SUSTAINABILITY

REPORT

CFA Institute Research & Policy Center

Green Finance Policy Evolution in China and the Impact of Pilot Zones: Huzhou Case Study

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Executive Summary

Mitigating the most significant physical risks of climate change requires stabilizing global temperatures at or below 1.5°C above preindustrial levels. Failing to hold temperatures below this threshold is expected to increase the probability of disruptions or permanent changes to our complex natural systems, resulting in concomitant negative socioeconomic impacts. Although these impacts will be felt globally, climate change impacts are known to be regressive, which means that emerging economies will be disproportionately affected.

To ensure that we do not exceed this threshold, it will be essential to reduce global greenhouse gas (GHG) emissions to a state referred to as "net zero." Put simply, this means reaching a state at which removals of GHGs balance additions to the atmosphere. Transformational changes to our economies and significant levels of investment to finance this transition are essential to achieve this goal. Given these challenges, we have seen governments worldwide begin to adopt policies and regulations to fund the transition to net-zero economies. The approaches taken toward greening the financial system have varied in different markets, however, leading to differences in both its definition and application that depend on local context.

In this paper, we examine the development of green finance in China, focusing on the role of pilot zones in shaping sustainable financial practices. Specifically, it delves into the case of Huzhou, a city that has successfully transitioned to a green development pathway. The Huzhou example offers valuable insight for other emerging markets aiming to integrate sustainable finance into their economic systems. In particular, we focus on the evolution of green finance in China and examine how it has utilized the pilot zone model to overcome some of the challenges it has faced as a result of its top-down design approach.

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The pilot zone model has proven to be an effective tool in China's green finance development because it allows for a more bottom-up, market-driven approach. Pilot zones allow cities like Huzhou to test innovative financial products and policies within a controlled environment before implementing them at the national level. Although not all of the pilot zones have produced results that could be implemented nationally, Huzhou stands out as one of the most successful applications of this model.

Huzhou's approach to green finance is marked by strong leadership and national and international coordination among government agencies, businesses, and financial institutions. The city has developed its own green finance taxonomy, has focused on industries such as textiles and batteries, and has created a range of financial products designed to help small and medium-sized enterprises (SMEs) transition to more sustainable practices.

A key success factor for Huzhou has been its emphasis on capacity building. Recognizing the complexity of green finance, the city has invested in educating local officials, financial institutions, and businesses about environmental standards and financial tools. Although its finance system was iterated several times throughout the pilot period, this foundation enabled Huzhou to establish a comprehensive system of green finance standards and regulations. Moreover, Huzhou collaborated with international experts and organizations to align its practices with global best practices while adapting them to its local needs.

To encourage the adoption of green finance practices, Huzhou implemented various policy incentives, including interest subsidies for green loans and rewards for green financial innovation. Additionally, the city introduced penalties for greenwashing, thus ensuring accountability and transparency in its economic system. Another innovative aspect of Huzhou's green finance approach is its development of digital platforms to streamline green project financing, particularly for SMEs. The Green Finance One-Stop Service Platform has significantly reduced the time and cost associated with accessing green finance, making it easier for businesses to participate in the transition to a green economy.

Huzhou's experience illustrates both the importance of and challenges associated with the development of green finance systems. Through phased capacity building and bottom-up experimentation, along with a "create first and improve later" mentality, Huzhou has developed several local green finance standards that have been adopted at the national level. The city's success in green finance not only has supported local economic growth but also could serve as a potential model for other emerging economies seeking to integrate sustainability into their financial systems. Huzhou has demonstrated how emerging markets can develop green finance ecosystems that balance environmental protection with economic development by focusing on local context, capacity building, and innovative policy tools.

Introduction

According to the Intergovernmental Panel on Climate Change (IPCC), human activities are responsible for nearly all of the 1.1°C rise in the average global temperature, resulting in increased droughts, forest fires, and more intense heat waves.[1] Greenhouse gas (GHG) emissions have received increasing attention, but current projections predict that temperatures will rise by 2.9°C compared with preindustrial levels by the end of the century, far above the 1.5°C threshold targeted in the Paris Agreement (United Nations Environment Programme 2023; McKay, Staal, Abrams, Winkelmann, Sakschewski, Loriani, Fetzer, Cornel, Rockström, and Lenton 2022). Crossing this threshold, estimated to occur by 2040, will further exacerbate physical climate risks and potentially cause permanent changes in complex natural systems, such as increases in forest decline in the Amazon and glacial melt (Woetzel, Pinner, Samandari, Engel, Krishnan, Boland, and Powis 2020; McKay et al. 2022). Although disruptions to these natural systems are anticipated to result in significant socioeconomic impacts at the global level, emerging economies are expected to be disproportionately affected (Asian Development Bank 2023; Kotz, Levermann, and Wenz 2024).

By implication, ensuring that we avoid the worst effects of climate change necessitates stabilizing temperature increases at or below 1.5°C. Meeting this goal will not be easy, as climate experts have noted that limiting temperature rise requires reducing GHG emissions to a net-zero state. Put simply, net zero represents a state in which GHG additions to the atmosphere are balanced by removals, but it will not be possible for all economic actors to reduce their emissions to zero.[2] Transitioning the global economy will require significant capital expenditure, with costs for just the energy and land-use sectors estimated to be as high as USD275 trillion, or USD9.2 trillion per year, by 2050 (McKinsey Global Institute 2022). Although the transition cost seems high, seizing the opportunity offers numerous benefits, while delaying action poses enormous climate risks.

[1]See NASA, "The Effects of Climate Change" at https://science.nasa.gov/climate-change/effects/.

[2]See Net Zero Climate, "What Is Net Zero?" at https://netzeroclimate.org/what-is-net-zero-2/.

Estimating the costs and benefits of climate change impacts is incredibly difficult, and projections vary from study to study based on their assumptions. In 2022, Deloitte estimated that our current policy pathway, which implies a 2.9°C temperature increase, would result in global economic losses of USD178 trillion over the next 50 years; a net-zero transition, however, would offer USD43 trillion in economic gains over the same period (Deloitte 2022). A 2024 study published in *Nature* by the Potsdam Institute for Climate Impact Research estimated damages from climate change to be USD38 trillion per year by 2049; in contrast, the costs of limiting temperature rise to 2°C would be USD6 trillion a year (Kotz, Levermann, and Wenz 2024).

The scale of this economic damage is compounded by its distribution. North America and Europe would see median incomes reduced by 11%, while Southeast Asia and Africa would face a 22% reduction. Unlocking the finance needed for transition will require implementing stringent regulatory frameworks, deploying advanced technologies, and fostering collaboration among governments, businesses, and civil society (Mak and Vinelli 2024). Although the exact implementation will differ from jurisdiction to jurisdiction based on their local social, environmental, and developmental context, lessons can be drawn by studying prior examples.

In this paper, we explore the past 15 years of green finance development in China—considered to be a leader in the region—and show how it has incorporated a pilot zone (i.e., bottom-up, market-driven) approach to a government-driven (i.e., top-down) development concept. Using these pilot zones, China has developed its definition of green finance, which includes sustainable finance taxonomies, carbon markets, and innovative green products, to begin transitioning its economy. We focus on the case of Huzhou, a midsize city in coastal China, which has transitioned to a green development pathway and continues to innovate based on its pilot zone experiences. By studying Huzhou's example, emerging and developing markets can draw lessons and determine whether and how these experiences can be applied to developing their own green finance frameworks and approaches.

This paper is divided into several sections. We first examine the case of Huzhou's pilot zone based on information collected during a series of interviews and roundtables with relevant stakeholder groups. We then discuss the climate change policy and finance system context in China, contrasting it with the US and European context. Knowing this local context is critical to understanding how green finance is defined in China. Next, we present a short history of the pilot zones to understand their purpose, benefits, and drawbacks. We then offer conclusions based on these pilot zone experiences. Detailed examples of some of the individual green finance projects are presented in Appendix A.

Case Study: Huzhou

Although pilot zones offer an opportunity to develop scalable green finance systems that address local and national priorities, not all have produced desirable results. Huzhou has stood out as an example of a successful implementation of green finance through the pilot zone approach for several reasons, including their labeling and verification of green projects, market-based incentives, green finance product innovation, and ability to lower transaction and search costs associated with procuring green loans. The People's Bank of China (PBOC) has formally acknowledged the policy innovations in Huzhou, including the development of its green finance taxonomy, and how it successfully shifted its economy to a more sustainable development path. Huzhou's success raises the question of how Huzhou could define "green" and transition its local economy to a new development pathway in a way accepted at the national level.

Before the Pilot

Regarding its development context, Huzhou is a city in Zhejiang Province, located in the heart of the Yangtze River Delta economic area and only 10 km from China's third-largest freshwater lake. It has also earned the moniker of the "City of Silk," as its traditional economy is based on textiles, building materials, and agriculture. Between 2015 and 2020, Huzhou averaged a year-on-year GDP growth of 7.1%, growing from RMB222.31 billion to RMB320.14 billion. Today, Huzhou has shifted away from the primary industries that had allowed for the rapid expansion of its economy, as its early growth resulted in increasing environmental degradation and human health impacts.[3]

As a result of these growing environmental impacts, public concern increased throughout the late 1990s and early 2000s, leading to calls for environmental protections—much like the United States saw in the 1960s and 1970s. Fishermen in Huzhou, along with the agricultural and tourism industries, were increasingly concerned about the environmental impacts of the cement industry, such as diesel contamination in the lake, which affected both water supplies and aquaculture, and air pollution, which required hotels to have to clean three times a day. The tourism industry exacerbated the water quality issue, as many hotels did not have wastewater treatment.

In addition to the cement industry, in the early 2000s, Huzhou was home to one of the largest e-bike battery manufacturers in China. This company was a significant taxpayer and employer and was preparing to launch an initial public offering (IPO) during this time period. The company, however, used a significant amount of lead in its production process and did not undertake any modernization efforts, which resulted in negative health and environmental

[3]The three-sector model in economics divides economies into three sectors of activity: primary (extraction of raw materials), secondary (manufacturing), and tertiary (service industries). See HKTDC Research, "Zhejiang: Market Profile" at https://research.hktdc.com/en/data-and-profiles/mcpc/provinces/zhejiang.

outcomes. These impacts triggered investigations from the local Environmental Protection Bureau and the introduction of bans on certain activities.

Momentum created through growing environmental awareness in the early 2000s allowed for the development of sufficient political will to address these issues. Although economic development was still considered important, the local government adopted an ideology of "Clear Waters and Green Mountains" and worked to figure out how to remediate the worsening environmental pollution and degradation. Actions taken by the local government were at times stricter than the national efforts and included new environmental regulations and bans; improvements in urban infrastructure, such as waste management systems; and tightened review processes for projects with potential environmental impacts. This period also saw the first market-based mechanism aimed at addressing local environmental externalities, with the launch of a local emissions trading system for pollutants.

Introducing new regulations, in conjunction with the other actions taken by the local government, had a pronounced effect on environmental quality. Water quality was improved through new discharge standards and the construction of new wastewater treatment plants, while water conservation requirements reduced the water intensity of the local textile industry. Several mines were shut, and cement plants were required to convert to electric transportation for clinker,[4] reducing carbon dioxide (CO_2) emissions by 10,000 tons per year. Environmental improvement did not come without trade-offs, however, as the number of companies involved in mining, cement, and battery production decreased within the province. In particular, the number of companies involved in producing lead-acid batteries decreased from 225 to 16.

Those that stayed in the battery industry were required to upgrade their facilities to meet strict environmental standards, which has led to the remaining companies becoming more efficient. As an example, Huzhou now has fewer battery manufacturing facilities, but the ones that remain are now carbon-neutral operations, including battery recycling operations, and provide the county with a higher overall tax base than before (see the "Tianneng Group" case study in Appendix A). These examples demonstrate the effect of growing environmental awareness on the demand for a greener economic development pathway. Although economic development remains a top priority, shutting down all polluting enterprises is not a viable option; instead, pathways must be developed for these companies to transition to more sustainable business practices.

According to interviews with the Huzhou municipal government, this 15-year period before the pilot zone represented the first two phases of Huzhou's economy. Phase 1 represented a lack of environmental care, and phase 2 focused on transitioning to tourism, travel, and local cultural industries that

[4]Clinker is essentially a mix of limestone and minerals that has been heated in a kiln. When limestone is converted to clinker, CO_2 is released.

leveraged their environmental resources (which is represented in the shift from primary to secondary and tertiary industries). Huzhou needed to balance environmental protection with its other needs, which included economic growth, employment, and urban–rural income disparities. These competing needs led Huzhou to think about phase 3 of its development, which it dubbed a "New Economy in Beautiful Scenery," which aimed to balance economic growth and environmental protection.

Moving to phase 3 would require Huzhou to adopt new modes of finance to encourage its industries to transition to a greener pathway. As the concept of green finance was emerging in China in 2015, Huzhou was one of the first to propose the establishment of regional pilot zones, predating the 2016 launch of the PBOC's guidance. In 2017, Huzhou was officially selected as one of the first batch of green finance pilot zones. It developed an action plan to build an ecosystem of green finance with regional traits and to encourage the rapid growth of green financing. Before it could begin building its financial system, however, Huzhou had to develop its green finance capacity.

Capacity Building

Because green finance covers a wide range of knowledge, including environmental science and law, practitioners need to develop a wide range of knowledge as well. Although they had strong industrial knowledge, all levels of the system in Huzhou lacked sufficient expertise to design and implement green finance standards, regulations, and infrastructure in 2015. As a result, the municipal government placed a strong emphasis on capacity building before the official start of the pilot zone, beginning with the top levels of the municipal government. In July 2015, representatives from the Huzhou government began to attend forums hosted by the PBOC, which brought together local and international green finance leaders and scholars to share best practices. Huzhou also held its own conference on eco-civilization in 2015, for which the mayor and vice mayor reached out to the PBOC to receive advice and assistance.

Following these initial forums, the municipal government kept in close contact with the PBOC, which facilitated communications with the central government. Huzhou was also the first city in China to develop an expert environment committee, the Huzhou Green Finance Institute,[5] to provide think-tank support. Close communications were also kept with the United Nations Development Programme (UNDP) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the main German development agency, to facilitate exchanges with experts outside of China. To better coordinate among environmental, industrial, and financial administrations, a steering group for green finance reform and innovation was established, headed by top party and

[5]The Huzhou Green Finance Institute is a nonprofit research institution that conducts research and runs pilot projects related to green finance and ESG investment. See Huzhou Green Finance Institute at https://www.hzgf.org.cn/.

government leaders, consisting of members from 45 government agencies and directed by the Huzhou government.

