

Working Paper

The Knowns and Unknowns of China's Green Finance

Sean Gilbert and Lihuan Zhou

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Executive Summary

China has enjoyed unparalleled success in lifting its population out of poverty—but it has suffered substantial environmental degradation in the process. Following an astounding growth trajectory over the last 40 years, it has reached an inflection point where it must chart a new development pathway.

As it enters its next phase of development, China has laid out a vision for “greening” its economy—creating what it calls an Ecological Civilisation (ECZ). It is now taking steps to embed that vision in the policies and strategies that guide its economic planning for the coming five years.

As part of its strategy, China has introduced a package of initiatives and reforms aimed at greening its financial system to stimulate related investments. China's is particularly noteworthy in that it arguably has been the most proactive country in the world in pursuing a coordinated and comprehensive approach to greening its financial system. Many other countries have made laudable progress on specific and targeted initiatives, but few have moved beyond a piecemeal approach.

Within the overall reforms, a number of the specific efforts—particularly enhancing green credit, establishing green development funds, and stimulating a green bond market—have the potential to speed investment in sustainable infrastructure for energy, land use, and urban development. This subset of China's green investment needs is critical to both China's long-term environmental conditions and its contributions to global environmental trends.

This paper offers a brief review of the green financial reforms that are likely to be most relevant to supporting infrastructure investing. The authors have consolidated data on various aspects of green investment in China to present a first snapshot of the combined progress in mobilizing green finance. The review also notes some of the mechanisms needed to enable the reforms to reach their full potential. For the subset of sectors examined, green finance appears to have almost doubled since 2011, and certain segments are evolving particularly quickly. For example, in 2016, China became the largest green bond market with \$30.2 billion issuance.



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About this working paper

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New Climate Economy
c/o World Resources Institute
10 G St NE
Suite 800
Washington, DC 20002, USA
+1 (202) 729-7600

New Climate Economy
c/o Overseas Development Institute
203 Blackfriars Road
London, SE1 8NJ, UK
+44 (0) 20 7922 0300

www.newclimateeconomy.report
www.newclimateeconomy.net



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A handful of actions will be necessary to maximize the ability of the reforms to contribute to China's goals. They include the following:

1. Continue to press forward on strengthening demand-side drivers, including by raising environmental standards, tightening enforcement and stiffening penalties for noncompliance, establishing clear environmental targets, and fixing pricing distortions. Green finance is built on the foundation of a strong environmental regime.
2. Ensure that reforms address the specific needs of sustainable infrastructure, which may differ from those of China's other green investment targets.
3. Develop more comprehensive baseline data on green financial flows and establish transparent tracking mechanisms that allow green finance to be assessed in the context of overall investment flows.
4. Ensure that financing flows to needed and productive assets that deliver measurable environmental improvements. Incentives must deliver quality, not just quantity. Building duplicative infrastructure or assets that are unable to deliver services (e.g., clean energy facilities that consistently operate at low capacity) may produce a "sustainable" piece of infrastructure, but it will not deliver on goals for environmental quality. The tracking of green financial flows must be complemented by monitoring the effects on environmental factors such as air, water, and soil quality; CO₂ emissions; and biodiversity.

How China's leadership and proactive policy embrace of green finance will translate into its overseas investments, particularly investments that draw on public finance (e.g., policy bank funding) or involve state-owned enterprises, remains unclear. As China pursues the green transformation of its economy and financial system, it has a tremendous opportunity to integrate the spirit of its thinking into its vision for regional economic development and to help other countries avoid a resource-intensive and pollution-intensive development phase. There will be significant policy incongruence if China is actively greening its own economy but sponsoring substantial "brown" investments abroad.

There are encouraging signs about the trajectory of the reforms, but much work still lies ahead for Chinese policy-makers. The results will be seen over the course of implementation of the coming 13th Five-Year Plan, which has the potential to mark a turning point in China's approach to managing the interaction between the environment and economic development.

1. China's new economic vision

Following an unparalleled trajectory of 40 years of growth that lifted 500 million out of extreme poverty, China has reached an inflection point, grappling with two trends that are changing its thinking on growth and development (UNDP, 2016). First, China is reaching the limits of the investment-driven strategy that fuelled its development over recent decades; it needs to increase the role of consumption, innovation, and services in economic growth. China's investment as a share of GDP peaked at 48% in 2013 (World Bank, 2016).¹

Second, environmental pollution incurred over the course of China's growth and an increasing number of high-profile pollution incidents have become the subject of growing public concern (Caxin, 2015). The intense focus on economic growth and development is giving way to greater emphasis on balancing growth and quality of life.

Alongside Xi Jinping's "Chinese Dream" and the Two Centenary Goals (People's Daily, 2016), the development of a greener economy has emerged as a key direction guiding Chinese economic planning. The concept of an Ecological Civilisation (ECZ) was first introduced in 2007 with the goal of conserving energy and resources and protecting the environment by changing China's industrial structure, growth mode, and consumption pattern. It did not take a central position in the narrative of China's economic development until 2012, when the report of the National People's Congress identified it as one of the five core development tasks and redefined it as green, circular, low-carbon development (Chen, 2016).

Forecasting investment requirements is a challenging task because of uncertainties about the future trajectory of government policies. However, researchers estimate that it would take US\$274–\$468 billion of green investment each year from 2014 to 2020 to shift the economy toward an ECZ (Kennedy, Zhong, & Corfee-Morlot, 2016).

Box 1

What is sustainable infrastructure?

While definitions of sustainable infrastructure vary in their details, they typically include that sustainable infrastructure:

- delivers low carbon growth that is compatible with global climate goals
- does not result in major negative environmental impacts or significant loss of natural capital
- supports inclusive economic growth
- provides affordable and economically sustainable services.

In China, “sustainable” or “green” infrastructure usually refers to investments that support its goals for low-carbon development, help create a circular economy, and contribute to the achievement of specific environmental objectives (e.g., reduction of SO_x emissions, site remediation, etc.) (Xinhua News Agency, 2015b). China has also developed definitions for green bonds and green credit that identify the specific industry sectors and types of projects that are considered green (PBoC, 2015; CBRC, 2014b). These taxonomies can lead to some controversial decisions. For example, green bonds can be used to finance some types of coal investments, including coal processing plants, coal gasification projects, and ultra-supercritical or supercritical combined heat and power coal-fired plants with installed capacity of more than 300 MW (PBoC, 2015). They are nonetheless the reference point for China’s policies and express its “green” objectives. For purposes of this paper, “sustainable” or “green” infrastructure refers to projects that are aligned with the environmental policy objectives and/or specific taxonomies developed by the Chinese government.

In May 2015, the Central Committee of the Communist Party of China (CPC) and the State Council issued the *Opinions on Further Promoting the Development of Ecological Civilisation* (henceforth the *Opinions*). This document set out standards, mechanisms, and assessments for better implementation of the ECZ. It also integrated 2020 targets that had appeared in other government documents on topics such as carbon intensity, energy consumption, water consumption, and forestry. The *Opinions* recognized the importance of markets and finance, which set the stage for the more specific financial policy reforms that followed (Xinhua News Agency, 2015b).

