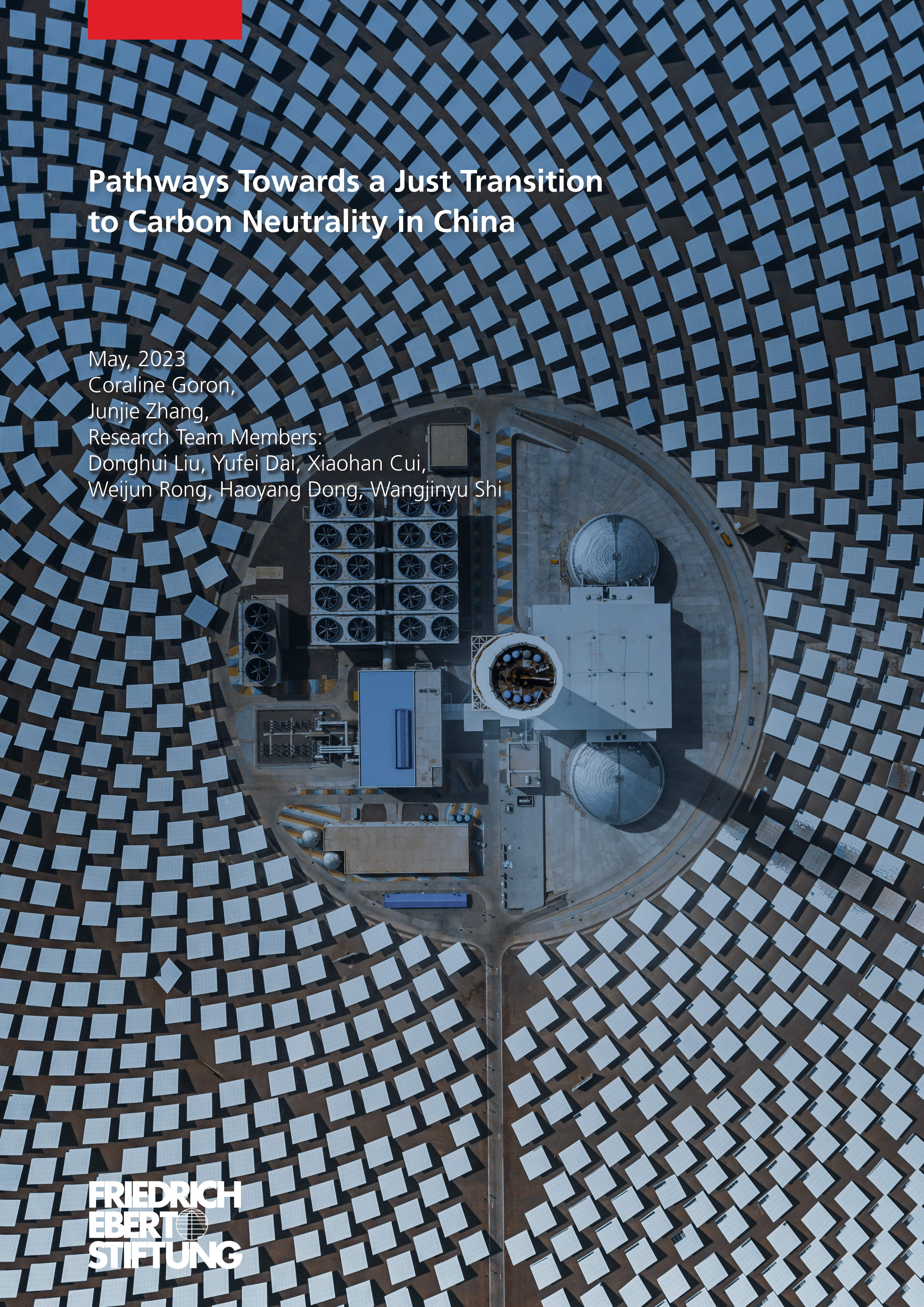

Pathways Towards a Just Transition to Carbon Neutrality in China

May, 2023

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Executive summary

Since the introduction of the 'dual carbon peaking and carbon neutrality' ('3060') goals in September 2020, climate change has become the main driver of the energy transition in China. Achieving these goals and keeping global temperatures under 1.5-2 °C requires bold, sustained, and fair energy transition strategies. The 'Action Plan to Peak Carbon Emission by 2030' issued on 26 October, 2021, outlines a combination of regulatory and market-based policy interventions to achieve peak carbon emissions before 2030. Still, the plan does not pay enough attention to the interventions' fairness impacts. China must decidedly engage in a 'just transition' to harness the energy transition while achieving a 'common prosperity,' correcting existing social inequalities, re-balancing its economic development, and creating decent and sustainable jobs for all its citizens.

This report explores several key dimensions and policy fields calling for the implementation of a just transition framework in China. **Chapter 1** examines China's energy transition's current and projected distributive impacts on industry, localities, and vulnerable social groups. The adverse impacts of the transition are expected to hit hard the energy-intensive industries that face either near-term phase-out or substantial investment costs affecting their financial stability and competitiveness. Among them, small and medium enterprises are particularly vulnerable to regulatory risks and rapidly increasing commodity prices. The localities where these industries are concentrated due to their resource endowment, historical legacy, or comparatively late economic development face particularly challenging circumstances in the transition. Similarly, the workers and communities that have relied on these industries, especially those located in less developed or resource declining localities may be particularly affected. While millions of workers in energy-intensive industries are at the risk of unemployment, low-income households face the risk of falling into energy poverty as cheap coal is phased out and replaced by greener but more expensive alternatives.

Chapter 2 investigates the Chinese government's implementation of the coal decommissioning campaign during the 13th FYP through a case study focusing on a coal-based city in Guizhou Province. Based on fieldwork carried out in July 2021, it focuses on the treatment of workers whose mines have been closed. Although many small, mostly but not exclusively private, coal mines were closed down, and the top-down decommissioning target was exceeded, overall total coal production capacity was increased through additional capacity added in larger, primarily state-owned, mines. Even though the phase-down of coal in that city was not started, significant impacts were observed in the localities where mines were closed, translating into an uncompensated loss of tax revenue for local governments and a significant active population outflow. Furthermore, the fieldwork found that the treatment of coal miners differed significantly depending on whether their employer was a state-owned or a private mine. Government resettlement funds were primarily used to support SOE mines, which resettled their workforce mainly by reemploying them in other mines or factories they own, placing the older workers in early retirement, or terminating their contract in exchange for a lump-sum compensation. By contrast, private mine workers were usually dismissed without any compensation. The municipal governments should capitalise on their current coal mining income in order to invest in economic diversification and lay the foundations for a 'just transition' towards a sustainable economy that includes mining areas' regeneration and revitalisation, and extend social services and retraining to all workers, including those employed in the private sector and adjacent informal sectors.

Moving from coal production to consumption, **Chapter 3** explores the implementation of the 'dual control' policy, which has been a critical instrument used by the central government to achieve carbon emissions reductions in industry by ordering them to reduce their energy intensity and by limiting their growth in energy consumption in the 13th FYP. However, the case study found that the energy intensity and consumption targets have not fairly distributed the overall reduction effort across localities and, consequently, on the industries they host. Moreover, it found that the enforcement of these targets, which was significantly strengthened in 2020 with the implementation of a new target implementation barometer and associated warning system, may have exacerbated this lack of fairness. Investigating the impacts of this new enforcement tool in Jiangsu Province, we found that the announcement of a 'red warning' in August 2020 led to indiscriminate power cuts across the province, regardless of municipalities' conditions and target performance, and that were implemented in targeted industries like cement and soda production in a manner that was equally indiscriminate and untransparent. Pointing out the apparent irrationality of these measures and their negative impact on both the local economy and broader supply chains, the chapter concludes by supporting recent policy changes indicating a shift away from drastic energy consumption control towards more targeted control of carbon emissions in the 14th FYP and calls for more scientific, transparent and fair distribution and enforcement of targets among localities and industries to avoid damaging the economy and to build confidence among compliant firms that their efforts are not in vain.

China does not only seek to reduce coal consumption in industry but also across society. Therefore **Chapter 4** analyses the 'clean heating programme,' which promoted the shift from coal-burning to greener energy sources in rural areas of China's northern provinces during the 13th FYP. Based on fieldwork in Hebei Province in June 2020, this case study focuses on assessing the impact of the fuel switch on rural households' disposable income. While the shift from coal to gas or electricity brings undeniable health benefits and convenience to rural households, how the policy was implemented locally may unintentionally impose a higher burden on the poorest households. First, different fuels and technologies ('clean coal', gas, factory waste heat recovery and distribution, electricity, including electric AC and solar heat pumps) involving direct and indirect costs for residents have been imposed without consultation. Second, implementation has varied widely across local administrative units depending on their economic wealth, with poorer localities receiving looser fuel switch targets but facing higher transition costs. Finally, due to differences in housing size, insulation quality and consumption calculation methods, the fuel switch has resulted in rural households paying a much higher incremental energy cost than their urban counterparts, in some cases possibly rising to over 15% of their disposable income as government subsidies are phased out. To mitigate these regressive impacts, the government should stabilise energy supply and energy prices, allow for longer-term transitions involving public participation, pay more attention to the quality and safety of the equipment installed in rural areas, and support stronger cross-jurisdictional cooperation mechanisms at the grassroots level.

Under the just transition framework, the energy transition can also be harnessed to address existing social inequalities. **Chapter 5** analyses the Photovoltaic Poverty Alleviation Project (PPAP), which was implemented during the 13th FYP to stimulate the expansion of solar PV in rural areas and to use the revenue generated by the sale of the electricity at subsidised prices to provide income for poor villages and households. On many levels, this policy was a great success since, by the end of 2020, it had allowed the installation of 26.36 GW of solar power in 60,000 villages, reportedly generating 18-billion-yuan of income per year that supported 4.15 million poor households and 1.25 million public service jobs. However, the case study analysis finds several implementation issues that put the sustainability of these projects at risk and, in some cases, may aggravate, rather than improve, the financial situation of the localities and rural households they were aimed to help. Specific challenges include illegal land grabs from farmers, the use of low-quality equipment and poor maintenance leading to accelerated efficiency losses, the creation of unsustainable household and local government debt, and a lack of transparency regarding the use of revenue leading to their misappropriation and embezzlement. Following the end of the PPAP policy in 2020, the chapter draws on these insights to formulate recommendations to foster more effective and fruitful implementation of existing projects and inform new policies putting solar power at the centre of rural revitalisation goals. In particular, it advocates increasing the oversight of PPAP projects and putting in place coordinated maintenance systems to maximise their life-long productivity, and developing regulatory frameworks to 1) ensure the most efficient and fairest use of rural land, 2) guarantee the best quality and maintenance of the solar equipment used, and 3) enable rural PV farms to generate revenue from the market rather than government subsidies by enabling their participation in market-based mechanisms such as the sale of green certificates or carbon offset credits.

In conclusion, the report underscores that whereas all the policies reviewed in the case studies have brought China a step closer to sustainability, their fairness impacts have not been sufficiently factored in policy design and implementation. Indeed, although each transition policy has included some measures of compensation and transitional support, these have often been insufficiently prepared and insufficiently funded, or implemented in an imbalanced manner, or tied to the achievement of short-term campaign-style policy goals. In addition, most policies have experienced frequent and unwarranted changes, which have left no time for local governments and stakeholders both to participate in policy design and to plan and prepare for changes. Instead, top-down policy mandates have encouraged local over-reactions and a focus on short-term achievements at the expense of sustainability.

Considering that a holistic policy design with a continuous focus on and effective participation of affected groups and their welfare, effective incentive programmes, and appropriately calculated and fairly distributed subsidies, is crucial for enabling a just transition towards carbon neutrality in 2060, we recommend the following general actions:

- Mainstream fairness considerations across all low-carbon transition policy design and implementation processes.
- Adopt an inclusive assessment system of low-carbon projects that integrates social outcomes alongside environmental performance.
- Ensure the provision of adequate, stable, and equitable compensation mechanisms for the social groups and communities which are negatively affected by energy transition policies and projects.

Contents

Abbreviations

CATL	Contemporary Amperex Technology
CCUS	Carbon capture, utilisation and storage
CPAD	State Council Leading Group Office of Poverty Alleviation and Development
CPC	Communist Party of China
FYP	Five-Year Plan
GDP	Gross domestic product
IEA	International Energy Agency
IMF	International Monetary Fund
IRENA	International Renewable Energy Agency
MHRSS	Workers Congress and submitted to the local Human Resource and Social Security Bureaus
MIIT	Ministry of Industry and Information Technology
MOA	Ministry of Agriculture and Rural Affairs
NCMSSB	National Coal Mine Safety Supervision Bureau
NDRC	National Development and Reform Commission
NEA	National Energy Administration
PPAP	Photovoltaic Poverty Alleviation Project
PPP	Public-private partnership
PV	Photovoltaics
SCIO	The State Council Information Office
SOE	State-owned enterprises
TCE	Tonne of coal equivalent

Foreword

With climate change becoming an ever-greater threat to humanity, efforts to protect the climate and limit green- house gas emissions have become widespread among all major countries, at least rhetorically.

In this context, the transition of how we generate the energy to run our economies is of utmost importance: we must move away from carbon-based fuels like coal, oil and gas, towards renewable energies like wind, sun and water. In an economy that is as reliant on coal as China's, this transition inevitably will produce winners and losers. On one hand, the new industries that need to develop will require massive investment, while promising great profits.

On the other hand, industries related to fossil fuels will suffer a steady decline, impacting their employees and the regions in which they are located. At the same time, rising energy prices will put additional pressure on lower income households.

In order to better understand how the energy transition in China is playing out in this context, the Friedrich-Ebert-Foundation's (FES) Shanghai Office and Duke University in Kunshan have decided to conduct this set of case studies. The goal of this study was to analyse what justice implications different aspects of energy transition hold and what lessons can be drawn.

The study not only provides a good insight into possible strategies through which the energy transition can be shaped socially, it also points out that fairness considerations and compensation mechanisms are key elements of a successful transformation.

Therefore, fairness considerations need to be mainstreamed across all low-carbon transition policy designs as well as during the implementation processes. This requires that assessment systems of low-carbon projects must integrate social outcomes along with environmental performance. However, it should also be taken into account that energy transformation will have negative consequences for individuals, groups and regions. For this reason, stable and equitable compensation mechanisms are needed to enable a socially and regionally balanced development. Both elements have to be taken into account when designing and implementing the transformation.

Because a sustainable and successful energy transition requires popular support, China's energy transition has to be a Just Transition that takes the losses of the transition's 'losers' into account and mitigates them. Only when the burden of transition is fairly shared across society, the transition project will be broadly accepted, especially in low- and middle-income countries where economic development needs are often pitted against climate and environmental protection. At the same time, as this report will show, not all good ideas in theory are good ideas in practice.

We hope the findings and the hands-on experience presented in this study will help policymakers and researchers find new or improve established paths towards a Carbon Neutral Just Transition.

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Introduction

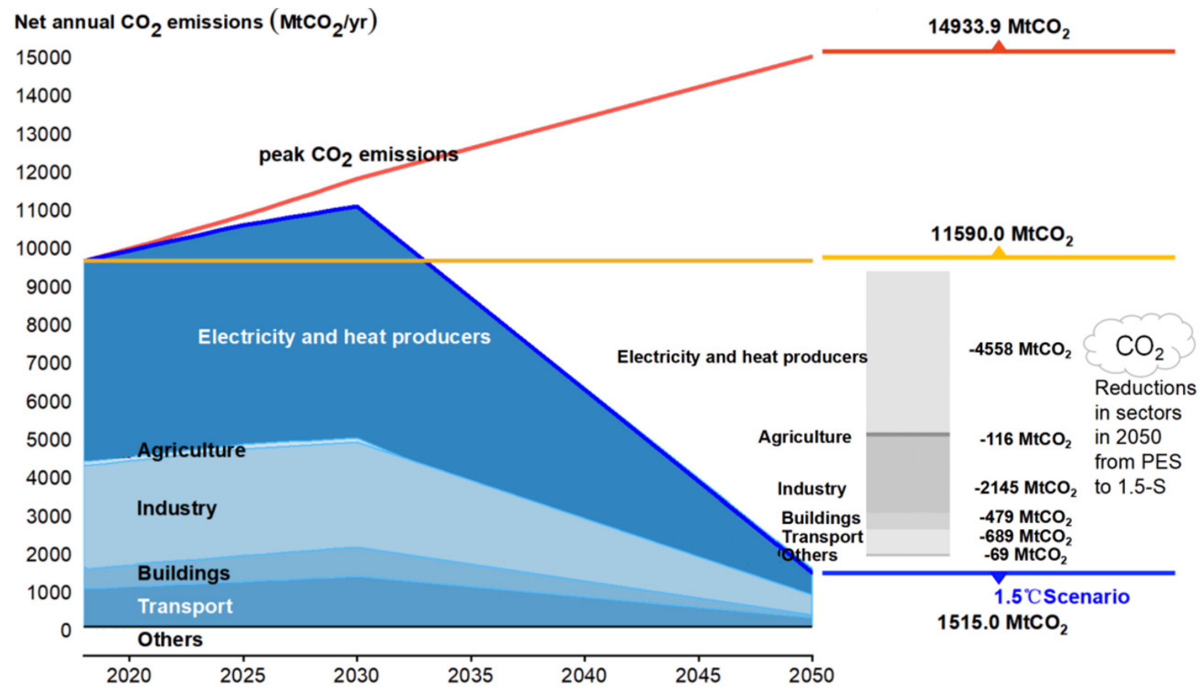
Since the introduction of the 'dual carbon peaking and carbon neutrality' '3060' goals in September 2020, climate change has become the main driver of the energy transition in China. Hitherto seldom mentioned in public discourse, low-carbon development has been elevated to a national strategy and become a hot topic in domestic policy forums and one of the few remaining anchors of international cooperation and diplomacy amid rising geopolitical tensions. The very concrete consequences for economic and social development have made climate change an issue high on the agenda of local governments and companies.

The existing literature shows that achieving the goal of carbon neutrality requires a systemic transformation involving the whole of society and economy. Due to China's heavy dependence on coal and its comparatively recent industrialisation, this transformation is bound to be particularly profound and challenging. To meet the target of net-zero emissions by 2060, China must immediately increase its non-fossil fuel annual growth rate and reduce its carbon emissions, which are still increasing in 2022, by 4 percent per year by 2030 (Figure 1).

