretical review with an exploratory comparative analysis based on indicators. Innovation in the renewable energy sector.

2. THEORETICAL FRAMEWORK

2.1 The Evolution of the Triple Helix: From Collaboration to Inertia INSTITUTIONAL

The concept of the Triple Helix, consolidated by Etzkowitz and Leydesdorff (2000), emerged as an alternative to linear models of innovation. In the linear model, innovation was viewed as a rigid sequence that went from basic science (university) to applied science. (industry). The Triple Helix breaks with this view by proposing a dynamic of interdependence.

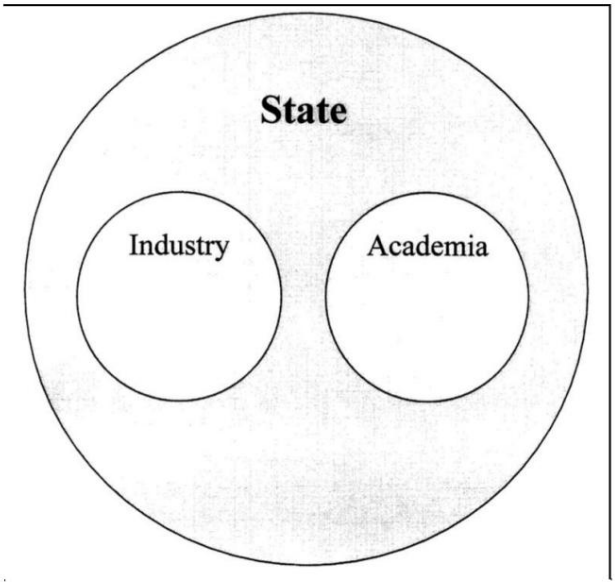
Historically, Etzkowitz (2008) identifies three stages of institutional evolution. The The first of these, Helix I (Statist), is characterized by a model in which the State encompasses the academia and industry, directing the other spheres and curtailing their autonomy (Figure 1).

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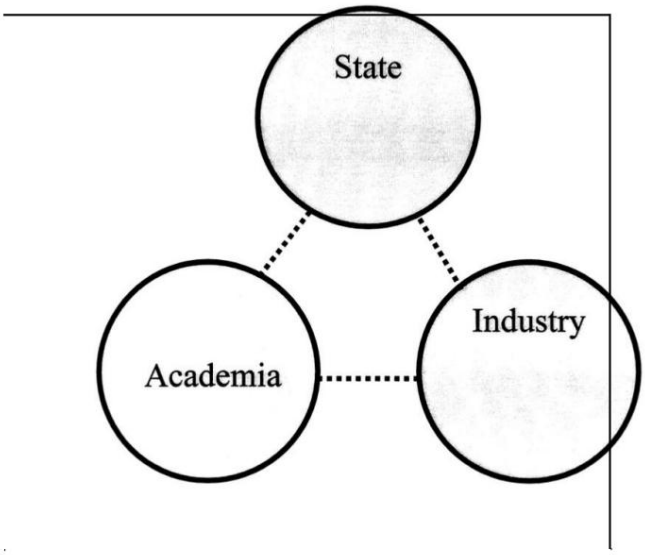
Figure 1 – Statist Model.



Source: Etzkowitz (2000).

In contrast, the Helix II (Laissez-faire) is characterized by the rigid separation between the spheres, with well-defined boundaries and limited interactions (Figure 2). At this stage, the prevailing belief that the market should dictate the pace of technology, leaving the State with only the function of regulator.

Figure 2 – Laissez-faire model.



Source: Etzkowitz (2000).

Finally, the Balanced Helix III proposes the overlapping and creation of organizations. hybrid (Figure 3). In this model, the university creates companies (incubators), and industry takes over. The role of technical training and the government acting as a financial facilitator through networks.

