Framework, Index, and Outlook in China

The Rural Equitable Climate Transition toward Carbon Neutrality and Shared Prosperity

Executive Summary

ES / December 2023

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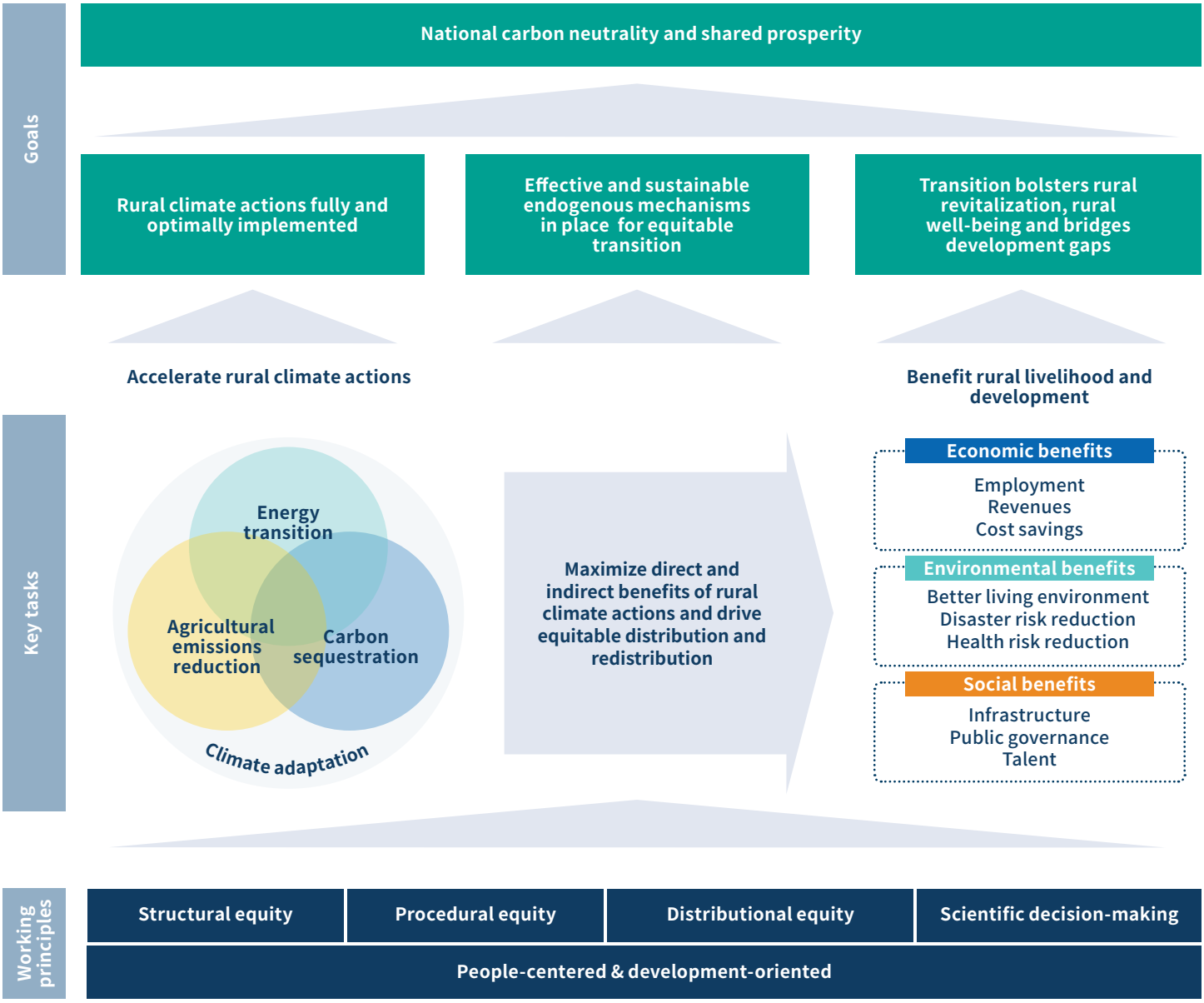
Framing the Rural Equitable Climate Transition in the Context of China

The need for an equitable transition toward carbon neutrality is more urgent than ever due to recent global health crises, frequent extreme weather events, and growing concerns about energy and food security.[1] In the context of rural China, an equitable climate transition has become increasingly important to achieve not only the nation's climate goal but also its promise of common prosperity for all. With a resident population of 500 million, rural China feeds nearly one-fifth of the world's population with 9% of the world's arable land, and is the foundation of national food security and social stability. Over the past few decades, China has lifted 770 million people out of poverty, mostly from rural regions. Despite significant development gaps, rural China presents great potential with its vast resources of renewables and areas that can be considered carbon sinks, which offers unique opportunities to advance rural development.

Considering both development and climate issues for rural China, the essence of the rural equitable climate transition is to implement climate actions in rural areas in an equitable and inclusive way on the premise of safeguarding national food security and the right to sustainable development for all, especially relatively disadvantaged groups such as smallholder farmers. At the same time, climate actions should be leveraged to create a wide variety of social, environmental, and economic benefits that are distributed in an equitable way to help improve the well-being of rural residents and narrow the urban-rural development gaps. These actions will contribute to China's goals of achieving carbon neutrality and common prosperity.

This framing is tailored to the specific context of rural China but has the potential to contribute to a similar process in other emerging economies that are also facing challenges to reduce emissions amid rapid urbanization, agriculture modernization, and infrastructure upgrades. As further elaborated in Exhibit 1, the ultimate goal of the transition is to contribute not only to carbon neutrality, but also to achieving common prosperity for all. This requires accelerating key climate actions in rural areas such as low-carbon agriculture development, energy transition, and carbon sequestration, and ensuring these actions can contribute to rural welfare and development from social, environmental, and economic perspectives. To achieve this, the transition must be people centered and development oriented, taking into consideration structural, procedural, and distributional equity, and ensuring that the decisions are scientifically sound.

Exhibit 1 Rural Equitable Climate Transition Framework



RMI Graphic. Source: RMI analysis.

Introducing the Rural Equitable Climate Transition Index Tool

RMI developed a first-of-its kind Rural Equitable Climate Transition Index tool (referred as the Index hereafter) to provide strategic insights for policy coordination, investment decision-making, technological innovation, and mechanism construction as well as a macro-level basis for a locally adapted transition and a baseline for future progress tracking. For these purposes, the Index includes four primary indicators to reflect the status quo and future development conditions of carbon neutrality and equitable development (see Exhibit 2): rural net greenhouse gas (GHG) emissions indicators, rural natural resources endowment for carbon neutrality, rural social livelihood and development, and rural innovation investment environment. The Index is completed by a selection of secondary and tertiary indicators to depict a holistic, clear, and neutral view of these primary indicators, taking into account data accessibility and replicability.

Exhibit 2: **Framework of the Rural Equitable Climate Transition Index**

Dimensions	Indexes	Subindexes	Indicators
Carbon neutrality[i]	**Rural net GHG emissions indicators**[x]	Current carbon emissions	GHG emissions from rural residential energy consumption
			GHG emissions from energy consumption in crop, forestry, livestock, and fisheries
			Other GHG emissions from crop cultivation
			Other GHG emissions from livestock
		Current nature-based carbon sinks	Forest and grassland carbon sinks
			Farmland soil carbon sinks
	Rural natural resources endowment for carbon neutrality	Renewable energy development potential	Rural wind, solar, and agricultural biomass power generation potential*
		Nature-based carbon sink potential	Projected forest carbon sinks in 2050
Equitable development	**Rural livelihood and development**	Energy consumption	Rural residential electricity consumption per capita
		Socioeconomic indicators	Per capita disposable income of rural residents
			Proportion of rural population with high school education and above
		Provincial food self-sufficiency	Net grain output
	Rural innovation and investment environment	Innovation environment	Local financial expenditure on science and technology per capita
			Regional innovation and entrepreneurship index
		Investment environment	Road density
			Change in growth rate of crop, forestry, livestock, and fisheries output+
			Change in growth rate of fixed asset investment in rural households+

Note:
x Higher scores indicate lower net GHG emissions
* Only includes biomass from crop residues
+ Change in three-year average annual growth rates
RMI Graphic. Source: RMI analysis.

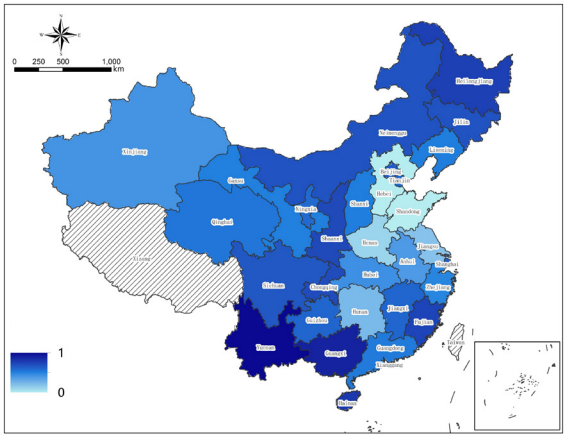
i The indexes are not comprehensive accountings of rural GHG emissions and potential, but indicators calculated from main rural emissions and carbon sequestration sources. See full report for a more detailed methodology.