These goals are daunting. To achieve them, the State Council outlined its governance system in 'The Action Plan to Peak Carbon Emissions by 2030' issued on October 26, 2021. According to this plan, China's carbon peaking strategy will rest on two pillars. The first pillar represents actions by the government, which sets intensity targets for energy consumption and carbon emissions and limits the development of 'high energy consumption and high emission' industries and projects through administrative command and control measures. These include, among others, the strict enforcement of energy consumption and emissions reduction targets and the systematic review of energy consumption and carbon emissions projections in environmental impact assessment and approval processes of new industrial projects. The second pillar is the market, which is invited to provide economic incentives to economic actors to develop and deploy energy-saving and carbon emissions-reducing technologies. Here, the national emissions trading system launched on July 16, 2021, could play an important role in the medium term. An effective combination of administrative and market-based measures could support the necessary acceleration of China's energy transition without

Chinese emissions going up on the short run, down on the long run

Figure 1： Carbon emissions in China through 2050



Source: BCG, 2020, McKinsey, 2021, Energy foundation, 2020 compromising the country's energy security and aspirations for increased prosperity.

However, the Plan pays little attention to the fairness impacts of these transition policies. Notwithstanding the declaration by President Xi in April 2021 that China must deliver social equity and justice with the green transition (Xinhua, 2021), the Plan falls short of spelling out a framework for just transition.

Just transition ensures environmental sustainability, decent work, social inclusion, and poverty eradication (Just Transition Centre, 2017). The concept of just transition was first proposed as a programme to support workers who lost their jobs due to the environmental protection policies adopted in the United States in the 1970s. Over time, it has come to mean something much broader, encompassing all government actions on climate change and climate justice. It was inserted into the preamble of the Paris Accord in 2015[1]and rallied countries under the Silesia Declaration at Climate COP 24 in 2018. In recent years, it has gained prominence and was a salient issue at the Glasgow COP26 in 2021. The Biden Administration and the EU have made climate justice, including just transition, a central piece of their climate strategy (Whitehouse, 2021, European Commission, 2021). Realising a just transition requires actions to provide decent and sustainable jobs for the impacted industrial workforce and enhance affected communities' revival while addressing pre-existing climate and socio-environmental injustices.

China must engage with a just transition to achieve carbon peaking and neutrality. Despite the rapid growth of the economy in past decades, China has become one of the most unequal countries in the world (IMF, 2018). Unbalanced growth, significant regional disparities, and income inequalities threaten its long-term sustainable development. The energy transition both requires and provides an opportunity to correct this development pathway. The concept of 'common prosperity' has been frequently mentioned and highlighted by President Xi in both domestic and international arenas (Xinhua, 2021). A just transition is in line with this broad objective. The government should focus not only on the effectiveness of sectoral and economic transition strategies but also on the distributional impacts they may have. Efforts are needed to manage the nationwide low-carbon transformation. Policies and plans must be put in place to help mitigate the adverse impacts on affected localities and groups, especially the most vulnerable ones.

To this end, this report explores several key dimensions and policy fields calling for the implementation of a just transition framework in China. Given the complexity of China's economic structure, energy mix, and regional heterogeneity, we adopt a twofold methodology. Chapter 1 brushes a macro-picture of China's low carbon transition and discusses its main distributive impacts on the national industrial structure, localities, and social groups. Then, Chapters 2 to 5 analyse the deeper mechanisms through which specific decarbonisation measures may lead to regressive outcomes in less developed and fossil-dependent regions and groups through carefully selected case studies. These include: the impacts of the coal capacity decommissioning campaign undertaken in 2016-2020 on coal mine workers (chapter 2); the distributive impacts of the 'double control' energy intensity and energy consumption cap targets enforced in 2020 on localities and industries (chapter 3); the impacts of the campaign to replace heating coal by gas or electricity on rural households' income (chapter 4); and the benefits and challenges faced by rural poverty alleviation PV projects in generating income and sustainable energy for China's villages. While pointing out challenges, these case studies also underline the efforts deployed by local authorities to address them and propose further actions based on domestic best practices and insightful international experiences, summarised in the concluding chapter.

1 'Taking into account the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities …' Paris Agreement (2015)

1. Impacts of the low-carbon transition on industry, localities, and social groups in China

The low-carbon transition led by the dual carbon peaking and neutrality '3060' goals will have a wide range of impacts on the Chinese economy, accelerating a profound restructuring of regional and industrial development patterns and the provision of social welfare. These impacts are unequally distributed among industries and strongly affect the localities and social groups who have relied on the industries facing drastic restructuring or complete phase-out. This chapter provides an overview of the key macro-level distributive impacts of the low-carbon transition on industries, localities, and social groups.

1.1 Impacts of the energy transition on industries

China's carbon peak and neutrality goals will mainly be achieved through emissions reductions in energy-intensive industries, especially power generation, ferrous metals, and nonmetal mineral industries, which accounted for as much as 82.58% of the country's total emissions in 2018 (Wind Database, 2018). According to research by the Tsinghua Institute of Climate Change and Sustainable Development, to maintain global temperatures under 1.5-2 ℃ , China's power and industrial sectors will have to abate 70-80% of their emissions over the next 30 years (Institute of Climate Change and Sustainable Development, Tsinghua University, 2020). These reductions in industrial emissions will occur in the steel, cement, chemicals, paper, and aluminium sectors, with a reduction rate of over 90% over the next 40 years (IEA, 2022, Table 1).

Chinese policy documents identify thermal power, petrochemicals, chemicals, steel production, non-ferrous metal smelting, and building materials as high-energy-consuming and high-emission or 'double high' industries. Policy controls their energy consumption and emissions, as well as new projects approvals. In May 2021, a new 'carbon emission impact assessment' (CEIA) was included, to this end, in Environmental Impact Assessment procedures. Regulations on energy audits, outdated capacity phase-outs, and industrial upgrading have also been strengthened. The 'Action Plan to Peak Carbon Emissions by 2030' reaffirms special efforts to achieve carbon peaking in the steel, non-ferrous metal, building materials, and petrochemical and chemical industries.

These measures are likely to have a stronger impact on small and medium enterprises in these targeted sectors and their downstream sectors. Compared with large

Table 1: Steel, Cement and Chemicals - China's main sources of emissions

Industry	Emissions in 2020 (Mt)	Emissions in 2060	Reduction rate in %
Chemicals	530	60	90
Steel	1500	120	92
Cement	1300	30	98
Aluminium	-	-	95
Pulp and paper	-	-	90

Carbon emission projections by industry in China in megatons (MT)

Source: IEA, 2022

companies, especially state-owned companies, small and medium private enterprises are less capable of sustaining stable levels of capital, even though this is critical to withstand an economic environment where the price of power and raw materials increases sharply due to environmental and climate regulations. It is also more challenging for them to achieve breakthrough technological innovations and attract new capital investments (McKinsey, 2022, Wen and Tan, 2011).

To be sure, the energy transition also provides new industrial development opportunities. These include, among others, new and cleaner energy technologies, such as wind and solar or green hydrogen, a multitude of energy-saving and resource re-utilisation industries, and new carbon capture, utilisation, and storage technologies. Some green industrial sectors have proliferated in China recently. According to several independent reports, some leading green enterprises have already outperformed traditional corporations in terms of market value (IBM, 2021). For example, Contemporary Amperex Technology (CATL), a Chinese group that is the global leader in the production of lithium-ion batteries for electric cars, has surpassed China Merchants Bank (CNY 1.27 trillion) and became the fourth most valuable A-share stock in China with a market capitalisation of CNY 1.3 trillion on July 8, 2021(IBM, 2021). LONGi, one of the leading suppliers of solar PV solutions, has increased its market valuation to nearly CNY 350 billion, approaching the market value of China's state-owned coal mining and energy Shenhua Group.

Correspondingly, many local governments across China have shifted their industrial development focus away from traditional energy-intensive manufacturing and engaged in a race to attract and develop green industries. Many have established high-tech zero-carbon industrial parks and deployed a range of industrial policy tools such as investment and production tax credits, loan guarantees, and preferential land provisions. Commercial banks have also been encouraged to use new green finance mechanisms while tightening credit control over high-energy-consuming and high-emission projects.

Notwithstanding these developments, the ability of localities to implement these policies and achieve 'green growth' is uneven. Their capability is closely related to their relative economic strength and the time frame in which they are expected to accomplish their transition. Fundamental differences in local economic structures and the strength of local financial systems make it more challenging for some to attract new, usually capital-and-technology intensive industries. Moreover, the necessary acceleration of emissions reductions will inevitably lead to the closure of significant heavy industry segments. Localities that concentrate on these industries will face important challenges in supporting 'sunsetting' industries, settling their debt, reemploying their workers, and compensating for the loss in local finances.

1.2 Impacts of the energy transition on localities

Chinese provinces and municipalities have made uneven progress in decarbonisation. High GDP, technology-driven, and service-oriented provinces and municipalities located on the left side of the graph in Figure 2, like Beijing, Shanghai, Zhejiang, and Jiangsu, have achieved a relatively high level of decarbonisation. Beijing has reduced its carbon intensity to below 0.5 tonnes per 10,000 yuan GDP.

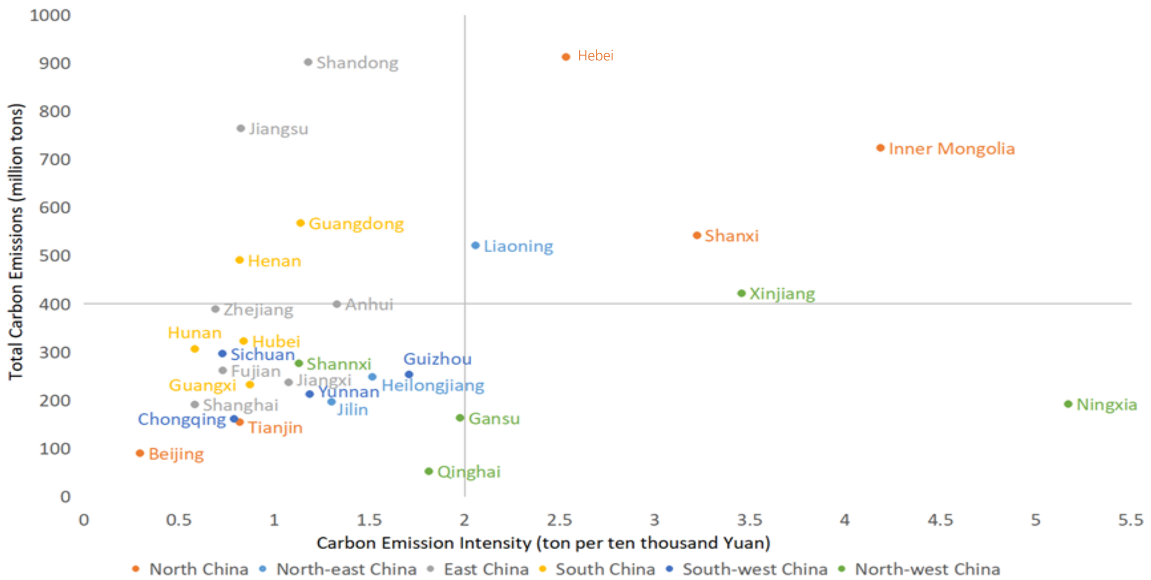
In 2020, it emitted only 0.41 tonnes of CO_2 per 10,000 yuan GDP, a drop of over 26% from 2015. But many of its high emissions industries have been moved to other localities, especially neighbouring Hebei, which is among the provinces with the highest carbon intensity levels, along with Ningxia, Inner Mongolia, Xinjiang, and Shanxi Province. These provinces' government revenue and social service provisions are highly dependent on fossil fuel extraction and heavy industries.

A similar disparity is visible at the municipal level. The index of carbon decoupling developed by Shan et al. (2021) for 294 municipalities in China between 2005-2015 indicates that only 11% of them had achieved 'strong decoupling,' whereas 65.6% only achieved weak decoupling and 23.4% displayed no decoupling at all (Figure 3)[2]

2 Strong decoupling is defined as municipalities with negative emission growth while their economy continues to grow. Weak decoupling describes municipalities that show slower growth of emissions than economic growth. Shan et al. (2021).

Industrialised provinces produce most of China's emissions

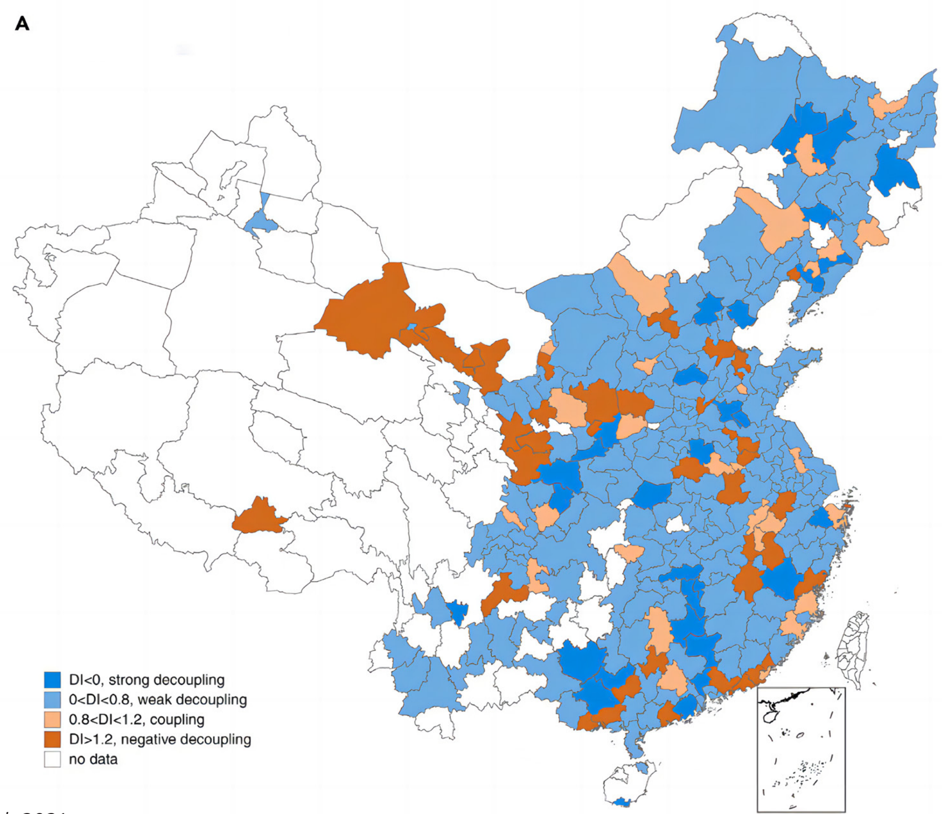
Figure 2. Divergences of Chinese provinces and municipalities in carbon emission and intensity level



Source: Emission Inventory of Provinces (2019) from Carbon Emissions Accounts and Datasets, Provincial Statistical Yearbook, (2019)

The decoupling of economic development and emissions

Figure 3. Decoupling index of carbon emissions and economic development of Chinese cities in 2005-2015



Source: Shan, et.al, 2021

Although each locality faces challenges in the pursuit of decarbonisation, the magnitude of the challenge and adequate strategies are bound to vary a lot. Resource-dependent localities face especially significant challenges in diversifying their industrial structure while maintaining economic development. The average carbon intensity of resource-dependent localities has been estimated to be 29.7% higher than the national average[3]. For example, over 60% of the economic output in Shanxi Province comes from coal and resource mining and thermal generation industries. Transitioning involves phasing out highly profitable (though sometimes debt-ridden) industries and finding pathways to attract green investments while dealing with massive unemployment and potential social instability. While many reconversion projects are being developed in various regions, there is no overall guidance and model to follow.

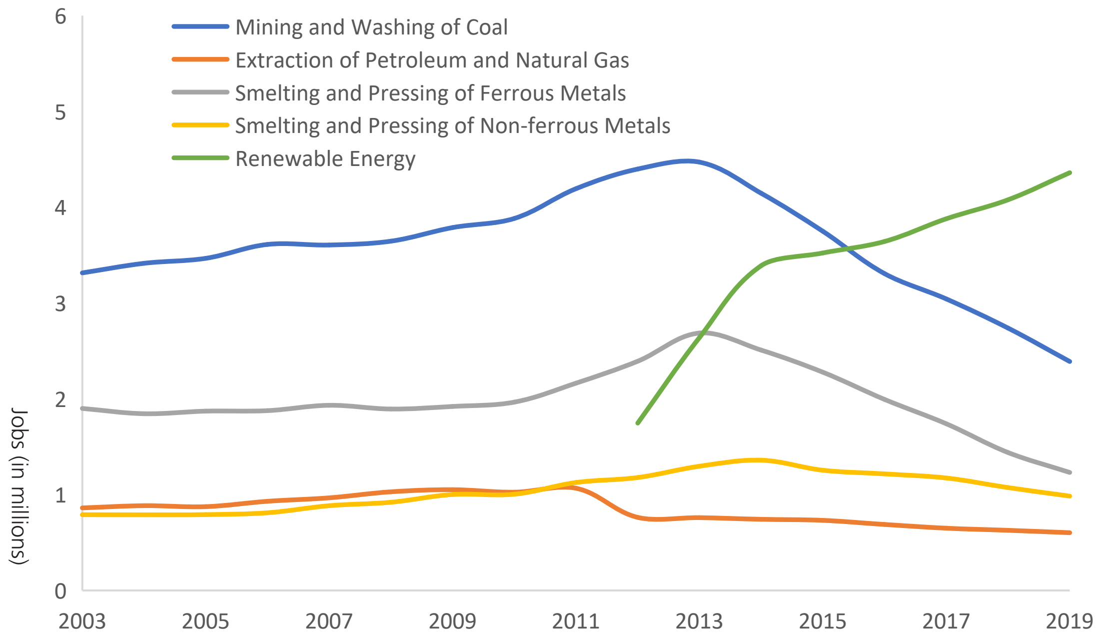
Manufacturing localities are usually giant energy consumers and carbon emitters. Jiangsu, Shandong, Guangdong, and Liaoning lead the pack, emitting over 500 million tonnes of carbon emissions each year. Light manufacturing may not consume large amounts of fossil fuel energy directly, but they consume a lot of electricity, currently still primarily generated by coal. Developing a low-carbon economy requires doubling down on improving energy efficiency and greening the power supply while controlling increases in production costs for these localities.