After the municipal government had developed sufficient green finance capacity, it began working with local financial institutions and banks to increase its capacity. They followed a similar top-down design, beginning with the headquarters at the province level and then moving downward. According to interviews with local banks, the initial learning process was quite challenging, particularly because of differences in terminology. To assist with this learning curve, the PBOC helped set up study groups, such as the China UK Study Group and Environmental Disclosure Work Group, to facilitate knowledge production.

As banks became more familiar with green finance concepts, they set up dedicated green finance departments, which would develop client-specific pricing and innovative products based on local context (see the "Eco-Industrial Park" case in Appendix A). Banks and financial institutions, including insurance companies, then took the lead on training the small and medium-sized enterprises (SMEs) with which they worked. To reduce compliance costs, the banks hired industry experts directly and provided them to their customers, instead of the companies needing to find their own experts. Through this method, the necessary capacities have been developed based on the green finance ecosystem in a top-down manner, with feedback flowing from the bottom up to the working groups, which has allowed for policies to be fine-tuned over time.

Although internal capacity building has worked well for the larger and mid-size banks and financial institutions at the higher levels, it has been more challenging for the banks at the county and rural level because of their size and diverse customer base. Although more than 80% of all financial institutions in China are rural,[6] they handle only about 14% of all assets and mainly handle microloans or loans to individuals. To overcome the lack of internal capacity, the rural banks seek assistance from external resources. For example, Deqing Rural Bank partners with the Bureau of Agriculture lab in Nanjing to conduct biodiversity and environmental impact surveys and to codevelop standards.

Development of Policy Frameworks, Incentives, and Products

Following its capacity-building period, in 2017, Huzhou began to work on how it would define and identify "green" activities. This was seen as the primary challenge because there was no universal national catalogue at the time, with the three ministries having released their own standards. To fill this gap, Huzhou began with the construction of its own labeling tool for SMEs and biodiversity. It borrowed heavily from the PBOC taxonomy but added in textiles, which was a

[6]"Mergers and Closures Loom for China's 3,800 Rural Banks," *Asian Baking and Finance* (2024), https://asianbankingandfinance.net/retail-banking/exclusive/mergers-and-closures-loom-chinas-3800-rural-banks#:~:text=As%20of%20December%202023%2C%20mainland,all%20of%20China's%20financial%20institutions.

major local industry. The standards for green textiles were quite strict, however, and required textile projects to employ technologies that enabled zero pollutant discharge, 100% water recycling, chemical recycling, or waste-heat recovery to be eligible for green loans.

In addition to labeling, Huzhou was involved in the development of local and national green finance standards, including 7 national standards, 21 provincial standards, and 2 municipal standards. The developed standards covered a range of topics, including the evaluation of green projects, green financing enterprises, green banks, and a special kind of financial institution (FI) that conducts business only in green finance, named "green finance specialized institutions," which are unique to China (see a partial list of standards and their stated outcomes is in Appendix B). This system of standards has continued to evolve and expand even after the end of the pilot, covering green building loans, green agriculture loans, green inclusive loans, and carbon-neutral banks.

Although Huzhou has developed a number of standards and regulations around green finance, it never made green finance mandatory and instead attempted to allow for market-driven growth. To encourage the application of green finance, Huzhou has employed several policy incentives to shape market expectations and give prompts to first movers in the market. In total, 25 measures have been announced on green finance reform, allocating RMB1 billion of a special budget to reward and subsidize specialized institutions for green finance, product innovation, talent attraction, and the development of standards (see **Exhibit 1**).

Huzhou's policy incentives can be grouped into three traditional categories: fiscal, monetary, and regulatory. Initially, incentives were based on "shades of green," with the government providing interest subsidies of 12%, 9%, and 6% for dark, medium, or light projects, respectively. As Huzhou gained more experience, incentives gradually expanded to a wider range of policy incentives targeting different objectives. Despite the recognition of pilot zones from the national level, such subsidies are provided in the local government's own fiscal and monetary capacity. Exhibit 1 provides a nonexhaustive list of current policy incentives in Huzhou. The maximum amount of subsidy to each enterprise ranges from RMB30,000 to RMB300,000 (roughly USD4,200 to USD42,000).

At the end of the pilot, Huzhou wanted to ensure consistency across different administrations over time by issuing Green Finance Promotion Regulations that codified both incentive and punitive measures into law as of 2022. The supportive measures for innovation in green finance fall into the city's fiscal mandate. At the same time, Huzhou also issued administrative penalties for "greenwashing" behaviors, such as false disclosure of carbon emissions, fraudulent application to government subsidies, or making false advertisements about green financial products.

Exhibit 1. Current Policy Incentives in Huzhou (nonexhaustive)

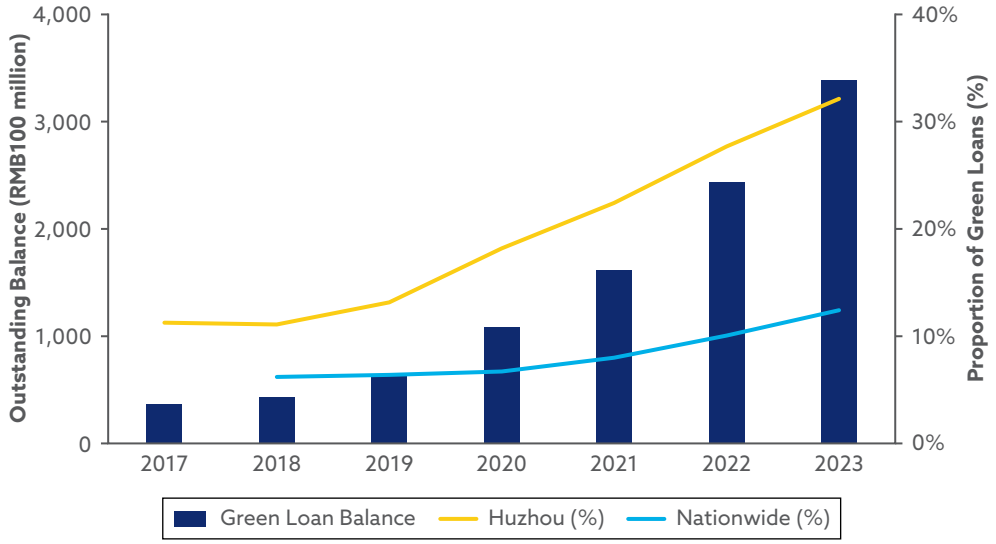
Green Inclusive Loan	For green inclusive loans in the current year, interest subsidies of up to 12% of the China Loan Prime Rate (LPR) will be provided to FIs based on their green finance performance, with a maximum interest subsidy of RMB150,000 per enterprise.
Green Bank	Banks that are approved as the first batch of green finance demonstration banks within the pilot zone and achieve significant results in areas such as "carbon-neutral" banking, green loans, and transition finance will receive a one-time reward of up to RMB300,000.
Green Bonds (e.g., carbon-neutrality bonds, transition bonds, sustainability-linked bonds)	Eligible enterprises and financial institutions issuing green bonds, carbon-neutral bonds, transition bonds, sustainability-linked bonds, and other debt financing instruments and asset securitization products (collectively referred to as "green bonds") can receive a subsidy of RMB100,000 for each successful issuance.
	For green bonds issued in alignment with the China–EU Common Ground Taxonomy, the subsidy per bond issuance will be increased to RMB150,000.
Green; Environmental, Social, and Governance (ESG); and Transition Insurance	For enterprises that purchase environmental pollution liability insurance, a subsidy of 30% of the insurance premium will be provided, with the cap of RMB30,000 per enterprise.
	For enterprises that purchase ESG insurance (discussed later in this section), a subsidy of 50% of the insurance premium will be provided, with the cap of RMB50,000 per enterprise.
Government Procurement	In government procurement of services related to banking or insurance, the performance of FIs in green finance will be used as one of the criteria in the bidding process.
Standard Setting	For FIs, research institutions, or local financial organizations, participation in the formulation of national or industry-level green financial standards will be rewarded with RMB250,000 at a maximum for each set of standards. Participation at the provincial level will be rewarded with RMB150,000 at a maximum. The lead drafting entity in formulation of standards on the municipal level will be rewarded RMB100,000 for each set.

Sources: Compiled by the author from publicly disclosed policy documents obtained from the Huzhou Municipal Government Office: https://www.huzhou.gov.cn/col/col1229213986/index.html.

FIs have taken the initiative in developing innovative green financial products, offering more than 180 varieties that range from loans and bonds to insurance and guarantees. These products also cover a wide range of themes, such as carbon efficiency, carbon price, electric vehicles (EVs), and green buildings. FIs and corporations have collectively issued 59 labeled green bonds, amounting to RMB39.41 billion (USD5.4 billion; National Financial Regulatory Administration, Zhejiang Bureau 2023).

Since 2017, Huzhou's outstanding balance of green loans has increased by an average 45.8% annually, contributing more than 50% of the overall loan balance increase (see **Exhibit 2**). As of March 2023, green loans accounted for 31.3% of the total loans, which was 21 percentage points higher than the national average and exceeded the rate in other emerging economies. At the end of March 2023, the outstanding volume of green loans reached RMB298.4 billion (USD41 billion), which was seven times higher than that of 2018. Green loans

Exhibit 2. Growth of Green Loans in Huzhou and China between 2017 and 2023



Source: PBOC, compiled by the Institute of Finance and Sustainability, Beijing Office.

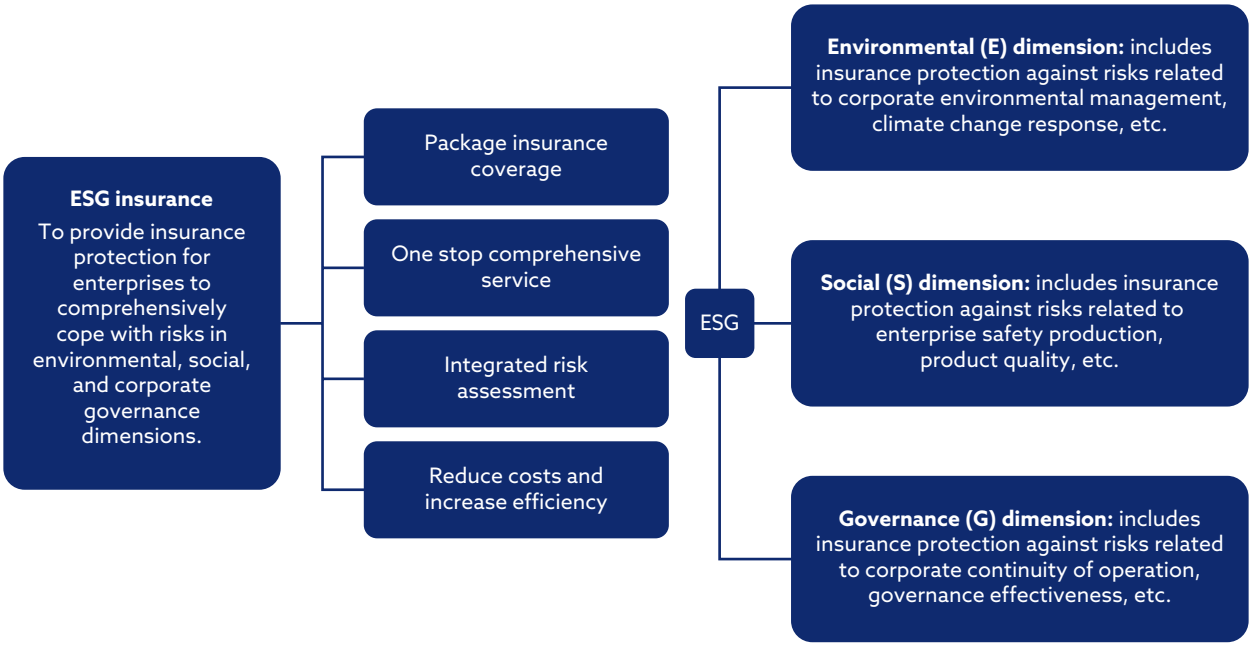
have also demonstrated significantly better performance, with an overall nonperforming loan ratio of only 0.002%, substantially lower than the financial sector average of 0.32%.[7]

Based on interviews with county and rural FIs, such as Deqing Rural Bank and Anji Rural Bank, county and rural banks have had to be creative in their product innovation because of their different markets and mandates. Anji Rural Bank has been developing green credit and loan methods that account for emissions of individuals. They have also developed rural revitalization loans, which serve more than 700,000 customers (97% of villagers). Deqing Rural Bank has developed a "carbon credit" for individuals who participate in local efforts like river cleanups or biking to work, which can be traded in for loan discounts.

These banks need to be innovative to remain profitable because they lack access to the PBOC lines of credit that large banks can use to subsidize the lower rates of green financial products. To make up for this lack, they rely on volume and increased business with individual households or entities. PICC Property and Casualty, for example, has developed environmental, social, and governance (ESG) insurance, which bundles together a number of products at a lower price than buying each separately but increases the overall business with a single customer (see **Exhibit 3**). Put simply, ESG insurance aims to shift from individual and single risk evaluation to a more comprehensive approach while shifting its purpose from post-event risk compensation to assisting with the entity's green transition.

[7]Provided by the local government office.

Exhibit 3. ESG Insurance Product Description and the Product's Definition of ESG Dimensions



Source: National Financial Regulatory Administration (NFRA), Huzhou Branch.

Development of Digital Platforms

To support the development of green finance, Huzhou has focused on the development of digital information systems to expedite the collection of information, identify green projects, and improve access to green finance products. One of the challenges Huzhou faces is that the majority of its economy consists of SMEs. Estimates place the number of SMEs in Huzhou at around 40,000 to 60,000, covering a range of sectors from manufacturing to services.[8] As a result, Huzhou needed to tailor its finance systems toward SMEs specifically, which presented a range of challenges.

Unlike large enterprises, SMEs face additional challenges in capacity and resource mobilization and traditionally have less staffing power and financial resources to devote to green finance activities. As a result, SMEs tend to find disclosures more challenging, have difficulty finding bankable green projects, and face relatively high costs for green certification from professional service providers. To overcome these hurdles, an efficient green finance digital infrastructure would offer a way to address information asymmetry and lower transaction costs.

[8]According to interviewees, SMEs with a single credit line of below RMB10 million accounted for 97% of customers.

Huzhou began by developing a green finance database to reduce the informational costs of banking institutions in identifying green financing entities and accounting for carbon emissions. This database has significantly facilitated green project financing. Based on this database, Huzhou developed the first version of an app, called "Digitally Intelligent Green Finance," which was aimed at speeding up green credit and loan applications. The app was then revised to include environmental information disclosure by financial institutions along with standardized templates and cases for carbon accounting. These standardized templates enabled SMEs to make quicker and lower-cost disclosures.