Insights from the Rural Equitable Climate Transition Index Results

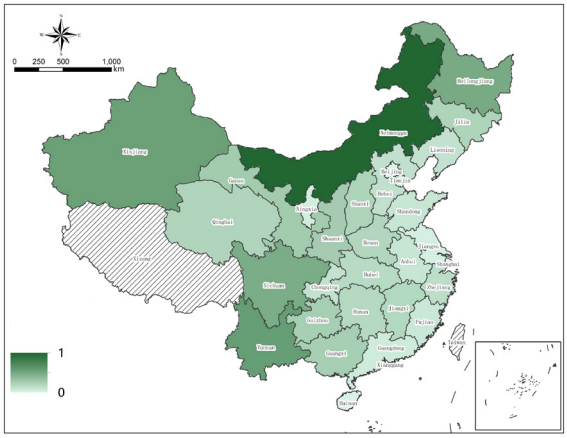
By entering provincial-level publicly available data from 2020, a historic year for China when the nation announced the successful eradication of absolute poverty and the official pledge to carbon neutrality, the Index indicates clear spatial alignments and mismatches. As Exhibit 3 shows, primary indexes within each dimension are fairly aligned. For example, provinces with greater renewable energy and natural carbon sink endowments in rural areas, which are mostly inland, also tended to have lower net rural GHG emissions in 2020; provinces with higher scores on rural livelihood and development also fared better in rural innovation and investment environment. Yet, index results on carbon neutrality and equitable development present a significant spatial mismatch among rural regions in various provinces. For example, inland areas richer in renewable energy resources and carbon sinks are generally less economically developed.

Exhibit 3 Spatial Distribution and Dispersion for Primary Indicator Scores

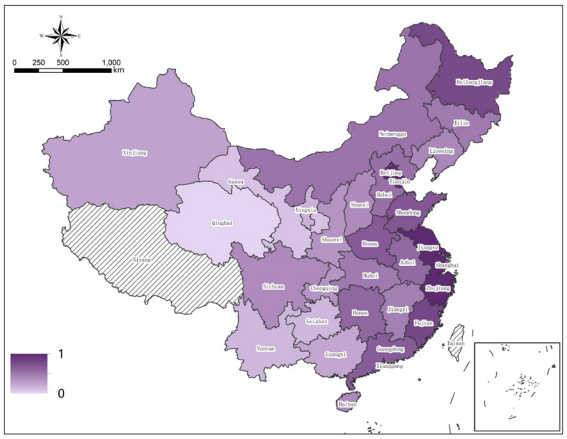
Rural net GHG emissions indicator



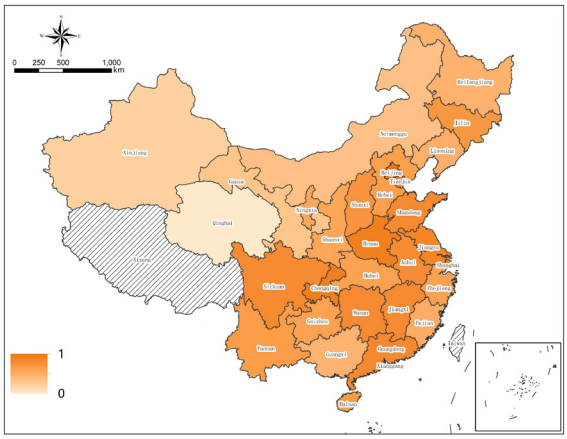
Rural natural resource endowment for carbon neutrality



Rural livelihood and development



Rural innovation and investment environment



RMI Graphic. Source: RMI analysis.

These results reveal great opportunities for advancing rural development through climate actions. First and foremost, it affirms that rural China has an abundant natural resources endowment — more than enough to support a national carbon-neutrality goal, and also has the potential to bring trillion-dollar investments and revenues to rural communities. Even after considering cost parity (based on current levelized cost of electricity) and land-use constraints such as topography, arable land protection, and biodiversity protection, the potential for renewable energy generation in rural areas within most provinces is tens or even hundreds of times greater than the current local energy consumption. In fact, total annual generation potential of renewable energy is far greater than the nation's 2020 energy demand.

This is particularly the case for rural areas in less-developed regions, which appear to have more abundant natural resources endowment for carbon neutrality, implying good prospects for narrowing regional development gaps through implementing rural climate actions that could strengthen local infrastructure and public services and unlock sustainable economic growth in those regions. Special attention should be paid to improving the innovation and investment environment in those regions as well as enhancing policy guidance and correcting market failures in rural areas as a whole. More economically advanced areas could also potentially play a leading role in investment and innovation to support the scale-up of effective business models and technologies, and leverage their regional influence to guide and assist less-developed areas.

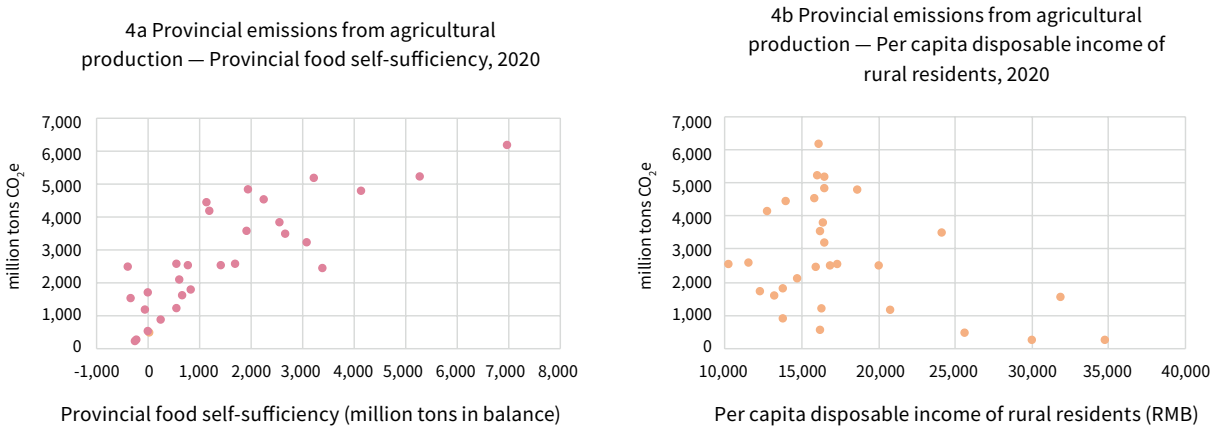
Further analysis of secondary and tertiary indicators reveals interconnected sectoral opportunities for the rural equitable climate transition:

Low-carbon agricultural development

Analysis of relevant indicators shows that agricultural emissions and emission intensity per unit output value are affected by an array of factors including the scale, structure, intensification level, and mode of agricultural production, but in general, provinces with higher agricultural emissions feature higher net food output, especially that of grains, and typically shoulder the responsibility of providing food not only to themselves but also to the rest of the country (Exhibit 4a), while also being relatively less well-off (Exhibit 4b). Therefore, the transition should be based on ensuring food security, respecting production habits, and promoting agricultural modernization while reducing emissions with measures such as optimizing spatial patterns of agricultural production, breeding, and efficient agricultural technologies.

When promoting low-carbon agricultural development in these key food-producing areas, particular attention should be paid to affordability and benefit distribution. Cost sharing needs to be extended to all responsible parties, especially other regions that benefit from food production of high-emissions provinces. A green premium is also a key measure to capture the value of low-carbon agriculture products and needs to be further explored.

Exhibit 4 Provincial Emissions from Agricultural Production: Provincial Food Self-Sufficiency and Per Capita Disposable Income of Rural Residents, 2020



RMI Graphic. Source: RMI analysis.

