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Beyond Technology: Why a Just and Fair Transition is Key to China's Sustainable Energy Future

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Abstract

Against the backdrop of global climate change, China's energy transition is a central task for achieving its "carbon peak" and "carbon neutrality" goals. Despite its remarkable achievements in clean energy development, technological innovation, and energy structure optimization, the social and economic equity risks inherent in this transition process must not be overlooked. This opinion article delves into these multidimensional challenges, which include structural path dependency on traditional energy, resulting in unemployment and social fragmentation in traditional energy communities, and the potential for "energy poverty" caused by rising energy prices. The article argues that a just transition is not a secondary or supplementary goal but an intrinsic requirement for ensuring the long-term sustainability of the entire process. To address these challenges, this paper proposes a series of systemic governance pathways, covering areas from improving legal and policy frameworks, promoting context-specific practices and innovative models, to building diversified financial support mechanisms and social security systems. An energy transition guided by principles of fairness and justice will not only solidify China's environmental achievements but also provide a solid foundation for its social stability and leadership in global climate governance.

Keywords: Energy transition; Just transition; Social equity; Energy policy; Climate change; Energy poverty; Sustainable Development

Introduction: A Global Leader at a Crossroads

Global Context and China's Dual Role

In the face of increasingly severe global climate change, energy transition has become a common strategic choice for nations seeking sustainable development. As the world's largest developing country and energy consumer, China's energy transition is critical not only for its own "carbon peak" and "carbon neutrality" targets but also for the global climate governance landscape. After years of relentless effort, China has achieved remarkable progress in its energy transition. According to industry reports and data from the International Energy Agency (IEA), between 2019 and 2024, China is projected to contribute 40% of global renewable energy capacity expansion. Its total renewable energy capacity reached 1,878 GW by the end of 2024, exceeding its 2030 wind and solar capacity targets six years ahead of schedule [1].

However, behind these impressive technological and economic achievements, a more complex and profound social issue is emerging: the problem of justice and equity in energy transition. China's energy landscape presents a significant paradox: while clean energy is being rapidly deployed, its energy system maintains a deep-seated dependency on traditional fossil fuels, particularly coal. As of 2023, coal consumption still accounted for 56% of China's total energy consumption and provided over 60% of its electricity generation [2]. This seemingly contradictory "dual-track" development model is not a simple policy failure but a necessary choice for China to simultaneously meet the immense energy demands of its high-speed economic growth and achieve its ambitious decarbonization goals. To ensure energy security, the swift development of new renewable energy sources coexists with the maintenance and even expansion of existing coal-fired power plants, which poses unique challenges for a just transition.

The Imperative of "Just Transition"

This concern for the social dimension marks a profound shift in the energy transition narrative. In the past, the discourse on energy transition primarily focused on technological innovation and economic efficiency—how to achieve a rapid energy structure replacement through technological breakthroughs. Now, as the transition deepens, people are realizing that technological

solutions must be synchronized with social solutions. A just transition is not a secondary or an additional goal to be appended to technological progress; it is an intrinsic requirement for ensuring the entire transition process is smooth, long-lasting, and stable. Ignoring the equity risks brought by the transition could trigger serious social and livelihood issues, which in turn could affect the overall economic and social development of the country. This article deconstructs the just transition framework into four dimensions—distributive, procedural, recognition, and restorative justice—to systematically assess and analyze the multidimensional challenges in China's energy transition.

Purpose of this Article

Therefore, this opinion article aims to provide an in-depth analysis of the multidimensional equity challenges facing China's energy transition and to propose systemic governance pathways. The goal is to provide a reference for achieving a truly sustainable and just future.

Core Argument: The Multidimensional Equity Risks of China's Energy Transition

The challenges of China's energy transition are multidimensional. They are not merely technological and economic challenges but are complex social and political-economic ones. Each issue outlined in this article is underpinned by deeper structural, social, and economic roots.

Structural and Procedural Challenges: Path Dependency and Decision-Making Injustice

China's energy transition first faces deep-rooted structural barriers. China's energy resources are characterized by "rich coal, poor oil, and little gas," leading to coal's long-standing dominance in energy consumption and the formation of a "complete and vast industrial system." This strong path dependency on traditional energy is deeply intertwined with regional economies, employment, fiscal revenues, and existing social interest structures. Consequently, energy transition is not a simple technological replacement but a transformation that touches upon the existing socio-economic power structures.