By contrast, China's affluent localities, dominated by the service industry, like their counterparts in western countries, need to address their direct consumption and indirect, imported emissions. After shutting down and relocating most coal-fired power plants and heavy industries to neighbouring regions, local emissions in Beijing, Shanghai, and Shenzhen are generated mainly by transportation and housing, issues which can be addressed by policy measures supporting the phase-out of fossil-fuel vehicles, the acceleration of thermal renovation and the deployment of incentives for green and low-carbon consumption.

Sadly, around 20% of Chinese municipalities in the north-eastern rust belt have already experienced decreased carbon emissions due to economic depression

More jobs in Renewables, many Jobs still in Carbon-intensive Industries

Figure 4. Industrial employment trends in carbon-intensive and renewable energy industries (2003-2019)



Source: China Labor Statistical Yearbook (2004-2020), IRENA (2012-2020))

3 Taking the 262 officially defined resource-dependent municipalities as the research sample

rather than decoupling (Guo et al., 2021). Jilin and Heilongjiang, for instance, saw their emissions plateau in 2012 and 2016, respectively, because of resource depletion, industrial decline, and population loss (Yuan, 2022). Trapped in a seemingly unstoppable spiral of decline, these areas could find a way out through new green development. Still, they face difficult geographic, climatic, economic, social, and political conditions to win the race for green tech investments.

1.3 Impacts of the energy transition on social groups

Achieving speedy and deep decarbonisation of the Chinese economy exposes hundreds of millions of workers and communities to the risk of unemployment and increasing living costs. In the past decade, employment in the coal mining and dressing industries has shrunk by half (CEIC DATA, 2021). During the 13th Five-Year Plan (FYP) period, reducing steel and coal industries destroyed an estimated 1.8 million industrial jobs. As shown in Figure 4, employment in carbon-intensive industries has decreased sharply since 2013, by 4 million.

Although the clean energy industry has created new jobs, around 2.8 million since 2012, the precise number, quality, and sustainability of these jobs remain debatable. Moreover, these opportunities are not necessarily in the same communities and populations. A fair transition away from coal calls for proactive plans to develop alternatives and help the workforce move into decent and life-sustaining jobs and industries.

Besides employment, switching to cleaner but more expensive energy may also harm low-income households; 29.6% of rural households, mainly in the colder northern regions, still used coal as the primary fuel for heating in 2019 (He et al., 2020). As China aggressively cracks down on dispersed coal burning, many households have faced financial difficulties in switching from coal to natural gas or electricity. The extent of the impact depends highly on the capacity of the government to compensate for these increases with subsidies. To keep the energy transition socially and politically sustainable, special attention must be paid to these compounding factors (loss of industrial jobs, increasing living costs) affecting the working class in China.

2. The fairness impacts of coal decommissioning: the case study of City A in Guizhou Province

The impact of the phase-down of coal on employment and the economy is a crucial concern for all countries whose energy system relies heavily on coal. This is also a significant challenge for China, which produces nearly half of the world's coal (BP, 2021) and is home to the world's most labour-intensive coal mining and washing industry; after a peak in 2013, it still employed an estimated 3,749,000 workers in 2015 (China Labour Statistics Yearbook, 2016). In 2016, the central government launched an unprecedented coal decommissioning campaign, which was expected to bring about 1.3 million layoffs (People's Network, 2016). This chapter focuses on Guizhou Province, which is sometimes referred to as the 'coal ocean of south China,' for its 50 billion tonnes in coal reserves, the fifth largest in China and the largest by far in the southern half of the country (Guizhou Provincial Bureau of Statistics, 2021). Even though it is likely to remain a vital coal base in the coming decades, its handling of the 2016-2020 decommissioning campaign provides a learning experience for how the coal phase-out could impact China's coal miners.

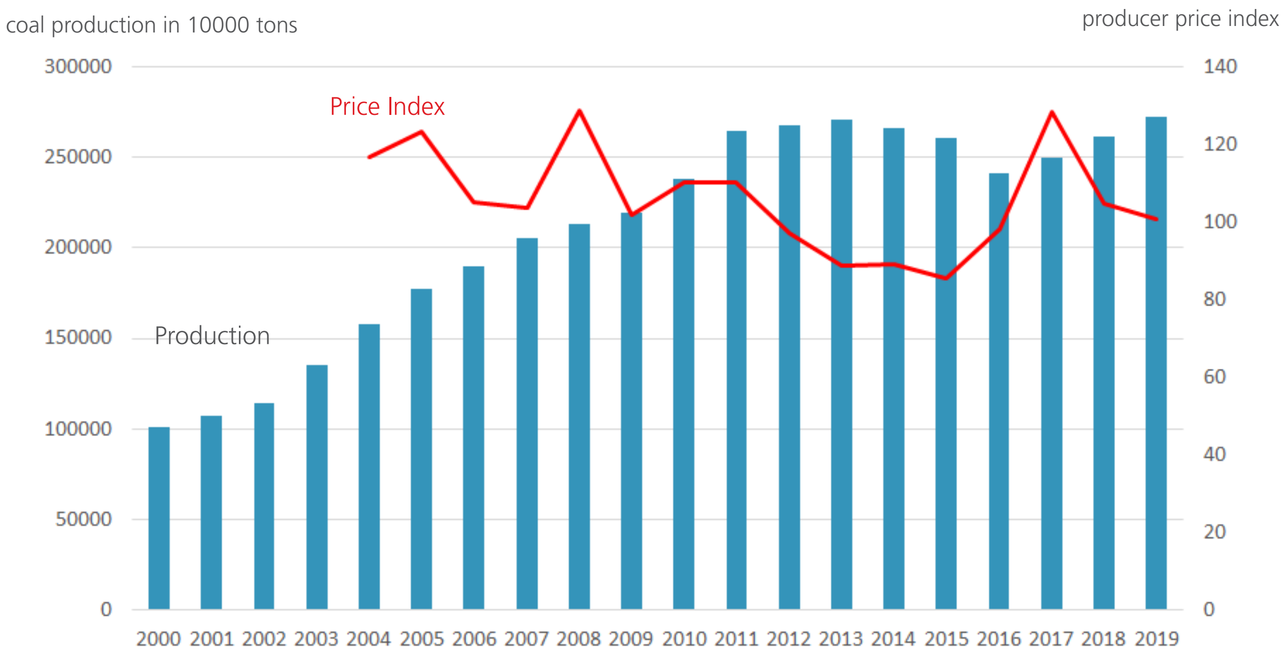
2.1 The coal decommissioning campaign of 2016-2020

In 2016 the central government launched a coal decommissioning campaign to rebalance the supply and demand of coal and contribute to its air pollution and carbon emissions reduction goals (State Council, 2016). As the coal price index kept falling from 110.86 in 2010 to 85.4 in 2015 (see Figure. 5) (CEIC, n.d.), oversupply became a looming threat to the development of the Chinese coal industry.

In February 2016, the State Council proposed reducing coal capacity by about 500 million tonnes/year and restructuring about 500 million tonnes/year of coal capacity within 3 or 5 years (State Council, 2016). To achieve this goal, three tasks were proposed: strictly

Coal production stable at a high level, prices fluctuating at a high level

Figure 5. Coal production and price index in China



Source: CEIC Data: https://www.ceicdata.com/en/china/producer-price-index/producer-price-index-coal) control new capacity by prohibiting the commissioning of new capacity unless equal capacity is closed; eliminate outdated capacity that violates laws or policies; withdraw capacity that is environmentally harmful or uneconomical (see Table 3). The National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology (MIIT), the National Energy Administration (NEA), and the National Coal Mine Safety Supervision Bureau (NCMSSB) jointly assigned decommissioning goals to each province through Target Responsibility Contracts with local leaders, who did the same with municipalities, and municipalities with counties.

For the first time, to prevent unemployment, the State Council put forward four ways to resettle the laid off workers: reemployment within the enterprise, early retirement, termination of employment contracts with compensation, or public welfare positions. It also set a Special Award and Supplementary Fund (hereafter, 'the Fund') to support the resettlement of layoffs. Soon, the Ministry of Human Resources and Social Security issued more detailed guidance on these four resettlement methods (MHRSS, 2016), while the Ministry of Finance created the 100 billion Fund and mandated related management methods to encourage the earlier and overshooting of coal decommissioning targets (Ministry of Finance, 2016). Although the policy mentioned that the Fund could be used to resettle 'qualified' non-state-owned enterprises (qualified as decided by provincial governments), its use was prioritised for SOEs.

2.1.1 The coal decommissioning campaign in Guizhou Province

At the end of 2015, Guizhou counted around 709 mines, yielding a total of 151.59 million tonnes/year (Zhang, 2016). In 2016, the central government required Guizhou to close 510 coal mines representing over 70 million tonnes of production capacity (almost half) by 2020 (General Office of Guizhou People's Government, 2016). The Guizhou government scheduled this overall target over the following five years across its municipalities (Table 2). On May 9, 2019, the Guizhou government further released a policy that ordered the closure of coal mines with a production capacity of 300,000 tonnes/year (General office of Guizhou People's government, 2019).

Mirroring the central government policy, the Guizhou government also proposed several ways to help lay off workers, including reemployment within the enterprise, early retirement, retraining for employment and entrepreneurship, and public welfare positions. Moreover, the provincial government also provided additional funds to encourage the closure and restructuring of old capacities (Guizhou Provincial Department of Finance, 2017).

Guizhou's Slow Departure from Coal

Table 2. Annual plan of coal decommissioning in Guizhou

Year	Number of closed coal mines	Reduced capacity (million tonnes/year)
2016	100 or 142	18.97 or 23.11
2017	120	15.03
2018	130	17
2019	110	14
2020	20	5
Total	480 or 522	70 or 74.14

Source: General office of Guizhou People's government, 2019

2.1.2. The coal decommissioning campaign at the municipal level

City A's coal reserves stood at 23.019 billion tonnes in 2015, accounting for 40% of Guizhou's reserves. It is also the largest coking coal base in the south of China, valued for its diversity and quality. Following the closure of 55 outdated coal mines with a total capacity of 8.31 million tonnes per year between 2013 and 2015 (City A Municipal Energy Bureau, 2016), its coal production capacity was 61.7 million tonnes per year in June 2015 (City A's Municipal Energy Bureau, 2015). In 2016, City A signed a Target Responsibility Contract with the provincial government and committed to close to 13.1 million tonnes per year between 2016 and 2020, equivalent to 21% of its capacity (City A Municipal Development and Reform Commission, 2018).

Under this policy, smaller mines experiencing losses or having suspended production were encouraged to report to county governments to officially close and sell their capacity to other coal mines, who could thereby expand their capacity above the 300,000 tonnes/year production threshold (General office of Guizhou People's Government, 2019). Then the list of coal mines to be closed was submitted to the provincial government and publicised each year. County / District governments were charged with carrying out the mine closures. The coal mines designated for closure were required to adopt a resettlement plan, which had to be approved by the mine's Workers Congress and submitted to the local Human Resource and Social Security Bureaus for verification (MHRSS, 2016). Closing coal mines were also expected to restore the ecological environment (Ministry of Natural Resources, 2019), except if their capacity was purchased by another mine, in which case the latter would become responsible for it. However, the funds granted by various levels of government to resettle workers and restore the environment covered only a fraction of the needs, most of which had to be covered by the enterprises.

By 2020, City A had closed 55 mines, representing 13.12 million tonnes of capacity (People's Network, 2019), thus overshooting its target of 13.10 million tonnes/year. Guizhou Province closed 477 coal mines representing 74.26 million tonnes of production capacity, also achieving its goal of 74.14 million tonnes/year (Xinhuanet, 2021). However, in the same period, many new coal mines opened, and new capacity was developed. Therefore, the total capacity did not decrease but increased from 709 mines representing 151.59 million tonnes/year in 2015 (Zhang, 2016)[4] to 764 coal mines representing 328.01 million tonnes/year in 2021 (Guizhou Provincial Energy Bureau, 2021). In 2021, the province still planned to increase output by 20 million tonnes/year (Guizhou Daily, 2021). Correspondingly, a local official in City A explained that:

"With the shrinking coal market in neighbouring provinces, Guizhou Province needs to produce more rather than reduce its so-called 'overcapacity.' Overcapacity' may exist in the provinces like Shanxi and Inner Mongolia but not in Guizhou. So, we don't regard coal decommissioning as reducing total capacity. It is just a way of optimising and restructuring the coal industry. Small coal mines below a minimum capacity have to close or merge with other coal mines. The capacity flows like water from small, scattered, private coal mines to larger, concentrated, SOE coal mines."

2.2 Workers in two closed coal mines of City A

There are significant differences in how private and SOE mines operate and resettle their workers. Based on fieldwork carried out by the team in July 2021, this section compares an SOE coal mine and a private mine. The former resettled all its 1,345 workers according to a resettlement plan by terminating their contracts with compensation, re-employing them in other coal mines, or granting them early retirement. No resettlement plan was adopted in the latter, and most of the 300 workers were laid off without compensation.

2.2.1. SOE coal mine SY workers

SY coal mine was designed in 1966 and began production in 1974. It belonged to S Mining Bureau at that time. In 1998, the S Mining Bureau was transferred to Guizhou Province and reformed as a provincially owned SOE named Guizhou S Mining Group in 2001.

4 This excludes one central SOE mine

SY coal mine had both second-generation mining workers and former farmers in its workforce. However, both had similar labour contracts and legal employment status. SY would usually sign 3–5-year contracts with workers and 10-year or more extended contracts with managers. All would become permanent contracts afterwards. The average annual salary at SY mine was around 56,000 CNY, significantly higher than the average annual salary of S Mining Group (37,000). Workers' monthly salaries varied between 3000 to 8000 after tax depending on their position. Although lower than net salaries earned in private coal mines, they came with a complete 'five social insurances package' including retirement pension, occupational injury insurance, medical insurance, unemployment insurance, maternity insurance, and housing providence fund.

In 2016, the Guizhou government designated the S Mining Group to lead its coal capacity decommissioning campaign. The group decided to close the SY coal mine with 0.9 million tonnes/year and another coal mine with 0.45 million tonnes/year. SY experienced three major deadly gas accidents during its early years. Gas leaks were still considered a significant risk, which may explain why it was chosen. Yet SY was a profitable mine, accounting for 10% (0.2 billion yuan) of the total profit of S Group. Moreover, it was about to take on a project worth 70 million amid rising coal prices.

On August 10, the SY coal mine was ordered to close by the party committee of S Mining Group. All the underground equipment was withdrawn within one month, and the wellheads were all closed by September 12. After closing, SY issued a first resettlement plan, which included re-employing workers in other coal mines and companies under the S Mining Group and early retirement for workers within five years of retirement, affording those workers a minimum wage in City A (1,790 CNY). However, the plan did not include the option to terminate contracts with compensation[5]. First, the Group preferred to reemploy the workers in other coal mines in need of it, and second, they did not want to use the 0.48 billion Yuan government Fund to compensate workers.

As a result, in a rare move, over half of the Workers Congress rejected the resettlement plan. Following negotiations with the mining group leadership, the plan was revised to include an option for workers to terminate their contracts with compensation, which was unanimously approved by the Workers Congress. According to a SY manager, 45% of employees eventually chose to leave with compensation, 37% to transfer to other coal mines and companies in the group, and the remaining 18% received early retirement benefits. However, nearly 100 workers unsatisfied with the compensation brought a petition to the local government. They complained that the compensation they received had been calculated based on the average monthly salary of S Group rather than the higher average monthly salary at SY coal mine. Eventually, the group revised the compensation to pacify the petitioners. Only 30-40 employees were left in the coal mine to deal with asset disposal, use of funds, social insurance, and other benefits. The community around the coal mine, which remains managed by SY, saw its population shrink from 2,000 people to just about 200.

Figure 6. Interview with previous manager and workers of SY mine

Source: field study

5 According to article 28 of the Labour Law and article 47 of the Labour Contract Law, the compensation to terminate a contract shall be paid to the worker based on the previous 12-month average wages multiplied by n+1, n being the number of years spent by the employee in the mine, with a cap at 12 years.

2.2.2. Private coal mine FA workers

FA coal mine is a collective owned by a township in Shandong Province but operating as a private coal mine in Guizhou's City A. It was established in 2007 and employed around 300 workers. Most of the managers were from Shandong, while workers were hired from the surrounding villages. The coal mine had annual contracts with managers and workers, whose salaries were based exclusively on their team's production output. The average salary of managers was around 10,000 yuan per month, and that of workers ranged from 5,000 to 9,000. This salary came along with only basic occupational injury insurance, which is illegal but was thought a sensible choice for the leadership since worker mobility was very high and government supervision was lax. Based on our interview with the manager of the FA coal mine, they intended to provide the full five social insurances, as required by the government, if they were able to resume production.

The workers at the FA mine enjoyed more flexibility than workers in SOE coal mines. For example, they had no minimum or maximum number of working days. They also had no weekends or holidays except the Spring Festival and could decide to work as much or as little as needed, sometimes going off to do other work and coming back weeks or months later.

In July 2019, the FA coal mine was required to suspend production because its capacity was only 150,000 tonnes/year (General Office of Guizhou People's Government, 2019). To be allowed to re-open, FA decided to increase its capacity to over 300,000 tonnes/year, but it could only do so if it closed equivalent capacity elsewhere. Thus, it bought another private mine with a capacity of 150,000 million tonnes/year for the sole purpose of closing it and expand its production using greater mechanisation and automation. The Guizhou government subsidised 20% of the mechanisation and automation measures. However, when we visited the mine, the mechanisation and automation upgrades had yet to start due to a lack of funding.

Figure 7. Interview with the manager of FA mine

Source: field study

Following the suspension of production in 2019, workers were all dismissed except for 11 staff members (electricians, drivers, and guards). Contracts were terminated without any compensation. Consequently, workers left the village to find jobs elsewhere, while managers returned to their hometowns in Shandong.

