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Opinion

The Energy Transition: Between Climate Urgency and Socioeconomic Viability

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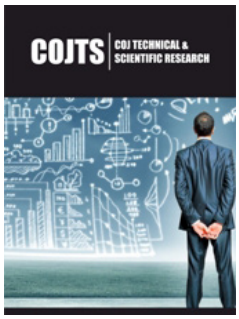

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Abstract

The energy transition is one of the greatest challenges of the 21st century, involving not only technological innovation but also deep social, economic, and geopolitical transformations. The world's dependence on fossil fuels contrasts with the urgent need to reduce carbon emissions, making change inevitable. Renewable sources, such as solar and wind, hold great potential but still face limitations related to intermittency and infrastructure. The process also requires just transition policies to prevent inequality and economic abandonment in regions dependent on oil and coal. Moreover, geopolitics is shifting from the dominance of oil to strategic minerals of lithium and cobalt. In Brazil, despite a relatively clean electricity matrix and vast renewable potential, the pre-salt oil reserves remain a strong economic dependency. The success of the transition will depend on balancing climate urgency, economic feasibility, and social justice, representing a historical necessity that will define the future of the next generations.

Keywords: Energy transition; Renewable sources; Fossil fuels

Introduction

The energy transition is emerging as one of the greatest challenges of the 21st century. More than a technological issue, it involves a structural change in the ways we produce, distribute, and consume energy, with direct repercussions on the global economy, geopolitical relations, and the daily lives of billions of people. Amid the pressures of the climate emergency and the commitments made in international agreements, such as the Paris Agreement, governments, businesses, and civil society face a dilemma: how can we drastically reduce greenhouse gas emissions without compromising economic growth and energy security?

Discussion

On the one hand, the scientific consensus is clear, continuing the fossil fuel-based model is unsustainable. The energy sector accounts for approximately three-quarters of global carbon emissions and is the main driver of the climate crisis. On the other hand, it is undeniable that oil, gas, and coal still represent the basis of the global energy matrix, accounting for over 80% of primary supply. This duality highlights the paradoxical nature of the energy transition. it is urgent, but also fraught with technical, political, and social barriers. Among the possible paths, the expansion of renewable sources plays a central role. Solar and wind energy have experienced rapid growth over the past two decades, driven by cost reductions and technological advancements. However, they still face challenges related to intermittency and integration into transmission grids, which require investment in storage and digitalization. Nuclear energy, although controversial, is re-emerging as a low-carbon alternative, especially in countries seeking energy stability. Furthermore, there is a promising field in Carbon Capture, Storage, and Utilization (CCUS), green hydrogen, and second-generation biofuels-technologies that can reduce the impact of difficult-to-decarbonize sectors such as steel,

cement, and shipping. However, the energy transition cannot be reduced to a technological equation. It is, above all, a social and political transformation. Replacing fossil fuels with renewables implies reconfiguring entire production chains, redistributing jobs, and addressing historical inequalities. Regions highly dependent on oil or coal exploration face the risk of "economic abandonment" if there are no just transition policies capable of retraining workers and promoting new opportunities. Resistance from certain groups, coupled with economic lobbies, remains a significant obstacle.

Another crucial aspect is the geopolitics of energy. Control over oil and gas reserves has historically shaped power relations between nations. In this new scenario, strategic minerals such as lithium, cobalt, and rare earths-essential for batteries and renewable technologies-become key elements. This shifts the axis of international tensions and could generate new dependencies. Countries holding these resources gain centrality, while others are forced to seek technological alternatives to reduce vulnerabilities. From a consumer perspective, the transition also presents dilemmas. Electric cars, solar roofs, and smart energy management systems are more accessible, but still restricted to segments of the population with greater purchasing power. Social inclusion must be prioritized; otherwise, it risks creating an uneven transition, in which few benefit from clean technologies while many remain marginalized. The often-overlooked aspect of energy efficiency can be a quick and low-cost path to reducing emissions, expanding access, and democratizing the benefits of change. Brazil occupies a unique position in this debate. With a relatively clean electricity matrix-composed largely of hydroelectric power-the country has the competitive advantages to lead the transition. The potential for expanding solar and wind energy is immense, especially in the Northeast, as is the capacity to develop the biofuels and green hydrogen markets. However, Brazil also relies heavily on oil as a source of foreign exchange and jobs, especially in the pre-salt layer. This creates a strategic crossroads: how to reconcile renewable energy leadership with maintaining a thriving oil industry? The answer lies in long-term planning, investment in innovation, and public policies that align sustainability and competitiveness.

Conclusion

The energy transition is not just a choice, but a historic necessity. The central question is not "if" it will occur, but "how" and "at what pace." A slow process could jeopardize the goal of limiting global warming to 1.5 °C, bringing devastating consequences for ecosystems and vulnerable populations. An abrupt and poorly planned process, in turn, could generate economic crises, mass unemployment, and political instability. Striking a balance requires political courage, international cooperation, and social engagement. Therefore, defending the energy transition means defending a future in which prosperity and sustainability go hand in hand. The climate emergency no longer allows us to postpone decisions. It is time to transform rhetoric into concrete actions, integrating science, technology, and social justice. The challenge is immense, but inaction will be far more costly. The energy we choose today will determine not only our tomorrow but also the survival of future generations.

Conflict of Interest

I declare that there is no financial interest or other conflict of interest.