2. Articulating the role of markets and finance in creating an Ecological Civilisation

In framing its ambitions to establish an ECZ, China’s leadership recognized the need to shift economic activity and land use towards lower-impact pathways. China made the leap that many other countries have not yet taken of developing a program of reforms aimed specifically at shifting investment patterns and greening its entire financial system.

In September 2015, the Central Committee of the CPC and the State Council issued the *Overall Plan for the Reform of Ecological Civilisation System* (henceforth the *Plan*). The overall objective of the reform is to establish institutional arrangements and a governance framework capable of supporting an ECZ by 2020. The *Plan* and the *Opinions* call for improving environmental protection by deploying more economic and market-based strategies to overcome the failures resulting from the absence of market drivers and insufficient public engagement (Chen, 2016).

An integral part of promoting the development of an ECZ is to improve economic policies relating to resource pricing, taxes, and fiscal policies and incentives. These policies provide incentives for green investments. The *Opinions* references a number of specific ideas, including reform of pricing for the rights to use resources; increases in fiscal support for the development of clean technology, remediation projects, infrastructure, and other green needs; enhancement of tax incentives for energy efficiency, environmental protection, new energy, and ecological development; promotion of green credit; exploration of financing models that use pollution permits as collateral; and the advancement of pilots on liability insurance for environmental pollution (Xinhua News Agency, 2015b).

The goal of establishing a green financial system was fully formalized through its inclusion in the *13th Five-Year Plan for Economic and Social Development of the People's Republic of China*, published in March 2016, which will guide China's economic and social development from 2016 through 2020. It reflects much of the thinking of the Plan and further highlights the development of green credit, green bonds, and green development funds (Xinhua News Agency, 2016b).

In August 2016, the government took another substantial policy step when seven ministries jointly issued a roadmap to build a green financial system in the *Guidelines for Establishing the Green Financial System* (henceforth the *Guidelines*).² The Guidelines specifies detailed policy and regulatory actions to build a green financial system in China. It defines green finance as financial services provided for economic activities that support improvement of the environment, mitigation of climate change, and more efficient use of resources (PBoC, 2016b). The inclusion of climate change and resource efficiency is noteworthy, particularly from the perspective of supporting investment in sustainable infrastructure.

3. Translating concepts into goals and targets

Solidifying the conceptual framework of an ECZ has been an important step, but it is equally critical to see the concepts translated into specific goals and performance evaluation criteria for subnational governments and officials. The 13th Five-Year Plan defines a number of goals that are directly and indirectly linked to sustainable infrastructure (see Box 2). The 13th Five-Year Plan also includes sectoral policies on water, climate, and energy that set specific targets linked to ECZ that will influence the nature of investment needs. Box 2 Table 1.1 shows some of its specific goals.

Box 2

Sustainability goals in China's 13th Five-Year Plan

The 13th Five-Year Plan sets out new carbon and energy intensity targets for China's economy, including an 18% reduction in carbon intensity and a 15% reduction in energy intensity from 2015 levels and an increase of non-fossil primary energy consumption to 15% (Xinhua News Agency, 2016b). Specific goals include the following:

Sector	Goals
Energy	<ul style="list-style-type: none"> Integrate hydro development and ecological protection. Continue to promote wind and photovoltaic power, and actively support solar thermal power generation. Accelerate the development of biomass, geothermal, and tidal energy resources. Improve supporting policies for wind, solar, and biomass electricity generation. Implement the National Energy Conservation Action Plan; limit total energy consumption to 5 billion tonnes of standard coal equivalent.
Transportation	<ul style="list-style-type: none"> Prioritise public transportation; accelerate the development of urban rail transit, bus rapid transit, and other large-capacity public transit; and encourage green commuting. Support the development of new-energy vehicles (e.g. electric vehicles) and green low-carbon industries. Strictly implement electric-vehicle charging station standards in new residential communities. Promote urban cycling, public transit services, and other green commuting systems.
Buildings	<ul style="list-style-type: none"> Implement energy-efficiency improvement plans and green building development plans. Improve the resilience of city buildings and infrastructure to disasters.
Water	<ul style="list-style-type: none"> Accelerate the construction of urban water supply facilities. Implement the National Water Conservation Action Plan; limit the total volume of water withdrawn to 670 billion cubic meters.
Industry	<ul style="list-style-type: none"> Accelerate the exit of steel, coal, and other industries that have excess capacity.

Many of the objectives in the 13th Five-Year were also highlighted in the 12th Five-Year Plan and do not necessarily represent a new direction. Like its predecessor, the 13th Five-Year Plan emphasizes continued support to renewable energies, public transportation, new-energy vehicles, and green buildings. It also includes some notable new priorities:

- *Energy*: It is the first five-year plan to limit coal development across China. Total installed capacity of coal power plants will be capped at 1.1TW in 2020 (55% of total installed capacity in 2020, a decrease of 4 percentage points from 2015). The plan also downgrades the importance of coal in China's energy from first under the 12th Five-Year Plan to sixth.
- *Land use*: It is the first five-year plan to highlight sustainable agriculture and forestry. It references farmland rotation, fallow plots, large-scale techniques for reducing water use in irrigation, dry farming, and the creation of sustainable agriculture demonstration zones. It prohibits all commercial logging of natural forests and calls for the development of innovative property models to guide private investments in reforestation.
- *Cities*: It proposes establishing intercity railways to efficiently link cities and towns. The 12th Five-Year Plan promoted highways.

The goals for energy and cities represent substantive policy shifts on politically sensitive sectors with well-established interests. The coal sector is struggling, with consumption falling since 2014. There is momentum towards halting coal expansion in the east while continuing to add new coal capacity in the less economically developed and less urbanized western regions. Decreasing coal consumption is part of an ongoing trend that reflects structural changes in the economy, slower economic growth, and increased development of non-fossil fuel energies (Xinhua News Agency, 2015a).

Structural change in the economy is characterized by the less energy-intensive service sector surpassing heavy industry as a percentage of GDP in 2012; the service sector has been the main driver of GDP growth, accounting for 58% of GDP growth in 2016 (National Bureau of Statistics, 2017). For the agriculture and transportation sectors, the direction is not as clear. However, reforms are being introduced that are intended to support the flow of financing towards rail.

4. New reforms to green the financial system

Executing the 13th Five-Year Plan will require substantial new investments that the government will not be able to finance alone (CCICED, 2015; UNEP Inquiry, 2015). According to estimates by the People's Bank of China, 85–90% of the required investment to achieve the targets will have to come from private capital (PBoC & UNEP, 2015). Annual direct investment to implement the Air Pollution Prevention and Control Action Plan from 2013 to 2017 is estimated at US\$56 billion (¥368 billion), for example. From 2013 to 2016, the central government provided an average of just US\$5.6 billion (¥36.6 billion) a year—about 10% of the required investment—through the Air Pollution Prevention and Control Fund (Dong et al., 2015; Ministry of Finance, 2016b; Xinhua News Agency, 2016a).