2.3 The fairness impacts of mine closure

2.3.1. Uneven distribution of resettlement funds

According to the Measures for the Management of Special Award and Supplementary Fund for Industrial Enterprise Structural Adjustments, the Fund had to be used mainly to compensate SOE workers. Even though it could also be used to resettle the workers from 'qualified' private mines, the definition of who qualified being left to the discretion of local governments (Ministry of Finance, 2016). In Guizhou, the provincial government clarified that it would focus on resettling SOE coal mine workers (General office of Guizhou People's government, 2016). Therefore, according to the example given by an official at a District Energy Bureau, an SOE coal mine with an annual capacity of 420,000 tonnes would receive 30 million yuan (around 71.5 yuan/tonne). A qualified private coal mine producing 150,000 tonnes/year would receive 2.7 million yuan (around 18 yuan/tonne). FA mine did not receive any funds at all.

This unequal distribution of government funding is partly caused by the fact that the calculation of the funding to be granted takes into account the number of workers to be resettled or compensated. However, private coal mines usually suspend production and let their more flexible workers go before the official closure. Operating in a grey zone, some of them do not want to at Private mines thus rarely claim resettlement needs. SOE coal mines in similar situations in which they halted production would instead give long vacations to their workers and would thus still have many of them to resettle.

This difference between private and SOE coal mines is rooted in their different employment systems. It is not exclusive to the coal mining industry but shared across all industries. Highly flexible private coal mine workers would have no chance to receive any salaries once production is suspended. Therefore, they would leave to find employment elsewhere, expecting only to receive their due wages. On the contrary, SOE coal mine workers have relatively stable employment, some of them having worked in the same SOE for several generations. Even when their mine is unprofitable or has suspended production, their contracts would be maintained even with reduced salaries. The workers would also hold on to their position and associated social benefits, even while earning income outside from other activities, and expect to be resettled or compensated when their contract is terminated.

2.3.2. Severe and uncompensated impacts on local economy

Due to the concomitant opening of other mines, the overall social impact of coal mine closures in City A during the 13th FYP remained limited. However, these impacts were significant locally and may grow in scale under a more ambitious coal phasedown.

The large-scale closure of coal mines will benefit the local environment since most closed coal mines were small, backward, and polluting. The closed coal mines and the government committed to implementing ecological restoration, at least on paper. However, examples of unaddressed continuous pollution are not rare. For example, coal mine B in City A was closed in August 2017 but had yet to begin its ecological restoration work when we visited it in 2021, four years later. Another coal mine in City A was found to be secretly mining coal under the name of ecological restoration and causing severe environmental damage.

The closure of mines in remote mountainous areas inevitably affected the township economy. Besides the mines themselves, most of the surrounding small businesses closed down as well, and the local government's revenue was severely impacted. According to a district-level official, this loss of revenue was primarily due to how coal mines pay their taxes. "The impact is so big! We obtained 0.4 billion in revenue from coal mining in 2012, but now there is only one coal mine in operation, which produced 30,000 tonnes of coal last year. If we collect 100 yuan for each tonne of coal, that means just 3 million in revenue." While private mines submit all their taxes to the county government, SOE coal mines only submit around 10% of their taxes to the county government and the rest to higher levels of government. Therefore, the closure of small private mines or the purchase of their capacity by larger SOE mines leads to a significant decrease in tax revenue for grassroots governments.

2.4 Policy implications

This in-depth case study of the resettlement practices in Guizhou Province's privately operated and SOE coal mines provides several policy lessons. First, despite the central government's emphasis on the '3060' dual carbon goals, the policy signals on the necessary coal phase-out in coal provinces like Guizhou fail to resonate. Both local officials and coal mine managers did not appear to worry about the future of the coal industry in their region. They believed that the government could not quit coal and would mention technologies like CCUS that would facilitate green coal production. With coal prices rising and the government insisting on energy security in the winter of 2021, coal mining has become a highly profitable industry. Thus, more constant price signals making renewable energy structurally cheaper and internalising the environmental cost of fossil fuels are needed to drive the future phasedown of coal mining.

Secondly, social insurance schemes should cover migrant workers, part-time workers, flexible workers, and SOE workers alike. More robust implementation of labour laws and improved access to social benefits should be pursued.

Third, enterprises should be further encouraged to anticipate, diversify their activities, and revitalise their assets while they are still profitable, to prepare for the transition and mitigate the impact of mine closures on the local economy. Mining area conversion projects should be systematised and scaled up wherever possible. Industries can be significantly supported by local government plans to diversify the economy and avoid massive capital and population outflow. In relatively remote areas like City A, choices may be limited but not necessarily doomed. For instance, local governments could develop alternative agriculture and tourism based on ecological restoration efforts.

Fourth, the government should play a more substantial role in providing locally grounded, stable, and decent jobs. In China, enterprises are expected to play a central role in resettling laid-off industrial workers, especially SOEs. Coordinating reemployment with government plans for local industrial transition can be done most efficiently through collaboration between enterprises and the government. Thus, in addition to checking more comprehensively on mining companies' compliance with local resettlement policies, local authorities should also provide skill-building and professional retraining to workers in line with plans to develop a more sustainable economy.

3. The fairness impacts of energy consumption restrictions: allocation and implementation of the dual control targets in Jiangsu Province

The reduction of carbon emissions relies on controlling the consumption of fossil fuels even more than on the control of their production. In China, one of the essential policies to reduce the consumption of fossil fuels by industry has been the use of 'dual control targets,' which command the reduction of the energy consumption and the energy intensity of local economies and industries by a fixed, minimal amount over each five-year plan period (NDRC, 2021, the annual Central Economic Work Conference, 2021, Dong and Feng, 2021). This chapter reviews the most recent distribution and enforcement of the dual targets in 2021. It analyses its fairness impacts by focusing on Jiangsu Province, where widespread power cuts were experienced following target implementation warnings. It demonstrates serious fairness side-effects that should be addressed to ensure a smooth and economically sound low-carbon transition.

3.1 The development and mechanism of the dual control policy

The mandatory control of energy intensity was put in place in the 11th FYP in reaction to rapidly increasing energy consumption and significant setbacks in energy efficiency gains under the 10th FYP. The policy went through several revisions and updates before President Xi labelled it the 'dual-control' policy in 2020 (the Fifth Plenary Session of the 18th Central Committee of the Communist Party of China (CPC), 2015, SCIO, 2020) (Table 3). In September 2021, with the approval of the State Council, a new 'Plan for improving the dual control system of energy consumption intensity and total volume' (hereinafter referred to as the 'Plan') was issued by the NDRC, which upholds the 'dual control' policy as an effective measure to reduce carbon dioxide emissions from energy consumption. In this way, the Plan connects

Goals set by the Five-year plans (FYP)
Table 3. Targets for the 'dual control' policy

Period 1	Non-mandatory energy conservation targets	
9th FYP (1996—2000)	5%	
10th FYP (2001—2005)	10%	
Period 2	**Mandatory energy intensity reduction targets**	
11th FYP (2006-2010)	20%	
12th FYP (2011- 2015)	16%	
Period 3	**Mandatory energy intensity reduction target**	**Mandatory total energy consumption increase cap**
13th FYP (2016-2020)	15%	5 billion tonnes of standard coal.
14th FYP (2021-2025)	13.5%	No cap

Source: Yuan., et al, 2011, Zhao &Wu, 2016, NDRC, 2021 the dual control policy to the new dual carbon peaking and neutrality goals (NDRC, 2021).

Indeed, the control of total energy consumption and energy intensity has helped to lower energy consumption and, thus also, carbon emissions. In the 11th FYP, China's energy intensity decreased by 19.1%, even though overall energy consumption skyrocketed well beyond the targeted 2.7 Btce and reached 3.1 Btce in 2010 (Yuan et al., 2011).[6] This could have occurred again in the 12th FYP if the slowdown of the economy in 2014-15 had not impacted heavy industry activities.

Which energy-saving targets have been set by the provinces?
Table 4. The provincial energy-saving target from the 11th FYP

	11th FYP	12th FYP	13th FYP
National goal	20	16	15
Hainan	12	10	10
Qinghai	17	10	10
Xinjiang	20	10	10
Inner Mongolia	22	15	14
Guangxi	15	15	14
Guizhou	20	15	14
Yunnan	17	15	14
Gansu	20	15	14
Ningxia	20	15	14
Shanxi	22	16	15
Liaoning	20	17	15
Jilin	22	16	15
Heilongjiang	20	16	15
Shaanxi	20	16	15
Anhui	20	16	16
Fujian	16	16	16
Jiangxi	20	16	16
Henan	20	16	16
Hubei	20	16	16
Hunan	20	16	16
Chongqing	20	16	16
Sichuan	20	16	16
Beijing	20	17	17
Tianjin	20	18	17
Hebei	20	17	17
Shanghai	20	18	17
Jiangsu	20	18	17
Zhejiang	20	18	17
Shandong	22	17	17
Guangdong	16	18	17
Tibet	12	10	–

Source: Zhao & Wu, 2016; The State Council, 2017

6 http://www.gov.cn/jrzg/2011-06/11/content_1881722.htm

In the 13th FYP, while the GDP growth rate dropped in 2020 due to the Covid-19 pandemic, energy intensity still decreased by 13.2% from 2015, though coming short of the 15% target of the 13th FYP (NDRC, 2021). However, this command-and-control policy instrument's design and enforcement mechanisms may hinder China's ability to pursue a just energy transition, as it mandates local governments to 'meet targets' that are not equitably distributed (Table 4).

The dual control policy focuses on achieving two key targets: the energy intensity reduction target and the energy consumption increase target. The energy intensity reduction target regulates and manages energy consumption per unit of GDP. It has been implemented as a mandatory target in the Five-year plans since 2006. The energy consumption increase target limits the additional energy consumed based on a reference year (the first year of the FYP). It was introduced in the 13th FYP as a complement to the energy intensity target, which was considered unreliable by many, as explained below. These targets are passed on to the provincial level and further passed on to municipalities and districts/counties. Through target-responsibility contracts between higher and lower levels of government, the lower-ranked government is responsible for the next higher-level government (Lo, 2020; Kostka & Goron, 2020).

Industry plays a critically important role in the dual control policy (Lo and Wang, 2013). Targets are not only distributed to subordinate governments but also to major industrial energy consumers in each jurisdiction. These industry targets are distributed according to three broad categories based on their energy consumption levels: 'Hundred' enterprises (with the highest levels of energy consumption), 'Thousand' enterprises (with a lower level of energy consumption), and '10,000' enterprises (with the lowest level of energy consumption among the three types, but still significant compared to all other enterprises). The responsibility for setting and evaluating these targets also lies with different levels of government (Table 5, NDRC, 2017).[7]ll evaluation results of enterprises' performances are incorporated in government evaluations and occupy a significant part (NDRC, 2017).

In return, governments have also supported industry in its efforts to reduce its energy consumption. Some local governments provide different financial support

Who sets targets for enterprises?
Table 5. Provincial energy savings targets from the 11th FYP

Group	Energy consumption in 2015 (tonne of coal equivalent)	Target set by	List approved by	Evaluation by
'Hundred' enterprises	≥ 3 million	provincial government	central government	provincial government
'Thousand' enterprises	≥ 500,000	provincial government	provincial government	provincial government
'10,000' enterprises	<500,000 and >10, 000	municipal government	municipal government	municipal government

Source: NDRC, 2017

7 发展改革委关于开展重点用能单位"百千万"行动有关事项的通知:http://www.gov.cn/xinwen/2017-11/13/content_5239248.htm; The "1000 Enterprises nergy Saving Programme"(千家企业节能行动实施方案)was adopted in 2006. It designated over 1000 top energy-consuming enterprises, which had to make a special effort to reduce their energy intensity. The initial target of energy savings of 100 million Tce (Mtce) was officially surpassed in 2009, a year ahead of schedule. Because of this success, in the 12th FYP, the Plan was extended to over 16,000 enterprises representing over 60% of the country's final energy demand (the Top 10,000 Programme, 万家企业节能低碳行动实施方案) which aimed to reduce industrial energy use by 255 Mtce by 2015.

for energy audits by energy service enterprises (Goron, 2017). Moreover, the Energy Saving Reconstruction programme carried out since the 11th FYP[8] provides subsidies to support the technological retrofits of qualified companies[9]. The subsidy is paid according to the annual energy savings achieved at 240 yuan/tonne of standard coal saved for projects in the eastern region and 300 yuan/tonne of standard coal for projects located in the central and western regions. Participating companies must have their energy savings verified by third parties. Nevertheless, most firms have remained relatively passive in the face of measures they interpreted as something local officials required rather than an investment in energy savings, which could help them reduce their energy costs. Moreover, local governments have a severe lack of capacity to verify the data provided by companies (Zhao & Wu, 2016).

3.2 Unfair target allocation practices

The target allocation system has known drawbacks. First, the target distribution does not accurately reflect the different economic situations and respective responsibilities for lowering carbon emissions across localities. In n the 12th and 13th FYP, the government did not disclose a detailed target allocation methodology (Cnenergy, 2017). Since the 11th FYP, most Chinese localities have received very similar targets, irrespective of their distinct economic and energy structures (Lo & Wang, 2013; Kostka and Goron, 2020). During the 12th FYP, the range of energy intensity targets varied from −10% to −18%, but 22 out of 31 provinces received targets within 1% of the national target (Kostka & Goron, 2020). This situation was reproduced in the 13th FYP. Second, the distribution becomes increasingly less rational, consistent, and transparent at the local level (Li et al., 2016). This allocation system can significantly affect the economic development of less advanced provinces and localities (Kostka & Goron, 2020). However, research has also highlighted that some localities, though not all, have been able to adjust their target or their effect through bargaining with superiors, thereby possibly ‘correcting’ unfairness to some degree in the implementation process (Zhao & Wu, 2016; Kostka & Goron, 2020). Yet, this entails significant uncertainties about whether unfairness can be corrected since these bargains are untransparent and get severely constrained when higher-ups are pressured to achieve their targets. As for enterprises, although opportunities to negotiate the target may be rare, some may have enjoyed some degree of flexibility in implementing their targets through 2021, as responsible governments would consider their development needs in the evaluation process.

3.3 More stringent enforcement

The Plan published by the NDRC in September 2021 updated the dual control policy. Significantly, the Plan rolled back the emphasis on total energy consumption control introduced in the 13th FYP (NDRC, 2021). More precisely, it indicated that starting with the 14th FYP, the energy intensity reduction targets would be broken down into two indicators: a primary target and an incentive target. Local governments would have to complete their primary target and would be exempt from strictly implementing the more constraining total energy consumption target if they achieved the incentive target (NDRC, 2021). In addition, the Plan is more careful about local needs to expand energy use. It reserves a small amount of energy consumption space for the development of critical industrial projects and renewable energy projects, and it expressly excludes renewable energy consumption from the target (NDRC, 2021). However, the Plan does not clarify the method used to distribute the target across localities.

In parallel, the NDRC significantly reinforced the supervision and enforcement of the dual control targets (CBGC, 2021). Previously, targets were evaluated through the cadre evaluation system, with results presented as ‘achieve,’ ‘overachieve,’ ‘basically achieve,’ and ‘not achieve’, taking into consideration several indicators besides the achievement of the numerical target (NDRC, 2017, NDRC, 2018, NDRC, 2021). This evaluation system was published annually, though sometimes with delay.

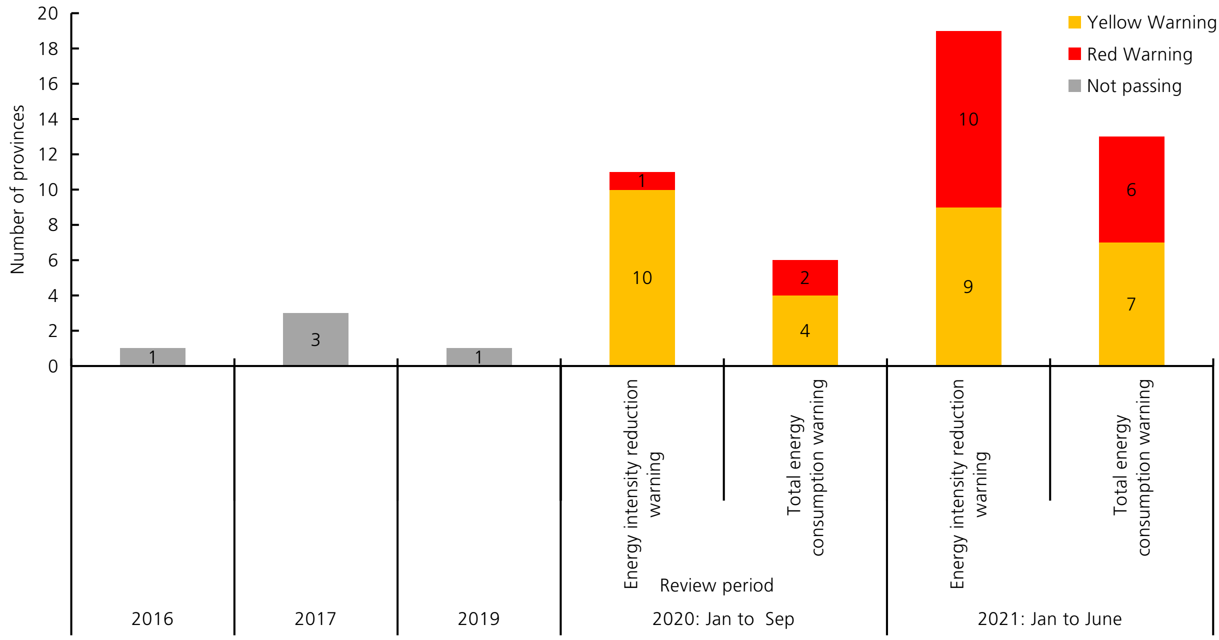
Starting in 2020, however, the NDRC started publishing barometers of the target achievement situation in different provinces, combined with a warning system

8 http://www.gov.cn/gongbao/content/2012/content_2084246.htm

9 Energy consumption and energy saving requirement: annual energy consumption of 20,000 tons of standard coal or more before the reconstruction with an energy saving of 5,000 tonnes standard coal or more

How has the change in the evaluation system changed the evaluation result?

Figure 8. Provinces' evaluation results before and after implementation of the warning system in 2020



Source: NDRC, 2017

(Figure 8) (Gov, 2021). The warning system includes red, yellow, and green levels. A red warning means the gap between the target and the achievement value is higher than 10%. A yellow warning means the gap is within 10% of the target value. No standard reporting period[10] nor timing was published for the release of the barometer, which has been irregular). In addition, the precise consequences of the warning are unclear. From the Plan, it seems that localities receiving a warning will be expected to control the production and construction of 'two high' (high energy consumption and high carbon emissions) projects more strictly[11] and to ensure the achievement of at least the 'basic' target.

However, the sanction system is opaque, making it difficult to evaluate the actual level of stringency. First, there is no publicly available implementation plan explaining the rationale and mechanism underlying the barometer and warning systems. Second, because NDRC implemented this evaluation system in 2020, its linkage to the Plan issued in September 2021, particularly to the new system of primary and incentive energy intensity targets, remains unclear.

What is observable is that the release of the barometer in August 2021 was followed by power cuts in many targeted provinces, whit numerous press reports attributing them to local governments' efforts to achieve their dual control targets. Jiangsu Province was one of these localities, and therefore, the following section elaborates on the fairness impacts of these policy-induced power cuts on sub-provincial localities and enterprises.

3.4 The fairness impacts of dual control target enforcement in Jiangsu Province

3.4.1 Target allocation in Jiangsu Province

Jiangsu Province had a high level of energy consumption in 2019, a total of 32,310 (10,000 tce), ranking third

10 The barometer is quarterly based but without a standard reporting period. For example, the 2020 barometer was published by NDRC based on the evaluation of the first three quarters, while in 2021, NDRC published the barometer based on the first two quarters.

11 High energy consumption and high emissions projects usually include 6 categories of industries such as coal power, petrochemical, chemical, steel, non-ferrous metal smelting, and building materials.

What are the double targets for cities and industry in Jiangsu Province?

Table 6. Target allocation in Jiangsu Province in the 13th FYP (cities with the same intensity target are marked with the same colour)

	Energy intensity reduction target %	Energy consumption increment control target (1,000 tce)	GDP per capita (yuan)	GDP (billion yuan)	Secondary industry (billion yuan)	% of GDP of secondary Industry	Industrial sector (billion yuan)	% of GDP of industrial sector
Suqian	10	47	65,503	3262.37	1367.35	41.91	1124.25	34.46
Lianyungang	10	154	71,303	3277.07	1372.35	41.88	1107.60	33.80
Huai'an	17	126	87,507	4025.37	1630.98	40.52	1286.78	31.97
Yancheng	17	161	88,731	5953.38	2379.38	39.97	1924.52	32.33
Yangzhou	17	124	132,784	6048.33	2786.35	46.07	2244.17	37.10
Taizhou	17	106	117,542	5312.77	2541.1	47.83	1973.08	37.14
Nantong	17	224	129,900	10036.31	4765.85	47.49	3956.90	39.43
Nanjing	18	442	159,322	14817.95	5214.35	35.19	4331.59	29.23
Xuzhou	18	346	80,673	7319.77	2931.61	40.05	2346.16	32.05
Zhenjiang	18	156	131,580	4220.09	1988.63	47.12	1770.01	41.94
Changzhou	18	206	147,939	7805.32	3616.15	46.33	3231.84	41.41
Wuxi	18	280	165,851	12370.48	5751.19	46.49	5126.15	41.44
Suzhou	18	626	158,466	20170.45	9385.58	46.53	8514.39	42.21

Source: Jiangsu Provincial Bureau of Statistics, 2021

nationally (Yangzi Evening News, 2021). Electricity consumption in Jiangsu reached 626.4 billion kWh, to which industry[12] contributed 72% (Jiangsu GOV, 2020). The 13th FYP dual control targets in Jiangsu were allocated to the province's 13 municipalities and industries. The allocation system displayed unscientific and untransparent qualities,resulting in a target distribution that did not accurately reflect the different economic situations across localities. For example, Xuzhou and Nanjing municipalities received the same energy intensity target despite having a widely different GDP per capita. At the same time, there is a 7% difference between the energy intensity targets distributed to Lianyungang and Huai'an even though they have a similar GDP per capita, size of secondary industry, and the industrial sector (Table 6).

During the 13th FYP period, the province's energy consumption per unit of GDP dropped by 20.6%, overshooting its energy intensity target of 17% in the 13th FYP.

Achievements regarding the total energy control target were not published[13] , and yet Jiangsu Province received warnings in 2021 (Table 7, Table 8).

12 'Secondary industry' refers to the mining industry (excluding mining auxiliary activities), manufacturing (excluding metal products, machinery, and equipment repair industry), electricity, heat, gas and water production and supply industry, and construction industry.

13 http://js.news.cn/2021-08/28/c_1127803753.htm

Have 'dual control' targets been achieved by Jiangsu Province?

Table 7. Evaluation of 'dual control' targets in Jiangsu province from 11th FYP to 14th FYP

Five-year plan	Evaluation year	Energy intensity reduction	Total energy consumption
11th	n/a	achieved	n/a
12th	2011	18.06% of the target achieved	n/a
	2013	65.21% of the target achieved	n/a
	2014	surpassed	n/a
	2015	surpassed	n/a
13th	2016	achieved	achieved
	2017	surpassed	surpassed
	2019	achieved	achieved
	2020 (Jan to Sep)	no warning	no warning
14th	20201 (Jan to Sep)	red warning	red warning

Sources: Gov documents for target evaluation from 2011 to 2020

How did cities in Jiangsu score on their 'dual control' targets in the 13th FYP?

Table 8. Evaluation of target achievement in 2017

	Energy consumption increment control target	Energy intensity reduction target
Suqian	achieved	achieved
Yancheng	achieved	achieved
Zhenjiang	achieved	achieved
Xuzhou	achieved	achieved
Lianyungang	achieved	achieved
Huai'an	not achieved	achieved
Yangzhou	not achieved	achieved
Taizhou	not achieved	achieved
Nantong	not achieved	achieved
Nanjing	not achieved	achieved
Changzhou	not achieved	achieved
Wuxi	not achieved	achieved
Suzhou	not achieved	achieved

Source: published in 2019, Jiangsu Gov[14]

14 http://gxt.jiangsu.gov.cn/art/2019/1/22/art_62056_8094832.html

3.4.2 Impact of power cuts on electricity use and industrial production in Jiangsu Province

The power cuts began in August and were reported until the end of September, affecting the production of industrial enterprises and the daily lives of residents (CCTV, 2021). Based on data from the Jiangsu Provincial Bureau of Statistics, the following section analyses the impact of these power cuts on the electricity use and production of different sectors. The electricity consumption and industrial production data clearly show that the power cuts impacted Jiangsu province's energy use. While the province's electricity consumption in 2021 was higher than in 2020 from January to July, it dropped to 2020 levels starting around the release of the evaluation warning (Figure 9), with a slight rebound from October to December. The prefectural level data follows the same trend , even though the starting time of the impact varies slightly across localities. Notably, this province-wide impact does

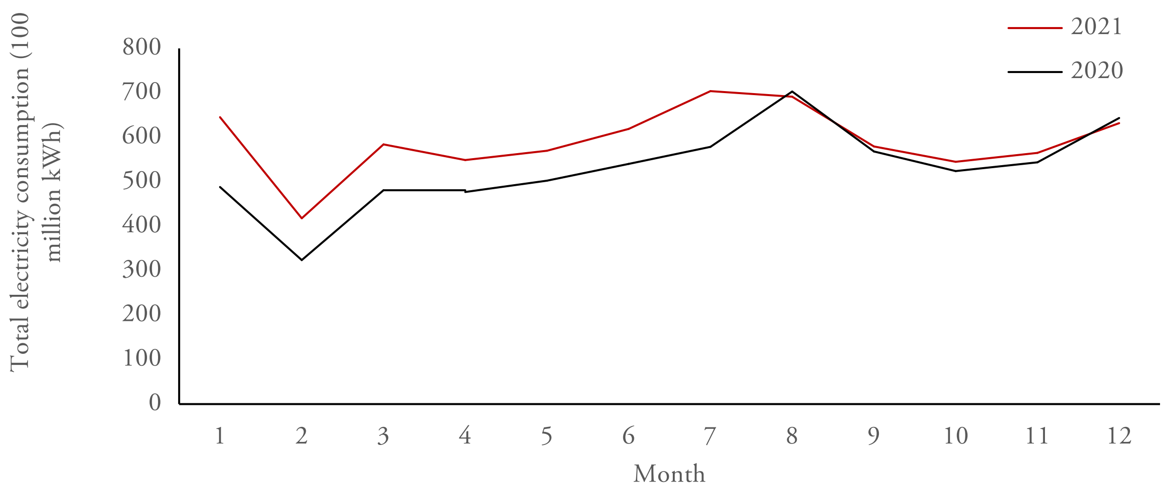
not align with the performance of different municipalities in their 2017 target completion evaluation (Table 8). Five municipalities completed both targets, which should mean that they were in a good situation regarding their target performance, yet they were still affected by the power cut. The one-size-fits-all power cuts across all municipalities in Jiangsu province thus disregarded both their performance in achieving the target and the economy.

The value-added industrial output data reflected industrial production changes and its economic growth. The value-added industrial output data further confirms that the power cut caused a drop in production across Jiangsu Province starting in August 2021. Industrial enterprises above a designated size (referring to industrial enterprises with revenues from principal activities over 20 million yuan), in 12 out of 13 municipalities in Jiangsu Province experienced their lowest value-added industrial output in August, September, and October in 2021. However, the value-added industrial output of Lianyungang, Yangzhou, Suqian, and Nanjing were apparently more strongly affected, with negative figures in August, September, and October.

News and information spread about the production shut-downs induced by the power cut. However, industries experienced differentiated impacts depending on how local governments handled the power cuts. Although very little information was released by the Jiangsu government, the partial elements of a 'Dual control plan for energy consumption' released to the press on September 19, 2021, indicate that it would put local

How was Jiangsu Province's electricity consumption impacted by the warning in July 2021?

Figure 9. Total electricity consumption (in 100 million kWh) in Jiangsu Province in 2021 and 2020



Source: Jiangsu Provincial Bureau of Statistics, 2021

What was Jiangsu Province's plan to limit production for different categories of companies?

Figure 10. Partial information of the Jiangsu Province 'Dual control plan for energy consumption'

Categories	Energy consumption limitation measures
Category A	Keep electricity consumption at the same level year on year.
Category B	Reduce production by 10%
Category C & all printing and dyeing enterprises	Restrict production by implementing the measures of 'opening two (days) and halting two (days)'
Category D	Halt all production

Source: Partial information of the Jiangsu Province "Dual Control Plan for Energy Consumption on September 19, 2021" (Jingji, 2021)

industries into four categories seemingly based on their electricity consumption, although it does not provide further rationale or lists (Figure 10).

The power cuts translated directly into significant production reductions. In general, government statistics show that industrial production declined for 25 industrial products. Among these, 12 products saw a significant drop in production from August to October 2021 compared with the same period in 2020 (Jiangsu Provincial Bureau of Statistics, 2021). Most importantly, the impact of the power cuts focused on a few sectors, while the rest of the products had minor to no impact. The sectoral reports released by securities companies identified the same categories of products severely impacted by the power cuts, especially ash[15] ,cement[16], and steel[17]production (Sealand Securities, 2021). Since Jiangsu Province's soda ash production accounts for 17.4% of China's soda ash production, the policy impacts could be expected to have had repercussions across supply chains.

3.5 Policy implications

The dual control policy has been an essential command and control policy tool used by the Chinese government to limit energy consumption, enabling it to obtain rapid emissions reductions when strong enforcement signals are sent from the top down (Gov, 2022).[18] However, this instrument raises the problem of cost-effectiveness and equity issues.

First, despite some attempts to adjust targets to local conditions, the current allocation process does not share the transition burden equitably. Second, the fact that local government energy-saving measures relied mainly on industrial energy savings and the arbitrary distribution of the targets has led companies to adopt a passive attitude, i.e to consider them government demands rather than a way to save on their energy bills. Third, even though the 14th Five-Year Comprehensive Work Plan for Energy Conservation and Emissions Reduction reaffirmed the link between the dual control target and carbon neutrality, the dual control policy still focuses on

15 A production reduction plan was put in place in September, leading to the operation rate falling by around 20% (Sealand Securities, 2021) (Sealand Securities, 2021)

16 14 out of 37 cement clinker kilns ceased production. A production limit of 30%-50% was imposed on the industry (Sealand Securities, 2021)

17 60% of steel mills were required to stop production entirely (Sealand Securities, 2021)

18 The 14th Five-Year Comprehensive Work Plan for Energy Conservation and Emission Reduction http://www.gov.cn/zhengce/content/2022-01/24/content_5670202.htm

energy consumption, which is not the most appropriate indicator to decouple economic development from carbon emissions.

Recent policy documents recognise this. In December 2021, the annual Central Economic Work Conference put forward that China would transition from the dual control of energy consumption to the dual control of carbon emissions (Gov.cn, 2021). The 14th FYP also stipulates using a carbon intensity target as the primary tool (Gov.cn, 2021). A mandatory carbon intensity target has been passed down to local governments since the 12th FYP, but not to firms. It has suffered from similar allocation fairness issues. The dual control of carbon emissions is thus expected to add a long-awaited absolute carbon emissions cap or reduction target, even though the 14th FYP indicates that it would only 'complement' the carbon intensity target and targets for industries (Gov.cn, 2021). However, progress will be slow due to the lack of national standards for calculating emissions that could be applied (Yuan Jiahai cited in Jiang and Gao, 2022). Moreover, the fairness impacts will remain intact unless more refined methods of allocation and more transparent and orderly enforcement methods are put in place.

Meanwhile, the 2021 Plan has already taken an essential step by excluding renewable energy consumption from the total energy increase cap and energy intensity targets[19]. However, the impact of this change will depend on local governments and individual companies' ability to prove that they can source their electricity from renewables, which is not easy in the current monopolistic retail electricity market.

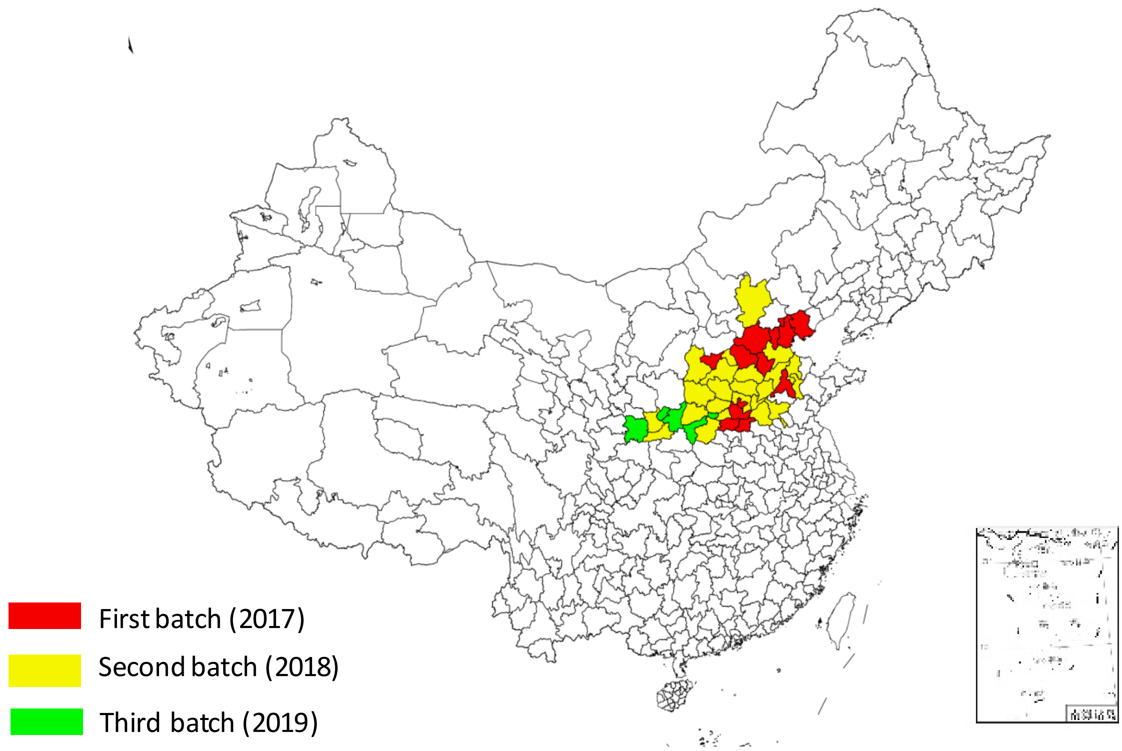
19 The Opinion on Improving the Institutional Mechanism and Policy Measures for Energy Green and Low-Carbon Transformation https://www.ndrc.gov.cn/xxgk/zcfb/tz/202202/t20220210_1314511.html?code=&state=123

4. The fairness impacts of clean heating programmes: cases studies from two neighbouring localities in Hebei Province

Besides reducing carbon emissions from industry, reducing bulk coal consumption by households is another essential measure to reduce air and climate pollution in China. The clean heating programme rolled out in Northern rural areas from 2017 to 2020 is a representative programme of efforts made to drastically reduce bulk coal consumption in the countryside. Residents in these regions, who have traditionally relied on coal for heating and cooking, were required to switch from coal to natural gas, electricity, concentrated solar power, or at least 'clean coal'[20] , in a campaign driven by China's 'blue sky defense war.' Several studies have shown the environmental and health benefits of this energy transition policy. However, its economic impacts on rural households have been questioned. This chapter analyses these impacts on rural residents in Hebei Province by zooming in on the campaign rollout in two localities to evaluate the distributional impacts on rural households and the actions that the local government has adopted to facilitate the transition.

Where was the Clean Heating Programme carried out?

Figure 12. The three pilot batches of the clean heating programme



Source: People's Daily, 2018, Energy Research Institute National Development and Reform Commission, 2021

20 According to the Hebei provincial standard of clean briquette (DB13/2122-2014), 'clean coal' for resident use is made from low sulfur and low volatile anthracite dust and additives that require sulfur to be less than 0.4%, volatile less than 12%, ash less than 24%, moisture less than 4% while maintaining a calorific value above 5740 kcal. It is estimated that using clean briquette coal can save more than 20% of coal consumption (with a special clean coal stove, the coal saving rate can reach more than 30%). Sulfide and toxic gas emissions can be reduced by more than 70%, and smoke dust emissions will reduce by over 80%.

4.1 Clean heating programme in Northern China: the case of City B in Hebei Province

China launched the rural clean heating programme in early 2017. The programme called for reducing bulk coal consumption in northern rural areas and enhancing the supply and use of cleaner energy sources such as natural gas, electricity, and biomass. Beijing, Tianjin, and 41 other cities in Hebei, Henan, Shandong, Shanxi, and Shaanxi provinces were listed as pilots, rolled out in three successive batches (Figure 12). By 2020, clean heating renovations covering 2.98 billion square metres and 26 million households had been reported, with a total investment of over 200 billion CNY by local and central governments (Huanjingbao, 2020).

Hebei Province was put at the forefront of this campaign. By 2019, it reported that it had replaced over seven million rural households' coal stoves with cleaner energy sources, making it the province with the most significant scale nationwide (Hebei Daily, 2021).

City B was among the first batch of clean heating pilots and officially launched its campaign for coal stove substitution in February 2017. 'Coal to gas' and 'coal to electricity' conversions became a top priority for local officials. Facing strict liability assessment, the municipal government issued a plan with detailed targets, actions, and supporting policies.

According to the plan, the rollout of the campaign throughout the municipality distinguished three areas based on their technical and economic feasibility. First, the downtown areas were ordered to achieve zero coal consumption by the end of the year. All households in downtown areas were to be provided with gas-based central heating systems. The 16,000 households who were not able to join the central heating system had to substitute coal for cleaner alternatives. Second, households in 'Four Priority Districts' covering 380,000 rural households had to achieve zero coal consumption by the end of 2017. Third, other rural areas in the municipality received relatively looser objectives. While households located in suitable areas were declared eligible for transition to clean heating, others were only required to use clean coal. The 2017 target for these areas was to achieve coal substitution for 50,000 households and increase the clean coal utilisation rate to 90%.

Supporting policies were adopted to accompany the transition. Households transitioning from coal to gas could receive 2,900 CNY in subsidies for engineering costs, 1,000 CNY for heating equipment costs (mainly wall-hung furnace boilers), and 900 CNY for gas costs in 2017. Households upgrading from coal to electricity could be reimbursed 70% of the purchase cost of electric heat pumps (capped at 5,000 CNY) and receive up to 900 CNY in subsidies for their electricity bill. Rural households using clean coal could get some help as well: 80% of the cost of a new adapted coal stove could be reimbursed (capped at 1,600 CNY), and they could also receive 300 CNY in subsidies to purchase each tonne of clean coal. The financial burden of the engineering work and subsidies was borne by the municipal and county governments, with a ratio varying between 1:1 to 3:1 (Table 10).

4.2 Coal substitution in two rural localities of City B

To better investigate the impacts of the clean heating campaign on rural residents, we undertook a five-day field trip to two townships of City B, which are geographically adjacent, but belong to different administrative units and have distinct situations in terms of economic development as well as clean heating policy. These differences directly lead to different impacts of the clean heating transition on their residents, revealing the complexity of the coal phase-out at the local level.

Township A is located in District A, which is included in the aforementioned 'Four Priority Districts'. Township A used to have a strong economy that heavily relied on cement production. The heavy industry structure led Township A to be at the forefront of air pollution governance in City B. Most cement factories were either shut down or forced to undertake expensive technology upgrades during the years 2013-2014. In 2017, when the clean heating transition officially started in City B, Township A was assigned with a radical policy goal (according to District A) of completing a 'coal to gas' transformation for the entire township population of 32,000 (8,000 households) within a single year.

The 'coal to gas' transformation in Township A was achieved through a multi-party collaboration within a condensed timeframe of six months. The local government, the

An example of policies that are being implemented on the ground

Table 10. Clean heating and related supporting policy in City S in 2017

Clean heating policy		Supporting policies	
Downtown area	• Gas-based centralised heating • Coal substitution for rest 16,000 households by the end of 2017	Coal to gas	• 2,900 CNY for engineering costs • 1,000 CNY for heating equipment costs • Up to 900 CNY for annual gas costs
Four priority districts	• Achieved zero coal consumption in all 396,000 households by the end of 2017	Coal to electricity	• Reimburse 70% cost of electric heat pump, capped at 5,000 CNY • Up to 900 CNY for annual power bill
Other rural areas	• Promoting clean heating in suitable areas and achieved coal substitution in 50,000 households • Promoting clean coal in other areas, and increased the clean coal utilisation up to 90%	Clean coal	• Reimburse 80% cost of new coal stove, capped at 1,600 CNY • 300 CNY subsidies for each tonne of clean coal bought

Source: government policies

local natural gas company, and village cadres all played vital roles in the process. The local government in Township A mobilised and delivered instructions to officials in village committees and cooperated with the local gas company to achieve speedy pipeline construction, gas supply, and equipment maintenance deals. By the end of 2017, Township A had carried out 6,925 'coal to gas' conversions and had another 1000 households transfer to gas-based heating during the following year.

Township B has a different story to tell. Township B is located in County B, one of the least developed areas in City B. The average per capita disposable income in Township B was 10,350 CNY in 2019, which is only half of Township A's 20,915 CNY. County B did not belong to the 'Four Priority Districts' and had no explicit transition goal in 2017. An initial target of achieving 'coal to electricity' transformation for a mere 5,323 households (out of an estimated 90,000 in the county) was assigned to County B in 2018.

Absent a consistent policy design, we found that clean heating transition in Township B was carried out by each village separately, with mixed outcomes. Some villages near local power stations or chemical plants, like Village B1 in Table 11, constructed district heating systems relying on the waste heat generated by plant boilers. Villages located in flat areas, like Village B2 and Village B3, considered implementing 'coal to gas' or 'coal to electricity' transitions, while others located in hilly areas or isolated areas, like Village B4, opted for clean coal instead.

Thus, though adjacent in location, the diverse policy settings have caused significant variations in the two townships' transition pathways, resulting in different levels of clean heating infrastructure and public service, residents' satisfaction, and transition costs among townships, villages, and even smaller units, which are further detailed in the next section.

Examples of different transition methods of the clean heating programme

Table 11. Clean heating transition and process in four villages in Township B

Village	Transition method	Transition process
Village B1	Waste-to-energy centralised heating system	• Launched 2018 • Promoted by several phases • SStill 20~30 households left due to location reasons or personal willingness
Village B2	Coal to gas	• Launched 2017 • Most households participated in the transformation in the subsequent one or two years
Village B3	Coal to electricity	• Launched 2017 • A share of households tend to switch back to coal due to high operating costs
Village B4	Clean coal	• Launched 2017

Source: Fieldtrip

4.3 Distributional impacts of the clean heating programme on rural residents

During the field trip, we visited and interviewed the local government and gas companies in District A and Township A and the electric heat pump retailer in Township B and did a phone interview with local officials and a gas company manager in County B and Township B. In addition, we visited 4 to 6 villages in each township and interviewed more than 30 rural households, which were selected freely and randomly across different corners of the townships. We also obtained policy design and implementation information from the government. We inquired about the heating cost and quality from the resident and retailer sides and analysed the ensuing fairness impacts

Our investigations found that the clean heating programme did substantially increase residents' heating costs, but the impacts are myriad, reflecting policy fragmentation and gaps (Figure 13).

4.3.1. Differences among clean heating methods

Figure 14 shows the residual cost of four clean heating technologies in Township A and B paid by households after receiving the government subsidy. The graph on the left shows the cost of the heating equipment and the equipment installation fee. The graph on the right shows how many times the various costs, such as fuel fees, electricity bills, and heating costs, increased compared to traditional bulk coal. For example, let us suppose that one household previously needed 1,000 CNY to purchase bulk coal for one heating season, it now must spend around 1,500 CNY to maintain the same quality of heating when using clean coal or waste energy centralised heating, around 2,000 CNY for the equivalent gas bill, and 3,000 CNY for the electricity bill, after receiving the government subsidy.

As shown in Figure 14, heating using clean coal is the cheapest alternative, but it is also the least effective in reducing air and climate pollution. Waste energy heating involves the highest equipment cost but the lowest varied cost, like clean coal. However, according to several villagers interviewed in County B, the heating effect of the waste energy centralised heating system was unsatisfactory. 'The indoor temperature is not as warm as burning coal, and the temperature setting cannot be adjusted,' said one villager in Village B1.

Given the subsidy scheme, heating by electricity and gas involved approximately the same cost increase for consumers. As the national power grid continues to decarbonise, heating by electricity (especially heat pumps) will bring more health-carbon benefits than gas. Nonetheless, the equipment needed for electric heating is currently much more expensive. Given the current technology, the capital cost of a heat pump without subsidy is 2-7 times higher than gas (Zhou, et.al, 2022). Thus, electric heat pumps cannot easily be made generally available to localities that cannot provide significant subsidies due to financial constraints. As a result, measures that reduce the capital costs of heat pumps in poorer provinces are required, especially in rural locations with cold winters.

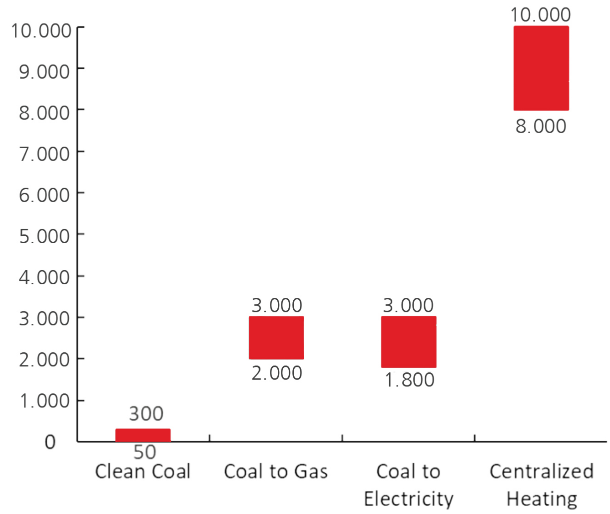
Moreover, the cost gap compensated in our case by government subsidies is bound to become apparent when the maintenance and replacement costs are considered. According to the information we collected on the ground, the general service life of a wall-hung furnace boiler and an electric heat pump is 5 to 10 years, and a decline in heating effect was observed after the third year. Yet repair and replacement costs are not subsidised.

Figure 13. Visit to village households in township A and B

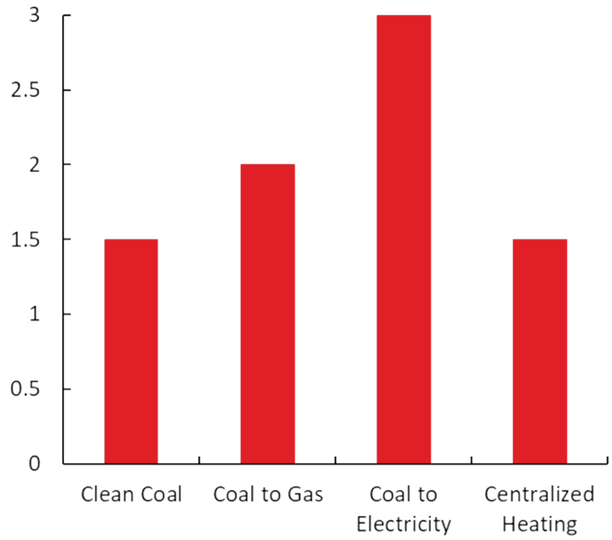
Source: Field study

What is the cost difference between different clean heating methods? (with subsidies)

Figure 14. The fixed cost (left) and varied cost (right) of different clean heating methods



Fixed cost of installation of the clean heating system (CNY)



Varied costs of clean heating fuel compared to bulk coal (CNY)

Source: Data collected through interviews with various local stakeholders during fieldwork

During the transition in Townships A and B, individuals could choose from a limited range (2-3) of differently priced furnace boilers or electric heat pumps available in their village, but they did not have the option of choosing the fuel. The policy decision regarding the fuel conversion choice, time frame, and subsidy level were all decided by different levels of government and village committees. None were open to input from villagers. A resident in Village B3 expressed frustration at this top-down process: 'We don't have a central heating system in our village… [Central heating system] is much cleaner and more convenient, I wish we could have it, but I don't get to choose'(Figure 15).

4.3.2. Differences between the two townships

District A had better support policies than County B. First, when the municipal government equipment and operation subsidies expired in 2018, District A decided to finance an extension of the subsidy provided for the next two years, while County B did not. This had a direct impact on villagers in Township B. A villager in Village B4 told us that, 'We didn't install the stove in 2017 (when the coal-to-gas policy was first introduced to the village). We tried to install it a year later but spent lots of time negotiating with the government. However, we still could not get the subsidy because the deadline had passed.' In addition, unlike County B, District A also set subsidies for gas cookers and conducted a programme of rural house renovation to improve their thermal conditions. Besides, when transferring from coal to gas, villagers in District A could sell their coal stoves to the government for 100 CNY, while the villagers in County B could only sell their idle stoves as waste. Based on all these differences, villagers in District A faced lower transition costs than villagers in County B, even though their average income was twice as high.

4.3.3. Differences between rural and urban areas

We also found that the transition unintentionally imposed a higher transition cost on rural areas than urban areas, even though urban residents are typically much wealthier than villagers. In 2019 per capita disposable income in District A was 34,303 CNY for urban residents, against 19,171 CNY for villagers. In County B, it

Figure 15. Pictures of wall-hung furnace boiler (left) and electric heat pump (right) in

Source: Field study

was 30,344 for urban residents, against just 9,324 for villagers.[21] The cost difference for the energy transition between urban and rural areas is mainly explained by the fact that villagers in rural areas must install individual boilers, which are more expensive than gas-based centralised heating systems. Moreover, as shown in Table 12, the fee for centralised heating in the urban areas is calculated based on floorspace at 22 CNY/m2 per heating season. Looking at the average housing conditions we found during the field study; we estimated that each urban household in District A would need to spend around 1,760-2,640 CNY for heating (after receiving subsidies) per heating season (5.1% to 8.7% of their annual income). By contrast, even without taking equipment and installation costs into account, the average heating cost in rural areas was around 1,500-3,000 CNY per household in 2017-2018, and the cost climbed to 2,000-4,500 CNY in subsequent years with the progressive withdrawal of gas subsidies (from 7.8-15.6% in 2017-2018 up to 10.4-20.2% of their annual income). One rural couple in Township A commented, ‘We prefer to live with our children downtown during the winter. Their house has a better thermal effect than our rural house, and their heating fees are not as high as ours’ (Table 12).

4.4 Policy implications

Township A and B villagers had a mixed evaluation of the clean heating programme. On the one hand, many appreciated the clean, convenient, and high-quality heating brought by the transition and would not want to revert to using coal again. On the other hand, they worried about rising heating costs, especially as the subsidies were rapidly phased out. Based on the transition dilemmas we found during the study, we suggest that the government pay more attention to the potential financial risks that clean heating programmes bring to rural residents and take the following measures to minimise regressive impacts.

21 2019 City B Statistical Yearbook

Differences between urban and rural households,

Table 12. Gas-based heating in urban and rural area of District A

	Urban area in District A	Rural area in District A
Heating way	Centralised heating	Heating with wall-hung furnace boiler
Installation fee	Covered in property fee	2,900 CNY (covered by subsidies)
Heating fee with subsidy	22 CNY / m2/ heating season (Based on area)	0.9 CNY / m3 (2017-2018) 1.98 CNY/m3 (2019-2021) (Based on gas used)
Housing condition	Usually, 80-120 m3 with a good thermal effect	Usually, larger housing surface with low energy efficiency
Heating cost per season	Around 1,760 – 2,640 CNY (estimated)	Around 1,500 – 3,000 CNY in 2017-18 and 2,000-4,500 in 2019-2020 (based on fieldwork inteviews)
Share of annual income	5.1% to 8.7%	7.8-15.6% in 2017-18; to 10.4-20.2% in 2019-20

Source: City B local policies, data collected from interviews with local stakeholders

First, the government should guarantee rural residents access to affordable heating amid rising global gas and power prices. City A government managed to ensure a stable energy supply since the beginning of the clean heating programme in 2017, except for the gas shortages that occurred during the first winter of 2017 due to the sudden increase in gas demand in northern areas brought by the campaign. However, the potential effects of rising gas prices in the future should not be overlooked. Since retail gas and electricity prices are determined by the government, villagers' ability to avoid the impacts of natural gas price fluctuations depends on its ability to mitigate them. China's gas supply is highly dependent on imports, and the Covid-19 pandemic and Russia's war in Ukraine have already caused gas shortages in Europe. They will undoubtedly lead to broader impacts worldwide in the following months and years. Safeguarding affordable gas supplies for northern rural households in the heating season should move up on the list of priorities for local and central governments.

Second, to build a low-carbon and just society, the government should emphasise the importance of public participation mechanisms and enhance information provision and dialogue with communities. According to the feedback we got during the field trip, households are eager to be involved in the policy design of fuel-switching strategies, timelines, and subsidy plans. An incentivised, orderly phase-out of fossil fuels with fair and transparent subsidies is more acceptable for rural residents than the speedy rollout of top-down action plans. In addition, we suggest that local governments conduct post-implementation investigations to monitor the experience and clean heating effects, which can help officials identify the improvements needed.

Third, we suggest the government pay more attention to energy efficiency and safety management during and after fuel conversion. In Township A and B, gas supply companies regularly conducted safety checks for rural households. Still, we found many natural gas pipes exposed in the open or installed near electrical wires and other risky facilities, as shown in Figure 17. Natural gas pipe explosions have frequently occurred in recent years, so we suggest local governments take the safety risks of gas heating and cooking seriously, strengthen safety inspections, and enhance safety training for residents.

Fourth, we suggest that the government expands the welfare coverage of energy infrastructures by building inter-jurisdictional cooperation and integration

Figure 17. Natural gas pipe

Source: Field study

mechanisms. Comparing Townships A and B clearly showed that the extreme fragmentation of the administrative management of the energy supply may result in a decrease in welfare across all of society. When transitioning from coal to natural gas in 2017, Township A connected to the City B pipe network and extended the pipe network to every village and household in the township, even those located in hilly areas. However, the geographically adjacent villages in Township B were excluded from this plan. Thus, the villages in poorer Township B could only choose to implement more expensive coal to electricity conversions or access gas through crock car transport. To achieve a just transition, energy services areas should be extended to improve the cost-effectiveness of energy infrastructures and fairness of access conditions among communities.

5. Achievements and shortcomings of Photovoltaic Poverty Alleviation Projects as a just transition policy tool

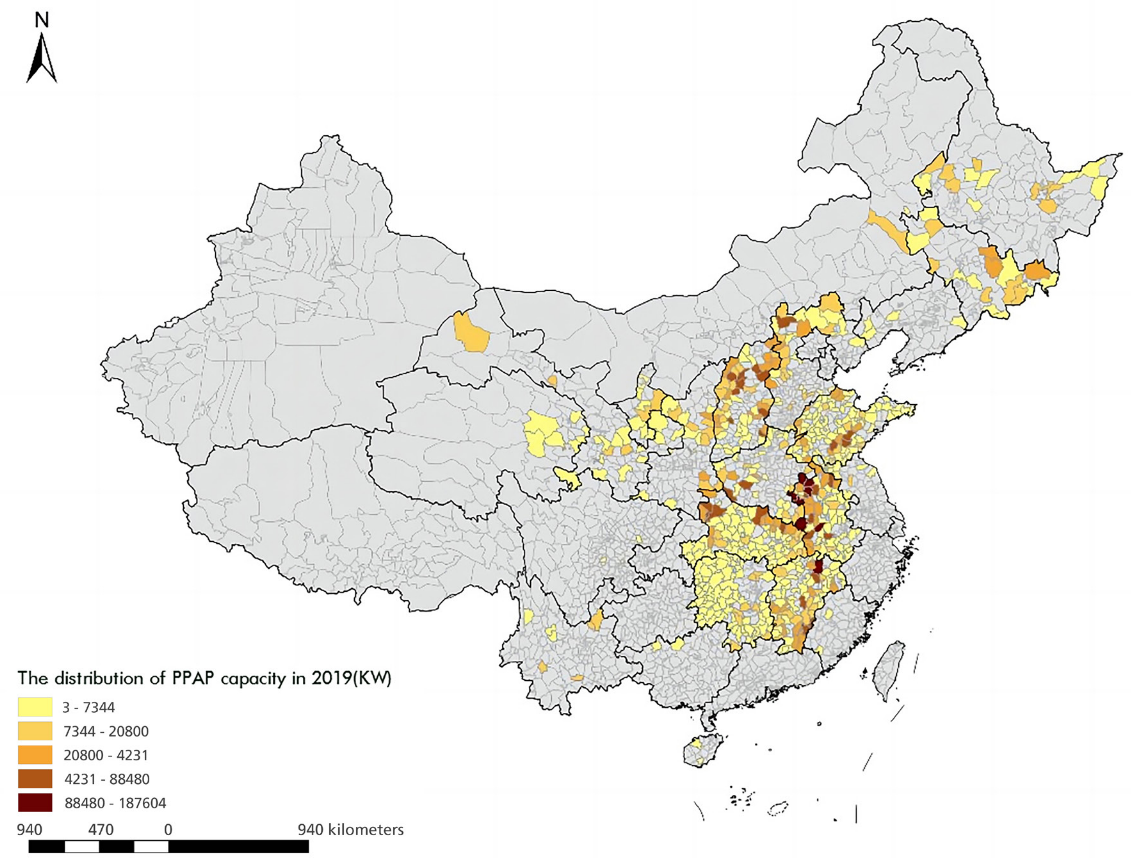
The Photovoltaic Poverty Alleviation Project (PPAP) is an energy policy that was implemented from 2014 to 2020, and which aimed at contributing to the elimination of extreme poverty in rural areas by utilising the income generated by installed PV plants with the support of a very generous feed-in tariff (Li, Zhang, Wang, McLellan, Liu & Wang, 2018; Wang, 2020). Even though this policy was terminated in 2020, its achievements and shortcomings as a just transition policy tool can inform our understanding of the role that renewable energy projects can play in enhancing the fairness of the energy transition and how PV expansion can promote rural revitalisation.

5.1 PPAP policy background and development

The PPAP policy was initiated in 2014 to install 10 GW and generate revenue for 2 million registered poor households[22] by the end of 2020 (NEA, 2015). The PV stations generated electricity that was sold to the grid, and which was entitled to receive an enhanced feed-in-tariff guaranteed for 20 years, as well as priority access to subsidy funding compared with ordinary PV projects (see Table 13) (NEA and CPAD, 2019).

Where were the PPAPs implemented?

Figure 18. The distribution of PPAP capacity in 2019 (county level)



Source: data collected by the team from multiple sources, including news report for each province

22 China established an electronic information system to identify and manage the registration of designated poverty households and poverty villages and counties. The standard for registered poverty households is 2,736 RMB net income per capita per year. http:/keywords.china.org.cn/2021-01/11/content_77102893.html. http://www.huzhu.gov.cn/info/1013/2141.htm

Comparison of feed-in tariffs between PPAP and ordinary PV
Table 13. Feed-in tariff for PPAP and feed-in tariff for ordinary PV

	Feed-in tariff for PPAP		Feed-in tariff for ordinary PV projects	
	PV Stations	Rooftop PV panel	PV Stations	Rooftop PV panel
2020	0.65-0.85	0.42	0.35-0.49	0.08 (Households) – 0.05 (Business)
2019	0.65-0.85	0.42	0.40-0.55	0.18 (Households) – 0.1 (Business)
2018	0.65-0.85	0.42	0.50-0.70	0.32
2017	0.65-0.85	0.42	0.55-0.75	0.37

Source: NEA & CPAD, 2019 (left) NEA & CPAD, 2019 (right)

However, with the intense political pressure to eliminate extreme poverty and the enthusiasm of the PV industry attracted by the generous tariff, the response from local governments and the PV industry was more substantial than planned. As a result, by 2020, 26.36 GW of PPAP were installed across 60,000 villages, reportedly generating 18 billion CNY in income per year, providing income to 4.15 million poor households, and creating 1.25 million public service jobs (NEA, 2021a).

During the eight years of its implementation, three main models of PPAP were explored, including rooftop PV panels, village-level PV stations, and cross-village centralised PV stations, each supported by distinct financing mechanisms (see Table 14):

Rooftop PPAPs (see Figure 19) would install PV panels on households' rooftops or in their courtyards. The poor household would pay for the PV panels (often with the help of the local government), consume the generated electricity directly, and sell the excess back to the grid at 0.42 CNY per kWh. Under this model, the investment, property rights, and revenue belonged to the household.

Village-level PV farms (see Figure 20 & Figure 21) would be installed on village land and sell all the generated electricity to the grid at subsidised tariffs ranging from 0.65 CNY to 0.85 CNY per kWh, depending on location. These stations were paid for by the county government (with the support of poverty alleviation funds from higher levels of government) but officially owned by the village collective. In the pilot stage, the governments distributed 3,000 CNY per year to each poor household. After the release of The measures on revenue distribution of village PV stations in 2017, the village collectives obtained the discretion to decide how to use the revenue for local welfare enhancement, including by creating welfare job positions, improving local infrastructures, setting rewards, and distributing money directly to poor households with limited work opportunities.

Centralised PV stations (see Figure 18) were larger farms that were allowed to receive private investment alongside the local (usually county-level) government. Once the revenue earmarked for designated poor households (3,000 CNY per year) was distributed, the rest was proportionally distributed between the investing government(s) and enterprise(s).

According to the investigations led by Bai and colleagues (2021), centralised PPAPs were initially the most popular model, accounting for 41% of all PPAP projects by the end of September 2018. However, in 2018, the NEA and CPAD issued Measures for PPAPs management, which retained only the village PV stations model and forbade private investment and bank loans for these projects. This decision was principally made because these projects were thought to create a dangerous financial burden on local governments, and in order to prevent the income generated by the PPA from being used for debt and interest repayment instead of poverty alleviation. The poverty alleviation rooftop PV projects

What types of PPAP exist?

Table 14. Three modules of PPAP

	Rooftop PV panels	Centralised PV stations	Village PV stations
Typical installed Capacity	5 kilowatts	20,000 kilowatts	300 kilowatts
Typical investment scale	50 thousand yuan	150 million yuan	2 million yuan
Typical investors	Poor households (some with government support)	Government + enterprises	Government
Major advantages	Flexible location; targeted at poor households directly.	High-quality electricity generation, good maintenance, and operations due to scale advantages	High-quality electricity generation; easier grid connection; fair income distribution
Major disadvantages	Low-quality electricity generation; difficulties in maintenance and operations; very low affordability for poor households	Very low affordability for local governments, generates debt and interest payments; curtailment problems due to inadequate grid infrastructure.	Difficulties in ensuring maintenance; low motivation and payment defaults to PV companies.

Source: Based on (Wu, 2018)

were discontinued for other reasons, principally because of the difficulty of monitoring the risk for poor households and the difficulties of maintaining and managing the scattered equipment.

At the end of 2019, the NEA and the former CPAD (2019) announced the termination of the PPAP programme together with the end of the national poverty alleviation campaign, which resulted in the immediate suspension of new PPAP projects' approvals, even though provincial governments may still develop local PPAP policies if they wish to.

However, solar power will continue to play an important role in China's 'rural revitalisation' plan and efforts to reach carbon peaking and neutrality. Under the national target announced at the 2020 Climate Ambition Summit (Xinhuanet, 2020), China's installed capacity of wind and solar power should more than double and surpass 1,200 GW by 2030 (from 535 GW in 2020). A series of documents have been released that combine rural revitalisation and the energy transition in rural areas. These include the Rural revitalization law (MOA, 2021), which confirms the objective of increasing renewable energy production and use in rural areas, and the Opinions on accelerating rural energy transformation to promote rural revitalisation (Gov, 2021), which outlines the policy instruments and implementation tools that can be used to develop photovoltaics in rural areas by 2025.

5.2 Successes and shortcomings of the PPAP policy during the 13th FYP

5.2.1. Benefits generated for impoverished households

According to the NEA (2021), the PPAPs generated 18 billion CNY and benefited 4.15 million poor households, creating 1.25 million jobs for impoverished households in the process. Those recipient households typically consisted of elder and/or disabled rural residents who have a limited

How were different PPAP projects financed and operated?

Figure 19. Centralized PV Stations

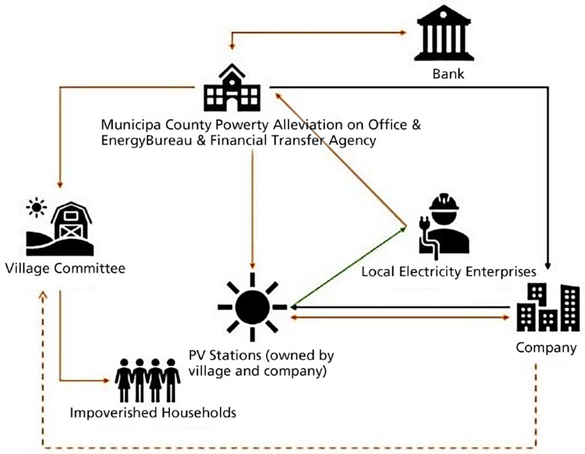


Figure 20. Rooftop PV Panels

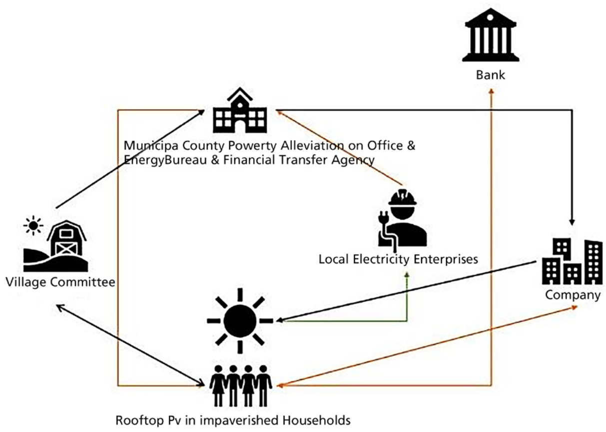


Figure 21. Village PV Stations(before 2018)

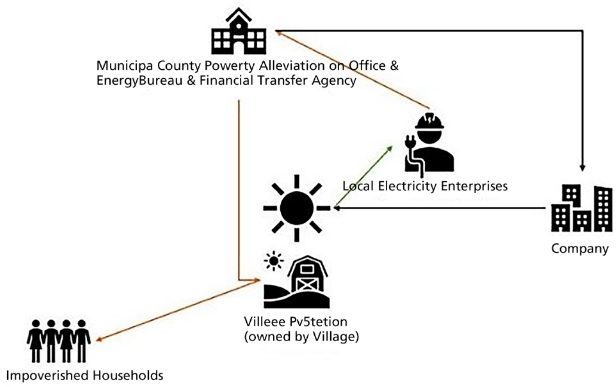
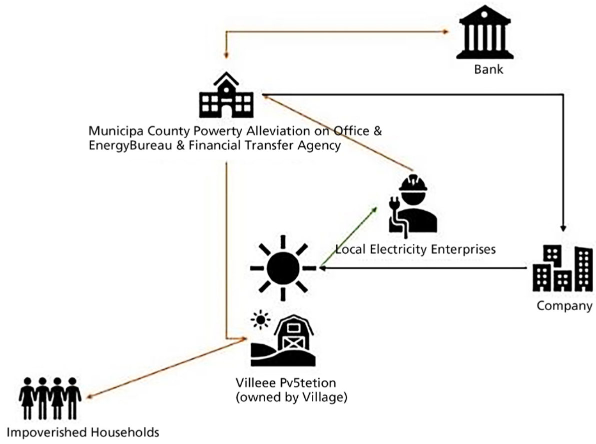


Figure 22. Village PV Stations (after 2018)



Source: Based on information synthetised from (NEA, 2018; NEA and CPAD, 2019)

ability to earn income or get support from their families. The PPAP essentially brought them 3,000 CNY per year of additional income (Lo, 2021). In addition, the policy also encouraged the creation of local public welfare jobs, including those needed for the simple maintenance and cleaning of PV panels and small-scale social welfare activities to enhance the village economy (NEA, 2019). Moreover, the generated revenue could also be used to improve the village’s environment, transportation infrastructure, and sanitation (Lo, 2021).

5.2.2. Issues with the implementation of PPAPs

Rooftop PV projects: Without institutionalised monitoring mechanisms, the transactions between poor households and PV sellers suffered from information asymmetry, and many households were misled by unscrupulous companies who preached installing rooftop PVs as a way ‘to get big profits with low costs’ (Liu & Liao, 2021a). In several instances, poor households were led into taking on high levels of personal debt from local banks or other lenders. Some salespersons sold and installed rooftop PV at a price higher than the market price, and some dealers exaggerated the benefits that could be generated or lied about the payback period. For instance, villager A in Fujian Province installed a 22 KV rooftop PV at 200,000 CNY, which was 70,000 CNY higher than the market price, and the income he earned from rooftop PVs was 'far from sufficient to cover the loan repayment' (Liu & Liao, 2021a). Moreover, the maintenance cost would usually amount to over 1,000 CNY per year or more, which was not included in the deal (Liu & Liao, 2021a). A manager of a PV company in Dongguan, Guangdong Province, confessed that the payback period for rooftop PVs was at least ten years but that they had to withhold this information from their customers: 'Who would like to buy our devices if we told them the truth?' (Liu & Liao, 2021a).

Another compounded risk of such projects is the bad quality of many poor households' rooftops, which, according to one practitioner from the PV industry, 'have a low loadbearing capacity and a high risk of collapse, especially on windy and rainy days' (Liao, 2022).

Centralised PV stations: Centralised PPAPs involved substantial investment from PV enterprises and other investors, as well as loans taken by local governments to cover their share of the investment (typically over 150 million CNY). The high quality of the electricity generated, and the good maintenance and operations provided by investors keen on ensuring returns were major advantages of this model (Wu, 2018). Nonetheless, the high investment amount quickly generated significant local government debt and high interest repayments (Wu, 2018). Moreover, this model allowed private investors to cash in on the very generous PPAP feed-in tariffs at the expense of the state.

Village PV stations: The key reasons that led the government to privilege village PV stations after 2018 were that, first, it represented a seemingly more affordable investment for local governments. Second, it could contribute to improving the rural electricity grid and relevant infrastructure. Finally, after 2018, the policy provided discretion to the village collectives owning the project to dispose of the revenues to create more rewarding local welfare jobs and finance local renovations, while maintaining the distribution of minimal welfare revenues for those unable to work (NEA, 2019).

However, these projects have also encountered several issues jeopardising their sustainability in the long run. First, many village PPAPs have generated land-use conflicts. A PV station typically requires between 30 and 40 acres of land per MW. In a rush to meet targets and take advantage of soon-to-be phased-out Feed-in-tariff, a series of malpractices occurred in the selection of projects sites, such as the illegal occupation and damage caused to agricultural land and ecologically protected land. For instance, County A in Anhui Province was reported to have forced local villagers to rent their farmland (China5e, 2016). Elsewhere in Shanxi Province, another county government was reported to have destroyed more than 300 acres used by local farmers as an apple orchard to construct a 9MW village PV station (Sohu, 2018).

Some localities experimented with smart, land use enhancing combinations of village PV stations and local farming/forestry/aquaculture projects. However, they lacked policy guidance, regulations, and instructions to navigate complex construction standards, land status, and tax issues. This regulatory vacuum led to random project approvals, sudden cancellations, and various degrees of project performance (Yao, Dong & Li, 2021).

Second, low-quality equipment, poor farm siting and design, and irresponsible management have led to an early decrease in some village PV farms' productivity. According to the Circular on the power generation of village PV stations released by the State Council in 2019, the generation capacity of 37% of all 15,696 village PV stations was lower than 80% of their theoretical value (BJX, 2019). Social media users have exposed many problems. For instance, one PV station in Shandong Province adopted shoddy equipment products faked as big brands (Sohu, 2016); another reported that village PV stations in one town in Jiangsu Province experienced a 30% year-on-year revenue decline due to a lack of proper maintenance (Xinhua, 2020). Inappropriate tilt angle, shadowing caused by obstacles, disordered scaffolding, and irrational design are among the common problems uncovered among many PPAP projects in Anhui Province, according to the investigations of the specialised PV industry media Guangfumen (2017). In some cases, locals were hired to do basic maintenance instead of professional technicians without receiving appropriate training to fix technical issues.