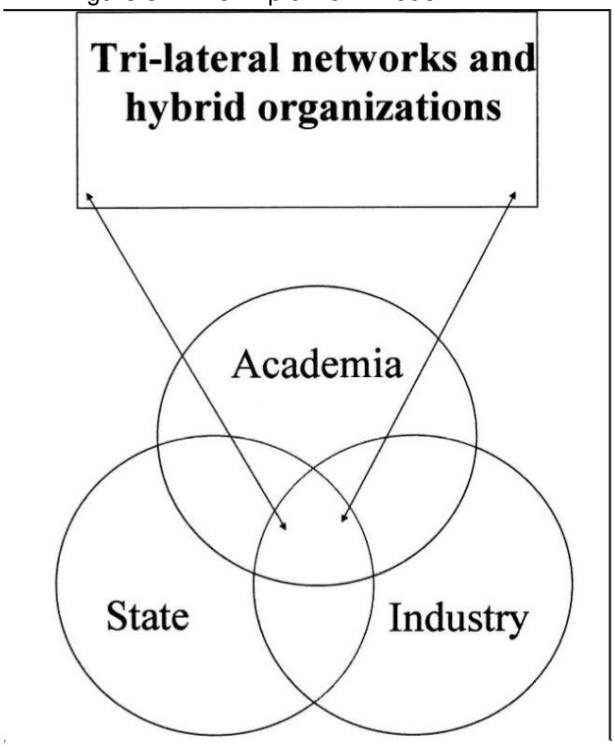
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trilateral.

Figure 3 – The Triple Helix Model.



Source: Etzkowitz (2000).

However, it is observed that Helix III, although celebrated in the literature, lacks strategic directionality. As Mazzucato (2018) points out, the mere existence of networks of Collaboration does not guarantee that innovation will be geared towards solving structural challenges. The lack of a Public coordination with clear goals, such as the energy transition or digital sovereignty, makes it possible to that innovations focus on incremental gains, low risk, and high immediate return. for the private sector.

2.2 THE ENTREPRENEURIAL STATE: INVESTOR OF FIRST RESOURCE AND MARKET ARCHITECT

Mazzucato's (2014) central criticism lies in demystifying the sector's efficiency. The author demonstrates that the propensity of private capital in relation to the inefficiency of the public sector. Private risk is limited to stages of technological development where the return is already guaranteed. Predictable. The animal spirits of capitalism, often attributed to entrepreneurs. Individual [investment], was in fact preceded by state investment during periods of uncertainty. Knightiana (uncertainty that cannot be contained or calculated).

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> The role of the public sector is not only to correct market failures, but also being a first-resort investor, a market architect. and a catalyst for networks that drive structural change. The The state should not only oil the machine, but also build it. (Mazzucato, 2014, p. 28).

In this sense, the theory of the Entrepreneurial State engages with the need for a New Industrial policy, as argued by Rodrik (2004). The State must have the capacity to choose. directions, not necessarily specific companies to subsidize, but rather missions that require all the actors in the helix innovating towards a social need.

2.3 The University and Science Inspired by Use: The Quadrant of PASTEUR

For the university to integrate the Missionary Helix, it is necessary to overcome the dichotomy between basic and applied science. Stokes (2005) proposes Pasteur's Quadrant as the ideal location for contemporary scientific production. While the Bohr Quadrant focuses on pure basic research. and Edison's Quadrant in commercial application, without theoretical concern, Pasteur represents the A search for fundamental understanding, guided by a practical problem.

In this missionary reconfiguration, the University abandons its passive role as a seller. From patents to becoming a center of excellence that responds to the challenges posed by the State. This requires what Etzkowitz (2008) calls the Second Academic Revolution, in which the mission of Economic and social development is internalized within the university structure, but now subordinated to a connection of public interest, and not merely commercial interest.

2.4 Technological Revolutions, Financial Capital, and the Capture of VALUE

The sustainability of the Triple Helix is threatened by the dynamics between capital. financial and productive capital. Perez (2002) argues that, after the initial shock of a With technological revolution, financial capital tends to become detached from production, generating bubbles. Speculative practices that drain resources from effective innovation.

In the current model, the industry often operates in an extractive manner: it uses the knowledge generated with public funds to generate profits that are converted into dividends and in share buybacks, instead of being reinvested in the ecosystem. The Missionary Helix emerges,

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therefore, as a systemic correction tool, re-establishing the link between production of value and its distribution, according to the premises of economic development. coordinated and sustainable (Perez, 2002; Mazzucato, 2014).

Based on this framework, it becomes possible to empirically assess the extent to which Different institutional arrangements generate distinct results in terms of innovation and technological development.

3. MATERIALS AND METHODS

This study is characterized as qualitative research of an analytical nature. comparative, based on an integrative literature review and the use of secondary data. for exploratory purposes. The approach combines the theoretical foundations of the economics of innovation. with the comparative analysis of public policies, aiming to evaluate the explanatory power of model proposed by the Missionary Helix.