Huzhou has also developed an ESG evaluation model and system that can be applied citywide. A carbon accounting center for financial institutions has been set up, with more than 30,000 corporate carbon accounts covering 80% of their corporate clients and 80% of the city's total carbon emissions from production. This center provides valuable support for financial institutions to enhance their carbon accounting capabilities and to manage climatic and environmental risks. Although the municipal government provides ESG ratings, some counties have examined this model and added additional items to meet their local needs (see Appendix B).

As of today, the app has been updated and is now called the Green Finance One-Stop Service Platform,[9] which has been revised multiple times to tackle specific issues facing SMEs. Through big data, cloud computing, and other technologies, the platform has focused on green lending, green financing, and green credit ratings for SMEs. In recognition of the significant data barrier and the issues SMEs face in data collection and reporting, the Green Finance Platform has consolidated information from 31 government agencies, including the Huzhou Administration of Industry and Commerce, Huzhou Tax Bureau, and Huzhou Environmental Protection Bureau, that will be used in due diligence and ESG reporting. This effort reduces friction in the financial system. FIs can save time and effort in profiling clients and verifying their information, while enterprises can avoid duplicating efforts of having to submit the same information to multiple FIs on top of their regulatory requirements.

Applying green finance standards still demands a certain level of knowledge and capacity from financiers and enterprises, but incorporating this information into one platform has greatly reduced the complexity. Automizing the evaluation process, such as a project's overall alignment with green standards and ESG ratings for SMEs, not only alleviates these burdens for FIs and enterprises but also enhances the credibility of the process as the regulators provide the results. The evaluation results will feed into the due diligence process and be updated regularly for risk management purposes. Furthermore, companies can use the app to benchmark themselves against their competitors to determine their ESG performance under the same rating system.

[9]The platform consists of subplatforms like Green Loan Express discussed in the previous section, Green Financing Express, green regulatory data, and personal carbon accounts.

Another aspect of the updated platform is its similarity to other e-commerce websites, in which enterprises can browse through the various financial products offered (e.g., loans and equity financing) and financiers can browse through the various projects seeking financing. It is estimated that the average time for matchmaking between banks and enterprises has been reduced to 1.4 days, compared with 2.7 days originally. Moreover, the platform is constantly updating with more "smart" elements, including evaluation of future financing demands, recommendation algorithms, and risk monitoring; the interface of the most recent version can be seen in **Exhibit 4**. This update reduces friction by reducing redundancy in applications and creates competition for projects, which helps lower capital costs through reduced interest rates.

As of May 2024, the platform includes ESG ratings for more than 22,000 enterprises. Cumulatively it has assisted 59,000 enterprises to access bank financing, with a total of RMB550 billion (USD78.5 billion). According to the local government, they are expanding the platform for financial regulators so that regulatory review can be conducted automatically based on all the data, which further alleviates the burden for local regulators. Note that the app is available

Exhibit 4. The Latest Version of Huzhou's Green Finance One-Stop Service Platform

Source: Huzhou Municipal Government.

only for those in Huzhou's financial ecosystem. Markets that want to duplicate this kind of system will need to consider access by third parties if they cannot provide enough financing locally.

Post-Pilot Developments

Although Huzhou's pilot zone period has ended, it has not stopped working on its green finance system. Huzhou has continued to fine-tune its approach and has expanded its concept of green financing to include additional topics, including biodiversity and transition finance. In terms of biodiversity, Huzhou's agricultural and rural banks have been particularly active, designing products to encourage biodiversity protection at the local level. Deqing Rural Bank has developed products to address changes in animal husbandry, and PICC has developed wildlife rescue and casualty insurance to encourage farmers to not kill wildlife and to reimburse them for damages to cattle and crops.

Much of Huzhou's work is based on an ecological-oriented development model: It aims to develop relevant industries in conjunction with biodiversity projects to address the typical lack of return on investment (ROI) that occurs in preservation projects. A number of projects have been imitated along these lines (see the case studies for "Xiazhu Lake National Wetland Park," "Deep Blue No. 1," and "Bamboo as a Substitute for Plastic" in Appendix A). These projects paired biodiversity protection with a viable business and local partners to address economic and environmental concerns simultaneously.

In terms of transition, Huzhou's eight most energy-consuming industries account for 70% of energy consumption while providing only 37% of the total value addition by all large enterprises. Under the national dual-carbon goals, the need for transitioning the carbon-intensive sectors has become more pressing than ever; the overall carbon budget is limited, leaving insufficient room for new industries to settle in Huzhou. Huzhou needs to quickly transition these industries to allow for additional growth to occur, or it will lose out to neighboring cities. The development of transition finance is far more difficult than green finance by its nature, as climate transition is inherently a long-term, dynamic process and thus requires ongoing evaluation, as opposed to green economic activities that are already certified.

Developing countries like China are still in the process of industrialization, with newer infrastructure and growing market demand. Therefore, care is needed in designing transition pathways, policies, standards, and financial products to ensure a credible and smooth transition while minimizing the risks of "transition-washing" or causing economic stagnation. In the case of Huzhou, its exploration into transition finance has been built on its previous experiences, policy setup, and market infrastructures.

Huzhou has approached transition finance as an extension, or even a part, of green finance, sharing such similar pillars of development as taxonomies, disclosure, incentives, and products, while presenting such distinct elements as the need for transition planning. In January 2022, Huzhou introduced China's first municipal-level road map for transition finance, which identified seven primary tasks, including developing taxonomies, incentives, transition finance services, and digital platforms.

Huzhou first launched its Transition Finance Taxonomy in 2022 and updated it in 2023. It outlines 106 transition technology pathways for "8 + 1"[10] carbon-intensive sectors locally in the form of a "whitelist," with the rationale of achieving technological neutrality. The transition pathways in the taxonomy can be generalized into four categories: clustering of industries, decarbonization of production process (including reduction in source and process as well as carbon sequestration at the end), infrastructure upgrades, and purchase of third-party consultation services. The taxonomy establishes a baseline and targets for "carbon intensity" instead of energy consumption intensity, reflecting unit CO_2 emissions per RMB10,000 of industrial added value. Compared with the energy consumption intensity approach, the carbon intensity approach is more straightforward and can avoid being affected by the increasing proportion of renewable energy in the grid.

The municipal government has formulated several other guidance documents in addition to the taxonomy. These include guidelines on carbon accounting for banks, transition target-setting for enterprises in the key sectors, assessment for just transition, developing "carbon-neutral" banks, and outlines or templates for formulating transition plans. In the case of Huzhou, this approach has followed the rationale of "create first, improve later" and has emphasized the practicality of transition planning from the perspectives of both policymakers and practitioners.

Just transition is particularly important to Huzhou because of its significant rural population. Huzhou has historically focused on closing the gap between rural and urban populations and has one of the smallest urban-to-rural income gaps in China, at 1.5 times, which is nearly half the national average. To ensure a just and equitable transition, Huzhou has also issued an assessment methodology with multiple quantitative and qualitative indicators to help financing entities evaluate, disclose, and mitigate the potential social impact of their transition planning. A list of the indicators used in their methodology is included in **Exhibit 5**.

[10]The term "8 + 1" refers to eight traditional key sectors—textiles, paper, chemicals, chemical fibers, nonmetal minerals, steel, nonferrous metals, and power generation—with "+ 1" referring to wire and cable, which is classified as a subsector in the national industry catalogue. The wire and cable industry is included because of its high energy consumption (Jun and Chen 2024).

Exhibit 5. Indicators in Huzhou's Just Transition Assessment Methodology

Dimension	Indicator	Indicator Specification
Impact on Employee	Employee stability	Changes in the number of employees.
	Equitable distribution of income	Changes in the income level of frontline manufacturing workers.
	Employee growth plan	Status of staff training, including plans to provide training for new or upgraded skills, to support workers affected by corporate-level transition to access career opportunities and decent jobs.
Impact on Supply Chain	Supply chain resilience	Impact on (the number of) small and micro-financing entities in the upstream and downstream of the supply chain.
	Price effect	Provision of affordable energy.
		Provision of affordable raw materials.
Sustainable Development Impact	ESG performance	Its own ESG score compared with that of the same period last year.
		ESG score ranking compared with enterprises in the same industry in the city.

Source: Huzhou Municipal Government, compiled by the Institute of Finance and Sustainability, Beijing office.[11]

So far in small-scale pilot tests, negative scores are concentrated mainly in small enterprises, partially because of the absence of clear employee growth plans or declining ESG scores.[12] Although it is considered the social responsibility of enterprises in China to help employees grow, it is often untenable for smaller enterprises, particularly when they are already facing the downward economic pressure from climate transition, including income decline and increasing international standards on supply chains. Further capacity building is still needed from government agencies that oversee social welfare and employment as well as research institutions and civil society organizations. SMEs in other economies may find this challenge relatable to their own corporate transitions.

The Importance of Local Context: Understanding the Development Pathway of Green Finance in China

Determining Local Context

It can be difficult to understand what is meant when we say "green finance," in part because of its constantly shifting meaning and in part due to its various interpretations across different jurisdictions (UN ESCAP 2012). Therefore, creating an in-depth understanding of green finance requires interpretation

[11]The full table was provided by the Huzhou government in a research interview. Numeric thresholds were omitted by the author because the data were not publicized. The public version can be accessed at https://custom.huzhou.gov.cn/DFS/file/2023/07/28/20230728164430854xcmln3.pdf?iid=570150.

[12]Presented by the Huzhou government in a research interview.

through the lens of local context, leading to differences in both its definition and application across the United States, China, Europe, and other markets. Deriving the local context requires analysis of several factors, including the social, economic, environmental, cultural, and political dynamics of a specific location at a particular time. In terms of their importance in understanding climate finance, areas such as the level of development and the local approach to climate change generate the initial reference frame surrounding green finance (Fu, Lu, and Pirabi 2024).

Comparing and contrasting the evolution of climate change in different jurisdictions can provide valuable insight into the various stakeholder groups, such as investors, policymakers, and researchers, as well as how their beliefs and understanding affect their approach to sustainable development. Differences among these stakeholder groups can lead to slight but important variations in the meaning of green finance and its implementation regarding climate challenges and sustainability.

Although not a comprehensive history, we can begin by taking a short look at how climate change policy was formed in Western economies. This serves as an example to contrast with China's development path, setting the context for this case study. Concepts such as the triple bottom line and ESG were coined relatively recently, in 1997 and 2004, respectively; however, the idea that corporations also have responsibilities to the public or society, in addition to the satisfaction of shareholders, was first raised in US academic circles in 1953 (Bowen 2013). This idea was contentious at the time (Solberg and Tomilson 1997), but investors and companies were compelled to pay more attention to social issues because of movements associated with the Vietnam War and women's rights.

In contrast to the increasing attention given to social issues, climate change (and therefore climate policy) was primarily considered a scientific issue. During the 1960s, the public began to develop an increasing environmental consciousness, which was driven mainly by awareness of the harms of air pollution and the growing visibility of plastic waste. Despite some initial actions to address these issues, such as the establishment of the Environmental Protection Agency (EPA) in 1970, the launch of the first social and environmental mutual fund in 1971, and the issuance of the first carbon offset policy in 1976 (Kruse 2024), climate change would not become a significant US public policy issue until the 1980s.

Shifting the discussion surrounding climate change from a scientific issue to one that concerned the broader public discourse required calls from leadership figures in both the United Kingdom and the United States, including Margaret Thatcher and Al Gore, in tandem with a growing body of scientific evidence (Sandalow, Meidan, Andrews-Speed, Hove, Qiu, and Downie 2022). This expansion from scientific to public policy provided the discussion space needed for several advancements, including the publication of the United Nations' first "Who Cares Wins" report in 2004; the Principles for Responsible Investment

(PRI); and the Task Force on Climate-related Financial Disclosures (TCFD), which allowed for the mainstreaming of environmental sustainability and the development of green finance boundaries.

Despite the common calls for action in the United States and the EU, their approaches taken toward green finance, while similar, have distinct differences. Early trends in climate investment in both jurisdictions focused on divestment from fossil fuel resources, particularly coal, with several US states proposing divestment regulations and shareholder engagement and advocacy (United Nations Environment Programme 2016; Fu, Lu, and Pirabi 2024). Approaches to green finance in the United States have been pursued primarily at the state level, which has led to a somewhat fractured landscape in which some states have set renewable energy targets or developed green banks, whereas others have no such policies. The trend in areas with these policies, however, has focused on shifting capital flows to support a green transition.

In contrast, the EU has taken a "whole-of-government approach," in which individual member states may have their own policies but act collectively to set the EU's agenda, initiatives, and targets; adopt EU laws; and develop a common language and a clear definition of sustainable activities. In the EU's policy context, sustainable finance is vital to achieving the European Green Deal, which includes decoupling growth from resource use. Western green finance approaches have ingrained this approach of reducing absolute emissions. As an example of how this affects policy developments, the EU Emissions Trading System (ETS) assists in disinvestment in the member states by placing a price on carbon and establishing a decreasing cap on absolute emissions. A portion of the funds collected through the ETS is then distributed to member states to support the financing of climate and energy initiatives and to encourage long-term decarbonization.[13]

Climate change discourse during the 1980s and early 1990s in China followed a similar trajectory as that in the West; it was initially rooted in public health, particularly the public's concerns related to worsening air pollution in Beijing (Jun 2016). This discourse was led mainly by the State Science and Technology Commission, consigning the discussion around climate to scientific and foreign affairs issues. During this period, the government was focused on implementing its market-based reforms; thus, the scientific approach to climate issues continued for much of that time, culminating with the formation of the National Climate Change Coordinating Group (NCCCG) in 1990. The goal of this new agency was to improve the coordination of several different government ministries, including the Ministry of Foreign Affairs, the Ministry of Science and Technology, and the State Meteorological Administration (Stensdal 2014).