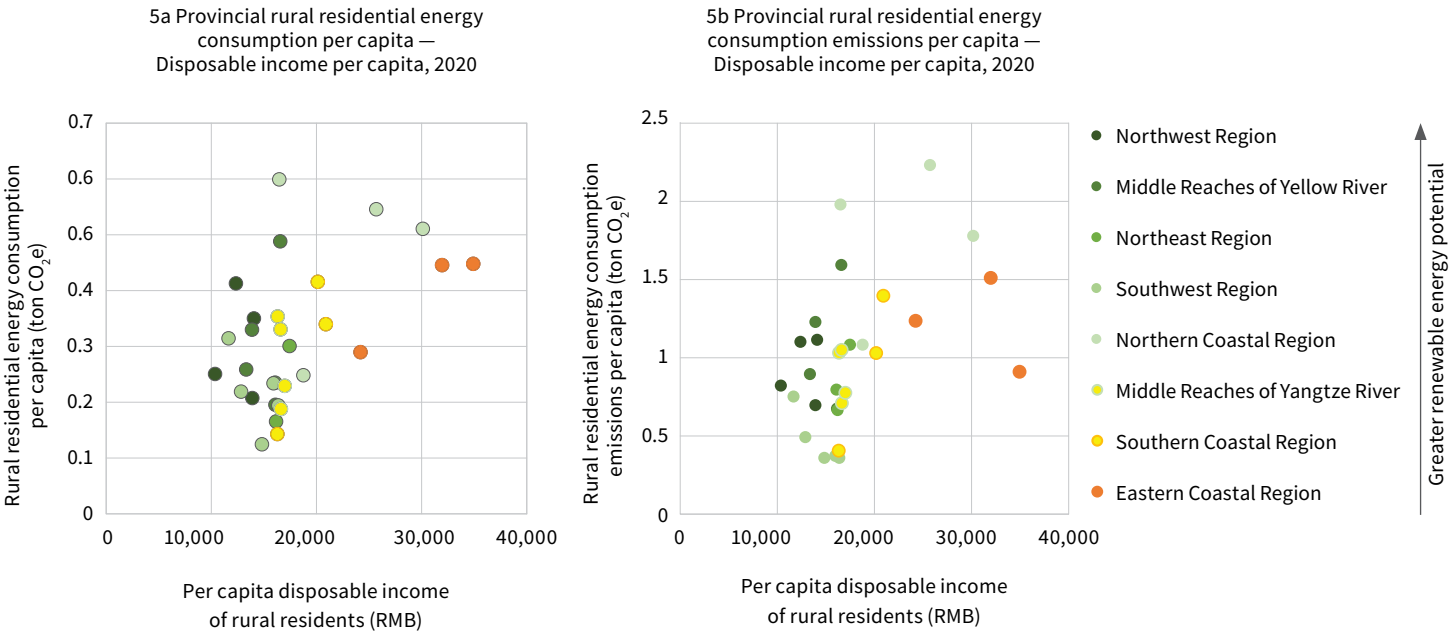
Rural equitable energy transition

Analysis of relevant indicators reveals that rural communities in economically less-developed areas typically have lower levels of household energy use and associated emissions but more abundant renewable resources (see Exhibit 5). Therefore, deployment of rural renewable energy resources should remain a priority, especially in less-developed areas, in order to meet their future energy needs while avoiding a high-emitting growth path. In fact, Exhibit 5 shows an inverted U-shaped trend toward the higher income level, whereby some of the most economically advanced regions have started to bend the curve thanks to cleaner energy mix in the grid — as well as better energy efficiency management as another indispensable part of the rural equitable energy transition.

Meanwhile, those less-developed areas often feature higher net food output as well as higher agricultural energy use and emissions. This indicates huge potential to decouple energy emissions from agricultural modernization by exploring the coupling of rural renewable projects with the promotion of electrification in the agricultural sector and clean energy technologies such as hydrogen, bioenergy, etc.

To leverage rural renewables to effectively decouple energy emissions from economic growth as well as provide new revenue streams for rural communities without too much up-front cost burdens, especially for those less developed regions, particular attention should be paid to increasing local renewable consumption and benefit sharing with local communities. This will require participative business models, innovative financing instruments, green premium mechanisms, and industrial convergence. Energy storage technologies and systemic changes to enable greater variable renewable energy and grid flexibility will also be pivotal.

Exhibit 5 **Provincial Rural Residential Energy Consumption and Emissions Per Capita, 2020**



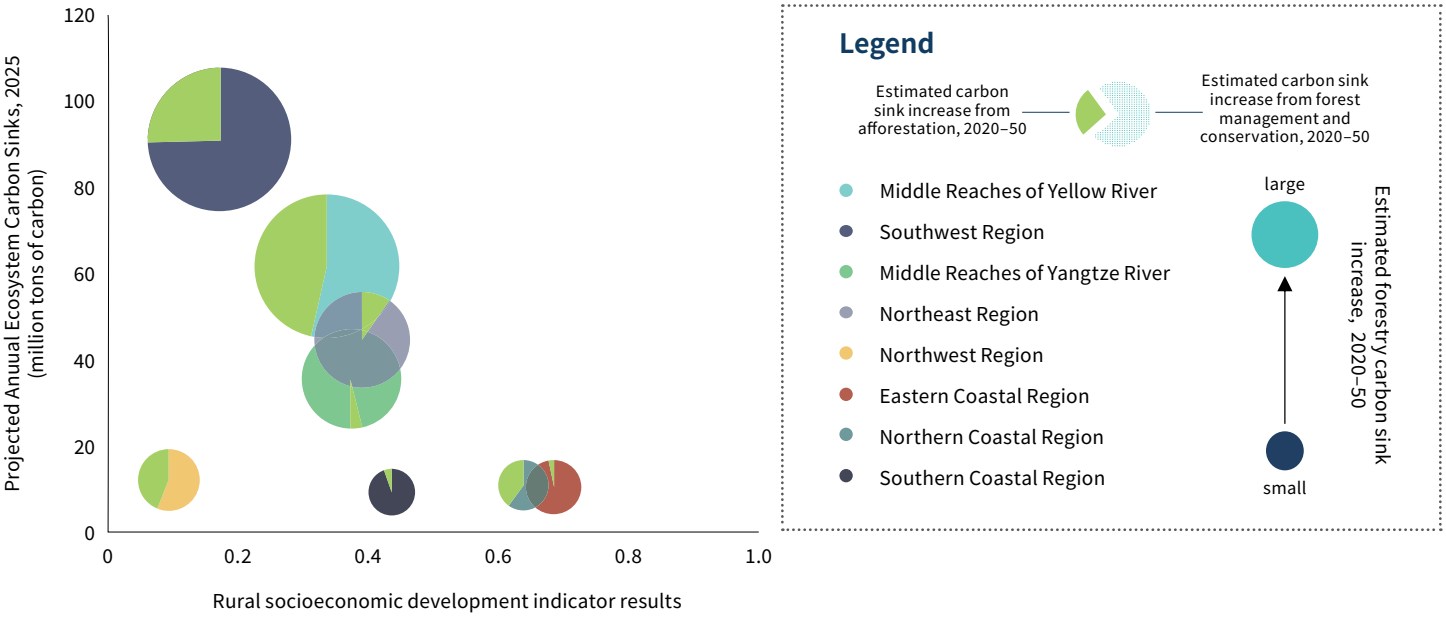
RMI Graphic. Source: RMI analysis.

Enhancement of nature-based carbon sinks

Index results show that rural ecosystems currently offset more than 60% of rural emissions. Many regions with larger carbon sinks also happen to score lower on rural livelihood and development (see Exhibit 6). This means the management, improvement, and monetization of carbon sinks (e.g., through carbon trading) can offer great opportunities for advancing rural development in these regions, and special attention should be paid to affordability and benefit sharing of relevant actions, all of which would require enhanced equity considerations since these regions are often highly biodiverse and also home to many ethnic minority groups.

When it comes to specific measures, considering limited land resources and the relatively low forest carbon sequestration rate in China, forest management and conservation presents a greater potential for carbon sink increase than afforestation as shown in Exhibit 6. Other research also shows that forest management and conservation is more economical, with only one-third of the net cost per unit of carbon sequestered, and it may even generate a net gain if all co-benefits are taken into account.

Exhibit 6 Projected Growth of Carbon Sinks by Region, 2020–50 (2050 Data Only Includes Forestry)



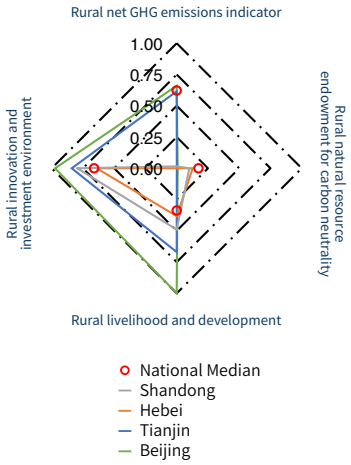
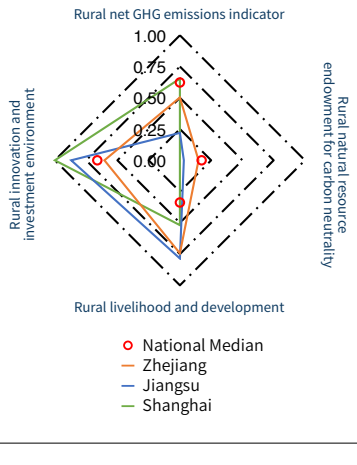
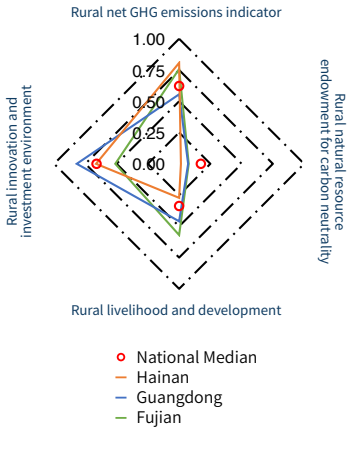
RMI Graphic. Source: RMI analysis.