A deeper problem lies in the intersection of this structural path dependency with procedural injustice in the decision-making process. While top-down national policies are beneficial for setting ambitious goals rapidly, their implementation can unfairly transfer the costs of transition to the most vulnerable groups. One study found that, in the context of policies aimed at rapid coal overcapacity reduction, powerful stakeholders, to protect their own interests, shifted the costs of transition to the most vulnerable actors, thereby exacerbating existing injustices [3]. This unjust transfer stems from the lack of effective participation channels for affected communities and workers. The lack of transparency and public participation in the decision-making process marginalizes the voices and demands of local communities facing industrial collapse. Furthermore, the traditional Chinese cultural emphasis on "endurance and compliance" also, to some extent, limits individual voice and agency. This cultural dimension further compounds procedural injustice, making it difficult for vulnerable groups to effectively defend their rights.

Social and Recognition Challenges: Community Disintegration and Identity Crisis

The impact of energy transition on traditional energy industries is particularly severe, posing not just an economic problem but a profound social and structural risk. When traditional energy sectors face a "cliff-edge impact," it is accompanied by the closure of numerous factories and enterprises, mass unemployment, and factory demolitions, leading to "significant labor redundancy" and "serious social and livelihood issues." One study on China's coal industry shows that in a baseline scenario consistent with carbon neutrality goals, the mining industry alone is projected to lose over 1.1 million jobs by 2030 [4].

This is more than just individual unemployment. For traditional energy cities that have long relied on a single industry like coal or oil, the entire community's social structure, cultural identity, and collective memory are built on that industry. When the industry collapses, the community's social cohesion is at risk of fracturing. This social issue is also accompanied by a lack of "recognition justice." The contributions and historical value of workers who have toiled for years in traditional energy sectors are often overlooked in the new clean energy narrative. Their unemployment is not just a loss of income but a crisis of self-worth and identity. Therefore, addressing this challenge requires more than simple economic compensation; it necessitates comprehensive "social and humanistic care" and vocational retraining to help them transition their identity and values from a traditional industry to an emerging one.

Economic and Distributive Challenges: The Threat of Energy Poverty

In the early stages of energy transition, the high costs of technology research and development often make new energy prices relatively high, while related low-carbon policies can also drive up the prices of traditional energy. This dual effect directly impacts residents' quality of life, especially for low-income households. They may face a dilemma: on the one hand, the transition of high-energy-consuming industries may lead to unstable household income; on the other hand, rising energy prices further increase their living burden, making it difficult for them to afford basic energy services and potentially plunging them into "energy poverty" [5].

"Energy poverty" is defined as a state in which people lack adequate access to energy services (such as lighting, heating, and cooling) to live a decent life. This emerging form of social inequality is a key indicator of whether an energy transition is just. It demands that the basic energy security of low-income

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groups be a core consideration in policy formulation. Research shows that policy measures, including income transfers and improving energy efficiency, can effectively reduce the proportion of households facing energy poverty [6]. This provides a clear policy direction for China to address this challenge.

Governance Pathways: Building a Multidimensional Safeguard System for a Just Transition

Table 1: The Multidimensional Challenges and Governance Pathways of China's Just Energy Transition.

Justice Dimension	Primary Challenge	Governance Pathway	Core Measures and Recommendations
Structural & Procedural	Deep-seated industrial path dependency and procedural injustice from top-down decision-making.	Improve legal and policy frameworks.	Add clauses on just transition to energy laws; ensure public participation and information transparency through hearings and new media.
Social & Recognition	Social disintegration of traditional energy communities and worker identity crisis.	Implement context-specific re-employment and social security systems.	Develop transition plans for traditional enterprises; provide comprehensive vocational retraining and humanistic care to help workers transition their identity and values.
Economic & Distributive	Emerging "energy poverty" due to rising energy prices.	Build diversified financial mechanisms and a social safety net.	Implement policies such as energy subsidies for low-income groups; encourage multi-party funding; gradually lower costs by increasing energy efficiency.

To systematically address the challenges outlined above, China needs to build a multidimensional and comprehensive safeguard system for a just transition. This system should transcend simple economic or technological solutions and organically integrate legal, policy, practical, economic, and social security measures (Table 1).

Legal and Policy Safeguards: Anchoring Justice Principles at the Legislative Level

The law is the embodiment of the state's will and the "top-level design" for a just transition. Although China has committed to a "1+N" policy framework to achieve carbon peaking before 2030 and carbon neutrality before 2060 [7], these policies still have "stringency gaps" and "coverage gaps" in their implementation, which may lead to certain sectors and areas being overlooked. Formally writing the principles of equity into the core clauses of energy law and establishing a complete legal system to promote the fairness of energy transition will ensure that these principles are followed at the highest level in subsequent policy formulation, fund allocation, and interest coordination. Furthermore, upholding the public disclosure and transparency of energy transition-related information and safeguarding the public's right to know and participate through hearings, expert forums, and new media interactions are crucial prerequisites for ensuring fair policy-making. One study shows that the public's positive attitude toward carbon neutrality goals is a key factor in their successful achievement [8].

Practice and Innovation: Pilot Programs and Context-Specific Solutions

In the complex process of transition, practical exploration is paramount. Shanxi, as a "pilot zone for comprehensive energy revolution reform," has demonstrated remarkable achievements in promoting the clean and efficient use of coal and developing a diverse mix of clean energy sources [9]. However, a successful model cannot be simply replicated with a "one-size-fits-all" approach. Whether a successful model from one region can be simply copied to another depends on its resource endowments, economic structure, and historical background. Therefore, the core value of pilot projects lies in their methodology and lessons learned, not in simple result replication. Future practices should emphasize "context-specific solutions," developing targeted plans for traditional enterprise restructuring, business reorientation, and personnel re-employment based on the specific conditions of each region.

Economic and Financial Mechanisms: Diversified Funding and Risk Sharing

Achieving a just transition requires immense financial support. Relying solely on government fiscal subsidies is unsustainable and can lead to inefficiency. Therefore, building diversified financial and market mechanisms is crucial. It is recommended to implement attractive fiscal subsidies and tax incentives to ease the pressure on enterprises during the transition and encourage public and private funds to participate in the energy transition. This will transform "equity" from a social goal into a sustainable "business model." Establishing dedicated transition funds for the traditional energy sector to help enterprises rationally assess asset values and complete industrial restructuring, while also setting up corresponding research and development funds for new energy technologies, will provide strong financial security for the entire transition process. By using market-based mechanisms, the costs and risks of the transition can be distributed among a wider range of social entities, thereby reducing the burden on a single group (such as unemployed workers or low-income families).

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Social Security and Humanistic Care: Building a Safety Net and Capacity

To address the challenge of unemployment, providing economic subsidies alone is far from sufficient. Unemployed workers in transition, especially older individuals with lower education levels, face not only a loss of income but also an identity crisis. Therefore, providing them with "social humanistic care and training support" is of paramount importance. This includes psychological counseling, career planning, job interview guidance, and training in new energy-related skills. This "re-empowerment" philosophy goes beyond traditional "re-employment" training, aiming to help individuals regain a sense of self-worth, successfully transition their identity and capabilities from the traditional to the new energy sector, and cultivate more high-quality professional talents. Furthermore, to address the issue of "energy poverty," the government can provide basic support for low-income households through policies like energy subsidies and gradually lower new energy prices by improving energy efficiency and developing low-cost energy sources, making energy affordable for all residents.

Conclusion

China's energy transition is an inevitable path toward achieving the grand mission of "carbon peaking and carbon neutrality." Despite its extraordinary achievements on a technological and economic level, its success will depend on the proper governance of transition-related equity risks. An unjust transition could lead to social imbalances and conflicts, thereby weakening the foundation for its long-term development. As research has shown, neglecting a just transition can lead to policy failure and social protests, hindering the realization of transition goals.

By improving the legal framework, promoting context-specific practices, building diversified financial mechanisms, and providing comprehensive social security, China can systematically address the equity challenges it faces during the transition. This is not only about the well-being of its people but also about China's global image and influence. By proactively addressing its own equity challenges and sharing its experiences with the international community, China can evolve from a leader in clean energy technology to a model for the "just transition" concept. This will provide a new, people-centered paradigm for global climate governance, giving China a more profound moral and policy influence on the international stage. Fundamentally, an energy transition built on a foundation of fairness and justice is the key to achieving a sustainable, harmonious, and prosperous future for China.

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