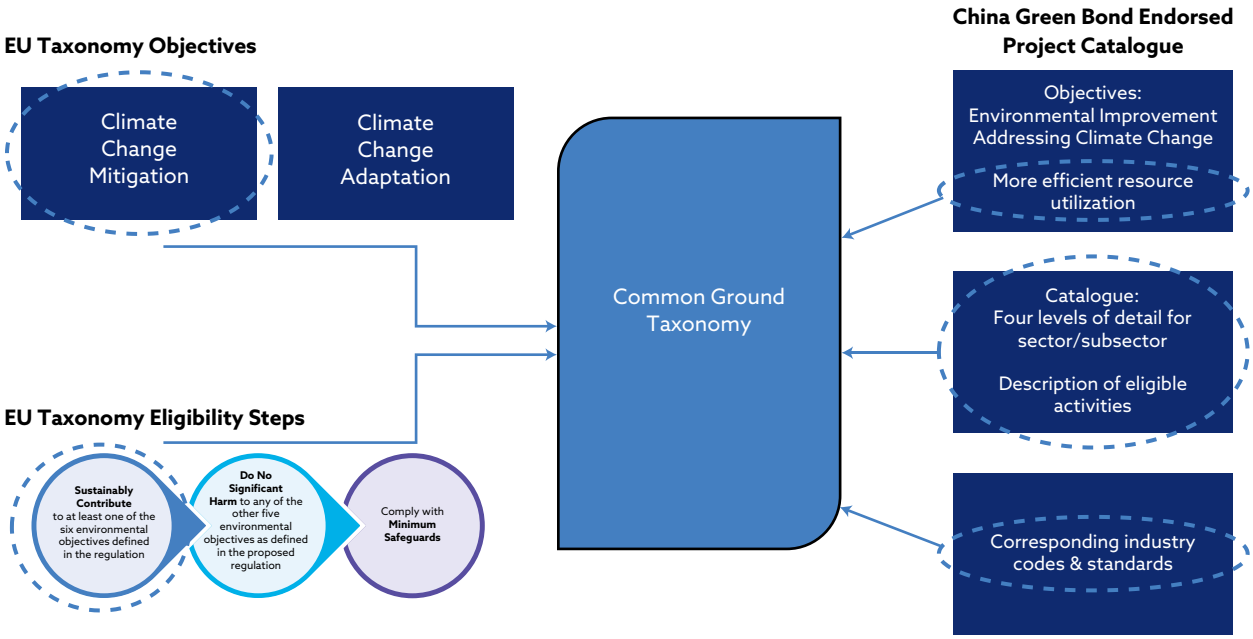
Following the formation of this group, climate change in China began to be seen as a developmental issue in addition to a scientific one. This viewpoint would go on to influence much of China's early work on climate change, starting with its participation in negotiations with the UN Framework Convention

[13]For a more complete discussion of carbon markets, see Yang and Preece (2024).

on Climate Change (UNFCCC), in which China prioritized the inclusion of "common but differentiated responsibilities."[14] The UNFCCC established each country's responsibility to act to mitigate climate change but then amended this requirement based on their level of development (Ella 2017). The success of these negotiations led to China becoming one of the original signatories to the UNFCCC at the 1992 Rio Earth Summit.

In addition to the principle of differentiated responsibilities, several related beliefs held by China regarding climate change were noted. These included the idea that protecting the environment, much like climate, was a common task but with the greater responsibility falling to industrial countries. Furthermore, Premier Li noted that environmental protection must be coordinated with economic growth and international cooperation efforts should respect national sovereignty. The influence of these principles can still be seen in China's green finance approach today, particularly in the development of the Common Ground Taxonomy, which aims to harmonize local (e.g., country-specific) and international approaches while still respecting local context. This taxonomy has led to differences in the number of objectives, categories of economic activities, and features, such as "Do No Substantial Harm" and minimum safeguards. Although much can be broadly matched, variations at the granular level affect comparability and compatibility. **Exhibit 6** illustrates some of the similarities and differences between the EU Taxonomy objectives and the Common Ground Taxonomy.

Exhibit 6. Comparison of the EU and Common Ground Taxonomies



Note: Minor differences at high levels can lead to more significant differences at the granular level.

Source: International Platform on Sustainable Finance (IPSF) Taxonomy Working Group (2021, p. 24).

[14]From UNFCCC, "Article 3: Principles": https://unfccc.int/resource/ccsites/zimbab/conven/text/art03.htm.

Five years after Rio, China signed the Kyoto Protocol, which did not impose any emission limitations on developing countries. In the following year (1998), the NCCCG was moved into the State Planning and Development Commission, demonstrating an understanding of the broad impacts of climate change by policymakers. Climate change would not be mentioned at the highest government levels until three years later in the 10th Five-Year Plan,[15] although no metrics or targets would be set to address it. At the same time, targets were set for air pollution and afforestation, highlighting the environmental priorities of the time. Unsurprisingly, this period was marked by rapid economic growth, industrialization, and urbanization, which led to increasing air pollution and decreasing energy efficiency as a by-product of the continued focus on GDP and economic indicators despite signing on to Kyoto (Stensdal 2014).

The first shifts in China's approach toward climate change can be seen in the 11th Five-Year Plan,[16] which introduced binding energy efficiency targets. Although GDP and economic targets were still considered more important, this plan marked the first time environmental targets would influence promotion opportunities for provincial and local leaders (Qi and Wu 2013). In addition, the release of the National Assessment Report on Climate Change and the Fourth Assessment Report by the IPCC highlighted the seriousness of the threat posed by climate change to China. In further acknowledgment of the severity of the danger, the NCCCG was again elevated to a higher bureaucratic level and became the national leading group on addressing climate change.

The balance between economics and the environment was more tenuous during the 2008 global financial crisis, which spurred the Chinese government to launch a stimulus package. Although part of the package supported renewable energy development, the bulk went to support energy-intensive industries and construction projects, which led to a temporary easing of environmental regulations and, unsurprisingly, decreased energy efficiency and increased emissions (Jin, Andersson, and Zhang 2016). These events created domestic constraints that may have contributed to the failure to reach an agreement during negotiations at the 2009 Copenhagen Conference (COP 15), despite China having announced its first emissions goal just before the conference, which targeted a 40–45% reduction in baseline emission by 2020 (based on 2005).

The stated goal was ambitious, but China's growth at the time depended on access to low-cost energy, which at the time consisted mainly of coal. According to analysts at the time, government leadership would be reluctant to disturb this status quo unless it was necessary, which would have been required if a stringent agreement had come to pass. This reticence to disturb their growth formula was one of the reasons that the Chinese delegation insisted on removing the 1.5°C target during negotiations, which allowed for emission reductions to occur at their own pace (Lynas 2009). This is not to say China

[15]The period of the 10th Five-Year Plan covers 2001–2005, inclusive.

[16]The period of the 11th Five-Year Plan covers 2006–2010, inclusive.

was ignoring climate change but rather that it was simply approaching climate change through the lens of a development issue.

Throughout this period, it remained clear that growth was still the priority as the government set measurable GDP targets for each industry and financial incentives for the strategic sectors. Beginning with the start of the 12th Five-Year Plan,[17] policymakers shifted their focus to enhancing innovation capacity through reforms to educational and institutional systems to support low-carbon development efforts. Furthermore, concepts related to low-carbon development, ecological civilization, and green economy were given significant attention during the party congress, as these areas were seen as key to driving future growth. At the same time, China also became an active participant and supporter of the Paris Agreement, where it would spend a considerable amount of effort on such challenging issues as the "common but differentiated responsibilities" principle that has underpinned China's position on climate change since the UNFCCC negotiations.

The 2014–16 period represented a shift of green finance leadership to the PBOC. In 2014, the PBOC and the UN Environment Programme (UNEP) established a green finance task force, and in 2016, a road map was developed at the national level that set performance targets and progress indicators. This leadership shift would have a number of impacts, including the issuance of green bonds in China for the first time. The PBOC established its initial definition of green finance as "financial services provided for economic activities that are supportive of environmental improvement, climate change mitigation, and more efficient resource utilization" (People's Bank of China 2016), which was similar but not identical to the EU definition discussed previously. Another important aspect is that although the PBOC definition provides some guidance, it leaves the finer details to be fleshed out at the lower levels, which are responsible for policy implementation.

These influences can be seen in China's Paris Agreement commitment and several of its policy statements since then, which reiterated its position on addressing climate change as a development issue. President Xi Jinping's "dual carbon" goals announced in 2020 are the most important of these statements, requiring reducing CO_2 emissions by more than 65% compared with 2005 by 2030 and adding an increase in the percentage of nonfossil fuels to the energy mix. These goals have been tempered by statements made by leadership in 2021 and 2022, however, which made it clear that emissions reductions must be pursued in an orderly manner to ensure energy security, supply chains, and national security are not compromised. As a result, China's emission reduction goals are not absolute and are based on a per unit of GDP approach, in contrast to the absolute reduction requirements of the United States and the EU (People's Republic of China 2022; US Department of State 2021). Although these goals are similar and may even lead to similar endpoints, they will arrive through very different pathways.

[17]The period of the 12th Five-Year Plan covers 2011–2016, inclusive.

As we discuss in the following sections, China leveraged the development of green finance reform and innovation pilot zones (hereinafter "pilot zones") as tools for the development of its green financial system. This approach leverages market participants at the city or province level to develop innovative products, tools, and regulations in a controlled environment before implementation at the national level. The main idea behind this approach was that differentiated models suited to regional features could be tested while experience and best practices with common characteristics could be replicated and scaled up. In short, the use and development of the pilot zones can be an extension of China's climate policy context, because it aims to support economic development and emission reduction based on local context.

Effects of Political Economy Systems on Local Context

Although the reference frame generated by climate change provides some insight into the development of a country's green finance system, it does not provide us with a full picture. As government bodies have increased their involvement in sustainability efforts, the varied modes of governance employed in different jurisdictions will affect the approaches taken in the development of green financial systems (Wang 2018). Much like in the case of climate change, we can compare and contrast the different governance systems in China, the EU, and the United States to observe how their distinct political economies have affected the implementation of green finance in each territory.

Beginning with the Western economies, variations in the green finance systems developed in the United States and the EU can be attributed to their political economies, with the United States taking a liberal market economy (LME) approach in contrast to the coordinated market economy (CME) approach taken in the EU.[18] In short, coordination occurs primarily through market mechanisms in LMEs, whereas formal institutions take a more active role in the economy and stakeholder relations. The EU and the United States run their economies in different ways, but both can be construed as liberal democracies that apply a bottom-up market facilitation approach to the development of their financial systems (Woll 2021; Follesdal and Hix 2006).

As a CME, green finance policy in the EU is primarily driven by the European Commission and the European System of Financial Supervision. This includes the European Central Bank, the European Securities and Markets Authority, the European Banking Authority, and the European Insurance and Occupational Pensions Authority. Below the EU level, green finance policies are implemented by national regulatory and supervisory bodies and central banks in each EU member state. Under the EU's "whole-of-government" approach, they launched the EU Action Plan for Financing Sustainable Growth, which aimed to reorient

[18]See Oxford Reference, "Varieties of Capitalism," https://www.oxfordreference.com/display/10.1093/oi/authority.20110803115237783.

capital flows toward sustainable investment while managing financial risks stemming from climate change, environmental degradation, and social issues.[19]

The basis for the action plan was derived from recommendations passed down by the high-level expert group (HLEG) on sustainable finance. The HLEG was initially established in 2016 and consisted of experts from a broad range of stakeholder groups, including finance, civil society, and European and international institutions. The development of the action plan demonstrates the bottom-up nature of the financial system in the EU, as it was built through an inclusive collaborative process between regulators and market participants. Researchers have also pointed to the duration of the processes as indicative of the market development independent of regulatory intervention (Larsen 2023).

This approach, which utilizes market facilitation and collaboration, has been further highlighted through the development of the EU's green bond standards and taxonomy. Although the EU began issuing green bonds in 2007, standards were not proposed for 14 years; it took another two years of debate before voluntary standards were adopted. This long duration of study and public debate highlights the bottom-up facilitation approach, which allows for markets to grow naturally with guidance from the state. Similarly, during the development of the EU taxonomy, an expert working group was formed, which included 35 members from civil society, academia, business, and the finance sector, as well as additional members and observers from EU and international public bodies. The group developed multiple drafts and received thousands of replies to its open consultation. Construction of the taxonomy demonstrated both the strengths and weaknesses of the bottom-up process, as strong lobbies with diverging interests could reduce the overall level of ambition or delay in the implementation of policies and regulations.

On the basis of the implementation of green finance in the EU, several fundamental aspects can be teased out. Utilizing a bottom-up market facilitation approach, the EU is reactive to markets and their constituents based on its limited mandate for promoting green finance (Larsen 2023). Efforts to improve green finance are driven by guidelines developed through thematic committees and inclusive input from experts and stakeholder groups. These efforts are characterized by multilayered negotiations between experts, civil society, and market participants, which increase transparency but also slow the overall implementation timeline. Furthermore, entrenched interests in the real economy sector, such as oil and gas, can use this process to exert influence to protect their interests. This factor was most obvious during the debates that occurred over the inclusion of fossil fuels and nuclear energy in the taxonomy (InfluenceMap 2020).

In contrast to the United States and the EU, green finance development in China is based on a top-down political economy mode, in which the central

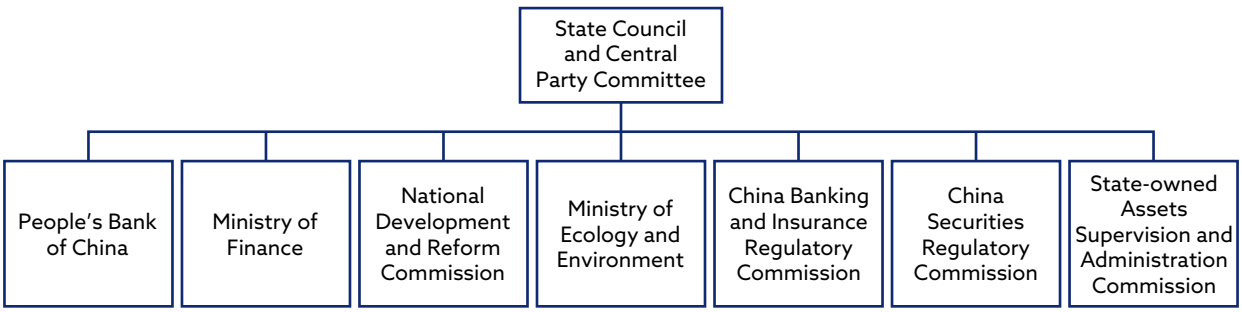
[19]See European Commission, "Renewed Sustainable Finance Strategy and Implementation of the Action Plan on Financing Sustainable Growth" (8 March 2018), https://finance.ec.europa.eu/publications/renewed-sustainable-finance-strategy-and-implementation-action-plan-financing-sustainable-growth_en.

government and regulators, in lieu of financial institutions or markets, take the guiding role (Naughton 2020). Furthermore, in a party-state capitalist economy, financial institutions are generally state-owned or are run and overseen by party committees, giving the state direct management of these institutions (see **Exhibit 7**). This influence can be clearly seen in the contrast between the roles of central banks in the EU and China regarding climate change. Whereas the European Central Bank operates with a limited mandate and, therefore, has been slow to take definite action to address climate change, the PBOC has been able to take on a central role (Boneva, Ferrucci, and Mongelli 2022).

As previously mentioned, the PBOC and UNEP organized a task force in 2014, which consisted of members from the finance sector, academia, and the government, to generate green finance policy recommendations. Over the course of nine months, the task force developed 14 recommendations that would underpin the "Guidelines for Establishing the Green Financial System." These guidelines were jointly launched in 2016 by the PBOC and six ministries: the National Development and Reform Commission (NDRC), Ministry of Environment Protection, China Banking Regulatory Commission, China Securities Regulatory Commission, and China Insurance Regulatory Commission.[20] This initial dialogue follows a similar pattern as that followed in the EU in that it was inclusive. This policy push, however, was considered to be driven by the state rather than a response to market needs.

Before the issuance of the guidelines, no green bonds had been issued in China. However, the market grew quickly in 2016 following the establishment of the guidelines and taxonomies, becoming the second-largest market after the EU.[21] Growth in the market was primarily driven by state-owned banks and enterprises, followed by local governments and policy banks, with private companies representing only 3% of the market (Escalante, Choi, Chin, Cui,

Exhibit 7. Bodies Governing Green Finance in China



Sources: The bodies governing green finance in China during the period, as presented in Nedopil and Song 2023. In May 2023, the China Banking and Insurance Regulatory Commission (CIBRC) was replaced by the National Administration of Financial Regulation.

[20]See http://www.pbc.gov.cn/en/3688110/3688172/4048320/3712404/index.html.

[21]According to the Climate Bonds Initiative (CBI), China's green bond market is the second-largest market when the EU is considered as a whole and not as separate countries. See CBI's "Sustainable Debt Global State of the Market 2021" at https://www.climatebonds.net/resources/reports/sustainable-debt-global-state-market-2021.

and Larsen 2020). This low participation by private companies, despite the significant growth of the market, has been attributed by researchers to the influence of the state, with policy goals overriding the needs of the issuers (Nedopil and Song 2023). They also have noted, however, that the state has an important role to play in creating and supporting markets, particularly in emerging markets (Nedopil and Song 2023).

The growth of the green bond market provides evidence that the top-down governance model can allow for fast and coordinated development because of the direct control of the state. This approach requires a significant amount of coordination between actors, particularly at the central and local levels. An example of a lack of coordination can be found in the initial attempt at developing green taxonomies, with the National Development and Reform Commission (NDRC), China Banking Regulatory Commission, China Insurance Regulatory Commission, and PBOC all developing different standards in 2015. Differences in the standards can be attributed to several factors, including a closed-door, invitation-only deliberation process, the effect of entrenched interests, and political institutions resisting structural changes (Larsen 2023).

This effect is most obvious when comparing the taxonomy published by the NDRC, which oversees state-owned enterprises, and the PBOC. The NDRC included clean coal in its green industries catalog.[22] However, clean coal was omitted from the updated PBOC green bond taxonomy. Clean coal has since been omitted from the 2021 version of the green bond taxonomy jointly issued by the PBOC and NDRC, but it is still included in the NDRC's green and transition industry catalog, highlighting the importance of coordination between departments with similar mandates but different interests.

This impact of coordination and communication can also be seen at the central–local interface level. Increasingly strict national climate targets have led to a significant increase in renewable energy generation, yet stimulus money during the financial crisis and the COVID-19 pandemic was funneled primarily into coal-generating plants. Local municipalities may feel pressured to support this investment while they can, pitting local vested interests against national guidelines. This can also be a side effect of the top-down method, which relies on the issuance of abstract directives before developing clearer policies. Against this approach, guidelines are issued with little stakeholder engagement because the impacts are intended to be gradual. Stakeholders affected by the guidelines, such as the one launched by the PBOC, are expected to affect how the policy is scaled up over time by attending forums where they can offer suggestions to modify the requirements.

[22]"Clean coal" can be thought of as a combination of technologies that have been developed to diminish the negative environmental impact of coal energy generation. One example would be supercritical coal-fired plants without carbon capture and storage as they have higher efficiency and lower emissions than conventional plants. Emissions, however, are still greater than they are for nuclear and renewables.

Some aspects of this process have similarities with the EU, but party-state capitalism has several different characteristics that make it distinct. Although both the EU and China have utilized expertise-based committees to develop guidelines that span the breadth of the financial system, China has taken a more active role. The top-down approach taken in China uses a more technocratic policy control approach, which makes sense when the climate is contextualized as an economic issue tied to energy security and development. By utilizing state control, China has the ability to act and develop new policies and approaches at a much faster pace than allowed by a bottom-up approach. This quicker pace comes at the cost of lower stakeholder engagement, however, with participation guided by state agencies. Although this use of state power does limit the effect of industry lobbies, as we saw in the EU taxonomy case, the entrenched interests of state actors are more prominent.

The local contexts created by climate change and political economy have affected the implementation of green finance policies in different jurisdictions. Researchers have pointed out that the bottom-up approach taken by the EU,[23] which utilizes inclusive expert and stakeholder input and transparent long-time frame negotiations, has made it a global standard setter (Larsen 2022). At the same time, China's top-down approach, utilizing nonlimited mandates and a command-and-control approach, has led to it being considered a policy pioneer. Although these different approaches have led to distinct green finance systems, neither system is inherently better or worse than the other. What is more important, however, is how these systems can work to coordinate and harmonize their efforts.

The Purpose of Pilot Zones

Although the top-down approach utilized in China has allowed for the quick initial development of its green financial system, these initial efforts produced abstract guidelines that could lead to issues in their implementation because of a lack of practical examples. Transforming these macrolevel guidelines into detailed and actionable examples of policies and regulations was achieved by knowledge production through the use of experimental pilot zones at the municipal and micro levels. The goal of the pilot zones was to combine the top-down guidance approach with bottom-up localization to test green finance approaches and innovations under different economic situations to determine their scalability. Using this approach, the PBOC made comprehensive progress on its initial green finance strategy, which was organized around what it called the "five pillars of green finance":

- Developing and improving green taxonomies and standards
- Strengthening disclosure requirements and financial supervision

[23]Because the EU is a collection of 27 member states with no formal federal government, negotiation, dialogue, and compromise are required to ensure its proper functioning. As a result, the need to utilize its bottom-up approach is a by-product of the political context, which further differentiates it from the United States.

- Increasing incentive and restraint mechanisms
- Developing innovative green financial products and market systems
- Expanding international cooperation efforts

In combination with the six ministries that signed the "Guidelines for Establishing the Green Financial System," the state council launched the first batch of these pilot zones in 2017 to support the development of these five pillars. The first batch of pilot zone locations was selected based on several factors, including their development stage, economic activities (e.g., industrial composition), and natural resource endowment. Oversight of the progress made during the pilot period was provided by a combination of local governments and regulators at the provincial and prefectural levels and the PBOC, which created a new governance mechanism distinct to the pilot zones.

Through this mechanism, the pilot zones could communicate with the state council, which created a new level in their governance structure that was directly connected to the central and provincial levels. This connection allowed for smoother and faster communication between the central, provincial, and local levels, which encouraged the coproduction of regulatory knowledge by lowering bureaucratic frictions. This communication was important, as each of the pilot zone locations presents its own distinct mix of opportunities and challenges and, therefore, would prioritize different green finance innovations (see **Exhibit 8**).

Despite having different priorities, all of the pilot zones followed the same three-phase process, which consisted of the following:

- Application
- Development
- Conclusion

Application Phase

During the application phase, central-level regulators played a significant role: One-on-one counseling sessions were arranged between the PBOC and the applicant to facilitate the creation of the previously discussed direct communication channel. In-depth scoping research was conducted in this phase to determine the status of any current green finance programs and potential low-carbon development pathways, along with their feasibility. Following this initial step, local bank staff and government officials were given training opportunities at the central branch of the PBOC. They also were able to undertake study visits to other areas, both inside and outside of China, where green finance was considered to be more advanced so they could assess best practices.

Exhibit 8. First and Second Batch of Pilot Zones Launched in 2017

Province/Region	Municipality	Priorities
Guangdong	Guangzhou City	Support development of green financial products and service innovation to support green transformation.
		Support pillar industries, such as ecological agriculture and renewable energy.
		Support financial and commercial institutions to align social responsibility with performance.
		Support green fintech development to enhance capacity around risk management.
		Support development and cooperation in the Greater Bay Area for the green finance capital market.
Zhejiang	Huzhou, Quzhou	Huzhou City has focused on the use of finance to upgrade green industries, while Quzhou has focused on transforming traditional industries.
		Develop green financing for micro, small, and medium-sized enterprises.
		Establish cross-departmental and cross-agency collaboration and information-sharing mechanisms.
		Strengthen regulatory coordination and cooperation between finance, the real economy, resource conservation, and environmental protection.
		Provide financial support for green projects, such as renewable energy, resource conservation, green transport, and green buildings.
Guizhou	Gui'an New District	Encourage financial investment in emission reductions, circular economy, and ecological protection.
		Develop a system to support resource allocation to green industries.
		Explore ways green finance can support economic transition and development in underdeveloped areas for poverty alleviation.
		Develop infrastructure for big data.
Jiangxi	Ganjiang New District	Develop efficiencies in the use of local ecological resources and develop green finance to boost economic growth.
Xinjiang	Hami City, Changji City, and Karamay City	Leverage comparative advantages related to agriculture, low-carbon energy, high-end manufacturing pertaining to renewable energy systems, and environmental systems by designing financial products that support these efforts.
		Demonstrate green finance development in western and central regions.
		Support Belt and Road efforts.

Source: Author's compilation from multiple sources, including Cheng and Zhang (2024).

The PBOC set qualitative and quantitative targets during this phase, which included the following:

- Green loan growth
- Development of local financial risk profiles
- Development of infrastructure to support data collection and analysis

To encourage "learning by doing," the PBOC checked activities undertaken against these targets. To foster capacity building, the PBOC conducted regular capacity-building and knowledge-sharing sessions. Pilot zones were encouraged to devote additional staffing power and capital and leverage think tanks and industrial associations to assist in researching and disseminating green concepts, financial instrument development, and policy implementation. Pilot zones also participated in international exchange and cooperation to learn and apply global best practices. This learning was essential because pilot zones were responsible for the overall implementation of the green finance programs, including rulemaking, the establishment of inspection and performance assessment mechanisms, and resource mobilization.

Development Phase

Following the application phase, the overall goals for the pilot zone, and any construction issues, were clarified through meetings and exchanges with the PBOC and the six ministries. Local governments were encouraged to host Kickstarter meetings and make public announcements about the launch to generate local awareness among the general public and other stakeholder groups. Additionally, joint meetings were established between the active pilot zones, featuring a rotating chair, to facilitate knowledge production and exchanges between areas.

The linkage initially created in the application phase between the pilot zone and the PBOC was strengthened through the codevelopment of research projects. By combining central government-level ministries with local financial institutions, the research undertaken during the pilot had characteristics of both local and national-level priorities. Research generated in the pilot zones was also published through casebooks and annual progress reports to ensure that experiences were disseminated outside of the pilot zone area.

Additionally during this phase, pilot zones were encouraged to improve their environmental disclosure infrastructure, which typically has been accomplished through the application of fintech. Digital platforms were modified or established to facilitate the collection and analysis of information for supporting green finance efforts, including identification of projects, target measurements, or the potential environmental benefits of a project.[24] Midterm assessments were carried out by third parties to determine the pilot's progress against the

[24]Huzhou was the first of the pilot zones to establish digital platforms for its green finance efforts.

established development plans and targets. Both achievements and problems were highlighted during the assessment, and suggestions and target help were undertaken. The assessments were important because a pilot could be canceled if it was found to not contribute positively to knowledge coproduction efforts.

Conclusion Phase

After the designated pilot zone period, which typically lasted around five years, the special communication systems ended. This did not mean, however, the end of green finance capacity development in the zone. As the pilot zone program neared its conclusion, participants were encouraged to transfer the knowledge produced to other regions to encourage replication. The overall success of the pilot zone was then determined by a detailed examination of the assessment criteria determined during the development phase to encourage consistent development throughout the pilot zone process.

Importance of Capacity Building

A lack of sufficient green finance capacity amongst all stakeholder groups presents a significant hurdle to success in the pilot zones. According to a survey conducted by the Chongqing branch of the PBOC in 2019, "90% of firms were not sure whether their projects were "green" and 95% of credit management staff had limited green finance expertise" (Green Finance Committee 2023, p. 2). As a result, during the initial phases of pilot zone construction, local governments, enterprises, and financial institutions did not possess the necessary professional knowledge and understanding of green finance topics, such as standards and taxonomies, to ensure their pilot zones would be successful.

Unsurprisingly, the ministries also lacked a clear idea of how to develop green finance ecosystems or determining feasible implementation paths. The impact was particularly evident during the application phase. Without a mature green finance infrastructure or a centralized repository for green information, green project identification and financing relied almost entirely on manual work. This lack of capacity is not specific to China; according to the UNDP, developing countries have a great demand for green finance knowledge at all levels of the financial system, from government agencies to corporations.

Utilization of the pilot zone process creates a combined top-down and bottom-up development cycle, which should develop a reinforcing capacity-building cycle between different stakeholders in the green finance system (see Green Finance Committee 2023). Through these interactions, the pilot zone process should produce a catalogue of products and services that can be utilized by green industries. It should also produce infrastructure and organizational systems that can be used by regulators and financial institutions to more easily collect and analyze the necessary information. Although developing green finance capacity is foundational to pilot zone development, advancements arising during the pilot zone process reinforce capacity building through bottom-up development; moreover, their connection to the state council through policy coordination helps facilitate adoption at the national level.

In short, China's adoption of pilot zones reflects a shift from its traditional top-down developmental model, allowing for the coproduction of knowledge to take place through the testing and refining of diverse strategies in designated zones. Using this approach, China has aimed to more effectively address environmental challenges, drive economic growth, and facilitate green finance innovation while minimizing any potential negative impacts at the national level that could occur as a result of the issuance of more abstract guidance.

Conclusion

China's green finance standardization system was constructed according to the guidance of a "top-down" governance system combined with co-knowledge production and innovation common to "bottom-up" approaches. Huzhou is a particularly successful example of this process: realizing rapid development of its green finance system by developing several innovative green finance products and establishing a comprehensive system of standards and regulations. Its focus on capacity development and innovation through its "learn-by-doing" approach has allowed for the accumulation of valuable experience that has trickled up to influence development at the national level. Among the numerous reasons why Huzhou has stood out among the green finance pilot zones, a few may provide valuable context for other developing economies in which financial markets are at early stages of green finance development and in which more direct government guidance can influence the market landscape.

Huzhou's local government leadership has been fundamental to its success as a result of its active involvement throughout the pilot zone process. This effort can be contrasted with some of the other pilot zones, in which green finance was driven by lower levels but lacked the full support of their municipal governments. Even before the start of the pilot zone, the local government had begun to develop a culture of environmental awareness through regulation and enforcement, which helped set the stage for green finance. SMEs could see the importance of transitioning and implementing new technologies based on strict local standards.

Local government leaders also demonstrated a robust commitment to prioritizing green finance by facilitating coordination among different agencies and working to lay the foundation for digital infrastructure and policy alignment. At the same time, they integrated environmental planning into their mid- and long-term plans as well as in their city design, for example, by mandating that parks be built near residential areas to encourage a connection with nature. Through consistent messaging and continuous policy iteration, they have created a broad consensus among public and private players on the necessity of developing green finance.

Huzhou adopted a pragmatic approach to green finance according to the mindset of "create first, improve later." This approach can also be construed as a version of "perfect is the enemy of good," meaning that it may be best to start the process and continually improve it instead of waiting for all the pieces to fall in place. The municipal leaders achieved success by focusing on

solutions best available within the local capacity and development contexts, while understanding that there would certainly be gaps between local practices and global best practices. These improvements could be achieved progressively instead of waiting for detailed instructions or standards from the national level. Huzhou started with what was needed, determined what they could feasibly accomplish, and then refined it over time. This approach can be applied to policymaking and financial product innovation by local financial institutions.

This approach also allows for the testing of new ideas and models, which can then be adjusted based on feedback and results. Notably, local governments tend to have competing development priorities, such as creating rural employment, alleviating poverty, and increasing access to affordable energy. These priorities can be achieved together through localized policy design and financial solutions. The local government, however, must ensure that they have strong communication with the national government to ensure that they are properly balancing development and environmental protection in ways that meet national priorities. Huzhou's government was able to develop a significant amount of trust with the PBOC and central government through constant communication, use of expert groups, and stakeholder engagement through working groups like the steering group, which were headed by top party and government leaders and included members from 45 government agencies.

Huzhou has also focused on developing the skills and capabilities of local professionals in green finance while learning from and cooperating with international entities. By partnering with global organizations, such as CFA Institute and GIZ, and participating in international initiatives, such as the G20 Sustainable Finance Working Group, Huzhou has tapped into the abundance of best practices and innovative solutions worldwide, which can benefit local stakeholders around major and emerging topics of green finance. Notably, these international collaborations have facilitated a two-way exchange of knowledge. Huzhou has learned from global experiences and shared its insight and successes, contributing to the broader discourse on green finance in developing economies.

Although Huzhou's success with financial incentives illustrates their potential usefulness in fostering market-driven finance activities, policymakers and institutions cannot rely on them forever. To be sustainable, green finance ecosystems must become self-sustaining and reduce their need for external financial support over time. This issue was raised during the interviews, as FIs noted that green or transition finance products can meet the profitability criteria only with subsidies. Banks interviewed in the writing of this report expressed their expectation that what has been done in Huzhou will foster a culture of green preference among consumers and investors, which will support the commercial viability of these financial products.

Another challenge lies in determining ways to encourage diversification in financial products. Green loans have been the dominant product used to promote Huzhou's green transition. These loans, however, typically have

a low-risk appetite, which required Huzhou to set more lenient nonperforming loan targets to encourage FIs to increase the number of green loans in their portfolios. Loans also typically have shorter time frames, which may be misaligned with the long development cycles and nontraditional payoff structures associated with many green or decarbonization technologies. A heavy reliance on loans may also limit the financial flexibility of firms because of an increase in debt burden. Emerging and developing markets will need to work to set standards to attract investment through green or other bonds—for example, to increase product diversity and ensure that the mix is appropriate for their circumstances.

Markets may also struggle to find why they need to implement green finance in the first place, given the higher cost it imposes on companies through increased disclosure requirements. A lesson that seems consistent between Huzhou, the EU, and the United States appears to be to start by focusing on local issues and industries. In all three cases, green finance did not initially spring up because of climate concerns but was an evolution of awareness of the impacts of pollution on public health, be it air or water. By starting locally, regulators can build political will by addressing immediate local needs and creating tangible improvements in the local environment. They can also foster changes in mindset and culture around broader climate change issues.

Another important lesson for both developing and emerging markets is related to reducing friction in their green finance system. Huzhou's digital finance tools serve a dual role, the first function being decreasing matchmaking times between financial institutions and entities needing financing. By reducing this search time, overall search costs for FIs and firms are reduced. The second function is data collection and analysis, significantly reducing the costs associated with ESG disclosures, carbon accounting, ESG ratings, and assurance. These costs can be substantial for SMEs and FIs and present a barrier to market formation. By centralizing data collection and creating standard templates, fragmentation in disclosures can be avoided while smaller firms that may be traditionally priced out can enter the market.

Other emerging markets can draw on several lessons presented here, but recreating this success in other areas will require significant care. As noted throughout this paper, the local context affects the design and implementation of green financial systems significantly. In both top-down and bottom-up systems, care must be taken to ensure vested interests do not override the policymaking process, as was noted in the EU case. It also is necessary to balance local needs with international standards, as industrial market standards may not fit an emerging market well, but they need to be comparable enough to allow for financing. In the case of Huzhou, many of its systems are open only to those within Huzhou's ecosystem, which does not pose a problem as they can fund many of these projects themselves. Other markets may require more external investment and will need to consider how to allow third parties to engage with local players on an even field. These challenges are not insurmountable, however, and the case of Huzhou provides many emerging markets with significant relatable experiences from which to draw.

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Appendix A: Case Studies

This appendix features several case studies that highlight various aspects of Huzhou's green finance system. These case studies were assembled through interviews conducted with local businesses and financial institutions in collaboration with GIZ, the Institute of Finance and Sustainability (IFS), and the Capacity-Building Alliance of Sustainable Investment (CASI).

Case Study 1. Dadongwu Construction Science and Technology Co., Ltd.: Sustainable Construction

At the national level, China's construction industry was responsible for more than 45% of overall energy use and 51% of its carbon emissions in 2023, which indicated a significant increase from 22% of emissions in 2020. Construction accounts for more than half of all emissions. It would be impossible for China to meet its "dual carbon" targets, which aim to reach peak carbon emissions by 2030 and reach full carbon neutrality by 2060, without improvements in this sector. In 2024, China's National Development and Reform Commission (NDRC) set a target for the building of green and low-carbon high-quality buildings, starting in 2027, with the aim of making significant improvements in energy-saving and carbon emission reduction in the sector. This shift from traditional to green manufacturing, however, requires the application of innovative green finance approaches.

As Huzhou has worked on shifting to its third phase of development, transitioning its traditional industries and attracting new businesses using green finance approaches have become increasingly important. One such example is the Dadongwu Construction Science and Technology company located in the Nanxun District of Huzhou, which specializes in the production of prefabricated buildings. Based on Huzhou's green finance support measures, Dadongwu invested RMB3.2 billion in 2018 to develop an integrated manufacturing facility covering 466,666 m^2. An additional investment of RMB600 million was set aside for creating a Green Assembled Building, which prefabricated its components before transporting them for assembly at the construction site.

In contrast to traditional building methods, prefabricated buildings have been noted as having several production advantages. One of the most important advantages was in their construction efficiency that could halve project duration, decreasing labor costs, energy consumption, and material use during this phase. Other impacts included lowering environmental impacts by reducing on-site wet work, lowering noise and dust pollution levels, and significantly reducing construction waste. Furthermore, construction projects using prefabricated methods had higher material recycling rates, which limited landfill impacts.

To drive demand for green buildings, Huzhou implemented several policies starting in 2020. These policies included encouraging financial institutions to increase the borrowing limits for locals issued from the provident fund by 10%

if they are used to purchase green housing. They also were encouraged to offer a 10% discount in addition to existing subsidies on interest and guarantee fees for green loans made to sustainable building material companies if they have been included in the government procurement catalogue. Huzhou has leveraged these policy documents and special funds to drive lending to sustainable building companies while maintaining a stable overall level of lending to the construction industry.

As a result of these policies, local financial institutions, such as branches of the Shanghai Pudong Development Bank, Industrial Bank, Bank of Huzhou, and Zhejiang Commercial Bank, have offered incentives to support Dadongwu's transformation. These included lower interest rates on green infrastructure loans, syndicated mortgage loans for green factories, and the facilitation of receivables through blockchain receivable finance. Overall, these efforts provided financial support, diversified risks to mortgage lenders, and lowered the company's economic costs.

At the company level, Dadongwu's investments resulted in significantly reduced energy consumption, reduced waste and associated labor costs, and shortened project cycles, leading to overall lower building construction costs. Prefabricated buildings have increased as a percentage of their overall business and now account for 26% of the business by revenue, demonstrating the positive impacts of their green transformation on their overall business model. For Huzhou, preferential loans and innovative green finance projects have helped attract new industries to the area and have allowed it to remain competitive with other municipalities despite their stricter environmental regulations.

Case Study 2. Tianneng Group: Green Batteries

Tianneng is located in Huzhou's Changxing County, where more than 65% of China's storage batteries are produced. Unfortunately, this high production level has resulted in significant environmental impacts from traditional lead-acid battery production methods. In the late 1990s, Tianneng was a local leader in the battery industry; however, its production lines were inefficient, and it produced a single product and was a significant energy consumer. As Huzhou began to regulate the battery market, Tianneng's operations became unprofitable and required the company to shift its business structure to return to profitability. Tianneng leveraged Huzhou's green finance offerings and financial instruments to green their business structure to establish an intelligent, sustainable supply chain.

The first step Tianneng took was to develop a green and intelligent manufacturing system, which manages the entire life cycle of their batteries from production to supply chain. Production efficiencies have been introduced through the use of robots, interconnecting equipment, and continuously upgrading automated production lines. In the supply chain, the company has developed an innovative model to monitor, measure, and transmit information about the location and condition of each battery to enable comprehensive product control.

They also expanded their product line from lead-acid batteries to include intelligent energy storage systems, hydrogen fuel cells, and battery recycling services. They developed applications to provide integrated smart solutions for wind and solar projects to improve energy efficiency. In terms of their hydrogen fuel cell projects, they developed multiple types to accelerate the industrialization and commercialization of the technology. Through their digital management platform, they significantly increased the efficiency of their recycling efforts and achieved a 99% recycling rate for the lead-acid batteries they use.

Huzhou helped achieve this transformation by actively leveraging green finance policies and tools to leverage market forces and promote the transformation of its lead-acid battery industry. At the municipal level, Huzhou introduced several key policies, including the "Guiding Opinions on Financial Support for Special Rectification, and Transformation and Upgrading of Lead-Acid Battery Enterprises in Changxing County," the "Special Rectification and Support Policies for Lead-Acid Battery Industry," and the "Special Rectification for Lead-Acid Battery Industry and Support Policy for Staff Transfer at Enterprises Facing Difficulty." This basket of policies created support and incentives in taxation, land, fees, and equipment investment.

Based on these policies, financial institutions provided strong funding support to Tianneng. The Huzhou Branch of the China Construction Bank issued a medium-term loan specifically for the development of their lead-acid battery recycling process. The Agricultural Bank of China project loaned credit of RMB300 million to Tianneng, which was used for green production development of battery projects, and a fixed asset loan of RMB300 million for recycling used batteries. Finally, the branch of the Industrial and Commercial Bank of China provided Tianneng with a working capital loan of RMB300 million to develop their supply chain management systems. As a result of these loans, Tianneng increased its recycling rate and was able to adopt circular economy principles in its supply chain management systems.

Huzhou's financial institutions also established an environmental protection and credit linkage mechanism. This mechanism incorporates a company's environmental risks into the entire process of credit management, implementing an "environmental veto system" before loan issuance and developing an "environmental negative list" after loan issuances. This method incorporates environmental supervision information in the follow-up evaluation of companies' environmental risks and allows for the timely adjusting of credit policies.

The insurance industry has also played an innovative role in risk management. It pioneered the "insurance + service + supervision + credit" environmental pollution liability insurance model nationwide, using 50% of the premium for environmental risk health checks to detect hidden environmental risks among businesses. If a company fails to make changes or does not meet the standards of rectification, it would be subject to a series of consequences to its

bank credit. These include facing reductions in the borrowing limit, increases in loan interest rates, and even rejections of lending. This approach is seen as a type of proactive risk prevention.

As a result of its shift to a sustainable business model, Tianneng now ranks among the top 500 Chinese enterprises, with 20 production bases in seven provinces and nearly 30,000 employees. Although it originally produced only lead-acid batteries, it has since diversified its products. It has even built the first grid-side energy storage power station in China, the Zhicheng Energy Storage Power Station, as well as the world's largest single smart energy storage project, "Peaceful Shared Storage," and other benchmark projects. In terms of a circular economy and efficient resource utilization, Tianneng has reduced its environmental footprint by achieving a 70% water reuse rate, recycling 100% of its wastewater, and recycling 98% of its lead. Furthermore, the lead content in waste gases was reduced to 0.25 mg/m^2, which is far below the national standard of 0.7 mg/m^2.

In addition to its impact on waste generation, these efforts have also significantly impacted the company's carbon footprint. Tianneng Group's 2023 green power battery shipments were approximately 501 million units, representing more than 83.97 million KVAh in capacity, contributing to the country's low-carbon energy efforts. If converted into emission reductions, the volume of batteries sold by Tianneng each year could potentially reduce CO_2 by 226,665,000 tons, equivalent to 50.89 million tons of crude oil, fully reflecting the environmental benefits of China's "electric substitution for oil" strategy.

In addition to environmental aspects, Tianneng and its base in Xinchuan Village have also been active in rural poverty alleviation efforts for the past 20 years. They have been following a principle of "cobuilding of village and enterprises," guiding villagers to participate in village resource development and supporting service entrepreneurship by providing skills training, financial support, and employment support. This policy has resulted in more than 5,000 people receiving some form of employment in Xinchuan Village and surrounding villages. Nearly two-thirds of the villagers in Xinchuan Village are engaged in work related to Tianneng Group, demonstrating the deep integration of corporate social responsibility and rural revitalization strategy.

Case Study 3. Eco-Industrial Park by China Energy Conservation and Environmental Protection Group (CECEP Huzhou): Green Industrial Parks

The CECEP (Huzhou) Energy Conservation and Environmental Protection Industrial Park is Huzhou's first sustainable architecture demonstration site and a hub for energy conservation and ecofriendly industries. By applying green building technologies in the park's construction, CECEP has created a low-carbon industrial park in Huzhou, which has facilitated the transformation of SMEs. The park is supported by a range of green finance tools, such as financing

guarantees, expedited loan approvals, and preferential loans. These efforts have provided support for the park's construction, attracting businesses and supporting ongoing operations.

Small enterprises and microenterprises are vital to Huzhou's economy, but they struggle with pollution, small business clusters, difficulties obtaining financing, and low survival rates. To address these issues, CECEP—a centrally administered state-owned enterprise focused on energy conservation, emission reduction, and environmental protection—decided to build an eco-industrial park in Huzhou. The park has facilitated the aggregation and transformation of local industries through initiatives like green building, attracting green industries, and smart operations.

In the development of the park, CECEP utilized a number of green building technologies, including external wall insulation to lower heating/cooling costs, rooftop photovoltaics, and rainwater recycling systems. Buildings also utilized a light pipe system to transport daylight efficiently from outdoors into interior areas in lieu of electric lightning. These efforts have resulted in a number of positive impacts, including lower energy consumption and water use and reduced carbon emissions.

The park has also prioritized attracting high-tech companies focused on energy conservation and environmental protection, new energy, and new materials. It has done so by providing policy guidance, tax incentives, expanded financing channels, and research and development (R&D) incubation support for qualified enterprises. The overall goal of this approach was to create efficiencies through agglomeration effects, which lowered the costs associated with wastewater treatment and provided a range of other positive impacts.

Energy management systems at the park use smart technologies for forecasting and optimizing energy usage. This system monitors use by the enterprises at the park to ensure they meet energy consumption standards or face corrective measures, which can include relocation from the park if they fail to improve over time. The park also employs an intelligent dispatch system to enhance logistics and transportation efficiency, reducing carbon emissions. Additionally, it features an environmental monitoring system to conduct regular air and water quality checks, enabling prompt pollution management.

To promote the construction of these parks, Huzhou has issued a number of policies. These include the "Implementation Opinions on How to Accelerate the High-Quality Development of Small and Micro Enterprise Parks," "Guiding Opinions on Further Strengthening the Construction and Management of Small and Micro Enterprise Parks," "Implementation Opinions on Promoting High-Quality Development of Manufacturing Industry in Huzhou City," and "The Implementation of Small and Micro Enterprise Park Construction Management 'Standard Room' System Guidance in Wuxing District," which work together to provide an enabling policy environment for park construction and management.

Financial Institutions have also facilitated the development of these parks by providing financing guarantees, fast-tracking loan approvals, and offering preferential loans. During park construction, the Bank of China provided a credit line of RMB250 million and issued RMB140 million in development loans, while the Agricultural Bank of China, Bank of China, China Zhejiang Bank, and Bank of Huzhou provided RMB200 million in fast-tracked mortgage loans for companies moving into the parks.

Once the park began operation, it held financial service seminars and bank-enterprise matchmaking meetings, offering financing rates as low as 3.5% to companies. The park has facilitated around RMB150 million in enterprise financing at an average rate under 5%, easing financing issues for small enterprises and microenterprises. Banks have also provided specialized and comprehensive financial services, including settlement, credit, and wealth management, to support enterprises at different stages of development.

The park has attracted advanced technology and formed a cluster effect by gathering top-tier enterprises. Business clusters have a number of positive effects because they create a geographic concentration of interconnected businesses, suppliers, and associated institutions in a particular field. Clusters are considered to increase productivity, allow firms to achieve economies of scale and scope, and lower transaction costs. These have helped promote industrial development and have contributed to local economic growth and transformation.

As of today, 50 enterprises have set up operations in the park, generating an annual output value of RMB640 million. Through comprehensive technologies, such as building energy conservation, renewable energy, and green carbon sinks, the park has achieved 80% of its carbon-neutrality goal. Furthermore, the park's construction and operation have created many job opportunities for local residents. Its low-carbon footprint has had the secondary effect of promoting the upgrade of Huzhou's energy conservation and environmental protection industry and attracting government officials, domestic and foreign experts, and industry peers to visit and study at the park.

Case Study 4. Xiazhu Lake National Wetland Park: Biodiversity Conservation

The revitalization of Xiazhu Lake was made possible by integrating government-led protection policies and market-driven ecological compensation mechanisms. Revitalization efforts relied on developing green financial products tied to wetland carbon sinks, such as biodiversity credits issued through the Bank of China's Gross Ecosystem Product (GEP) platform to encourage community participation. This initiative showcases the synergetic relationship between finance, local communities, and ecological preservation.

Xiazhu Lake National Wetland Park, located southeast of Deqing County in Huzhou, is the largest natural wetland south of the Yangtze River and is home

to the endangered crested ibis. Despite its importance, the area suffered severe environmental degradation because of unregulated agricultural activity, including crayfish farming, which discharged effluent that contributed to the eutrophication of nearby waters. This degradation resulted in the significant loss of wetland functions and created risks to biodiversity.

In early 2020, Deqing County conducted a three-year wildlife resource baseline survey, which noted the presence and location of 535 plant species and 119 endangered plants. According to these results, the government formulated a series of protection policies, including the "Co-governance of Five Waters" assessment methodology to improve river and lake governance. It promoted the "Forest Chief Scheme" to strengthen species protection, conducted regular patrols and supervision to identify and promptly halt potentially destructive activities, clarified departmental responsibilities, and obtained land use rights through rental schemes to ensure effective implementation of ecological protection measures.

Deqing County also adopted a comprehensive ecological restoration and industrial transformation approach. To address the root causes of environmental problems, the ecological restoration project implemented source pollution control in agricultural areas, banning all agricultural farming activities within the wetland redline zones and collectively relocating aquaculture villages. The ecological restoration project included waterway communication, desilting, ecological bank protection, and dam repair measures. It also established a 100,000 m^2 underwater forest around the lake to absorb water pollutants. Additionally, it promoted the transition of the crayfish farming industry through a model of "Four (Decontamination) Tanks and Three (Filtration) Dams" to provide multistage treatment of aquaculture effluents, promoting the sector's green transformation and effectively improving the industry's environment.

Policy support was given by both Huzhou and the central government, with the central government providing crucial subsidies to support the ecological restoration project. At the same time, Huzhou's financial management departments actively sought support from the People's Bank of China's Carbon-Reduction Supporting Tool. Based on evaluations of the wetland's carbon sink value using the Gross Ecosystem Product (GEP) platform, more than RMB7 million has been allocated annually as fiscal transfer payments to villages prioritizing ecological protection over economic growth. The county also manages wetland resources through the "Trading Platform for Green Mountains Transforming into Golden Mountains" to promote constructing a wetland carbon sink trading platform and to initiate carbon sink collection and storage trading. This platform has encouraged high energy-consuming enterprises to purchase carbon sink credits, gradually opening the carbon sink market and expanding funding channels for wetland ecological compensation.

Using this enabling policy environment, Deqing County explored ecological compensation mechanisms for wetlands to address its long-term management challenges, such as declining economic benefits for villagers during the

beginning of the transition process. To address this economic pressure during the initial implementation of the "Fishponds-to-Wetland Conversion" policy, the Bank of Huzhou introduced the "Wetland Carbon Sink Common Prosperity Loan" product. This product provided dedicated credit lines and preferential interest rates based on the farmers' wetland carbon sink volume to support their transition to crop farming.

To promote the monetization of wetland value and the formation of the wetland carbon sink industry, the Deqing Rural Commercial Bank created the "PTD"—Production, Transaction, Demand—closed-loop system. Under this system, village collectives and farmers can access the "Wetland Carbon Sink Worry-Free Loan" and "Wetland Carbon Sink Common Prosperity Loan" to fund ecological restoration and their business transitions (Production). Deqing Rural Bank launched the "Wetland Carbon Sink and Green Mountains Transforming into Golden Mountains Loan" to support carbon sink storage and resource integration (Transaction). Last, high-carbon enterprises can access the "Carbon Sink Loan for Enterprises Seeking Transformation," which offers preferential interest rates and enables them to purchase carbon sinks to make their low-carbon transitions, creating a self-sustaining internal fund chain (Demand).

In addition, the Huzhou branch of Ping An Insurance introduced wetland carbon sink index insurance, which uses satellites to monitor and protect wetland carbon sinks against natural disaster damages. This insurance covers postdisaster recovery costs, carbon source removal, and ecological restoration. It also rewards policyholders if their carbon sink achievements exceed targets. Policyholders can range from farmers and organizations to enterprises, public institutions, and government bodies involved in wetland carbon sink projects.

Furthermore, Deqing County has focused on what it calls carbon inclusion. Financial institutions are encouraged to purchase wetland carbon sink credits while working to reduce their energy consumption and carbon emissions. "Biodiversity credits" calculated with the GEP were introduced, and villagers' environmental behaviors, such as recycling waste, were converted into these biodiversity credits. These credits were credited to their digital platform accounts and could be redeemed for household items and daily consumption, increasing public participation.

As of today, Xiazhu Lake Wetland Park receives 1.2 million annual visitors, promoting local tourism development and income growth. In early 2023, 366 tons of wetland carbon sinks were traded at RMB57.38 per ton, representing Huzhou's first online digital carbon inclusion project for voluntary emission reduction. After years of management and restoration efforts, the wetland has seen significant landscape, ecology, and biodiversity improvement, with water quality improving from class V to class II–III.

The improvements from the conservation project are significant. Class V rivers can be used only for navigation and industry, while class II–III can be used for recreation, fishing, and shellfish propagation. The area now supports

more than 800 flora and fauna species. The increase in wetland carbon sinks and the establishment of ecological compensation mechanisms has had a positive impact on climate change mitigation. Ecofriendly farming and water conservation are now essential for villagers' income growth, and initiatives such as the biodiversity credit have boosted public involvement by offering a model to achieve harmony between human activity and nature.

Case Study 5. "Deep Blue No. 1" Project: Revitalizing the Postmining Landscape

Deep Blue No. 1 is an outdoor café located in Hongmiao Village, Meixi Town, Anji County. Before its transformation, the site was a 50-acre abandoned mine pit with the typical associated problems, including safety hazards and poor sanitation, that had been troubling residents. Although the site has continued to gain popularity on social media because of its heart-shaped lake and deep blue color, restoration of the old mine has faced several challenges. Obstacles, which have included a complex stakeholder and property relationship, the long-term and extensive nature of the restoration, uncertainties surrounding return on investment, and government subsidies, have all deterred business involvement.

As a result of these issues, Hongmiao Village decided to partner with an entrepreneurial team of more than 10 university students to launch the "Deep Blue No. 1" Project. As a first step, the Meixi Town government allocated more than RMB40 million to consolidate mining rights to remove legal barriers to ecological restoration and the required development. It also fast-tracked infrastructure projects in the surrounding area, including roads, to prepare the area for additional development. The project also utilized a "Two Investments and Three Returns" model, in which villagers and the village collective invested 49% of the stake, thus receiving income from rents, wages, and dividends. At the same time, the entrepreneurial team held a 51% stake and managed the overall project, which was locally referred to as a "Collective + Company + Farmer" business model.

The entrepreneurial team consisted primarily of young individuals returning to their hometown who were familiar with both the consumption habits of young people and local dynamics. They innovatively merged the natural mine setting with the coffee and social media offerings to market the picturesque scenery. They developed appealing experiences, such as "optimal photo spots," and offered professional photography services, drawing tourists to visit and take photos.

To finance these initiatives, Anji Rural Commercial Bank provided funding through unsecured pure credit methods following the Ecological-Oriented Development (EOD) model. It offered RMB7 million credit to the Hongmiao Economic Cooperative for ecological protection and environmental governance and RMB10.9 million credit to the Deep Blue Group for characteristic industry operations. To date, Anji Rural Commercial Bank has issued 39 "Ecological Restoration Loans" totaling more than RMB50 million, which supported the

restoration and transformation of 13 abandoned mines and old factories, including the "Deep Blue Plan."

The revenue produced from the project has been substantial. To repay the loans, Deep Blue No. 1 charges RMB68 for an entry ticket and currently attracts an average of 2,000 visitors a day. The café set a national record by selling its highest number of cups of coffee in a single day—8,818 cups—in 2023 during the Qingming Festival holiday. As a side-effect of the overall infrastructure improvements in the area, Anji's rural coffee shops have attracted approximately 5.5 million tourists, generated more than RMB100 million in revenue, and increased the village collective income by more than RMB8 million. To date, the project has directly generated more than RMB20 million in revenue. Hongmiao Village has received RMB1.5 million in dividends and rent and more than RMB3 million in rent and wages from the project.

The project has effectively reduced environmental risks in the area, reducing air and water pollution by promoting ecological and environmental governance. It has also transformed abandoned resources to fuel youth entrepreneurship, leading to the rapid development of new tourism businesses, such as coffee, catering, and rural entertainment. This transformation has made the area more attractive as a destination, helped utilize social resources, and eased the employment pressures. The village collective's income will be used for infrastructure construction, such as road repairs, garbage classification, and building cultural and recreational facilities, such as libraries and art galleries. Villagers can also increase their income by buying shares of the project or setting up stalls, free of charge, effectively achieving the goals of rural revitalization and shared prosperity for villagers.

Case Study 6. "Bamboo as a Substitute for Plastic" Initiative: Financing Bamboo Utilization for Ecological Preservation

Anji County has developed a robust green financial ecosystem to support the national "Bamboo as a Substitute for Plastic" initiative, encompassing R&D, manufacturing, and consumer markets. Within this framework, green finance institutions provide special-purpose loans to enterprises to encourage innovation. They have also developed a collaborative platform that includes government, businesses, and financial institutions to broaden the product's reach. Furthermore, the project produces biodiversity credits calculated using the Gross Ecosystem Product (GEP; see the Deep Blue Case) to encourage residents and merchants to embrace ecofriendly consumption habits.

An exhibition center was also created to highlight locally produced bamboo products and provide information about the initiative. The center displays more than 1,000 bamboo-based products, including food, clothing, medicine, tableware, office space, and outdoor gear. These products demonstrate the potential bamboo presents in shifting toward a sustainable, low-carbon lifestyle. Anji's initiative consists of more than 100 local manufacturers of bamboo products, accounting for 30% of the local industry. These mainly manufacture

such products as outdoor bamboo flooring, disposable bamboo dinner and kitchenware, and small bamboo furniture, with an industrial output total of RMB491 million.

Anji decided to investigate bamboo as a replacement for plastic to address the growing concerns regarding plastic pollution and provide solutions, which has prompted UNEP to adopt a resolution aimed at decreasing the impact of plastics. In response, China launched the "Bamboo as a Substitute for Plastic" initiative and the International Bamboo and Rattan Organization in November 2022 to encourage the use of bamboo products worldwide, offering a solution to plastic pollution. Because of its ecofriendly, renewable, and biodegradable qualities, bamboo can directly replace nonbiodegradable plastic products in several fields, such as packaging and construction materials.

Anji, known as "China's Bamboo Town," has a total of 166,549 acres of bamboo forests, and its associated industrial output is worth close to RMB20 billion. In recent years, Anji has actively applied bamboo in construction, decoration, furniture, packaging, textiles, and disposable products to promote "Bamboo as a Substitute for Plastic." On the R&D side, the Anji County government has initiated several crucial bamboo industry research projects, from simple bamboo tableware manufacturing to extracting bamboo cellulose and lignin to create such products as bamboo film bags and bamboo straws. A bamboo industry research institute also was launched to overcome the challenges faced in bamboo processing and production and to increase supply. On the demand side, the government has focused on the administrative, residential, service, and critical industrial sectors, creating "Bamboo as a Substitute for Plastic" company and product lists to accelerate market penetration.