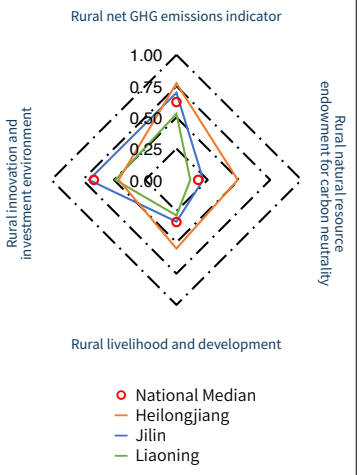
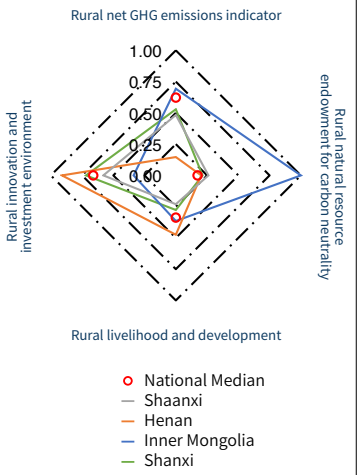
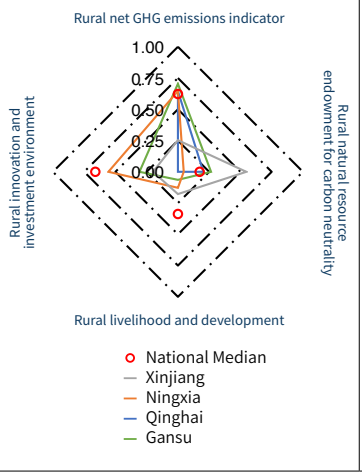
In addition to the national and sectoral-level insights above, the Index results also reveal regional features that could serve as a starting point for more comprehensive local action planning:

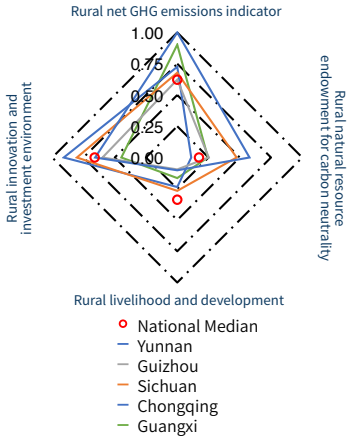
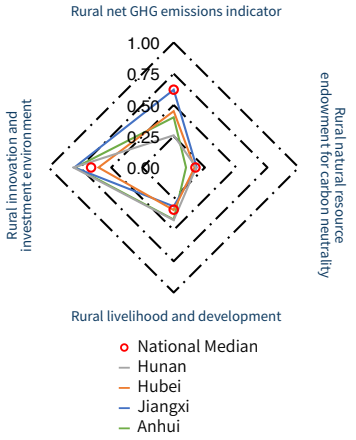
- **Coastal and inland rural regions show distinct heterogeneity.** Coastal provinces generally see a higher level of rural livelihood and development, as well as better innovation and investment environment. Emissions from residential energy use contribute to the greater part of their rural emissions. Several provinces with the highest net rural emissions in the country are in the coastal regions. However, the potential for rural renewable energy development and carbon sequestration in coastal provinces is generally low. Agriculture also has a smaller weight in the composition of the local economy, and thus they generally rely on food imports from other provinces. Inland areas are almost the opposite. Their index scores for rural livelihood and development as well as rural innovation and investment environment are relatively low, but they generally have higher agriculture output and food self-sufficiency, and rural emissions are dominated by agricultural production. The endowment of renewable energy and carbon sinks in many of the inland provinces is also at the forefront of the country. It is thus evident that different pathways must be explored for a rural equitable climate transition in coastal and inland areas.

- **Multi-province economic zones demonstrate localized features.** For example, the total endowment of renewable energy and carbon sinks in the Northern Coastal Region and the Eastern Coastal Region is not large, but the former has a high endowment of renewable energy per unit area, with Shandong ranking third in the country in terms of total agricultural biomass energy resources. Within the latter, Zhejiang is among the top in terms of the potential for forest carbon sinks among the coastal provinces, and therefore the development and utilization of renewable energy in rural areas and the protection and development of carbon sink resources can be accelerated in a locally customized way. Based on the Index results, Exhibit 7 highlights the potential opportunities for the transition for each economic region and some specific provinces as a reference for policymaking and investment strategies.

Exhibit 7 Regional Characteristics of the Rural Equitable Climate Transition Index and Potential Regional Transition Opportunities

Region	Rural Equitable Climate Transition Index	Regional Features	Region's Potential Transition Opportunities
Northern Coastal Region 		• Net rural emissions high in multiple provinces and cities; residential energy consumption main source of emissions • Rural carbon sequestration potential relatively low; renewable energy potential per unit area fairly high (Shandong Province particularly rich in agricultural biomass) • Many rural livelihood & development indicators and innovation & investment environment indicators top of the country (except that Beijing relies on imports for food consumption; Shandong and Hebei have potential for improvement in some other indicators)	• Piloting frontier low-carbon technology and business models in suitable areas to drive breakthroughs and scale up • Renewable energy deployment, heat pump promotion, housing renovation, distributed solar, and low-carbon livestock farming practices in suitable rural areas; smart grid and grid flexibility
Eastern Coastal Region 		• Residential energy consumption main source of rural emissions (emissions from crop cultivation high in Jiangsu Province) • The total potential for carbon sequestration in rural areas is relatively low (except in Zhejiang province) • Rural livelihood & development and innovation & investment environment scores highest in China (except that Shanghai and Zhejiang rely on imports for food consumption; growth rate of the agricultural industry is slowing)	• Emissions reduction of rural residential energy consumption, particularly through energy-saving and clean technologies, biomass energy utilization, and through grid interconnection and offshore wind energy development • Crop emissions reduction technologies; carbon sink protection and enhancement; exploring valuation mechanisms of low-carbon agricultural products and nature-based carbon removal
Southern Coastal Region 		• Rural residential energy consumption main source of emissions (except in Hainan Province where agricultural emissions are higher) • The potential for renewable energy development and carbon sequestration relatively limited • Rural livelihood & development and innovation & investment scores in the upper-middle range among provinces (Guangdong and Fujian rely on imports for food consumption; growth rate of the agricultural sector is slowing)	• Guangdong and Fujian: renewable energy development and utilization, including biomass from livestock manure, residential energy conservation, and electrification; Hainan: carbon sink protection and management; agricultural energy transition and efficiency; essential to promote rural livelihood through climate actions • Creating more opportunities and incentives to attract investment, technology, and talent toward climate-related industries; enhancing rural education and other livelihood aspects

Region	Rural Equitable Climate Transition Index	Regional Features	Region's Potential Transition Opportunities
Northeast Region 		• Emissions from agricultural production over two-thirds of the total emissions, of which crop cultivation is the main source • Rich in carbon sink resources; renewable energy development will need to prioritize farmland and ecosystem conservation; Heilongjiang's biomass from crop residues top among provinces • Net food-exporting provinces; momentum of agriculture sector growth rate in the upper-middle range among provinces; other indicators of rural livelihood & development and innovation & investment environment in the lower-middle range among provinces	• Forest ecosystem carbon sinks protection in the northeastern forest area; black soil conservation in the northeastern plains • Scaling low-carbon agriculture projects for large-scale production; emissions mitigation of agricultural machinery through efficiency improvement, electrification, and the utilization of biofuel • Strengthening support innovation & investment, rural education, and rural energy supply
Middle Reaches of Yellow River 		• Agricultural production main source of rural emissions (emissions from livestock farming particularly high in Inner Mongolia) • Renewable energy potential per unit area and estimated carbon sink potential are the second highest among regions (renewable energy potential in rural areas of Inner Mongolia accounts for 20% of the country's total; biomass from crop residues in Henan is the second highest among provinces) • The rural livelihood & development and innovation & investment scores are at the middle level in the country (Henan and Inner Mongolia are major food-exporting provinces; innovation & investment environment indicators show great variation between regions and indicators)	• Low-carbon transition and modernization in livestock farming • Development of renewable energy and carbon sink resources in suited areas; innovative utilization of biomass energy • Strengthening financial and technological support as well as cross-regional coordination for equitable rural climate actions
Northwest Region 		• Agricultural emissions account for over 70% of the total rural emissions, of which livestock farming is the main source • The region accounts for more than half of the country's rural renewable energy potential with particularly rich wind and solar resources (Ningxia has the highest potential for renewable energy power generation per unit area in the country) • The rural livelihood & development and innovation & investment environment among weakest in the country	• Renewable energy development and utilization; grassland ecosystem carbon sink conservation and restoration; renewable energy + ecological restoration; renewable energy + livestock farming; low-carbon livestock farming practices technologies • Improving various aspects of rural innovation & investment environment; considering cross-regional coordination for equitable climate actions

Region	Rural Equitable Climate Transition Index	Regional Features	Region's Potential Transition Opportunities
Southwest Region 		• Net rural carbon emissions among lowest in the country; agricultural production main source of emissions (Yunnan, Guizhou and Sichuan: more from livestock farming; others: more from crop) • Estimated forest carbon sinks highest in the country; renewable energy potential also high • Rural livelihood & development indicators at the low end among provinces; Chongqing and Sichuan: outperform in innovation & investment environment	• Carbon sink ecosystem protection and valuation mechanisms; tailored low-carbon transition and modernization of agricultural production • Deepening rural electrification and improving infrastructure services; improving lacking aspects of innovation & investment environment
Middle Reaches of Yangtze River 		• Net rural emissions at upper-middle range among provinces; emissions from agricultural production and rural residential energy consumption relatively balanced, emissions from agriculture production slightly higher, with more contribution from crop farming • Agricultural biomass and forest carbon sink potential at upper-middle range among provinces • Rural livelihood & development and innovative & investment environment indicators also around upper-middle range among provinces	• Incentivizing investment and technology innovation in low-carbon agriculture, carbon sink ecosystem protection, and the utilization of agricultural biomass • Agrivoltaics and multi-energy complementary solutions in suitable areas; improving clean energy ratio and grid flexibility

RMI Graphic.

Successful Cases and Next Steps

Despite the challenges, there are already a number of promising real-world cases that align with the core ideas of a rural equitable climate transition. In Tongwei of Gansu Province, government and corporate funded solar PV projects generated over US$30 million in extra income for local communities, lifting over 20,000 households out of poverty. In Hongze of Jiangsu Province, the carbon labeling program for rice unlocks multi-million-dollar higher price consumer market and transition finance. In Anji of Zhejiang Province, an innovative bamboo carbon sink trading program increases revenue income for bamboo farms by three- to fourfold while curbing deforestation. In Huangling of Guangxi Province, the development of the biogas industry boosts organic farming and ecotourism while avoiding burning wood for heating and cooking, and thus increased forest coverage ratio by over 30%. In Qingshen of Sichuan Province, government support for one young entrepreneur dedicated to replacing plastic product use with local bamboo has led to the creation of over 10,000 local jobs. And in China and Africa, the emergence of incentive schemes for lending to farmers and agricultural small- and medium-sized enterprises (SMEs) has been an important driver for low-carbon agricultural development. (For more information about these cases, please see the Appendix.)

These initiatives have gained remarkable results in promoting rural development through climate actions. They also demonstrate the joint roles of policy guidance, local leadership, market mechanisms, and social participation as well as the importance of business innovation in accelerating the rural equitable climate transition toward carbon neutrality.

These successful cases also provide references for the future implementation of the rural equitable climate transition in China. Yet more actions are needed from all stakeholders, including government, financiers, corporations, and local communities. Specifically, the following actions are recommended as next steps to tackle key challenges currently faced in the transition:

- **Construct a financial system that can effectively and continuously guide the flow of funds toward a rural equitable climate transition.** Public funding and development finance remain crucial in the short term, especially to provide stable incentives for scaling actions, but it is also increasingly important to leverage them to attract private investment in the transition. This requires improving rural credit systems; enhancing fiscal, tax, and investment policies; and strengthening asset management through instruments such as designated funds, bonds, trusts, and other investment and financing vehicles. Meanwhile, it is critical to use the revenues generated by the transition to improve rural development and well-being, and to fortify the rural innovation and investment environment to enable the continuation of the transition.

- **Accelerate innovation in industries and market systems that can promote the value realization and benefit sharing of a rural equitable climate transition.** Innovative and integrated industrial development paths are necessary to address bottlenecks and missing links within the industrial chains that are key for the transition (such as rural renewable asset operation and maintenance, agricultural waste collection and utilization, and carbon sink management). To correct market failures on public goods, it is also necessary to create green premiums and market demands as well as corresponding regulations for low-carbon agricultural products, diversified renewable energy, and nature-based carbon sinks. While doing so and as a minimum, social groups and ecosystems that may be negatively affected must be adequately supported and compensated. This will require improving risk assessment and product and service standards, and innovating insurance services and other risk management mechanisms. Where possible, novel market entities and business models should be fostered to include farmers, cooperatives, rural collective economies, local enterprises, and relatively vulnerable groups such as women and local ethnic minorities.

- **Accelerate the piloting and scaling of key technologies to improve reliability, economics, and synergies.** For relatively mature technologies (such as photovoltaics [PV]), implementation in rural areas with suitable conditions should be accelerated to form economies of scale. For emerging technologies (such as rural microgrids, smart distribution networks, biofuels, heat pumps, and agricultural machinery electrification and hydrogenation), the government should lead by strengthening support for research and development, exploring means to reduce costs and risks, and developing pilots and promotion paths. Special attention should be given to low-carbon technologies that can effectively enhance rural well-being, improve agricultural production efficiency and quality, or contribute to climate mitigation and adaptation at the same time.

- **Enhance the integration of rural infrastructure and social service systems with a rural equitable climate transition.** It is critical to seize the recent national policy window for developing new infrastructure to promote the construction of energy, transportation, and digital intelligence networks as well as innovative and integrated infrastructure that can effectively support rural climate actions and avoid high-emissions lock-in effects. Meanwhile, the government should expand and enhance the scope, scale, quality, resource integration, and mechanism innovation of relevant rural social services, such as the collection and utilization of agricultural waste, and the operation, maintenance, and risk protection of renewable energy and low-carbon agricultural assets. While doing so, effective models for the integrated development of primary, secondary, and tertiary industries should be explored,

in addition to new development paths of rural collective economy, to provide farmers with diversified job opportunities and financial gains.

- **Enhance the dissemination of information and promote comprehensive understanding of the rural equitable climate transition.** Raising whole-societal awareness and support is perhaps the single most important thing to accelerate the transition. Yet this is not possible without adequate information; statistics about agricultural and rural energy consumption, rural emissions and carbon sinks, natural resources endowment and utilization of renewable energy, and the impacts of climate change in rural areas are particularly crucial. Strengthening empirical research and systematic reviews of the real-world and long-term impacts of rural climate actions on rural development and well-being, as well as the synthesis of best practices and lessons learned, is also critical to ensure the transition process is effective and efficient.

- **Strengthen overall capacity building and youth-focused talent cultivation.** In light of the rural hollowing effects as a result of emigration of laborers to cities, guiding and supporting young talent to work and start businesses in rural climate initiatives, and fully leveraging their abilities to learn and use new technologies and information as well as their entrepreneurship and social media impacts, can accelerate the transition in multiple ways. Meanwhile, given the technical and managerial requirements for relevant work during the transition, it is also necessary to comprehensively enhance the capacity building of pertinent governments, organizations, and individuals, and consciously improve the local cultural environment and overall social governance.

- **Strengthen the regulation and supervision of all the above work.** In the process of policy formulation, program design, project decision-making, and full life-cycle management, comprehensive assessment should be carried out with full consideration of specific local conditions and local people's needs to avoid unnecessary negative impacts and social and environmental risks. It is also necessary to ensure clear delineation of rights and responsibilities, transparent information, standardized processes, adequate supervision, and robust feedback, evaluation, measurement, and verification mechanisms, to safeguard the efficiency and quality of the transition.

Notably, these recommendations are highly interrelated and mutually supportive and thus should not be treated in isolation. Indeed, a rural equitable climate transition requires a systematic transformation, which can be further interpreted in the following ways. First, it is important to not only accelerate tailored efforts at the local level, but also optimize regional and country-level coordination, including peer exchange, paired collaboration, and appropriate compensation mechanisms between regions.

Second, although strengthening directional policy support to correct market failures is imperative to accelerate the transition in the short term, innovating and enhancing market mechanisms are pivotal to ensure the transition can be scaled and sustained. Moreover, notwithstanding that government and enterprises will continue to play key roles in the transition, it is crucial to engage and leverage all parties in society. This is not only aligned with the essence of an equitable transition but can also leverage rural self-organization capabilities and cultural inheritance, thus improving the efficiency and quality of the transition.

Last but not least, a rural equitable climate transition in China cannot take place in silos. It is important to continue to enhance international collaboration toward a global equitable transition. While drawing on good practices and lessons learned from global peers, rural China may also offer wisdom and insights to help the world move toward a more prosperous, cleaner, and better future.

Exhibit 8 **Overview of Recommendations**

Finance **Guide continuous flow of funds toward a rural equitable climate transition**	• Provide stable incentives and innovate financial products for key rural climate actions • Improve rural credit systems; fiscal, tax, and investment policies; and asset management • Leverage policy-base finance to attract social capital investment to the transition • Utilize revenues generated by the transition to facilitate further transition efforts
Market **Realize and share benefits of a rural equitable climate transition**	• Address bottlenecks and missing links in industrial chains that are key for the transition • Create green premiums for low-carbon agricultural products, diversified renewable energy, and ecosystem carbon sinks • Enhance risk management mechanisms for vulnerable groups and ecosystems • Foster novel and inclusive market entities and business models
Technologies **Improve reliability, economics, and synergies of rural climate actions**	• Scale adoption of relatively mature technologies in suitable rural areas • Strengthen R&D for emerging technologies and develop critical demonstrations • Elevate support for low-carbon technologies with multiple co-benefits
Infrastructure **Enhance integration with rural equitable climate transition**	• Develop climate-positive new infrastructure for rural areas • Enhance social services systems to support rural climate actions
Information **Improve data, knowledge, and dissemination**	• Improve the collection and management of good-quality data to inform decision-making • Strengthen research on the real-world impacts of the transition and synthesize best practices • Raise whole-societal awareness and support for a rural equitable climate transition
Capacity **Youth talent cultivation and overall capacity building**	• Foster young leaders for a rural equitable climate transition • Enhance capacity building of all parties and particularly vulnerable groups
Monitoring **Strengthen the regulation and supervision of all the above work**	• Assess potential risks of policies and projects for vulnerable groups and ecosystems • Provide transparent information, standardized processes, and adequate supervision • Develop robust feedback, evaluation, measurement, and verification mechanisms

RMI Graphic. Source: RMI analysis.

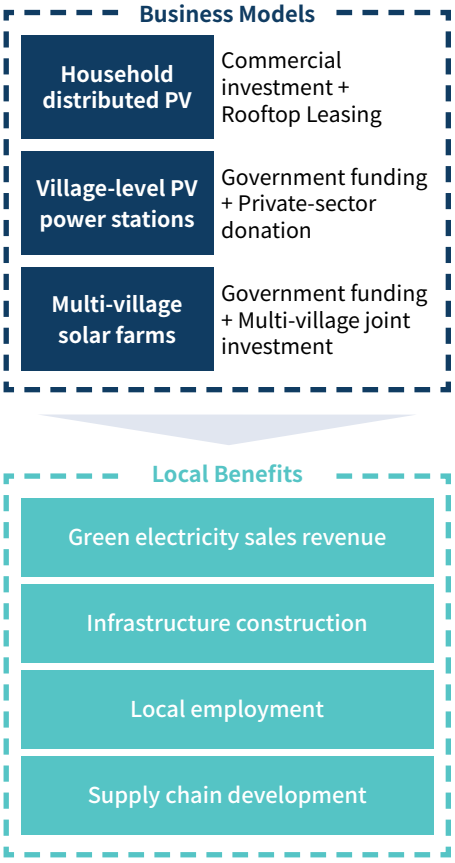
Appendix. Case Studies of Rural Climate Equitable Transition in China and Beyond

Case Study 1: Tongwei County in Gansu Province Converts Solar Resources into New Engine for Growth

Overview: Tongwei County in Gansu Province, a county with barren land but abundant solar resources, has been included in the National Pilot County for Photovoltaic-Based Poverty Alleviation program since 2014. By end of 2020, the county's solar power generation capacity reached over 160 MW, creating nearly US$30 million local revenues in the forms of tax, lease payments, wages, and dividends, etc. and lifting over twenty thousand residents out of extreme poverty. To date, local renewable industries fed by solar and wind contribute to almost half of the county's GDP.[2]

Exhibit 9

Business Models of PV Projects for Poverty Alleviation and Local Benefits in Tongwei County



RMI Graphic. Source: RMI analysis.

Approach and impacts: Vigorously developing renewable energy, the county has explored the construction of three types of PV-based poverty alleviation projects: household distributed PV, village-level PV power stations, and centralized PV power stations. Household distributed PV systems are often funded by enterprises, where farmers and village collectives enjoy the roof rental income during a 20-year contract period, and the assets are handed over to farmers or village collectives for free at the end of the contract period for continued benefits.[3]

The village-level PV power stations are funded mostly by government with some donation from companies listed under the national "Paired-Up Assistance in Poverty Alleviation" scheme. The assets are owned by the village collectives who distribute power generation proceeds toward the provision of public-interest jobs, incentives, and subsidies and small-scale public welfare undertakings. The centralized PV power station projects adopt the model of joint village construction, with the proceeds being used for the salaries of public-interest job personnel, rights-authenticated small public welfare undertakings in the village, and the consolidation, upgrading, maintenance, and renovation of small infrastructure projects. [4]

Lessons learned: A few factors are considered essential to the good results of Tongwei's countywide PV construction. First, stable and strong policy support such as designated funding, pilot programs, paired assistance schemes, and feed-in-tariffs, are critical to address the financing gap. Second, the county actively develops innovative and diversified PV project construction models based on the resources and economic conditions of the villages, including the exploration of agrivoltaics to address land-use tension, unlock new revenue streams, and increase local consumption of renewables. Last but not least, placing local benefits at the front and center of the policy and project design is fundamental, particularly when it comes to ensuring the revenue incomes are used for the sole purpose of poverty alleviation and local development.

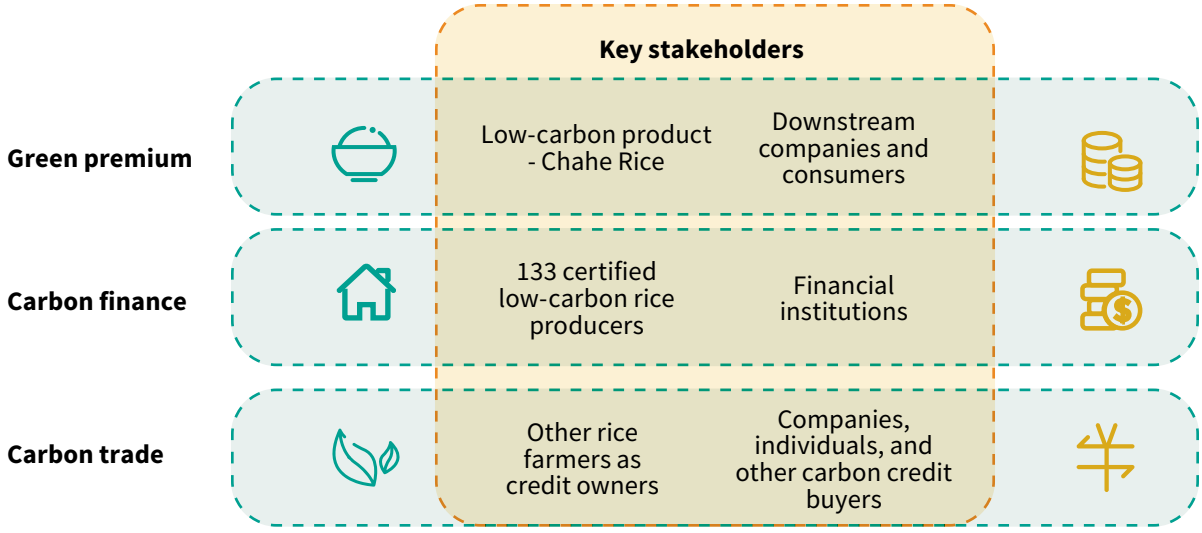
Case Study 2: Pilot Carbon Labeling of Agricultural Products in Hongze District of Jiangsu Opens New Ways to Monetize Low-Carbon Agriculture

Overview: Hongze District of Huai'an, Jiangsu Province, is the first district in Jiangsu to successfully develop carbon trading for rice.[5] Building on its good progress in fertilizer and pesticide reduction and efficiency improvement, the district constructed the Huai'an Hongze District Carbon Labeling System of Fertilizer Reduction project to establish a working mechanism from methodology to practice, and from carbon to cash. Starting with the local specialty agricultural product brand Chahe Rice with a multi-million-dollar market size, the carbon labeling system is expected to help increase farmers' income in multiple ways, thereby incentivizing low-carbon agricultural practices.

Approach and impacts: The construction of the carbon labeling system starts with the methodology, including the mechanism of a detailed accounting system of rice production activities from input to harvesting to straw management, and the carbon emissions reduction accounting method based on the reduction of chemical fertilizers. On this basis, a total of 133 production entities from five villages across the district were selected as the demonstration entities for carbon labeling. The carbon emissions reduction of these entities was accounted and graded, and the grading results were reviewed by experts. Finally, the carbon emissions reduction of the entities in the demonstration zone was certified for labeling.[6] The value of the labeled agricultural products will be delivered through green premiums paid by downstream business and consumers, or through a voluntary carbon trading market. The certification of production entities also acts as a green credit system to unlock financial support for low-carbon practices.

Lessons learned: China's low-carbon labeling of agricultural products is still in the exploratory stage. The Hongze experience can provide multiple references. First, synergy of pollution reduction and carbon emissions reduction in agricultural products can be realized through more scientific and reasonable fertilizer management. Second, the low-carbon premium for agricultural products still requires enhanced customer awareness and brand construction. Third, it is still necessary to optimize relevant market mechanisms such as the carbon trading market to monetize the value of low-carbon agricultural products. Robust accounting methodologies and MRV systems shall be key to all of the above.

Exhibit 10 **Benefits from Agricultural Products Carbon Labeling of Hongze District**



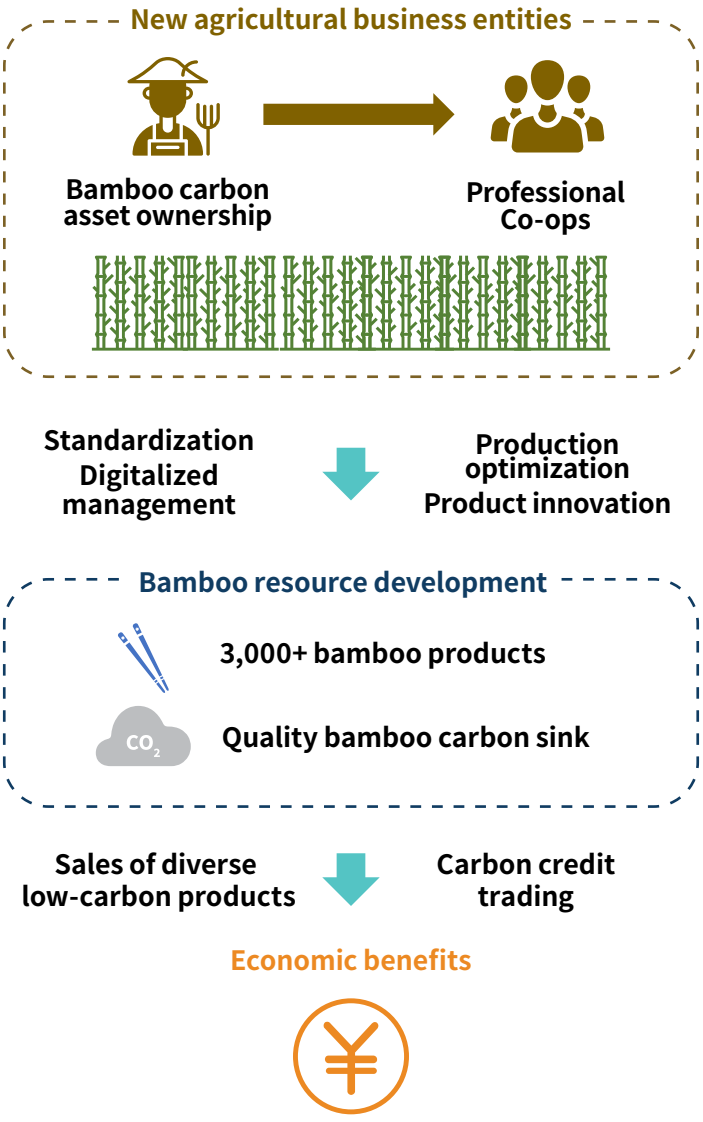
RMI Graphic. Source: RMI analysis.

Case Study 3: Anji County of Zhejiang Innovates Bamboo Forest Carbon Sink Enhancement and Trading Model to Boost Rural Revitalization

Overview: Anji County of Zhejiang Province is known as the number one bamboo township in China with an area of 1.01 million mu (673 million m^2) of bamboo forests, creating 20% of the annual output value of the Chinese bamboo industry with 1.8% of the national bamboo production.[7] In recent years, it has been exploring an effective pathway for monetizing bamboo forest carbon sinks by utilizing its rich bamboo resources, creating an integrated multistakeholder solution of bamboo forest carbon sinks production, trading, and income distribution, which has increased bamboo farmers' revenue income by three to fourfold while also doubling the carbon sequestration capacity of local bamboo forests.[8]

Exhibit 11

Economic Benefit Delivery Pathway for Bamboo Forest Carbon Sink Resource Development in Anji



RMI Graphic. Source: RMI analysis.

Approach and impacts: Anji's bamboo forest management–based carbon sink project began with the establishment of a robust bamboo forest carbon sinks accounting system and the improvement of bamboo forest carbon sequestration. The county collaborated with a core team at Zhejiang Agricultural and Forestry University to establish a bamboo forest carbon flux observing system and released the methodology for bamboo forest management–based carbon sink projects.[9] Based on this, a digital bamboo forest management service system was created for life-cycle tracking and management of product footprints.

Various participating entities play their roles in the monetization of bamboo forest carbon sinks through the establishment of a multi-stakeholder benefit-sharing mechanism among enterprises, cooperatives, and farmers. A bamboo forest carbon sink collection and storage trading model was built to promote the trading of carbon sinks in the market and encourage enterprises to voluntarily purchase carbon. Over 40 thousand farmers have voluntarily converted their bamboo forest resources into shares with local cooperatives equipped with professional bamboo forest management teams, mostly recruited from local communities, receiving dividends at the end of the year in proportion to the shares of their bamboo forests.[10] The robustness of this management, accounting, and trading system also helped unlock low-interest loans from commercial banks for bamboo forest management to increase carbon sinks.

Lessons learned: The bamboo forest development model in Anji County demonstrates that exploring local carbon sink resources cannot only drive green agricultural development, help build an ecological civilization, and mitigate climate change, but also boost the village's collective economy and local employment, and increase income for farmers. The key is to open the entire pathway from the carbon sink accounting methodology to the product carbon footprint management and finally to the monetization of carbon sinks.

Case Study 4: China's Number One Biogas Village Creates a New Model of Five-in-One Eco-Circular Agriculture

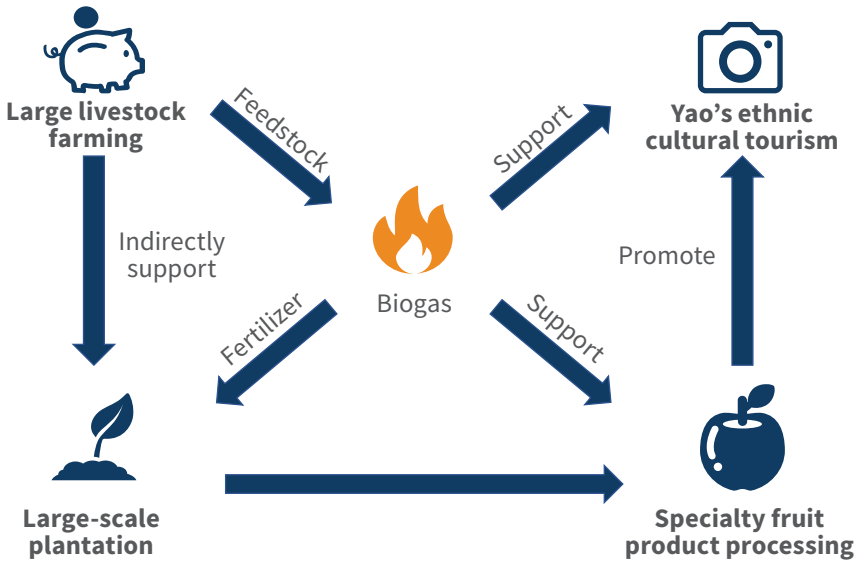
Overview: The development of biogas in rural China has experienced a booming period since the 1980s and has played an important role in addressing deforestation, waste management, and energy provision in rural areas. However, it has faced the problem of many abandoned projects in the new millennium due to excessive expansion amid decreasing rural population and family farms.[11] Known as the number one biogas village in China with the earliest and most popularized use of biogas, Huangling in Guangxi Province offers experience and reference for the rural clean energy transition with its evolving models of green growth powered by biogas.

Approach and impacts: The first biogas digesters in Huangling Village were built under the government's leadership. In the early stage, a three-in-one ecological agriculture model of breeding-biogas-planting was developed by constructing a biogas digester to serve a pigsty, a small vegetable garden, a small orchard, and a small fishpond. However, the industry chain of this model was difficult to sustain with the aging and diseases of fruit trees, disconnection between planting and breeding activities, insufficient biogas raw materials, and declined use rate during the 21st century.

Therefore, the local community adjusted the agricultural structure, promoted the at-scale operation and industrial development of breeding and planting, introduced a fully managed model with a designated biogas service provider, and created a new five-in-one eco-circular agricultural model of breeding-biogas-planting-processing-tourism. The development of the biogas industry not only guarantees the villagers' domestic energy supply and offers a much cheaper substitute for LNG that was increasingly used, it also improves the living environment in the village with better waste management and avoided wood-burning for heating and cooking, increasing the local forest coverage rate from 47% in 1983 to 82% today.[12] The fertilizer produced by the biogas digester also enables the prosperous development of the local fruit plantation industry. The persimmon plantation area in Gongcheng reached over 218,000 acres in 2020, with the certified green food area more than 100,000 acres.[13] The relevant industries have become an important revenue stream for local farmers.

Exhibit 12

Biogas-Centered Five-in-One Eco-Circular Agriculture Model of Gongcheng County



RMI Graphic. Source: RMI analysis.

Lessons learned: The history of biogas development in Huangling Village is an invaluable attempt to create a benign internal cycle of agriculture that continuously enriches the revenue stream of local residents. The new five-in-one eco-circular agricultural model of breeding-biogas-planting-processing-tourism is attributed to the full exploration and long-term planning of the local government, and the success of this model requires reforms be adapted to the local conditions. In addition, the experience of Huangling Village reveals the significance of rural biomass energy resources in supporting the achievement of the national strategic goals of carbon neutrality, energy transition, circular economy, and rural revitalization. Its green low-carbon value should be further converted into more benefits for farmers.

Case Study 5: Social Finance Supports Agricultural SMEs to Drive the Agricultural Low-Carbon Transition and Local Development

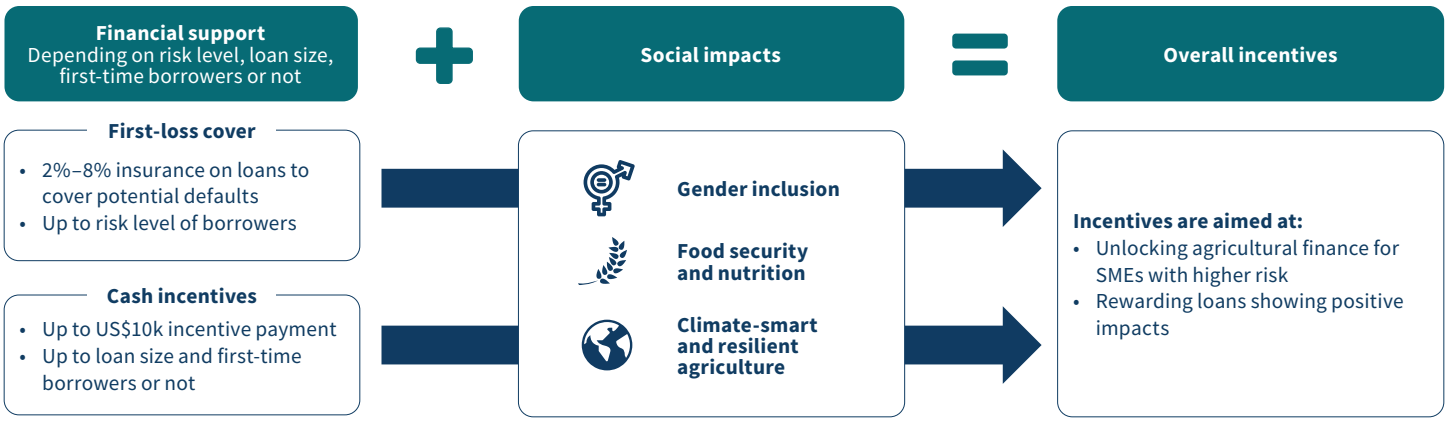
Overview: Agricultural SMEs often face large financing gaps due to high business risks. To bridge the gaps, Aceli Africa, an African market incentive organization, is committed to leverage social capital and promote the establishment of an inclusive financial market. The Chinese company Chongho Bridge focuses on providing microcredit services to farmers to boost the green low-carbon development of agriculture. Both cases provide references for social finance to help with the low-carbon transition of agricultural SMEs.

Approach and impacts: Informed by extensive data analysis, Aceli Africa has designed two incentives for Agri-SME lending. First, Aceli provides lenders with a portfolio first loss to mitigate risks: for each loan between US$25,000 and US$1.5 million, Aceli deposits 2%–8% of the loan value into a reserve account that is used to cover the first loss in the portfolio. In addition, Aceli further raises lenders' willingness to lend to agricultural SMEs by offering an origination incentive up to US$10,000 for loans between US$25,000 and US$500,000.[14] Set up in 2020, Aceli has unlocked over US$85 million loans for African SMEs by end of 2022, safeguarding jobs for sixteen thousand farmers.[15]

Spinning off from a poverty alleviation project by the World Bank, Chongho Bridge mainly provides small loans to smallholder farmers, and specifies pollution control and ecological protection as important prerequisites for credit approval. It also provides a package of loans combined with the provision of products and services that help reduce fertilizer uses, improve soil carbon, install solar PV, and other works to promote rural energy transition and low-carbon agricultural development. Building an extensive network of local teams serving over 100,000 villages, Chongho issued a total of $36 million in small loans in just year 2020.[16]

Lessons learned: The experiences of Aceli and Chongho Bridge can provide multiple insights. First, providing subsidies and limited guarantees for microcredit can raise the willingness of financial institutions to lend, leveraging a large amount of capital with a small amount of incentives to effectively fill the financing gap of agricultural SMEs. Second, data analysis on the financing gaps of agricultural SMEs in China and the leveraging benefits of financial support still need to be enhanced to help unlock financial support. Third, binding farmer-aid loans with green low-carbon technologies can make every fund a driver of the low-carbon agricultural transition for greater benefits.

Exhibit 13 **Aceli Africa's Model for Leveraging Financing to Support Agricultural SMEs**



RMI Graphic. Source: RMI analysis.

Case Study 6: Nurturing Young Climate Leaders and Helping More "Miss Guos" Return to Their Hometowns to Start Eco-Businesses

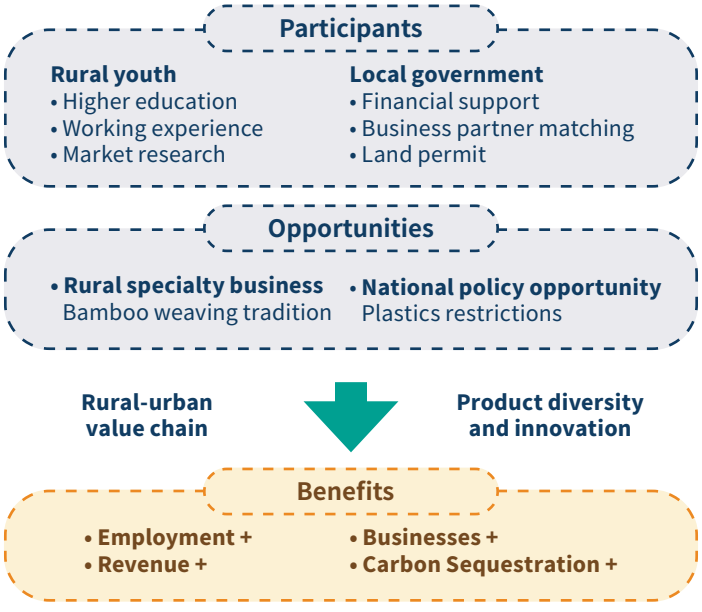
Overview: China's rural areas are experiencing a serious "hollowing" effect due to significant loss of young and strong laborers. Meanwhile, rural climate actions face challenges such as lack of field laborers, management and technological capacity, and motivation of farmers in emissions reduction and carbon sequestration. Enabling young people to return to their hometowns to start businesses and nurturing young climate leaders can help create sustained momentum for the rural equitable climate transition. Guo Qian, who was born in 1994 in Ganjiagou Village of Qingshen County in Sichuan Province, successfully started her own business after returning to her hometown with the support of the government, and has become a role model for the rural equitable climate transition in the region.

Approach and impacts: Qingshen County in Sichuan Province is the hometown of bamboo weaving art in China. Born into a bamboo weaving family, Guo Qian tapped her experience in hotel management after graduating from university and her deep dive into the industrial supply chain to seize the opportunity of the national Plastic Restriction Order to start her own business that produces green and eco-friendly products for high-end hotels based on the bamboo products of her hometown. The Qingshen County government has offered robust support for Guo Qian's startup. For example, in accordance with the Twenty-Two Measures to Promote Entrepreneurship in Returning to Rural Areas issued by the Sichuan provincial government, the County helped coordinate the land for her factory and connected local bamboo weaving manufacturers for a partnership to provide technical support.

To date, Miss Guo's startup is supplying nearly 500 hotel brands with annual sales of nearly $4 million. The company creates flexible jobs for more than 13,000 people annually, enabling the local farmers to increase their income and revitalize the local industry, while achieving the benefits of emissions reduction through the replacement of plastic with bamboo. In addition, Miss Guo set up and chairs the Qingshen Association of Entrepreneurship in Returning to Rural Areas with assistance from the local government to attract more university graduates and other returning and young entrepreneurs committed to the construction of their hometowns.[17]

Exhibit 14

Qingshen County Government Supporting Returning Young Entrepreneurs and Enabling a Rural Equitable Climate Transition



RMI Graphic. Source: RMI analysis.

Lessons learned: In this case, the policy support of the local government and the initiative of the young people returning to hometowns jointly promote the development of the rural carbon-neutral initiative based on local conditions and drive local employment and economic growth. The county government's practice of providing support in capital, technology, and industrial land to engage returning entrepreneurs in the revitalization of their hometowns is also an example for local governments. Non-governmental organizations also have important roles to play. For example, in 2022, RMI provided strategic and technical support for the Hainan Free Trade Port — Avenue of Dreams International Youth Innovation and Entrepreneurship Competition, in particular for innovation and entrepreneurship in rural carbon neutrality. Nearly 1,000 people entered the competition and more than 20,000 participated in online learning. Such activities are expected to cultivate young climate leaders like "Miss Guo" to accelerate the rural equitable climate transition.

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