Green investment needs run the gamut from remediation and control (e.g., cleaning up contaminated sites, building wastewater treatment plants, etc.) to investments in upgrades, conversions, and infrastructure replacement to reduce future pollution and resource consumption loading. Green finance in China typically encompasses both these needs, with a substantial portion of funding linked to infrastructure. While views differ as to the relative priorities and urgencies within these diverse needs, there is widespread recognition of the importance of scaling up green investment.

The 13th Five-Year Plan, the *Plan*, and the *Opinions* propose a series of reforms for greening the financial system to mobilise private capital. Individually, the reforms are not necessarily unique, but as a package they are notable in that (a) they are included in core economic planning and policy documents, (b) they propose a systemic and detailed approach to multiple green channels within the financial system, and (c) China's central bank is championing them. This combination of features makes China's approach stand out in a global context and has stimulated the establishment of similar initiatives on green finance in other countries and regions (UNEP Inquiry, 2015).

The financial system reforms cover several areas:

- *The banking sector*: Building on the existing green credit policy, the Guidelines calls for encouraging financial institutions to issue more green loans and commits to exploring how to leverage public finance to support the growth of green loans through mechanisms such as interest subsidies, on-lending, and loan guarantees. It also seeks to create incentives

for financial institutions to give more careful consideration to extending finance to enterprises with substantial environmental impact by calling for clarification of lenders' environmental liabilities and environmental and social risk stress testing.

- *Capital market:* The Plan seeks to ensure channels for green financing, particularly through the issuance of green bonds by banks and corporations to support the securitisation of green credit assets. In addition, it calls for expanding green investment products, including potentially establishing a green stock index. It encourages institutional investors to invest in green financial products and conduct environmental and climate risk stress testing.
- *Direct investment fund:* To fill some of the financing needs that banks and capital markets may not meet, the Plan calls for the establishment of market-based green development funds at the national and local levels.
- *Disclosure:* The Plan calls for the mandatory disclosure of environmental information for listed companies and improvements in disclosure mechanisms to inform communities and the broader public.
- *Rating and assessment:* The Plan calls for infrastructure to support financial institutions in their due diligence and evaluations by providing tools for calculating environmental costs and evaluating environmental impacts.
- *Insurance:* The Plan addresses mechanisms for reducing the risk of investments by improving guarantee mechanisms for low-carbon, eco-friendly projects and increasing risk compensation. It also calls for establishing a mandatory insurance system for environmental pollution liability for high-risk industries, in order to ensure that they have the capacity to cover the cost of environmental damage.

In addition to the reforms targeting the financial system, the Guidelines include a number of policies that enable much wider use of market mechanisms to govern the environment. They include the promotion of trading of water rights, pollution rights, and carbon emissions rights; acceleration of the reform of resource and environmental taxes and fees; and improvement of the royalty systems for use of natural resources owned by the government.

China's leadership and ministries have endorsed these financial system reforms. The extensive and complex work of translating the intent of the reforms into detailed policies and implementing rules and regulations still lies ahead. The reforms span multiple agencies and levels of government, which will mean that implementation will move at different speeds, and coordination will be critical but challenging (Wang, 2015). The impact of these reforms on investment flows to sustainable infrastructure will depend in large part on the speed, efficacy, and degree of coordination of the implementation.

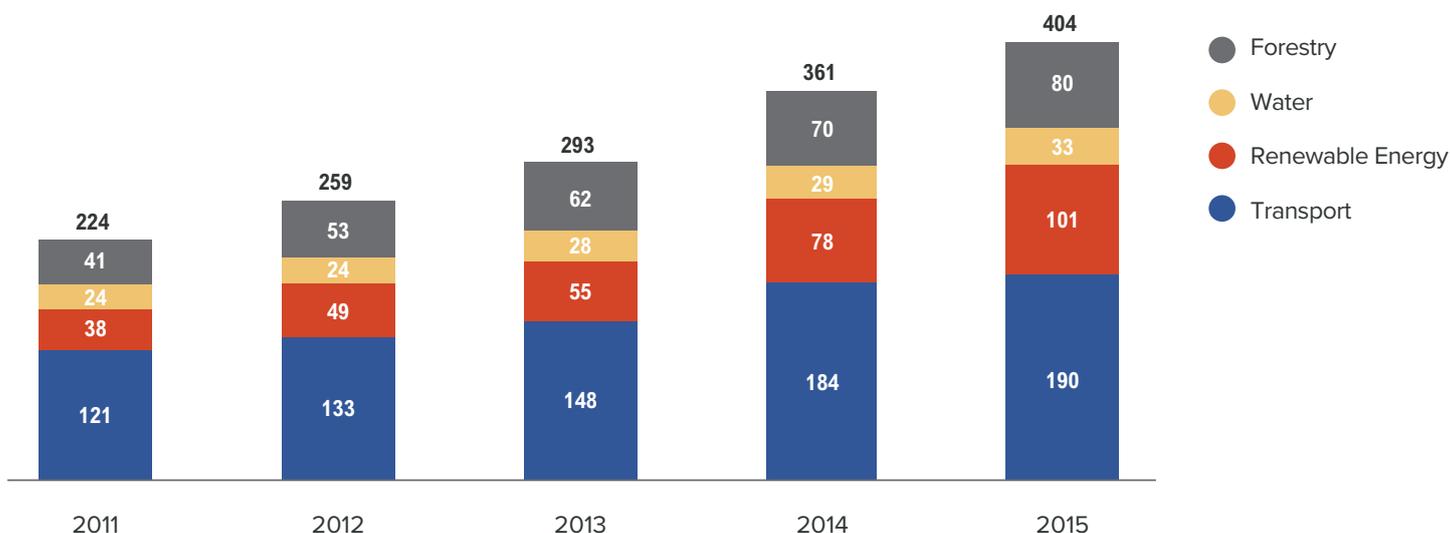
4.1 THE BASELINE

A baseline is needed in order to assess the impact of the reforms on patterns of infrastructure investment. Establishing a baseline is difficult, because no single data source captures all of China's green investment flows. The authors compiled data from a number of sources, but an exhaustive estimate is beyond the scope of this paper. Moreover, to provide a meaningful reference for tracking effectiveness over time, these figures need to be placed in the context of overall investment flows.

The banking system is the most important source of financing in China. In 2007, the green credit policy issued by the Chinese Banking Regulatory Commission (CBRC) became the first of China's major green finance policies. It helped stimulate flows of green finance, but tracking the success of the policies is challenging because of limited data on green investment. The CBRC established a detailed Green Lending Statistics Accounting System, but the published data is limited to an annual update on outstanding green credit loans and start only in 2014.

Drawing on publicly available sources on a subset of sectors profiled as important areas of sustainable infrastructure in the work of the New Climate Economy, the authors estimate that investment flows in selected green sectors in China rose from US\$224 billion in 2011 to US\$404 billion in 2015 (see Figure 1). These sources are incomplete and therefore understate actual flows. Because of data limitations, for example, these estimates do not include several important sectors, including energy-efficient or green buildings, sustainable agriculture, and electric or other new-energy vehicles. In addition, investments in the transport and water sectors include only investments in fixed assets, not investments in operations and maintenance or labour.