To encourage this development, Anji County issued several policies. These include the 2022 "Implementation Opinions on Accelerating the Revitalization and Development of Anji's Bamboo Industry" and "Implementation Opinions on Encouraging Bamboo as a Substitute for Plastic and Promoting Bamboo Product Innovation," the "2023 Bamboo as a Substitute for Plastic Work Plan" and the "Bamboo as a Substitute for Plastic New Material Procurement Award and Subsidy Measures," and the "2024 Bamboo as a Substitute for Plastic Application and Promotion Base Construction Plan." The county also invests RMB20 million annually to support the development of the bamboo industry.

Under this policy environment, the Anji Rural Commercial Bank has played a crucial role by providing financial support to the "Bamboo as a Substitute for Plastic" initiative. It has allocated RMB300 million annually in special credit funds to support technological innovation and product upgrades for bamboo manufacturing companies, and it has opened a green credit channel with preferential interest rates to encourage capacity expansion among manufacturers. The bank has also colaunched policies with government departments to support the green transformation of farmers' markets, and it has expanded online and offline procurement channels for "Bamboo as a Substitute for Plastic" products. Furthermore, the bank has leveraged the

PBOC's biodiversity credits, calculated using the GEP, to subsidize merchants' procurement of "Bamboo as a Substitute for Plastic" products. This effort has had the effect of reducing their operating costs and encouraging residents to accumulate these green credits to exchange for daily goods, with the intent of promoting green consumption habits.

Anji County also established a local market and trading mechanism for bamboo forest carbon sinks, creating local carbon credits. This mechanism has had the effect of monetizing the ecological value of bamboo forests, providing additional economic incentives for bamboo forest protection and management. In addition, Anji County launched the first county-level Bamboo Carbon Sink Collection, Storage, and Trading Platform as well as a bamboo forest carbon credit digital application in China, which contains an aggregate of 138,379 acres of bamboo resources for market trading. Companies on the platform reinvest operational profits into cooperatives through the "operation platform + cooperative + farmer" benefit-sharing mechanism. Under this mechanism, farmers receive guaranteed returns from bamboo forests, a 60% share of value-added dividends, and wages from project participation, realizing income from rent, dividends, and wages. Village collectives receive the remaining 40% of the value-added dividends to be used on community projects or to carry out a secondary distribution to villagers and disadvantaged groups.

As of result of their conservation efforts, Anji's total bamboo industrial output reached approximately RMB18 billion by 2023, contributing 10% of the nation's total bamboo industrial output while producing only 1.8% of the country's bamboo. Anji has developed 37 large-scale enterprises, attracting leading companies and creating more than 3,000 products, including decorative materials, daily necessities, and bamboo shoots. Additionally, Anji has 730 bamboo-themed homestays, attracting 3.785 million tourists in 2023 and generating RMB1.31 billion in revenue. Bamboo forest carbon credits achieved a trading volume of 25,000 tons, generated RMB1.72 million, and donated 21,000 tons of carbon credits to the 19th Asian Games for its carbon-neutrality goals.

The "Bamboo as a Substitute for Plastic" initiative has significantly reduced local plastic waste. By the end of 2022, the effort to replace "six small items," such as toothbrushes and combs, with bamboo replacements in hotels and homestays alone reduced waste by more than 2,000 tons. The growth of the bamboo industry has created a number of local job opportunities in the supply chain, including planting, processing, design, and sales. Farmers leasing their bamboo resources and assets in exchange for shares have received rent and dividends from bamboo industry cooperatives and wages from bamboo forest management, increasing village collective operating income by about RMB1 million annually and household income by RMB10,000. Furthermore, 80% of the initial and annual incremental net income from bamboo forest carbon credits was returned to the village, benefiting villagers collectively.

Case Study 7. Changxing Rural Commercial Bank: Carbon Efficiency Platform

Changxing Rural Commercial Bank launched its digital platform, the Carbon Efficiency Platform for businesses, to support Changxing County's low-carbon transition. As a county-level financial institution, the bank upholds the "green + inclusive" principle, ensuring that enterprises have equitable access to financial services. The bank's initial focus was on driving the transformation of the textile industry, as it is a pillar industry of Changxing County with more than 3,000 enterprises, most of which are small and micro-level workshops with high carbon emissions. These enterprises typically face funding shortages, limited financing options, and limited access to talent and technology. The bank has worked to transform the industry by developing transition finance standards, developing carbon efficiency metrics, and creating innovative carbon efficiency products.

Changxing Rural Commercial Bank's platform draws from digital tools launched in 2021 by Huzhou City to monitor corporate carbon emissions and create "carbon efficiency codes." Based on such codes, which were initially limited to large businesses, Huzhou provided differential financing and preferential interest rates to businesses. In July 2022, Changxing Rural Commercial Bank created its Carbon Efficiency Platform for small enterprises and microenterprises, extending benefits from carbon efficiency codes to these enterprises. By leveraging electricity data to track 31 energy consumption indicators, they can facilitate green loans and provide ESG risk monitoring. In 2023, the Huzhou financial data engine, green loan classification system, and corporate ESG evaluation system were incorporated into the platform, and the SME platform was upgraded to the Carbon Efficiency Platform for Businesses.

Support from the local government for this program came in the form of fiscal policy incentives, including subsidies on green loan interest, risk compensation, pilot rewards, and the development of local transition finance standards. Furthermore, they integrated carbon-efficiency metrics to develop comprehensive performance evaluations for small enterprises and microenterprises. Tailored support was provided based on these metrics, including such policies as land supply, fee reduction, and higher loan-to-value ratio for industrial land mortgages. In addition, reverse penalties were implemented on this basis, including variable electricity pricing to push enterprises toward energy efficiency improvements.

One of the most important pieces of guidance produced was the "Taxonomy of Economic Activities for Transition Finance in the Textile Industry," providing guidelines for identifying and prioritizing key emission reduction areas and assisting the bank in project selection and impact assessment. Furthermore, the bank's transition financial products received strong market demand, providing a robust foundation for business development. These products included "Energy Carbon Efficiency Loans," "Micro Carbon Efficiency Loans," and "Transition Loans for the Textile Industry," which were priced primarily based on an enterprise's

carbon-efficiency levels and using differentiated interest rates to incentivize emission reductions by businesses.

As previously mentioned, carbon-efficiency levels were directly incorporated into the credit approval process, affecting loan limits and interest rates. Enterprises could enjoy up to 60 basis points in discounts based on their carbon-efficiency level and green credentials. The bank also optimized processes and enhanced postloan risk management, dynamically adjusting its financial services. Carbon efficiency has been integrated into all stages of loan management for the textile industry, from preloan investigation to postloan monitoring. As of May 2024, Changxing Rural Commercial Bank has provided RMB6.871 billion in lending to 1,316 small enterprises and microenterprises with carbon efficiency ratings of 3 or above through this platform, spurring RMB3 billion in enterprise investment in technology upgrades.

The overall effect has been an acceleration in the green transformation of Changxing's economic structure. Using differentiated interest rates, the bank addressed funding issues for small enterprises, boosting market activity. At the same time, its green credit initiative led to a 0.026-ton reduction in carbon emissions per RMB10,000 of output, with a projected 5% overall decrease in the county's carbon emissions per output unit in 2023. This approach has showcased the strategic role of financial support, particularly for small enterprises and microenterprises, in fostering low-carbon projects.

Case Study 8. Bank of China, Huzhou Branch, Anji, Changshuo Subbranch: Building a Carbon-Neutral Bank Branch

The Bank of China's Anji, Changshuo Subbranch in Huzhou (i.e., the Changshuo Branch) has transformed itself into a carbon-neutral bank by combining green credit support with low-carbon operations. The branch enhanced its green finance services by boosting its percentage of green credit in terms of overall credit and managing the nonperforming ratio of these green loans. At the same time, the branch achieved low-carbon operations by implementing energy-saving updates and using 100% renewable energy, intelligent energy systems, and green office initiatives.

Leveraging its solid foundation in green finance, which it developed over the course of the pilot zone's period, the Changshuo Branch dedicated two years to the development of its low-carbon operations and to reducing the carbon intensity of its assets. On 15 August 2021, it officially became the first green smart branch in the Bank of China system, recognizing its efforts to achieve carbon-neutrality status.

At the operational level, or its Scope 1, the Changshuo Branch adopted the use of green building materials and renewable energy solutions. This branch has rooftop photovoltaic power stations that generate more than 20,000 kWh annually and an intelligent building energy management system that reduces energy consumption by HVAC and other building systems. The branch also

offsets its carbon emissions by participating in forest carbon sink projects, purchasing green power certificates, and trading in carbon markets.

To reduce the carbon intensity of its financial assets, or its Scope 3, Changshuo Branch implemented such measures as prioritizing funding for low-carbon projects, expediting approval processes for green credit, implementing differential fund pricing, setting specific risk management indicators, conducting green performance assessments, and creating mechanisms to disclose carbon neutrality–related environmental information. The branch also reviewed the carbon emissions of enterprises involved in its investment and financing businesses and started allocating resources toward green, low-carbon areas. It also leveraged financial tools to encourage enterprises to gradually reduce their carbon emissions.

To develop its approach, the Changshuo Branch has relied on policy and regulatory support from banks at higher levels of the financial system, including the central and policy banks. In 2021, the Bank of China issued the "Green Construction Standards for Bank of China Branches," which included basic standards for branch construction and green finance demonstration sites. In May 2022, Huzhou City released the "Carbon Neutral Bank '28–58' Vision Plan" and the "Regional Carbon Neutral Bank Construction Guidelines," which specified paths and standards for local banks like the Changshuo Branch. These guidelines included several topics: carbon emission reduction, developing green finance business, implementing carbon footprint management, and achieving carbon neutrality in the banks' operations and investment activities.

Regulatory bodies have supported these efforts through tax incentives, funding subsidies, priority allocation of green credit scales, and regulatory easing. Both the headquarters and Huzhou Branch of the Bank of China have provided support by allocating green credit quotas, establishing priority approval channels, providing guidance on green financial product innovation, offering risk management input, and training green finance talents to increase institutional capacity. At the same time, as a financial institution, the Changshuo Branch has increased green credit as a proportion of all its loans and has controlled the nonperforming loan ratio to improve its ability to provide green financial services.

This branch has actively integrated local green developments, prioritizing essential resources such as a larger credit scale, higher approval efficiency, and more attractive interest rate pricing in green and low-carbon areas. It also has allocated special green credit lines, prioritizing clients' financing needs for low-carbon and green projects. In addition, the branch launched innovative credit products for local characteristic industries, such as the "Industrial Carbon Sink Loan," "Green Loans for White Tea," and "Bamboo Township Mutual Wealth Loan," to provide financial support for local green projects. It also has offered financial support for green projects, such as the Anji Bamboo Carbon Sink, through syndicated loans, bonds, and other financing methods.

To manage its nonperforming loans, the Changshuo Branch has set a high tolerance for green loans, allowing their rate to be slightly higher than that of general corporate loans. This act was intended to alleviate concerns over risks at the initial stage of green projects. It also has increased employees' motivation to issue green loans through performance appraisal mechanisms, such as economic capital cost incentives and special bonuses.

As a result of these efforts, the green credit balance of the Changshuo Branch as of the end of May 2024 reached RMB5.292 billion, accounting for more than 70% of the bank's total loans, effectively driving their green transformation and demonstrating the high-quality growth of its credit assets. In particular, the "Green Loans for White Tea" initiative has fostered an agricultural industry chain worth more than RMB3 billion, increasing the average income of the 360,000 farmers in the county by more than RMB8,800. By investing in a range of areas, including urban renewal, ecotourism, and green technology industries, the branch has contributed to the greening of Anji's economy. As the first carbon-neutral smart branch, Changshuo Branch has provided an innovative model for other financial institutions that are looking to increase public awareness and participation in green initiatives.

Appendix B: Local Green Finance Regulations

Standard No.	Standard Name	Scope	Purpose
DB3305/T62-2018	Green financing enterprise evaluation specification	Evaluation of green financing enterprises in Huzhou City	Evaluation principles, procedures, and contents of green financing enterprises
DB3305/T63-2018	Green financing project evaluation specification	Evaluation of green financing projects in Huzhou City	Evaluation principles, procedures, and contents of green financing projects
DB3305/T65-2018	Code for construction of green financial franchise institutions in banking industry	Construction and management of green financial transfer institutions in Huzhou banking industry	The classification and basic requirements for the construction of green financial transfer institutions in the banking industry and the construction requirements for green franchise sub-branches, green financial management departments, and green financial business departments
DB3305/T89-2018	Code for implementation of green loans for beautiful rural construction	Implementation of green loan for beautiful rural construction	Implementation principles, support areas, self-construction of banking financial institutions, implementation procedures, and implementation requirements of green loans for beautiful rural construction

(*continued*)

Standard No.	Standard Name	Scope	Purpose
DB3305/T104-2019	Technical specification for risk assessment of environmental pollution liability insurance	Risk assessment of environmental pollution liability insurance for lead-acid battery, electroplating, chemical industry, textile dyeing and finishing, tanning, papermaking and hazardous waste collection, storage, utilization, and disposal in the insurance industry	Index system, assessment process, and assessment cycle of risk assessment of enterprise environmental pollution liability insurance
DB3305/T111-2019	Guidelines for the preparation of green finance standard system	Establishment and management of Huzhou green finance standard system	Terms and definitions, compilation principles and methods, standard system structure, documents, and management of green finance standard system
DB3305/T123-2019	Evaluation specification of regional green financial development index	Evaluation of regional green financial development index	Evaluation principles and contents of green financial development index
DB3305/T134-2019	Code for implementation of Green Park supported by banking financial institutions	Financial institutions within the jurisdiction of Huzhou City support the construction, transformation, and operation of green parks and enterprises in the parks	Provides the basic principles and support methods for supporting the construction of green parks. Includes guidance for the monitoring, evaluation, information reporting and disclosure for banking financial institutions to support continuous improvement.
DB3305/T135-2019	Code for implementation of green agricultural loans	Banking financial institutions within the jurisdiction of Huzhou City implement green agricultural loans	Support areas, implementation procedures, and implementation requirements of green agriculture loans in Huzhou City
DB3305/T136-2019	Implementation requirements of green inclusive loan	Implementation of green inclusive loans for banking financial institutions in Huzhou City	Implementation principle, support object, and direction of green inclusive loan
DB3305/T150-2020	Code for construction and evaluation of green microfinance companies	Construction and evaluation of green microfinance companies	The business model, support areas, management requirements, business processes, supervision, and inspection and evaluation requirements for green microfinance companies

Source: Adapted from Wu (2022).

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