The theoretical review was conducted based on classic and contemporary works on systems. innovation and industrial policy, with emphasis on the Triple Helix models (Etzkowitz; Leydesdorff, 2000; Etzkowitz, 2008), the theory of the Entrepreneurial State and innovation-oriented thinking. through missions (Mazzucato, 2014; 2018), the dynamics between financial and productive capital (Perez, 2002) and the contemporary approach to industrial policy (Rodrik, 2004). Based on this foundation, it was The theoretical proposal of the Missionary Helix was constructed as an institutional reconfiguration of innovation system.

For empirical purposes, a comparative analysis strategy was adopted between different Innovation policy regimes in the renewable energy sector. Cases were selected. representative based on widely documented evidence in the literature, distinguishing themselves two institutional arrangements: (i) policies aimed at correcting market failures, with emphasis in demand incentives, and (ii) mission-oriented policies, characterized by state directionality, inter-institutional coordination and induction of productive capacities and technological.

The analysis was complemented by the use of secondary indicators of innovation and technological development, obtained from consolidated international bases, such as the Organisation for Economic Co-operation and Development (OECD), the World Intellectual Property Organization (WIPO) and the International Energy Agency (IEA). The selected indicators These include, in an exploratory manner, investment in research and development (R&D), participation in technological production, patent generation, and integration into global value chains in the sector of renewable energies.

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The data are not used for inferential statistical purposes, but rather as...
Empirical evidence to support theoretical and comparative analysis. The goal is to identify patterns.
consistent across different institutional arrangements and their outcomes in terms of capacity to
Innovation, technological internalization, and retention of economic value.

Finally, the results of the comparative analysis are interpreted in light of the theoretical framework.
adopted, seeking to assess the extent to which the presence of state directionality and mechanisms
Institutional coordination contributes to overcoming the limitations observed in the models.
Traditional innovation approaches. This methodological strategy allows for the articulation of theory and evidence.
empirically, in a coherent manner, without displacing the analytical nature of the study.

4. RESULTS AND DISCUSSION

4.1 THE ARCHITECTURE OF THE MISSIONARY HELIX: OVERCOMING SYMMETRY

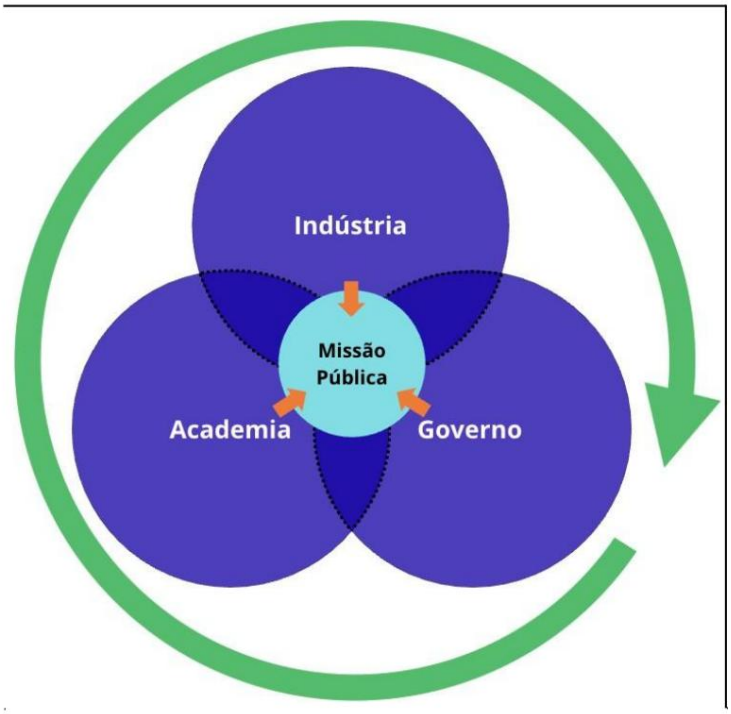
The main finding of this analysis is that the Triple Helix III (balanced) model
This fails because it assumes a symmetry of intentions between the actors. In practice, radical innovation does not...
It emerges from a spontaneous collaboration, but with a directionality.
Induced. The Missionary Helix reconfigures the institutional triangle by assigning the State the role
mission orchestrator, as shown in Figure 4.

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Figure 4 – Schematic Representation of the Missionary Helix.



Source: Own (2026).

As illustrated, the Missionary Helix reorients the balance between the spheres.
institutional. While the traditional model focuses on organic overlap, the model
The missionary introduces a core of directionality. In this structure, the interactions are not...
merely horizontal; the State sets the course through ambitious goals.

The mission functions like the centripetal force (illustrated by the orange arrows in the diagram) that
This drives the reorientation of the other two propellers: The Academy, whose research infrastructure...
It becomes geared towards offering specific solutions for the mission, overcoming the focus
exclusive in traditional metrics, such as publications or patents; and the Industry, which is attracted to
The network is valued not only for subsidies, but primarily for the opportunity to develop new...
High value-added markets that do not yet exist.

The distinguishing feature of this model is the Directionality Vector (represented by the orbital arrow).
(Green in Figure 4). It symbolizes the active public policy that shapes the market and maintains the system.
in coordinated motion. Unlike the statist model (Helix I), the Helix

The missionary does not stifle autonomy; she creates a space for problem-solving in which creativity thrives.
The expertise of industry and academia is channeled towards solving problems of public relevance. According to
According to Rodrik (2004), the success of modern industrial policy depends on a process of
Strategic self-discovery mediated by the public sector.

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4.2 The Role of Mission Agencies as Facilitators

For the Missionary Helix to be more than just an abstract concept, it requires...
Institutionalization of missionary agencies. The DARPA (Defense Advanced Research Projects) model.
Projects Agency) serves as proof of concept. These agencies act as the connective tissue.
from the helix: they hire project managers who move between academia and the market and finance
not only research, but also prototyping and demonstration, overcoming the Valley of Death.

They allow for technical errors, treating project failure as a necessary cost.
to the system's learning process. This dynamic alters the perception of risk. When the State signals
that is in the game for the long term, it generates a *crowding-in effect,* where
Private capital feels secure investing in technologies that, without state support, would be...
considered excessively risky (Mazzucato, 2014).

4.3 The Risk-Reward Nexus: Implementing Symbiosis

The most constructive outcome of this article is the design of the Risk-Reward Nexus.
It is argued that the missionary model is only sustainable if there is a mechanism for return.
that fuels the innovation cycle. If the taxpayer assumes the risk of uncertainty, they must share in the...
The fruits of success. To operationalize this symbiosis between the State and Industry, we propose three
Practical mechanisms of conditionality are detailed in Table 1:

Table 1 – Conditionality and Public Feedback Mechanisms.

Golden Shares and Royalties	In critical technologies fully funded by public agencies, the state retains a stake in any extraordinary profits. These resources are earmarked for innovation funds for future projects.
Clauses of Reinvestment	Companies that achieve high profit levels through state-based innovations are prevented from carrying out stock buybacks and are required to reinvest in R&D or local infrastructure (Perez, 2002).
Affordable Prices and Open Access	The agreement provides for regulated prices based on public investment received, preventing citizens from paying twice for the same innovation.

Source: Own (2026).

The implementation of these mechanisms aims to correct the historical asymmetry in which the risks
Socialized assets are used while profits are privatized. By establishing these conditions, the
Missionary Helix ensures that the private sector acts as a partner and not merely in an extractive capacity.

This new conditionality pact is what guarantees the fiscal and political sustainability of the
model. Without the return of successful investments to the public innovation fund, the State loses the
capacity to finance the next wave of radical uncertainty. Therefore, the Risk-Reward Nexus

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It is not merely a financial adjustment, but a tool for social justice and efficiency.

An economic mechanism that keeps the propeller in perpetual and virtuous motion.

4.4 ANALYSIS OF THE CASE OF RENEWABLE ENERGIES AND THE TRAP OF TECHNOLOGICAL SUBSERVIENCE

To empirically analyze the effects of different institutional innovation arrangements, the The renewable energy sector is a relevant field, given its high complexity. Technological, dependence on public policies, and the need for systemic coordination. A The energy transition involves not only expanding productive capacity, but also... building associated technological and industrial skills.

Countries that limited their actions to correcting market failures through subsidies. related to consumption or incentive tariffs without structural counterparts, they operated under a logic Compatible with Helix II. In this arrangement, an expansion of installed capacity is observed. accompanied by low technological internalization. Data from the International Energy Agency indicate that, in several countries, the initial expansion of solar energy was supported by the importation of equipment, especially from Asian countries (IEA, 2022). This pattern is reflected in the distribution of Intellectual property. The concentration of patents in renewable energy technologies. It is found mostly in economies that have adopted coordinated innovation strategies. According to data from the World Intellectual Property Organization and the Organisation for Economic Co-Operation and Development, countries like China, the United States, Japan, and Germany concentrate Most patent registrations in this sector, while countries with policies focused exclusively in demand they have a reduced participation (WIPO, 2023; OECD, 2023).

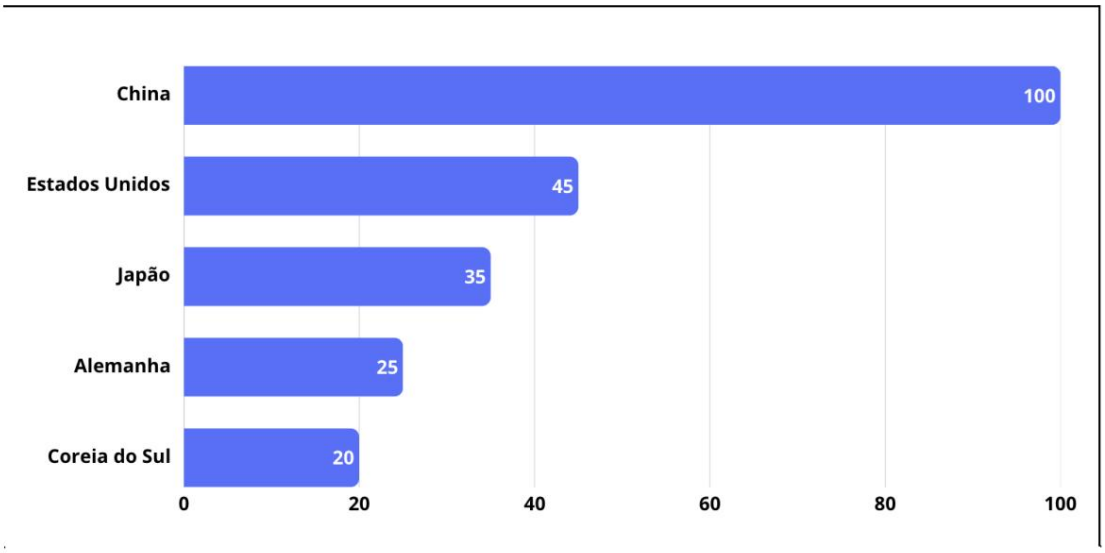
Figure 5 illustrates this concentration, highlighting the overall asymmetry in the generation of technological knowledge in renewable energies.

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Figure 5 – Relative distribution of patents in energy-related climate mitigation technologies (YO2E) by selected countries



Source: Own (2026).

Note: Values normalized to a relative index (China = 100), based on OECD ENV-TECH data.

This distribution indicates that the expansion of the domestic market does not necessarily imply, domestic technological development. In undirected models, dissociation is observed. between consumption and technological production, resulting in low retention of economic value and in dependence on external suppliers.

In contrast, countries that have adopted mission-oriented strategies have structured... Policies that combine public funding, scientific direction, and industrial coordination. As Mazzucato (2018) argues, the State acts as an agent that defines guidelines. technological and organizes the incentives necessary for its implementation. The experiences of Germany and China exemplify this arrangement, in which public investment is accompanied by institutional mechanisms that promote technological internalization and development productive capacities.

An analysis from the perspective of this article allows us to identify, in these cases, the operation of a An institutional arrangement compatible with the Missionary Helix. The alignment between the State, University and industry ensured that public investment was not wasted, according to summarized in Table 2.

Table 2 – Institutional Coordination for Energy Transition (Germany and China)

University Focus	on cutting-edge R&D for semiconductor materials and for Energy storage, aligned with Pasteur's Quadrant.

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State	Providing capital to the patient through public banks (KfW and CDB), assuming the long-term uncertainty that the financial market rejected.
Industry	Engagement in consortia that accepted efficiency and local content targets in exchange for markets guaranteed by the State.

Source: Own (2026).

The comparison between the arrangements shows that the presence of state directionality is evident. associated with greater capacity for technological internalization, industrial development and retention of economic value. In models driven exclusively by demand, one observes a A pattern of technological dependence, in which the State assumes the costs of the energy transition. while the benefits associated with innovation are appropriated externally.

In the model proposed by the Missionary Helix, the energy transition is structured as A public mission, guiding coordinated action among the three institutional spheres. The State It defines strategic guidelines and mobilizes policy instruments; the university directs its scientific capacity to address concrete challenges; and industry operates under conditions that link the Innovation for generating internal value.

As Polanyi (2000 [1944]) observes, the economic system must be incorporated into social needs. In this context, the policy of innovation in renewable energies begins to operate. as an instrument of structural transformation, contributing to energy security, the Environmental sustainability and technological autonomy. The data analyzed. They indicate that institutional arrangements with a higher degree of coordination and directionality exhibit Superior performance in building technological and productive capabilities.

FINAL CONSIDERATIONS

The analysis developed in this article has demonstrated that the classic configuration of The triple helix, in its balanced version, presents structural limitations associated with the absence of... of strategic directionality and the consolidation of institutional arrangements that favor the The disconnect between public investment and the private appropriation of the results of innovation. The Missionary Helix proposal was formulated as a reconfiguration of this model. based on the centrality of the State as an agent capable of defining technological and... coordinate institutional efforts.

The incorporation of empirical evidence, based on the analysis of the renewable energy sector, This allowed for the qualification of this theoretical proposition. It was observed that the capacity to generate technological knowledge, as measured by the distribution of patents in mitigation technologies

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Climate-related energy factors are concentrated in a limited set of economies.
This pattern indicates that market expansion is not enough to promote development.
domestic technology, requiring the existence of institutional mechanisms that articulate
Public investment, scientific output, and industrial capacity.

Comparative analysis showed that countries that adopted strategies guided by
missions offer greater capacity for technological internalization and value retention.
economic, in contrast to arrangements based solely on demand incentives.
The result is consistent with the central hypothesis of this study, according to which innovation of a certain nature...
Transformation depends on state direction and coordination among the actors in the system.
innovation.

In this context, the Missionary Helix provides an analytical framework capable of explaining the
differences observed in national trajectories of technological development, by emphasizing the
The need for alignment between the government, universities, and industry around public objectives.
defined. The proposed model also allows for further discussion on
The risk-reward nexus, by indicating that the sustainability of innovation systems depends on
The existence of mechanisms that ensure a social return on public investments.

From a theoretical standpoint, the article contributes to integrating the Triple Helix approach.
to the literature on Entrepreneurial State and mission-driven innovation, offering a
an interpretative structure that articulates institutional coordination, directionality, and distribution of
value. From an applied perspective, the results indicate that public policies focused on innovation
They must overcome approaches focused solely on correcting market failures.
incorporating instruments capable of inducing technological trajectories and strengthening capabilities
national production.

Finally, it is acknowledged that the study has limitations inherent in the use of data.
Secondary studies with an exploratory purpose and lacking inferential quantitative analysis. Research
Future researchers may deepen the investigation through comparative case studies and analyses.
longitudinal studies of innovation indicators and specific policy assessments in different
national contexts. Nevertheless, the findings presented here indicate that the construction of
Innovation systems capable of addressing contemporary challenges depend on the adoption of
institutional arrangements guided by public missions and supported by mechanisms of
coordination and social return on investment.

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REFERENCES

ETZKOWITZ, H. **The Triple Helix:** university-industry-government innovation in action. London: Routledge, 2008.

ETZKOWITZ, H.; LEYDESDORFF, L. The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university-industry-government relations. **Research Policy,** vol. 29, no. 2, p. 109–123, 2000.

INTERNATIONAL ENERGY AGENCY (IEA). *World Energy Outlook 2022.* Paris: IEA, 2022.

MAZZUCATO, M. **The Entrepreneurial State:** Debunking the myth of the public vs. private sector. São Paulo: Portfolio-Penguin, 2014.

MAZZUCATO, M. Mission-oriented innovation policy: challenges and opportunities. **Industrial and Corporate Change,** vol. 27, no. 5, p. 803–815, 2018.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD). *ENV-TECH database.* Paris: OECD, 2023.

PEREZ, C. **Technological Revolutions and Financial Capital:** the dynamics of bubbles and golden ages. Cheltenham: Edward Elgar, 2002.

POLANYI, K. **The Great Transformation:** The Political and Economic Origins of Our Time. Rio de Janeiro: Campus, 2000 [1944].

RODRIK, D. **Industrial Policy for the Twenty-First Century.** Cambridge: Harvard University Press, 2004.

STOKES, DE. **Pasteur's Quadrant:** Basic Science and Technological Innovation. Campinas: Editora da Unicamp, 2005.

WORLD INTELLECTUAL PROPERTY ORGANIZATION (WIPO). World Intellectual Property Indicators 2023. Geneva: WIPO, 2023.

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