Third, local governments also rapidly suffered a shortage of funds, and PV companies got stuck in payment default. The Measures for PPAP's management, issued in 2018 by the NEA and the CPAD, strictly banned social investments and bank loans, which left the cost of PPAPs to be borne mainly by financially drained county governments.

This caused significant delays in implementing some PPAPs and multiple instances of payment defaults to PV companies. According to one director of the Poverty Alleviation Office of Shanxi Province, the cost of building a 100-kilowatt PV station was 900,000 CNY, of which 500,000 were paid for through fiscal transfers from the provincial government. The remaining 400,000 had to be paid by the county government, which simply did not have it in its coffers (He, 2019). In another instance, PV company B told us they had sued a local government in Anhui for defaulting on payments. *'We only received 50% of the payment for the project three years after finishing the PV construction. Our workers and the upstream equipment companies have sued us to get their wages and invoices paid. We'll soon be bankrupt!'.* Countless similar stories can be found online. Among them, a case that made the headlines is that of a PV company that suffered from a 1.3 billion CNY payment default by the Henan provincial government in 2020 (Bjx, 2020).

Finally, there has been a damaging lack of transparency regarding the local distribution and use of the revenues generated by village PV stations. According to an investigation by Guangfumen (2016), many village committees in Shanxi Province did not publicise the revenues generated by their village PV stations, and villagers did not seem to be aware of such revenues being generated for them. One interviewed local villager commented, *'We don't know much about that. Maybe the village committee spent the revenue on something else. We don't get a share of the revenue, not even a cent cut from our electricity bill'.*

In summary, precipitation and overcommitment, lack of strict equipment technical standards regulations and quality evaluations, lack of anticipation of maintenance costs, and lack of transparency in governance have weakened the benefits that PPAPs could have offered to local development.

Figure 22. PV panels showcasing problems in the installation

Source: Photos from Guangfumen, 2016, 2017

(Left picture: shade over PV panels due to the insufficient space gap between the rows; Right picture: the metal frame of PV module does not connect with the grounding grid that protects it from lightning)

5.3 Addressing fairness impacts while developing solar energy in rural areas in the next decade

When the PPAP policy was terminated in 2020, the Chinese government outlined a new implementation roadmap and significant policy instruments to promote the development of PV power in rural areas in a way that is decoupled from poverty alleviation. In December 2021, the NEA and the Ministry of Agriculture and Rural Affairs (MOA) issued Opinions on accelerating the rural energy transformation to promote rural revitalisation (Gov, 2021). Several issues regarding the promotion of photovoltaics should be noted:

First, this document implicitly acknowledges and sketches a response to the management and maintenance issues mentioned above to ensure PPAPs' long-term sustainability. Specific measures put forward toward this aim include setting up a unified management system, organising professional teams for device maintenance, providing jobs, such as cleaning and patrolling positions, to local villagers, ensuring that the total amount of generated electricity is fed into the grid, publicising the expenses and revenues generated by PV stations, and exploring pathways for PPAPs to generate additional revenues, such as by joining the carbon trading market.

The document further encourages the integration of PV modules with other rural activities such as agriculture, aquaculture, animal husbandry, and forestry. It encourages the participation of private capital in electricity sales, energy storage, energy services, and investment in PV projects, notably through Public Private Partnerships.

Furthermore, three new policy focuses can be noted. First, the policy proposes to take advantage of the ongoing power market reform to explore the possibility of pursuing private sales of rural PV electricity to eligible local industrial consumers 'in surrounding areas.' However, this development is still in the incipient pilot stage. Various stakeholders, including grid companies, power companies, and local governments, face numerous challenges regarding the technical feasibility, accountability, and revenue distribution from such sales.

Second, to further consolidate the achievements of poverty alleviation of PPAP, the policy proposes to explore pathways allowing PPAP stations to join the carbon trading markets to broaden their income sources and generate additional revenue for poor rural areas and households. Although it does not mention any specific policy guidance and instruments, some provinces, like the ETS pilot Hubei Province, have already introduced related experiments from which lessons can be drawn.

Third, to increase China's wind and solar power capacity to 1,200 GW by 2030, the document encourages county-level governments to promote the installation of solar PV installations on public buildings and individual households. Shortly before this document was issued, the NEA issued a Notice on submitting the pilot programmes for rooftop solar power generation across the whole county. By September 2021, 676 county governments across the country submitted applications to be designated as pilots. According to the survey carried out by the specialised energy media Bjx, most of the 114 counties that have already signed contracts with enterprises to deploy rooftop PV panels chose state-owned energy companies as their project contractors (2021). The primary reason behind their choice is that they perceive SOEs as more receptive to the political task of developing renewable energy, regardless of the potentially significant and risky investments involved. They also expect SOEs to be more sensitive to their demands for additional contributions to local socio-economic development. For instance, many local governments have required SOEs to contribute a part of the revenue generated by their PV projects to develop local infrastructures and support rural revitalisation efforts (Ofweek, 2022).

Although the NEA has already issued a clear statement to encourage market-oriented promotion patterns and fair competition, some SOEs relying on significant financial and political advantages have already signed exclusive agreements with local governments to eliminate competition, monopoly becoming a 'hidden rule' (Ofweek, 2022). Moreover, such agreements afford state-owned companies the possibility to set potentially uncompetitive prices and thus expose residents to the risks of revenue decreases. For instance, an SOE energy company in Henan Province only pays villagers

30 CNY per year to install one panel on their rooftop, which is 10 CNY lower than the market price, and sets a higher maintenance fee (Liu & Liao, 2021).

5.4 Policy implications

The PPAP policy has made remarkable achievements in terms of spreading solar power in China's rural areas and generating income that contributed to the national poverty alleviation goals. (NEA, 2021a). However, this case study has brought out a number of design and implementation issues from which lessons can be drawn to ensure their continuous operation and revenue generation, as well as the fair and equitable sharing of the revenue generated, which is conducive to fast-tracking the low-carbon transition within China's rural areas over the next decade:

First, the siting of PPAP stations, the technical performance and maintenance of PPAP equipment, and the use and distribution of the revenues must be supervised throughout the project's life cycle. For instance, as suggested, centralised (national or provincial) operation and monitoring centres gathering real-time power generation data from all PPAP power stations could be established, to track revenue generation and maintenance needs. A reliable and independent verification process of the maintenance and profit allocation from PPAPs should accompany the deployment of such a platform.

Second, the integration of PV stations with other activities should be further supported to reduce the pressure on land brought by the expansion of PV farms. This requires more robust policy foundations and implementation mechanisms, including detailed policy guidance on project identification and land use regulations.

Third, PPAPs and other rural photovoltaic programmes should be integrated into the existing tradeable green certificate policy. They could provide green certificates to energy consumers to comply with their energy consumption renewable portfolio standards. More active efforts are also needed to enable them to join China's carbon trading markets to trade Certified Emission Reduction (CCERs) (Hou et al., 2019).

Fourth, the possibilities afforded by the ongoing power market reform to organise direct electricity sales to energy consumers, possibly at higher prices than local grid benchmark prices, should be explored and supported with the necessary regulatory and policy frameworks.

Finally, it is crucial to ensure fair market competition in the procurement process to avoid monopolising rural PV programmes by state-owned enterprises, and to standardise and improve the product and installation regulations supporting PPP and public procurement for rural PV projects.

6. Conclusion

This report has examined the fairness impacts of policies aimed at reducing coal production, industrial and household coal energy consumption, and a policy that uses the transition to alleviate social inequalities by providing revenues from rural PV projects to poor households.

Overall, these policies demonstrate the efforts and progress made in fostering China's society-wide energy transition. Each has made significant gains in the 13th FYP.

First, as shown in chapter 2, the coal capacity reduction campaign has led to the closure of 5,500 coal mines between 2016 and 2020, and more than 1 billion tonnes/year of outdated coal production were closed and restructured into larger, more efficient, and cleaner mines. (People's Daily Overseas Edition, 2021).

Second, as shown in chapter 3, the dual control targets have spurred energy efficiency efforts among industrial sectors, and the energy intensity of the Chinese economy has fallen by 13.2% (from 2015) between 2016 and 2020, with a cumulative reduction of 18.8% in CO2 emissions per unit of GDP (NDRC, 2021).

Thirdly, the extensive and rapid switch to cleaner fuels among rural households, discussed in chapter 4, has helped improve air quality in northern China. In 2020, the ratio of good and moderate air quality days in 337 municipalities reached 87.0%, an increase of 5.8 percentage points over 2015 (Ministry of Ecology and Environment, 2021).

Finally, whereas previously solar power had been concentrated in a small number of megafarms in a handful of north-western provinces, the PPAP policy discussed in chapter 5 led to the installation of 26.36 GW of solar PV capacity in 60,000 villages across the country (NEA, 2021a).

However, as outlined in the introduction, these efforts must be pursued and accelerated in the coming decade to achieve carbon neutrality and keep the global temperature increase below 1.5°C.

Furthermore, these policies have involved very substantial costs distributed unevenly across the economy and society. Since these costs are expected to increase sharply while new opportunities emerge in other parts of the economy, glaring fairness implications must be considered to avoid the transition resulting in local industrial collapse, exacerbated social inequalities, and social unrest.

China has already issued some policies to mitigate the most regressive outcomes of its energy transition programmes. Each of the policies examined in this report has taken the impact of the transition on stakeholders and affected groups into consideration. All have included some measures of compensation and transitional support. Reemployment measures have been implemented to accompany the large-scale decommissioning of coal mines in the 13th FYP; industries have received support to reduce their energy consumption and meet their targets, and rural households have received subsidies to minimise the incremental cost of switching from coal to gas or electric heating. Policies such as the PPAP programme have explicitly sought to use the transition to create welfare gains for the poorest in the country.

However, the analysis revealed that many of these compensatory measures have suffered from insufficient preparation and insufficient funding, and imbalanced or discriminatory implementation; they have often been tied to the achievement of short-term campaign-style policy goals. In the case of coal decommissioning (chapter 2), the treatment of laid off mine workers was shown to be discriminatory, and the economic impacts of mine closures on local communities appeared overlooked, leading to localised economic collapse and population outflow. Uncertainty about the pace of the coal phase-down in coal regions also appeared to hinder the formulation of an effective plan for organising an orderly, sustainable, and just transition of coal-dependent localities.

In the case of the dual control energy intensity and energy consumption targets (chapter 3), the application of indiscriminatory restrictions aimed to achieve top-down targets in the short-term, regardless of local conditions, performance, and policy compliance, was shown to affect production and industrial development, with counterproductive effects on efforts made to stimulate industrial upgrading and diversification.

In the case of the rural fuel transition (chapter 4), the fieldwork uncovered significant differences in the local implementation that led to the most regressive impacts being felt by households in the poorest rural communities.

Finally, due to a lack of preparation and oversight, the implementation of rural solar PV programmes (chapter 5) led in some cases to the non-materialisation of benefits and the creation of unsustainable debt for the villages and poor rural households it was aimed to help.

A holistic policy design with a continuous focus on affected groups and their welfare, effective incentive programmes, and appropriately calculated and fairly distributed, subsidies, is crucial for enabling a just transition towards carbon neutrality in 2060.

Furthermore, all four case studies showed that frequent policy changes have fairness implications. All the policies reviewed in this report featured swift, short-term, and dramatic top-down policy interventions. These types of interventions have many side effects, which included leaving no time for local governments and stakeholders to anticipate, plan and prepare, encouraging over-reactions and a focus on short-term achievements at the expense of sustainability, and constant shifts in focus along with changing top-down priorities, which also affect the strength of the policy signals in favour of the long-term energy transition. For example, the central government's focus on showing determination in pursuing an early peaking of carbon emissions amid a 'post-Covid lockdown' surge of economic activity led to a severe production shutdown, which was implemented locally in a seemingly indiscriminate but also discretionary and untransparent manner. Yet, the following month's production resumed as before, with more emphasis on resuming economic growth, until Covid-control measures hit with similarly disruptive effects a few months later.

Similarly, in the case of PPAPs, the policy and its very generous subsidies were tied to the 2020 poverty alleviation objective and were therefore terminated two years after they were rolled out nationwide. There was no time to develop the regulations that would have minimised its side effects and maximised its long-term benefits. In the case of the coal decommissioning campaign, the resettlement funds set up by the central government and provincial governments were tied to the achievement of decommissioning goals and wwere thus ended with their attainment in 2020. Similarly, the subsidies from the central and provincial governments provided to rural households to transition from coal to gas or electric heating were phased out within a few years, leaving the burden to provide support to households on already financially strained local governments.

Lastly, all the policies showed limited and uneven participation of targeted and affected social groups in decision-making and implementation (Hu, 2020). Yet we know that low-carbon transitions require the participation of a wide range of actors, including citizens, civil society groups, private capital, and local authorities (Sovacool et al., 2019).

These structural policy implementation issues may increase the social cost of China's low-carbon transition, and might jeopardise the efficiency and performance of the transition. A low-carbon transition can best succeed if it is based on shared beliefs and values, convergent interests and resources, and relations underpinned by the common understanding of the need to find pathways towards sustainability. Therefore, besides the detailed recommendations highlighted in each chapter, we also recommend the following general actions:

- Mainstream fairness considerations across all low-carbon transition policy design and implementation processes.
- Adopt an inclusive assessment system of low-carbon projects that integrates social outcomes alongside environmental performance.
- Ensure the provision of adequate, stable, and equitable compensation mechanisms for the social groups and communities which are negatively affected by energy transition policies and projects.

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Annex: List of Policies

Chapter 2

- 省人民政府办公厅关于印发贵州省煤炭行业化解过剩产能实现脱困发展实施方案的通知
  Notice on Printing and Distributing the Implementation Plan for the Coal Industry in Guizhou Province to Resolve Overcapacity and Achieve Relief from Difficulties
  https://www.guizhou.gov.cn/zwgk/zfgb/gzszfgb/201608/t20160828_70522674.html

- 关于印发《贵州省煤炭结构调整转型升级专项资金管理办法》的通知
  Notice on Printing and Distributing the Measures for the Administration of Special Funds for the Adjustment, Trans forma tion and Upgrading of Coal Structure in Guizhou Province
  http://czt.guizhou.gov.cn/xwzx/tzgg/201707/t20170731_64859102.html

- 省人民政府办公厅关于印发贵州省 30 万吨 / 年以下煤矿有序退出方案的通知
  Notice on Printing and Distributing the Plan for the Orderly Exit of Coal Mines Below 300,000 tons/year in Guizhou Province
  https://www.guizhou.gov.cn/zwgk/zfgb/gzszfgb/201906/t20190612_70523611.html

- 关于在化解钢铁煤炭行业过剩产能实现脱困发展过程中做好职工安置工作的意见
  Opinions on doing an excellent job of employee placement in the process of resolving excess capacity in the steel and coal industry and realizing development
  http://www.mohrss.gov.cn/SYrlzyhshbzb/jiuye/zcwj/JYzonghe/201604/t20160413_238000.html

- 工业企业结构调整专项奖补资金管理办法
  Measures for the Administration of Special Award and Subsidy Funds for Industrial Enterprise Structural Adjustment
  http://www.gov.cn/xinwen/2016-06/14/content_5082051.htm

- 中华人民共和国劳动合同法
  Labour Contract Law of the People's Republic of China
  http://rlsbt.zj.gov.cn/art/2021/4/9/art_1229506656_2267336.html

- 中华人民共和国劳动法
  Labour Law of the People's Republic of China
  https://gkml.samr.gov.cn/nsjg/bgt/202106/t20210610_330502.html

Chapter 3

- 中华人民共和国国民经济和社会发展第十四个五年规划和 2035 年远景目标纲要 The 14th FYP
  http://www.gov.cn/xinwen/2021-03/13/content_5592681.htm

- 国家发展改革委 国家能源局关于完善能源绿色低碳转型体制机制和政策措施的意见
  The Opinion on Improving the Institutional Mechanism and Policy Measures for Energy Green and Low-Carbon Transformation
  https://www.ndrc.gov.cn/xxgk/zcfb/tz/202202/t20220210_1314511.html?code=&state=123

- 国家发展改革委办公厅关于印发《2021 年上半年各地区能耗双控目标完成情况晴雨表》的通知
  Notice on the issuance of the "Barometer of the Completion of The Dual Control Target of Energy Consumtion in Each Region in the First Half of 2021",
  http://www.gov.cn/zhengce/zhengceku/2021-08/18/content_5631846.htm

- 国务院关于印发“十三五”节能减排综合工作方案的通知
  13th Five-Year Comprehensive Work Plan for Energy-saving and Emission Reduction
  http://www.gov.cn/zhengce/content/2017-01/05/content_5156789.htm

- The 14th Five-Year Comprehensive Work Plan for Energy Conservation and Emission Reduction
  (国务院关于印发 “十四五”节能减排综合工作方案的通知)
  http://www.gov.cn/zhengce/content/2022-01/24/content_5670202.htm

- 发展改革委关于开展重点用能单位“百千万”行动有关事项的通知，
  Notice on matters related to the“Hundred,Thousand and Ten Thousand” Actions for Key Energy-using Units
  http://www.gov.cn/xinwen/2017-11/13/content_5239248.htm

- 国务院关于印发“十四五”节能减排综合工作方案的通知
  The 14th Five-Year Comprehensive Work Plan for Energy Conservation and Emission Reduction
  http://www.gov.cn/zhengce/content/2022-01/24/content_5670202.htm

- 国家发展改革委关于印发《完善能源消费强度和总量双控制度方案》的通知
  Plan for Improving the Double Control System of Energy Consumption Intensity and Total Volume
  https://www.ndrc.gov.cn/xxgk/zcfb/tz/202109/t20210916_1296856.html?code=&state=123

Chapter 4

- 打赢蓝天保卫战三年行动计划 http://www.gov.cn/zhengce/content/2018-07/03/content_5303158.htm

- 石家庄市 2017 年散煤压减替代工作实施方案 http://www.sjz.gov.cn/col/1490952447017/2017/06/02/1496371599381.html

Chapter 5

- 中华人民共和国乡村振兴促进法 the Rural Revitalization Law
  http://www.moa.gov.cn/gk/zcfg/fl/202105/t20210507_6367254.htm

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