Figure 1
Estimated annual investment flows into selected sectors in China, 2011–15, US\$ billions



Note: For detailed statistics, see table A.1 in the appendix. Investment in forestry for 2015 is based on authors' estimation. Renewable energy excludes hydropower.

Source: Authors' calculation based on various sources. For source details, see table A.1 in the appendix.

4.2 REFORMS THAT MAY ACCELERATE FINANCE FOR SUSTAINABLE INFRASTRUCTURE

The reforms of greatest relevance to infrastructure are reforms related to bank lending, bond markets, and green development funds. Sixty percent of China's financial assets sit within the banking system.³ It has already played an important role in supporting the development of parts of the renewables sector, and its capital could quickly be redirected from brown to green investments.

Banks, funds, and bonds all have specific roles to play in the funding cycle of infrastructure projects. Infrastructure projects typically rely on bank lending, public finance, and mezzanine investors in their design and construction stages, because banks are most willing to manage the relatively high risks associated with the early stages of infrastructure. Once projects become operational, bond markets become an important outlet for allowing investors to exit and institutional investors to enter (Della Croce & Yermo, 2013). A brief look at developments in these areas shows varied progress in influencing investment flows.

4.2.1 Green bonds

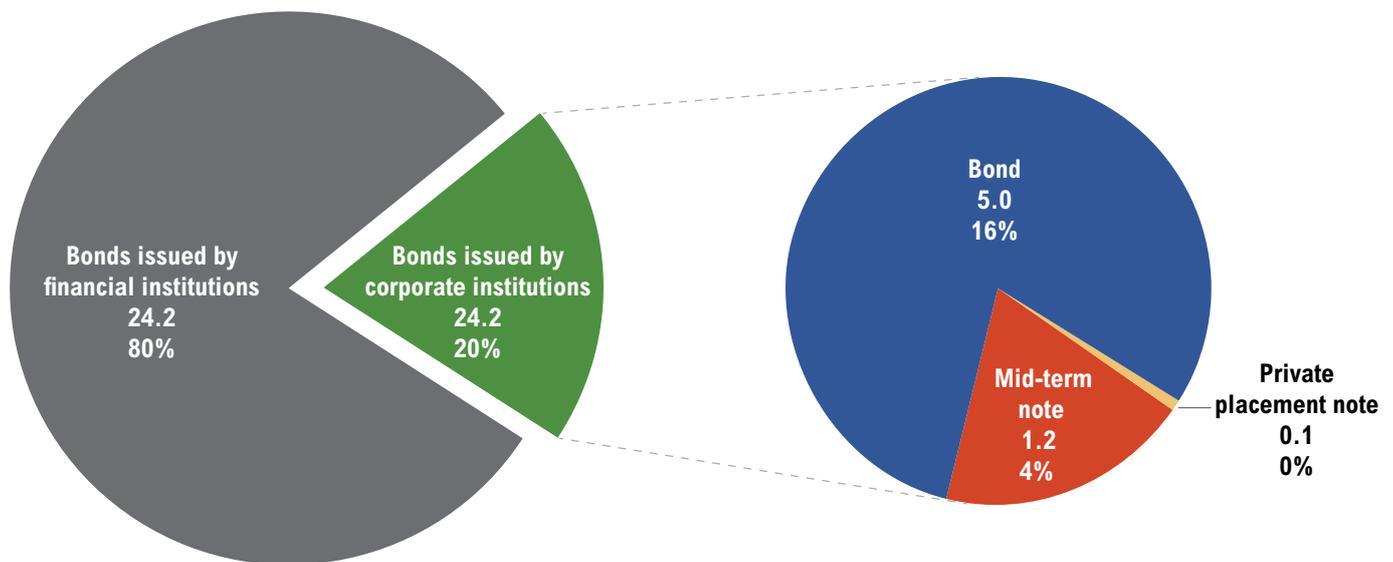
Of the various initiatives, green bonds have shown the most rapid progress since release of the Plan. Both regulators of the public bond market—the People's Bank of China (PBoC), which regulates financial bonds, the National Development and Reform Commission (NDRC), which regulates enterprise bonds, and the stock exchanges, which regulate corporate bonds—have issued guidelines on green bonds.⁴ Under PBoC's rules, issued December 22, 2015, issuers are required to establish a dedicated account or ledger for bond proceeds to ensure that they are invested in projects that correspond with the stated intent of the bond institutions (PBoC, 2015). When the funds are not invested in projects, banks can invest in enterprise green bonds and money market instruments with good credit ratings and liquidity (PBoC, 2015).

An accompanying project catalogue issued to support the PBoC's regulations recognizes six main categories of investments: energy saving, pollution prevention and control, resource conservation and recycling, clean transportation, clean energy, and ecological protection and climate change adaptation (Green Finance Committee of China Society for Banking and Finance, 2015). Issuers are required to report on their use of proceeds on a quarterly basis and are recommended, but not required, to

obtain independent verification. In 2016 financial institutions that are subject to this regulation issued 80% of all green bonds (see Figure 2). The project catalogue is also adopted in corporate green bond regulations by Shanghai Stock Exchange and Shenzhen Stock Exchange (Shanghai Stock Exchange, 2016; Shenzhen Stock Exchange, 2016).

On December 31, 2015, the NDRC issued its green bond guidelines for non-financial enterprises. They differ from the PBoC guidelines in some important ways.⁵ The NDRC guidelines cover 12 sectors and offer less detail than the PBoC guidelines. In addition, issuers can use up to half of green bond proceeds to repay bank loans and add to working capital, which may diminish the role of corporate green bonds in funding new projects. The guidelines do not include disclosure or verification requirements (NDRC, 2016).

Figure 2
Green bonds issued in China in 2016, US\$ billions



Note: 1. For detailed statistics, see table A.2 in the appendix. 2. Totals do not add up due to rounding in the right hand figure.

Source: China Finance Information, 2016

Companies and financial institutions started taking advantage of the new guidelines in 2016. A single year is far too short a period for projecting the likely long-term trajectory of the market, but the fact that offerings have come quickly to market does demonstrate that a market is in the making.

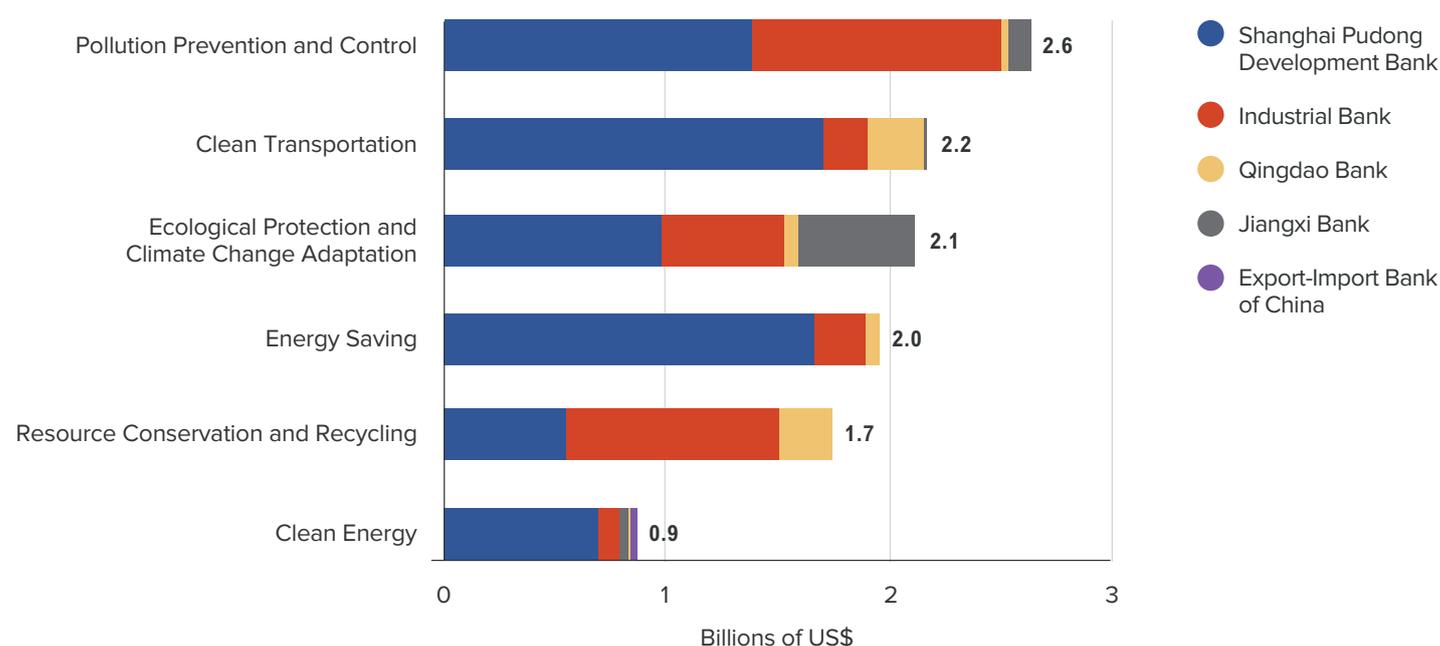
The focus of the green bonds has not been infrastructure. Six banks accounted for the bulk of issuances, with more than a third of their proceeds going towards energy savings and pollution prevention and control rather than infrastructure like clean energy (see Figure 3).⁶ This emphasis likely partly reflects the fact that the institutions are building bonds around lending portfolios targeted at resource efficiency and pollution control for private sector clients.

There may be a shift towards more infrastructure-related green bonds as more corporates come to market. Green bonds issued by corporates accounted for only 20% of the total issuance in 2016, or US\$6.2 billion (see Figure 2). Of the corporate bond proceeds, 69% will be invested in projects; the remaining 31% will refinance existing loans and add to working capital per bond disclosures (China Finance Information, 2016). Companies that build or manage infrastructure projects may choose to tap into the bond market in larger volumes using the new guidelines.

Two important trends will be worth observing. First, what shade of green will the funded projects be? Green bond standards define some minimum characteristics, but not all bonds of the same category deliver the same environmental outcomes, and the standards that exist include some controversial decisions, such as the inclusion of categories related to coal (see Box 1).

Second, will the green bonds generate new capital for investments? Critics of green bond markets often question whether the bonds finance new projects or projects that would have happened anyway. Even if they merely speed the circulation of existing capital through refinancing, green bonds may help stimulate investments that might otherwise not have been made.

Figure 3
Use of proceeds of Chinese green bonds issued by financial institutions in 2016



Note: For detailed statistics, see table A.3 in the appendix. Data for the Industrial Bank is as of the end of October 2016. The use of proceeds (\$11.5 billion) is less than the total green bond issuance (\$24.2 billion) because banks may not deploy all the money they raised through bond issuance.

Source: China Finance Information, 2016.

4.2.2 Green credit

Historically, bank loans have been the most important source of funding for green investments (PBoC, 2016a). Green credit policies were initially introduced in China in 2007; the most recent update was the green credit guidelines issued in 2012. In addition to promoting environmental risk management, those guidelines defined the role of green credit in promoting a green, low-carbon, and circular economy. To complement them, the CBRC developed the green credit statistic form, which provides guidelines for measuring green credit, and required banks to complete the form every six months.

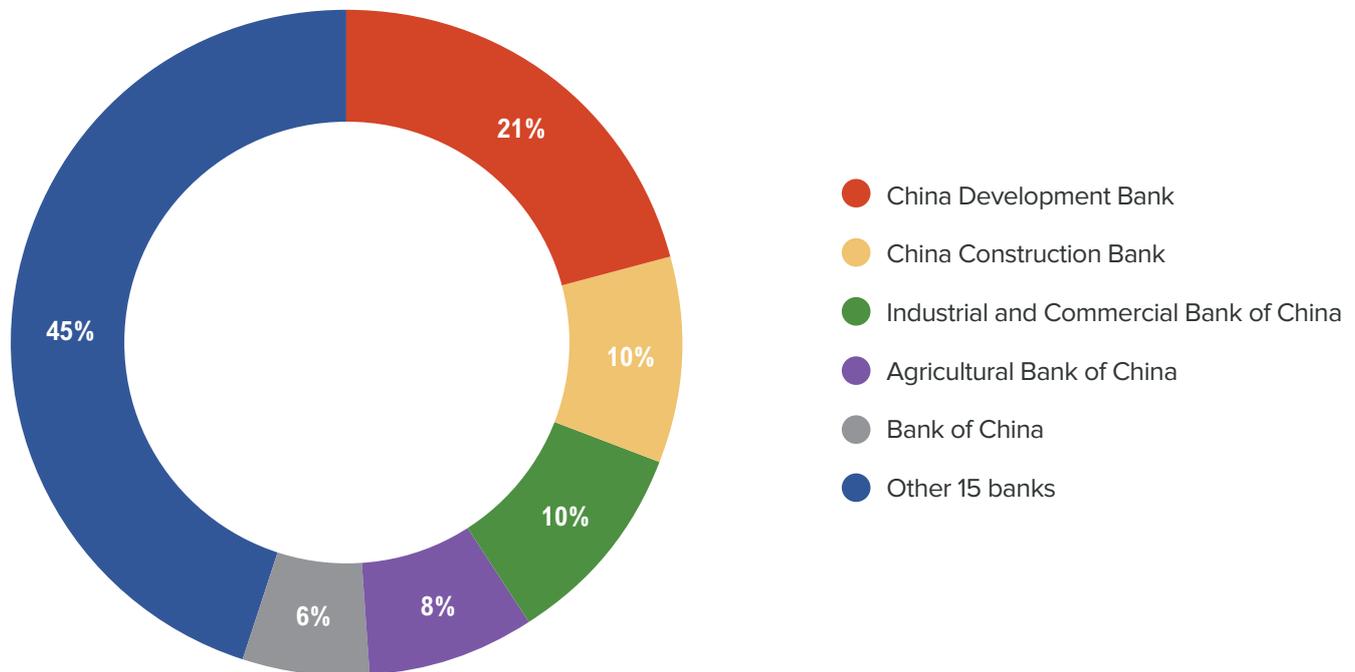
The guidelines have established a critical reference point for banks. But they are principle-based and general in nature and therefore lack specific protocols. Chinese banking and financial regulators have not yet established an evaluation system to underpin implementation, which some observers argue has led to uneven execution by banks (Economic Policy Research Center for Environment at the Ministry of Environmental Protection, 2010). In addition, certain types of green investments still face challenges in securing financing because of perceived risk.

A large proportion of bank loans still go to energy-intensive, highly polluting industries that have excess capacity (Wang, 2015). Because of their size, cash flow levels, assets, and other traditional measures, companies in these sectors may appear to have better credit profiles than less mature companies built on newer technologies. Older companies may also be perceived as having implicit or explicit guarantees from the local or national government.

The central government has issued several policies to resolve the overcapacity issue. Although it bans financing new projects in such industries, it promotes the acquisition of less efficient companies by more efficient ones and encourages commercial banks to finance such acquisitions (State Council, 2013). In addition, local governments are often unwilling to let insolvent companies go bankrupt because of concerns about unemployment, bad debt, and other issues associated with bankruptcy (Xinhua News Agency, 2014b).⁷ The process of resolving overcapacity in the iron, steel, and coal sectors is expected to speed up after the central government establishes the US\$16 billion (¥100 billion) special fund, mainly for relocating or retraining workers (Ministry of Finance, 2016a).

In 2015 green credit represented 9.7% of the total outstanding loans of 21 major Chinese banks, amounting to roughly US\$1.12 trillion (¥7.01 trillion) (Economic Daily, 2016a). The China Development Bank was the biggest issuer, with US\$240 billion (¥1.5 trillion) in outstanding green credit loans at the end of June, 2015, or 21% of total green credit (Figure 4) (CDB, 2016). The combined outstanding green credit loans of the “Big Four” commercial banks (the Bank of China, the Industrial and Commercial Bank of China, the Agriculture Bank of China, and the China Construction Bank) were US\$380 billion (¥2.4 trillion), or 34% of total green credit. The remaining 15 Chinese banks issued US\$500 billion (¥3.1 trillion) in green credit loans, or 45% of total green credit. These figures suggest that 55% of China’s green financial flows are dependent on the continued commitment of the five largest institutions.

Figure 4
Issuers of green credit in China in 2015



Note: Outstanding green credit of the China Development Bank is as of the end of June 2015.

Source: CDB, 2016; Economic Daily, 2016a; CCB, 2016; BOC, 2016; ABC, 2016; ICBC, 2016a.

Green credit varies greatly across sectors. As of the end of June 2014, 44% was invested in the transportation sector.⁸ Only 9% was invested in the solar and wind sectors (Figure 5) (CBRC, 2014a).

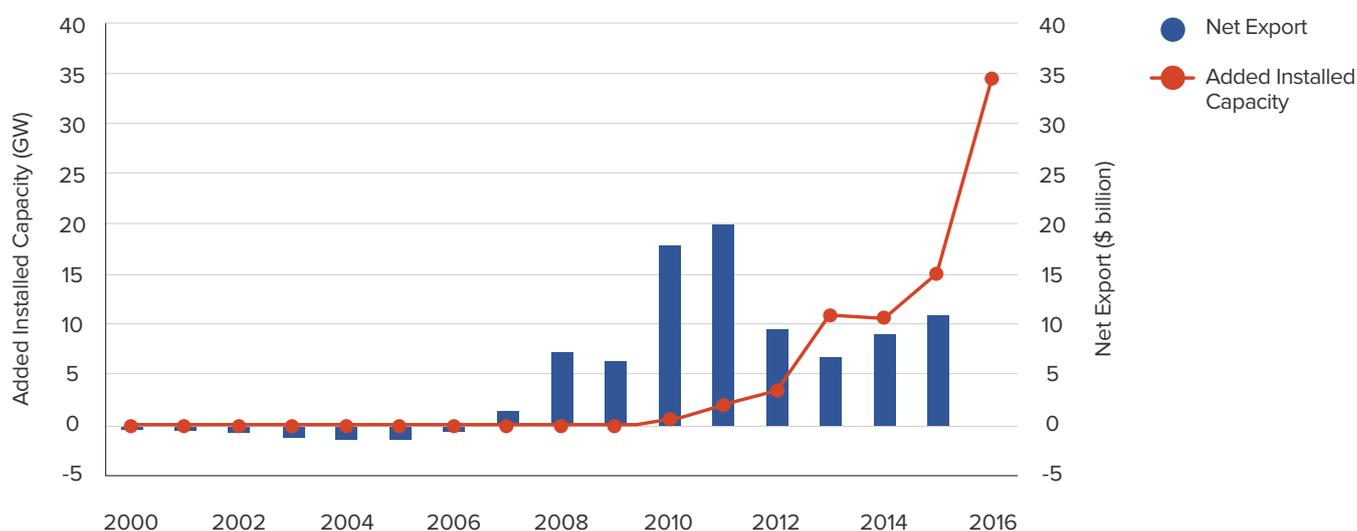
Box 3

Case Study: Increase in renewable energy installations

China's total electric power generation capacity reached 1,525GW in 2015, an increase of 11% over the previous year. Total installed renewable power generation capacity was 492GW (32% of total electric power generation capacity). Of the power-generation capacity added in 2015, 39% came from renewable energies. Wind power became the third-largest source of Chinese power production after thermal and hydro, with installed capacity increasing by a factor of more than 160 in the past decade, from 0.8GW in 2004 to 131GW in 2015. Installed capacity of solar PV also increased, rising from 0.9GW in 2010 to 42GW in 2015 (China Electric Council, 2016).

China's solar manufacture industry experienced high growth in the mid-2000s, driven by high demand from the European solar photovoltaic (PV) market. More than 90% of solar PV cells manufactured in China were exported (State Council, 2009); China's domestic solar power generation industry did not begin to develop substantially until 2012. In 2010, Chinese solar PV cell production surpassed global demand, prompting the Chinese government to issue incentive policies to increase domestic installation of solar PV power. The most important policy was a national feed-in tariff introduced in late 2011, at US\$0.15 (¥1) per kWh. Since then, Chinese domestic installed solar PV capacity has increased dramatically (NDRC, 2011).

Box figure 1.1 China's net exports of solar PV modules and added installed capacity, 2000–16



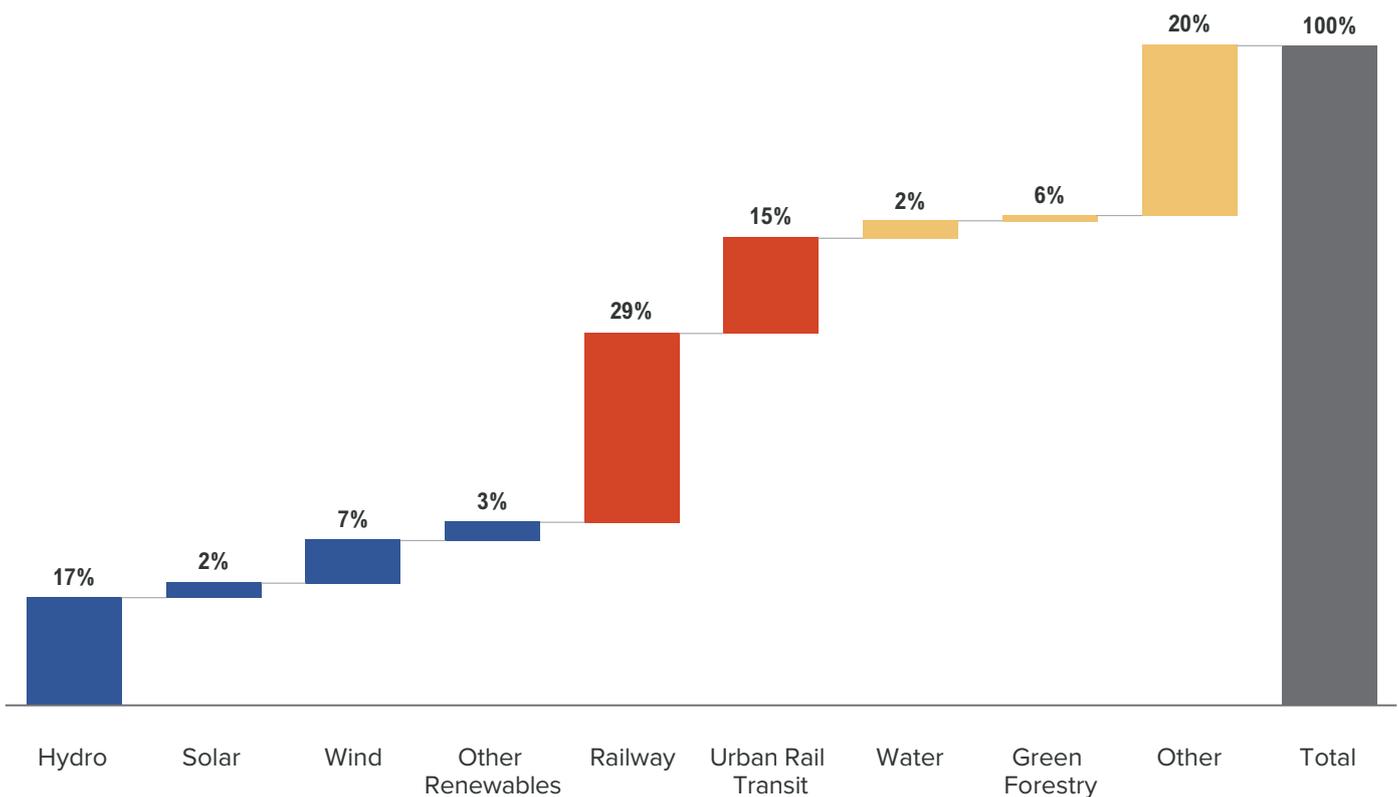
Source: National Renewable Energy Center, 2015; National Energy Administration, 2017; United Nations, 2016.

China's banking sector has played an important role in financing domestic renewable energy generation projects. The China Development Bank is one of the biggest renewable energy financiers in China. It participated in financing 33% of wind power projects and 30% of solar PV power generation projects in China. Its outstanding loans to new energy industries (wind, solar, and biomass) at the end of 2014 stood at US\$28.4 billion (¥187 billion) (CDB, 2015b).

Loans have flowed more readily to state-owned enterprises and listed companies; private companies find it difficult to obtain bank loans or raise capital through bond issuance (EY, 2014). Indeed, 80 percent of wind power generation and centralized PV power projects developed by state-owned enterprise came from bank loans (the rest was capital investment). In contrast, all of the funds for centralized PV power projects developed by PV manufacturers were in the form of capital (Zeng, Liu, Li, & Peng, 2014). It is even more difficult for distributed solar power generation projects to obtain external financing. Because such projects are smaller in capacity and less profitable than centralized PV power generation projects, they are less attractive to banks and investors.

Without new financing models, it will be very difficult to achieve the ambitious distributed solar development goals set by the government (EY, 2014). In the draft Solar Utilisation 13th Five-Year Plan (2016–20), China proposed having 70GW of installed distributed solar generation capacity by 2020 (Economic Daily, 2016b). In 2014, less than 17% of China’s total solar installed capacity was from distributed solar (National Renewable Energy Center, 2015). The draft Solar Utilisation 13th Five-Year Plan proposed studying establishing a national solar industry investment fund, a type of green development fund proposed in the Plan and the 13th Five-Year Plan (Economic Daily, 2016b). Such a fund could directly support distributed solar generation projects by providing capital.

Figure 5
Distribution of green credit in China by sector as of June 30, 2014



Note: Totals do not add up due to rounding.

Source: CBRC, 2014b

Given that green credit accounts for only 9.7% of outstanding loans, there is scope for increase. The 2015 report by the China Council for International Cooperation on Environment and Development (CCICED) recommends targeting 20% of total loan volume. The systematic green financial reform in the *Plan* calls for promoting green credit by providing incentives (e.g., interest subsidies) to help improve the financial profile of projects and increase the risk perception of high-polluting sectors by increasing banks' environmental liabilities. Reforms point in these directions, but it is still unclear how extensive they will be, and the data does not yet reveal significant acceleration in the marketplace.

4.2.3 Green development funds

The *Plan* calls for the establishment of market-oriented green development funds, a call that was echoed in the 13th Five-Year Plan with the inclusion of a new green development fund. To date, the central government has disclosed only the existing Energy Savings Special Fund, the Environmental Protection Special Fund, and other special funds as funding sources. It has not taken further steps to develop the detailed implementation plans behind these concepts.

Any funds established will face a few core questions that will define their place in the landscape of green finance in China:

- Will the fund be managed by a specialized investment enterprise or by a government agency?
- Will the fund rely primarily on grants or on incentives and de-risking mechanisms (e.g., guarantees, interest subsidies, etc.)?
- What types of investments will be allowed?
- What criteria will determine what constitutes a green project?

China has long had environmental protection funds and other channels for delivering government support to companies and projects. A path that is more market oriented and relies on leverage-based mechanisms would mark a significant departure from past approaches to disbursing funds.

Even as these new concepts were floated, innovation in the design of fund structures occurred at the sectoral and subnational level. Inner Mongolia launched an environmental protection fund, which was outsourced to a professional firm for management through the establishment of a master fund (People's Government of Inner Mongolia Autonomous Region, 2016). The National Energy Administration proposed a national solar fund, which will be open to private investors; it will focus on solar research and development (Economic Daily, 2016b). Chongqing has announced plans to launch a green development fund that will support green credit lending through the issuance of guarantees (Liu, 2016).

Subnational entities are moving forward. It is not yet clear whether the central government will create a new national green development fund or the degree to which it will pursue innovation in the design and deployment of existing funds. Two primary areas of innovation brought into the spotlight by the subnational announcements have been the use of professional management and the shifting of emphasis from grants towards public finance as incentives to generate a leverage effect to attract private investment.

4.3 MEASURES THAT MAY INCREASE DEMAND FOR SUSTAINABLE INFRASTRUCTURE⁹

Financial reforms are essential to creating a supply of funds for financing green investments. But institutions can engage in the market only if there is a steady pipeline of projects seeking financing. As demonstrated in the example of China's solar industry (see Case Study), policies that enable sustainable business models are critical to scaling investments. Policies that affect the costs associated with polluting, the pricing of inputs (resources), and performance standards are key to enabling reforms that stimulate demand to match the growing supply. China has taken varying degrees of action in these three areas.

4.3.1 Penalties for polluting

China's new Environmental Law went into effect January 1, 2015, dramatically changing the calculus of polluting in China. Historically, China has had strict laws on a number of environmental issues, but the penalties for noncompliance were very low. Under the revisions, the government has the power to impose a fine that compounds on a daily basis without limit to the size of the fine that can be accrued. Under the previous version of the law, the authorities imposed a one-time fine on each illegal

activity (Xinhua News Agency, 2014a). If aggressively implemented, the new law could have a profound effect on investment patterns as companies reassess the costs of noncompliance.

Six universities jointly published an assessment of the implementation of the new law in 2015 (Feng, 2016). It revealed that after implementation of the daily fine, 85% of violators undertook corrective action. In the past, some violators choose to simply pay the fine without taking any remedial action or investing in improvements to bring themselves into compliance. In 2015, the authorities transferred 2,079 administrative detention cases and 405 criminal cases to public security departments. The Ministry of Environment previously lacked the ability to bring this level of scrutiny and pressure on firms violating standards. In 2015, 52 cases of public interest environmental litigation were filed and accepted; there were virtually no cases before 2015 (Feng, 2016).

4.3.2 Environmental standards

Environmental standards set the minimum bar for achievement, which indirectly defines minimum levels of investment. Other types of standards, such as national or subnational targets, can also affect the decisions of private and public actors about initiating green investments if the government vigorously pursues them.

A systematic review of all of China's plans for environmental and other standards is beyond the scope of this paper. The government has already signalled its intentions to significantly tighten requirements in a number of areas under its "war on pollution" that will affect decisions on infrastructure investments. According to an environmental stress test conducted by the Industrial and Commercial Bank of China, 68–81% of small and medium-size firms with AA credit ratings will be downgraded because of the higher costs of compliance (ICBC, 2016b). These requirements include tightening controls affecting air, water, soil, and groundwater pollution and other areas. These reforms target infrastructure-relevant sectors, such as energy. Beyond its war on pollution, China is also tightening codes and requirements related to resource consumption (e.g., water and energy), which will also influence decisions linked to financing.

4.3.3 Emissions trading schemes

The cost of key inputs and resources influences decisions on usage and the relative merits of investments in achieving greater efficiency. In many countries, resources such as energy and water are not priced in a manner that reflects their actual economic costs, resulting in market externalities (such as carbon emissions). Alongside plans to green the financial system, the Plan has called for improving the governance of resources, including their pricing. Such adjustments could help drive demand for green and sustainable projects.

One of the most widely watched experiments has been China's movement towards establishing emissions trading schemes. At the 2009 Copenhagen climate talks, China committed to reduce the intensity of its CO₂ emissions by 40–45% by 2020 compared with 2005. The government chose an emissions trading scheme as the market tool to meet the target. To build experience and identify the challenges of establishing such a scheme, in 2013–14 it launched seven regional pilots (in Beijing, Chongqing, Guangdong, Hubei, Shanghai, Shenzhen, and Tianjin). A national emissions trading scheme is included in China's 13th Five-Year Plan and targeted to launch in 2017.

The pilot schemes have achieved mixed results. The government established operational schemes in a number of regions, creating important learning opportunities for China. In general, however, the carbon settlement prices were low and likely not at a level that would incentivise companies to pursue new green investments. The carbon prices of five regions (Chongqing, Guangdong, Hubei, Shanghai, and Tianjin) fluctuated around US\$3 (¥20) per ton of CO₂. The carbon prices for the other two pilots (Beijing and Shenzhen) fluctuated around US\$6 (¥40). According to one study, the abatement cost required to reduce Shenzhen's total emissions by 5% is about US\$20 per ton of CO₂ (Jiao, Xu, Ma, & Chen, 2014). Although the prices are too low, these schemes have nevertheless given China the opportunity to test approaches to implementation and build capacity. It will be important to watch how these pilots are incorporated into building a national scheme and the level of carbon pricing achieved.

5. Prospects for the future and questions

China has laid down the guideposts for nudging the economy towards a greener future. Its efforts at greening the financial system will play an important role in supporting sustainable infrastructure investment. Four areas are worth watching:

1. *Continued strengthening of demand-side drivers.* Efforts to stimulate expansion of green financing must be linked to the level of demand. China has already embarked on policy reforms around environmental standards and the internalizing of costs of unsustainable resource consumption and pollution. These efforts—including in politically challenging areas, such as reform of the fossil fuel subsidy and carbon pricing—must accelerate if the greening of the financial system is to take root. The degree of ambition and adherence to the specific targets underpinning the concept of ECZ will also play an important role.
2. *Development of a more comprehensive baseline and map of green financial flows.* China's green investment needs and current state of financing remain opaque. There is no well-established tracking system, and the data that is tracked (such as green credit statistics) is not released in sufficient detail. The problem reflects a variety of challenges, including the difficulty of defining green, the distribution of oversight and monitoring across multiple agencies, practical difficulties involved in tracing flows of private finance, and other issues. In the absence of a more robust capacity to track flows, it will be difficult to determine the effectiveness of different interventions and pinpoint blockages in the financial system.
3. *Alignment with the specific needs of sustainable infrastructure.* The reforms being implemented to green China's financial system are intended to address a wide range of needs; they are not aimed solely at financing infrastructure. The financing requirements for investment in more sustainable energy systems, urbanisation, and land use identified in New Climate Economy reports are different from the requirements for financing pollution control, soil remediation, and similar projects. In some cases, these differences pertain to the business models behind individual projects.¹⁰ However, some sustainable infrastructure opportunities (such as transport-oriented development) are tied to changes in modes of living as well as land use planning at the national and subnational levels, rather than solely the adoption of an improved technology within existing infrastructure systems. In developing reforms around green bonds, green funds, and green credit, it will be important to consider how they address the specific barriers associated with transitioning to and building out sustainable infrastructure.
4. *Real economy impacts of investment.* