

# Just Transition for China's Coal Regions Towards Carbon Neutrality Targets

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## Abstract

China has pledged to peak its carbon emissions before 2030 and achieve carbon neutrality by 2060. A crucial aspect of this commitment involves transitioning from coal-dependent activities primarily concentrated in certain regions pivotal to local economies, employment, and livelihoods. High-quality development necessitates identifying just transition strategies for these coal-intensive regions, ensuring inclusive benefits from the energy transition. These regions exhibit disparities in economic and industrial growth, with many low-income mining communities and inadequate public services. This calls for comprehensive policy interventions in economic, energy, societal, and environmental domains. This study aims to delineate just transition strategies for China's coal regions, considering their unique challenges and circumstances. Initially, this article reviews the evolution of “just transition” as a concept and its policy implications. Subsequently, it explores China's approach to achieving carbon neutrality through the lens of just transition, delving into the local economy's reliance on coal-related industries and the impact on employment. Following a clear delineation of the vision for just transition in China, the analysis focuses on identifying principles and pathways for transition. The goal is to propose nuanced and effective policies to ensure just outcomes in the context of China's energy transition.

## Keywords

carbon neutrality; China; climate change; coal regions; just transition; social justice

## 1. Introduction

Climate change presents a formidable challenge globally, necessitating urgent scientific and political attention. The Paris Agreement, concluded in 2015 and entered into force in 2016, proposes to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels” (UNFCCC, 2015). The IPCC Special Report on the impacts of global warming of 1.5°C indicated that achieving global carbon neutrality by the mid-21st century is imperative to restrain global warming within 1.5°C, to avoid irreversible negative impacts of climate change on human society and ecosystems (IPCC, 2018). Against this backdrop, the call for carbon neutrality is becoming increasingly urgent worldwide. By the end of May 2023, more than 130 countries or regions have proposed their carbon neutrality targets. Pivotal in this context is China’s commitment, declared at the 75th United Nations General Assembly in September 2020, stating “China will enhance its nationally determined contributions and take more vigorous policies and measures, striving to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060” (China SCIO, 2021). This extremely ambitious goal underscores the necessity for China to undertake extensive and profound systemic reforms in its economic and social systems, propelling a just energy transition (Lu et al., 2023).

China’s energy profile is notably characterised by abundant coal reserves, limited oil, and scarce natural gas, positioning coal as a historically predominant energy source (Zhang et al., 2019). This has led to coal’s substantial contribution to China’s energy production and consumption. Despite energy security concerns prompting a gradual and somewhat disorganised coal phase-out in China (P. Wang et al., 2021), the imperative carbon neutrality objectives necessitate an orderly withdrawal from coal and other fossil fuels (Gonzalez-Salazar et al., 2020; Pan et al., 2022). For a long time, China’s coal regions have made significant contributions to the country’s economic and social development. However, these regions are highly dependent on coal resources and related industries. Under the “carbon peak and carbon neutrality” targets, the gradual phase-out of coal will bring significant social and economic shocks to these regions, leading to job losses, income reduction, and welfare losses. With the world’s largest coal workforce, approximately 2.6 million strong in the coal mining and washing sector as of 2022, the phase-out of coal is poised to profoundly impact employment and socio-economic stability in these areas.

The rest of this article is structured as follows: Section 2 delves into a comprehensive review of the evolution of the “just transition” concept and related policies globally over the past decades. Sections 3 and 4 shift the focus to China, discussing the current landscape and expected future outlook for coal transition in specific regions. Section 5, finally, synthesises the insights gained and articulates a set of recommendations aimed at equipping China to adeptly navigate the impending challenges associated with the coal phase-out.

## 2. Development of the “Just Transition” Concept and Policies

### 2.1. Conceptual Evolution of Just Transition

The concept of just transition originated from North American labour movements approximately half a century ago, initially focusing on urging policymakers to take measures to protect, support, and compensate workers adversely affected by environmental regulations and policies. It emphasised the importance of safeguarding the welfare and rights of workers in industries facing decline due to environmental actions

(Mazzochi, 1993). Over time, the efforts from some international organisations such as the International Trade Union Confederation (ITUC) and the International Labour Organization (ILO) have propelled the just transition issue into the realm of international climate negotiations, positioning it as a crucial social mechanism for addressing the challenges of climate change (Krawchenko & Gordon, 2021). The concept has gradually become a fundamental component of the UN-led climate governance process and was included in the Cancún Agreements, the Paris Agreement, and subsequent decisions (Johansson, 2023). Notably, the Silesia Declaration on Solidarity and Just Transition adopted at COP24 in 2018 underscored the elevation of this issue to a significant position on the global climate agenda.

The concept was initially focused on addressing employment equity and labour market challenges during economic transitions, and the preamble of the Paris Agreement also explicitly advocated for a “just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities” (UNFCCC, 2015). Recent scholarly and political discourse has broadened the scope of just transition (X. Wang & Lo, 2021), centring on countries, industries, and communities adversely impacted by energy transitions (Heffron & McCauley, 2022; Morena et al., 2020). Evolving from its initial labour market orientation, just transition now encompasses a wider systemic socio-economic transformation, integrating principles of environmental justice, energy justice, and climate justice (Tavares, 2022). The commonly accepted concept of “equity” refers to fair inclusion or allocating resources such that people of different backgrounds and life experiences may reach an equal outcome (Polk & Diver, 2020). While “justice” goes beyond distribution to also include consideration of process and recognition (Fraser, 2009), it is the principle of upholding what is right and just, regardless of personal or societal biases (Goldman & Cropanzano, 2015). In terms of the goal of achieving social justice or ensuring equity, the original transition strategy emphasised the support offered to disadvantaged groups and regions affected by ambitious climate targets or transition, helping them to find new development opportunities. The concept has also evolved into using social justice as a guiding principle to promote economic and social transition fairly and inclusively towards a sustainable net-zero future. This comprehensive approach to a just transition advocates for a profound social and economic restructuring to eliminate the root causes of inequality.

Although the term “just transition” is not explicitly used in China’s major policy documents, the underlying principles of this concept are mirrored in the country’s policy orientations. China’s commitment to carbon neutrality aims to foster a development space that is of higher quality, more efficient, fairer, more sustainable, and more secure. It also promises to explore synergies between environmental protection, economic development, job creation, and poverty alleviation during the green transition. These policy objectives align closely with the essence of just transition, emphasising social justice and equity in the process of environmental and economic transformation. However, in reality, the current green transition policy framework in China sidesteps clear consideration of the social impacts of coal phase-out and lacks guidance and institutional arrangements on just transition.

## **2.2. Policy Framework of Just Transition**

While the importance of a just transition has gained advocacy internationally, there is no universally accepted definition and understanding of the concept. Developing countries focus on international justice from a recognitional justice perspective, recognising that not all members of society are equally valued in current socio-cultural, economic, and political arrangements and that climate change and transitional policies

threaten to exacerbate existing inequalities along gender, class, and ethnic/racial lines (Lewis & Hernández, 2020). Thus, they aim to seek greater international aid and cooperation in their transition. Developed countries, however, prioritise distributive justice and procedural justice, stressing the fair distribution of transition benefits and burdens among different groups and ensuring policy formulation procedures are just, equitable, and inclusive. This results in a fragmented and diversified landscape of just transition policies worldwide, reflecting the diverse priorities and perspectives of different nations and stakeholders.

Globally, various international institutions and national bodies have provided frameworks and guidance for just transition. The guidelines released by ILO in 2015 have emerged as a foundational element, significantly influencing the development of subsequent just transition policy frameworks. Regionally, the European Green Deal approved in 2019 included an innovative just transition mechanism offering targeted support for fossil fuel-dependent regions and sectors during the energy transition to ensure that no one is left behind due to the green transition. In 2021, the Fit for 55 package released by the EU introduced the Social Climate Fund (SCF) plan, aiming to help vulnerable households, small and medium-sized enterprises, and transportation users with the increased costs during the green energy transition and avoid energy poverty. Nationally, Germany established the Commission on Growth, Structural Change and Employment (WSB) to introduce compensation and assistance measures for affected groups and regions according to the comprehensive phase-out plan for coal-fired power plants by 2038. Similarly, France introduced the Energy Transition for Green Growth Act, which includes measures such as energy price shields and providing energy vouchers for low-income households to address the issue of rising energy costs for low-income households. Countries like the United States, the United Kingdom, Japan, South Korea, Australia, Spain, Italy, Greece, and South Africa have also developed strategic policies and specific measures to ensure a just energy transition (Tavares, 2022).

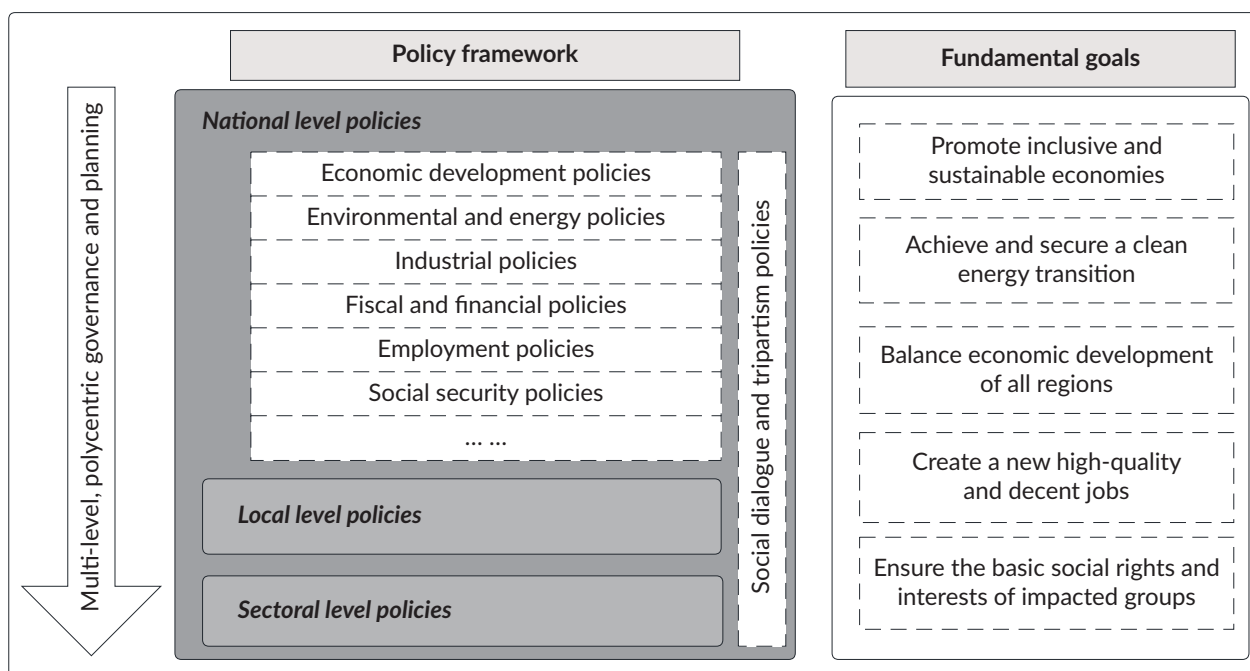
Just transition policies, as shown in Figure 1, aim to balance environmental objectives with economic and social challenges. These policies span a variety of domains, including national economic, environmental, energy, industrial, regional, fiscal, financial, employment, and social security policies, as well as sector-specific and regional policies (ILO, 2015; Sharpe & Martinez-Fernandez, 2021). The comprehensive approach indicates that just transition is not the sole responsibility of any single department but rather demands the establishment of an inter-agency coordination mechanism and active participation of all stakeholders in policy development and implementation.

Given the evident differences in development stages and actual circumstances of various countries, a universal one-size-fits-all policy approach for just transition is impractical. Countries or regions need to devise targeted policies that address their unique challenges. These policies should be tailored to fit the specific economic structures and local specifications, ensuring the identification of suitable and equitable transition pathways.

### **3. Just Transition Towards Carbon Neutrality Targets in China**

#### **3.1. Overview of China's Coal Industry and Regions**

Coal, the most prevalent and vital fossil fuel in China, plays a pivotal role in the nation's landscape. Recent statistics, as of 2020, indicate that China's verified coal reserves reached 1,431.97 billion metric tons, accounting for 13.3% of global coal reserves, ranking fourth among all countries, trailing only the United States, Russia, and Australia (BP, 2021). China's vast economic size and rich coal resources make it the



**Figure 1.** The just transition policy framework.

world's foremost consumer of coal. In 2021, China's coal consumption reached 86.17 exajoules, which accounts for a significant 53.82% of the total global coal consumption. Despite this heavy reliance on coal, there has been a discernible shift in China's energy consumption portfolio over recent decades, attributed to the accelerated development of renewable energy sources such as solar and wind power. This transition is indicative of a gradual decline in the proportion of coal in China's overall energy mix. Nevertheless, as of 2022, coal still represents 56.2% of China's energy consumption. This enduring reliance underscores the critical role of coal in China's energy strategy, despite the growing momentum towards cleaner energy sources.

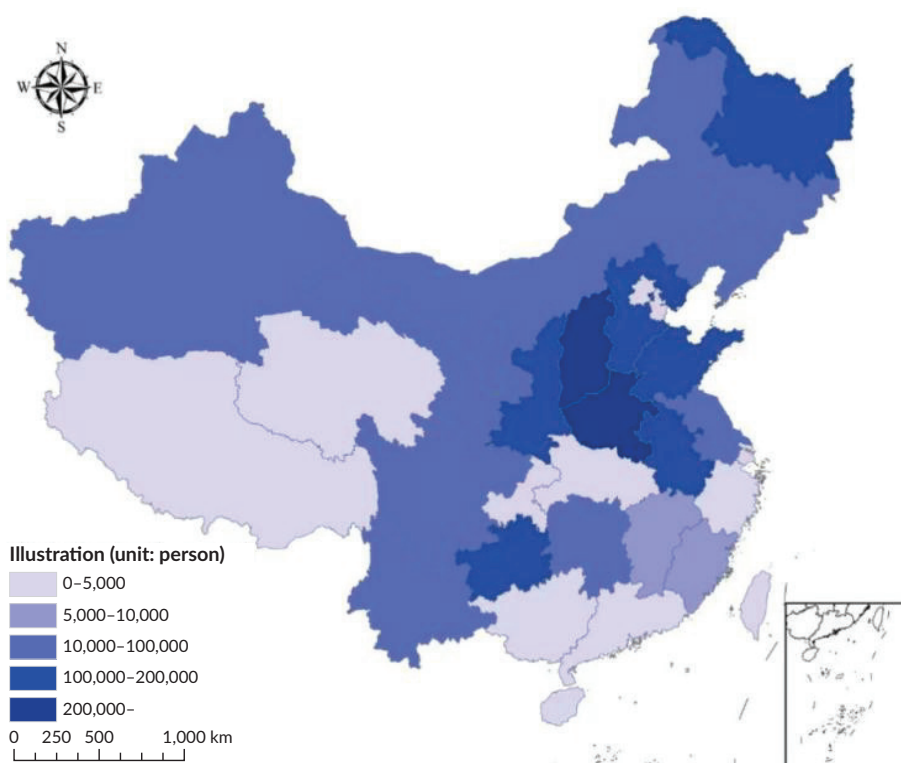
The trajectory of coal production and processing in China is a critical determinant of the country's socio-economic development. Coal production has increased from 622 million tonnes in 1981 to 4.07 billion tons in 2021, thereby establishing China as the preeminent coal producer globally. The decade spanning from 2002 to 2012 is often characterised as the "golden decade" for China's coal industry, coinciding with periods of heightened economic growth. With high economic growth, the surging demand for social fixed investment and infrastructure construction catalysed a continuous expansion of China's coal production capacity. During this period, China's coal production was augmented by 154.52%, with an average annual growth rate exceeding 10%. However, the unchecked influx of capital led to the accumulation of obsolete production capacity within the industry. The subsequent deceleration of economic growth exposed the problem of overcapacity. In response to declining coal demand and emerging environmental concerns, China initiated supply-side reforms aimed at optimising coal production structure and enhancing the proportion of high-quality coal. The announcement of China's ambitions for achieving carbon peak and carbon neutrality has exerted substantial pressure on the sustainable development of the coal industry. Amidst the complex international geopolitical situation, the Chinese government has accorded unprecedented priority to energy security, thereby navigating the intricate balance between an orderly coal phase-out and the assurance of a

stable energy supply. This complicated backdrop renders China's approach to a just coal transition distinctively challenging compared to other nations.

China's coal resources, while abundant and extensively distributed, exhibit a notable spatial imbalance in their geographical distribution. The bulk of these resources are concentrated in the North China and Northwest China regions. Specifically, four provinces (or autonomous regions), namely Shanxi, Xinjiang Uyghur Autonomous Region, Inner Mongolia Autonomous Region, and Shaanxi, collectively account for over 70% of the nation's proven coal reserves, making them the primary coal resource-rich regions in China. Although China's coal production continues to concentrate in regions with superior resource endowments and more favourable development conditions, the coal industry's employment is primarily concentrated in the central, northwest, northeast, and Yunnan-Guizhou-Sichuan regions, as seen in Figure 2. Historically, these coal regions have relied heavily on carbon-intensive or heavy industries for their economic sustenance, leading to an overproduction of coal and the accumulation of a substantial volume of disordered and low-quality production capacity. Furthermore, these regions exhibit limited economic development, characterised by a monolithic industrial structure and a lack of economic diversification, resulting in excessive dependence on the coal industry for regional economic development.

### 3.2. Challenges of Coal Phase-Out in China

China's predominantly coal-based energy structure poses a notable paradox when juxtaposed against its carbon neutrality ambitions, diverging from the global inclination towards a clean energy transition.



**Figure 2.** Geographical distribution of coal employment in China.

However, the abundance of coal resources and lower operational costs associated with its usage mean that an immediate disengagement from coal is not viable for China. Instead, the phase-out of coal is anticipated to be a gradual and lengthy process. The transformation is expected to have a profound impact on China's energy structure and regional economies, encompassing aspects of energy security, economic development, and social well-being. The intricacies of structural change in coal-dependent regions are multifaceted and region-specific, involving technical, political, economic, social, and cultural dimensions. Ineffective management may influence public perception of energy transition and climate change policies, potentially leading to issues concerning social stability.

China faces more formidable challenges in scaling down coal production compared to other countries worldwide. The most significant challenge in the coal transition is undoubtedly the direct impact on employment opportunities within coal-related industries. Notably, China maintains the highest employment coefficient for unit coal production globally, indicative of relatively low mechanisation and labour productivity (UNDP, 2023). The coal transition will necessitate a comprehensive adjustment of employment structure, predominantly affecting low-skilled jobs and leading to a shrinking labour demand industry-wide. Statistical data shows that direct employment in China's coal industry declined from approximately 4.30 million in 2012 to 2.60 million in 2022. Over the long term, the shrinking demand for labour in the coal production sector will persist. Projections indicate that under a 2°C scenario, China's coal mining industry's employment is expected to decrease to 1.2 million by 2030 and to around 200,000 by 2050. In a 1.5°C scenario, direct coal employment will reduce to about 150,000 by 2050 (NRDC, 2019). This trend highlights the increasing challenges in reallocating laid-off workers, who typically exhibit lower educational and skill levels and limited adaptability to industry transitions. Research also indicates that as China's coal industry gradually contracts, female and informal workers are often more vulnerable, facing higher risks of unemployment (UNDP, 2023).

Another significant aspect is the capital-intensive nature of China's coal industry. The rigidity of the carbon neutrality goal could lead to the early depreciation of coal-related assets or their conversion into liabilities, exerting substantial pressure on coal-dependent regions during the transition. The recent emphasis on energy security and supply has led to a continued expansion in coal-fired power and coal chemical production. In 2022, there were 82 newly approved coal-fired power plants with a total approved capacity of 90.716 gigawatts, a nearly fivefold increase from 2021. As a consequence, most of China's coal-fired power plants are among the youngest and most efficient globally, with an average age of only 12 years. A rapid shift away from coal in the short term could heighten the risk of stranded assets, adversely affecting the asset quality of enterprises and financial institutions, and even leading to credit default risks in the financial sector.

The ongoing transition and gradual phase-out of coal will present significant economic challenges for coal enterprises, characterised by rising operational costs and diminishing revenues. In 2021, the debt-to-asset ratio of China's enterprises above the designated size was reported at 64.9%. This financial strain was further evidenced by the recorded losses of 5.69 billion Yuan for loss-making companies. Looking ahead, the medium to long-term prognosis suggests that many coal enterprises, particularly smaller entities, may face bankruptcy or consolidation. Notably, the structure of China's coal industry is dominated by state-owned enterprises, accounting for over 90% of the market value of listed coal companies. This predominance of SOEs in the coal sector carries specific implications, particularly in some resource-based cities, where these large state-owned coal enterprises form the backbone of local fiscal revenue, employment, and social stability. Local governments



tend to provide extensive support to these enterprises, which can lead to the risk of “too big to fail” and even hinder coal transition.

The gradual decline of the coal industry in China is poised to engender a spectrum of social challenges, including large-scale unemployment, labour relocation, health issues for coal workers, population loss, disparities in talent supply, etc. Compounding these issues, many coal-dependent regions in China are also contending with some unresolved, deep-rooted challenges. Notably, these areas often suffer from significant deficits in urban infrastructure and public services. The exacerbation of these social challenges, stemming from the decline of the coal industry, could potentially impede economic development and reduce urban competitiveness in these regions.

Most of China’s coal industry is geographically situated in regions adjacent to coal deposits, which are predominantly located in remote areas. These coal-abundant cities or regions have historically functioned as crucial bases for national energy production. This situation has led to a concentration of various factors, particularly economic and industrial activities, around coal resources, resulting in a pronounced dependency on the coal sector. Taking Shanxi and Inner Mongolia as examples, the economic vitality of these major coal-producing regions is intrinsically linked to the flourishing state of the coal industry. The cessation of coal production in these areas poses a substantial risk to their economic stability, potentially leading to the collapse of their primary economic pillars and adversely affecting their prospects for sustainable development. Additionally, the geographical distribution of these coal regions, generally distant from major urban centres, presents additional challenges in attracting high-quality talents and emerging industries during the transition phases. These regions frequently suffer from underdeveloped public services and infrastructure. In the absence of a just and equitable transition strategy, these inherent challenges risk exacerbating the problem of regional development imbalances. In the historical context of China’s coal regions, large coal enterprises have traditionally assumed key roles in providing public social services, encompassing basic education and medical care. As the country embarks on a phase-out of coal and pursues industrial transformation, these entrenched social responsibilities need to be addressed. The process of divesting these coal enterprises from their long-held social responsibilities demands careful attention, particularly concerning the health of coal workers. Pneumoconiosis poses the most significant threat to coal workers’ health and is the most prevalent occupational disease in China. According to data from the Chinese Centre for Disease Control and Prevention, as of the end of 2021, China reported a total of 915,000 cases of occupational pneumoconiosis, with an estimated 450,000 individuals currently affected, mainly among coal workers in the southwest and central-south regions of China. In the context of the coal industry downsizing, the mental health issues of coal workers are gaining prominence. The decline of the coal sector has not only affected the careers of these workers but also their social status. This aspect underscores the need for comprehensive strategies that address both the physical and psychological well-being of workers in the coal regions.

## 4. Enabling Just Transition in China’s Coal Regions

### 4.1. Vision and Objectives of a Just Transition in China

China’s ambition to achieve carbon neutrality necessitates a comprehensive and just transition in its coal regions, encompassing economic, social, energy, and ecological dimensions. This transition is characterised



by its proactive and regulation-driven nature, distinguishing it from transitions driven by technological innovations or economic development, such as the advent of the internal combustion engine or structural economic adjustments.

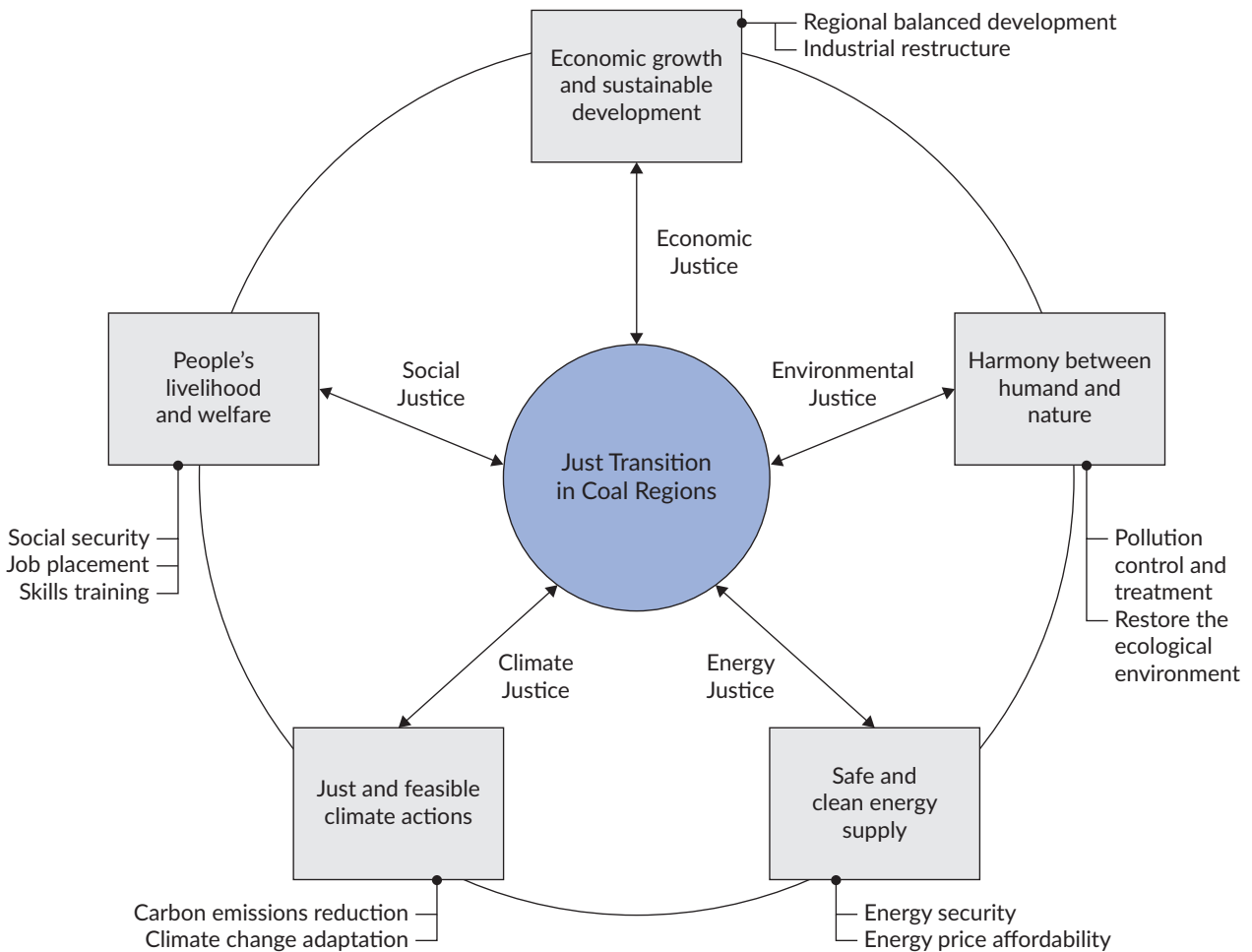
Coal has long been a pivotal component in China's energy structure, making its phase-out a challenging task. Despite China's clear commitment to achieving carbon neutrality, its approach to transitioning away from coal differs from that of other countries. This entails a dual strategy: a long-term gradual reduction in coal production and consumption, coupled with a short-term focus on enhancing the cleaner utilisation of coal resources. Government documents reaffirm coal's role as an essential stabiliser in energy security. The conspicuous absence of a definitive roadmap for coal phase-out in China results in a fragmented approach and a lack of unified vision for a just transition.

At the same time, China has defined the pursuit of "Chinese-style modernisation" as its medium- to long-term national vision, prioritising a people-centred approach. This strategy aims to ensure that modernisation addresses the diverse and layered needs of the people, advocating for an equitable distribution of its benefits. Chinese-style modernisation is envisioned to foster a harmonious relationship between humans and nature and to achieve collective prosperity. This suggests that the Chinese government is strategically positioned to take an active role in addressing climate change, integrating the realisation of carbon neutrality into its political agenda. Concurrently, the pursuit of collective prosperity demands a targeted governmental focus on regions heavily reliant on coal. This is critical to ensure their transformation and to pre-empt the onset of economic and social challenges in these areas. These aspirations impart unique implications and characteristics to the just transition of China's coal industry, setting it apart from its global counterparts.

Under these grand narratives, unjust treatment of coal-dependent regions during the transition could impede their positive response to energy transition and climate change policies, potentially leading to social stability issues. Therefore, effectively addressing the challenges and assisting coal regions in adapting to the changes induced by coal phase-out is crucial for the achievement of carbon neutrality. As depicted in Figure 3, the process of coal transition in China must concurrently consider multiple facets of justice: economic, social, environmental, climate, and energy. The critical question then becomes how to appropriately manage this situation and support these regions in adapting to the impacts of coal phase-out. The objectives are multifaceted: enabling coal regions to achieve high-quality economic development; improving people's livelihoods; restoring ecological environments; reducing carbon emissions; ensuring energy security and price stability, among others. The overarching goal is to facilitate a net-zero transition that allows all individuals to share its benefits and minimises any negative impacts on coal resource regions and their communities.

#### **4.2. Practice-Oriented Just Transition in China**

Although China has not yet formally established a policy framework specifically titled "just transition," the country has developed a robust background in policy practices rooted in social justice across various stages of social and economic transition. The transition from a planned economy to a market economy, the urbanisation of rural populations, and the industrial restructuring associated with environmental protection are all complex systemic projects. They are confronted with the challenges of worker redistribution and urban transformation pressures, necessitating the reconstruction of the social security system. In China's



**Figure 3.** Just transition in coal regions.

context, a pragmatic approach for achieving a just transition in coal regions would involve leveraging existing policy frameworks and drawing on past experiences.

China’s economic development has been marked by regional disparities due to differences in resource endowments, energy infrastructure, development conditions, and technological capabilities. These disparities necessitate a focus on “climate justice” within the country, as different regions and populations are differently affected by the impacts of climate change. The central government has underscored the need for regional customisation in the pursuit of the carbon neutrality goal, advocating for tailored tasks, objectives, and pathways based on local conditions, within the framework of nationwide coordination. Accordingly, coal transition policies should be regionalised to ensure the justice of the transition across different regions. For coal-dependent regions, it is imperative to foster the coordinated and sustainable development of the coal industry and alternative sectors. This approach can be actualised through strategic policies, fiscal support, and financial assistance, gradually reducing the economic dependence on coal and bolstering regional economic resilience.

The social impacts of coal phase-out necessitate the establishment of a comprehensive social security and employment support system aligned with China’s national circumstances. This system should involve

collaborative efforts from the government, enterprises, and workers, effectively addressing job losses and poverty issues encountered by affected or vulnerable groups during the low-carbon transition in coal regions. China's existing mandatory social security system encompasses social insurance, assistance, welfare, and support for retired state-owned enterprises and laid-off workers. The Employment Promotion Law of 2007 advocates policies supporting voluntary, market-regulated, and government-promoted employment, mandating local governments to incorporate employment expansion into their national economic and social development plans. To support a just transition in coal regions, special emphasis should be placed on improving public services, basic living security, and stable employment. These regions should receive more policy support and funding for the development of public services, social security and welfare policies, vocational training, and skill enhancement initiatives in areas like education, healthcare, culture, transportation infrastructure, and environmental facilities.

In the context of a just transition with coal-dependent regions for China, securing energy stability emerges as a paramount task. While most of these regions serve as national powerhouses in energy production, they must acknowledge the anticipated decline in coal demand and pre-emptively strategise to mitigate potential negative ramifications for both the local coal sector and the broader regional economy. To ensure the fulfilment of national energy demand, these areas are advised to refine and incrementally diminish their existing advanced coal production capacities. This approach entails a coordinated diminishment plan, taking into account the specific resource capacities and coal reserves of each region. Establishing dynamic adjustment frameworks, underpinned by state-of-the-art coal mining facilities, is crucial. These frameworks should allow for flexible scaling of coal production, contingent upon actual productive capacities, transport feasibility, and fluctuating demands for coal consumption. Additionally, these regions must devise overarching strategies for an orderly exit of coal mining activities. This includes the creation and refinement of compensation mechanisms for exiting the industry, steering industrial diversification, and circumventing precipitous downturns in both regional economies and coal sectors. Exploiting local resources to foster the collaborative development of diverse energy sources, including coalbed methane and shale gas, along with renewable energies like wind, solar, hydro, and biomass, can facilitate the transformation of these regions from monolithic coal suppliers to multifaceted and complementary energy hubs.

Moreover, ecological conservation and rehabilitation in mining locales constitute a critical focus during the just transition process. With escalating demands for a better ecological environment and the national directives for spatial ecological restoration, coal-dependent regions should prioritise environmental governance and ecological restoration in mining areas. Utilising resources such as abandoned coal mines and subsidence land for ecological restoration projects is pivotal. Additionally, the establishment and enhancement of legal and regulatory frameworks for geological environmental protection, coupled with the implementation of unified and effective environmental monitoring systems across the provincial, municipal, county, and enterprise levels are essential steps in this endeavour.

## 5. Conclusion and Policy Recommendations

China's comprehensive coal phase-out, spanning various sectors, stands to exert distinctly profound social impacts diverging significantly from experiences in other nations. A systematic approach is vital to facilitate a just transition in its key coal regions, harmonising the overarching climate goals with pivotal socio-economic factors, such as economic transition, energy security, job creation, and social stability.

To achieve carbon neutrality, China has instituted a plethora of policy documents at both central and local levels, covering areas like energy, resource utilisation, technology, and financing, progressively constructing a “1+N” policy architecture. Nonetheless, this existing framework for green transition inadequately addresses the social consequences of coal phase-out and lacks guidance and institutional structures for a just transition. To mitigate this challenge and enhance the facilitation of a just transition in coal-dependent areas, China needs to integrate principles that ensure livelihood protection and promote social equity into its climate policy strategies. We offer the following recommendations:

1. Planning for orderly coal phase-out as soon as possible: Acknowledging the deep entrenchment of coal industry interests in China, the process of coal phase-out shadowed by concerns for energy security is anticipated to encounter challenges. Coal interest groups may leverage social justice impacts to influence policy decisions. However, implementing justice and fairness does not mean ensuring that everyone benefits during the energy transition. To achieve carbon neutrality, new vulnerable groups will emerge in society, encompassing not only the existing economically impoverished groups but also the workers and residents of the affected areas and industries. It is necessary to identify a feasible path to mitigate adverse impacts, rather than inappropriately delaying or hesitating in promoting the energy transition. Otherwise, the committed climate targets will not be achieved on schedule. Effective planning and future arrangements for coal phase-out are imperative, with phase-out procedures adhering to explicit criteria, such as prioritising the exit of technologically obsolete and inefficient coal production capacities. Market-oriented measures like carbon markets and energy credit trading should also be employed to optimise the overall cost of energy transition.
2. Establishing a transparent and inclusive decision-making and implementation mechanism: Public participation is crucial for a successful energy transition. Involving all stakeholders in the decision-making process enhances comprehension of the challenges associated with energy transition. China must identify coal transition pathways suitable for its unique national context. At a macro level, the government should lead, acknowledging the significance, comprehensiveness, and strategic nature of energy transition, and designing clear plans and transparent adjustment procedures. A wider array of perspectives from associations, scholars, and environmental organisations should be incorporated to build consensus and minimise decision-making errors. Regionally, policies should engage directly impacted groups, listening to the opinions of local governments, industries, and workers. All the relevant actors should be allowed to participate in decision-making through appropriate means. In China’s context, the government could rely on think tanks affiliated with relevant ministries to convene relevant stakeholders to ensure voices from different parties are heard and considered.
3. Addressing employment and the social impacts of the coal transition. The severe impacts of coal phase-out on certain regions and groups should be fully and deliberately considered, aiming to prevent disproportionate bearing of transition costs. Specific plans for affected coal enterprises and coal regions should be crafted to eliminate poverty and prevent its recurrence, adhering to the principle of leaving no one behind. The government should support displaced workers with employment assistance, reemployment guidance, skills training, and entrepreneurship training, facilitating workers to find new jobs. Job creation in replacement industries should be encouraged through economic diversification plans.
4. Encouraging innovative financing mechanisms for just transition: Public finance plays a crucial role in building resilience and reducing transition risk for vulnerable groups. Fiscal policies through incentive mechanisms can guide behavioural changes, offering tax incentives and subsidies to enterprises hiring

former coal industry workers. Fiscal transfers should account for regional disparities and the uneven impact of coal phase-out, particularly favouring the provinces that face greater challenges in phasing out coal, like Shanxi and Inner Mongolia. Additionally, mobilising private finance is essential to supplement government budgets for employment and social security initiatives during just transitions.

5. Engaging actively in the global just transition process: In current international climate governance, there is more consensus than differences on the issue of just transition, and numerous countries are actively engaged in international cooperation in this area. China's participation in the declaration at the BRICS countries' Labour and Employment Ministers' Meeting in July 2022, advocating for efforts towards a just transition for all, exemplifies this engagement. In the future, China should continue to exchange knowledge and collaborate with the international community, actively contributing to the development of relevant international governance mechanisms.

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### Conflict of Interests

The authors declare no conflict of interest.

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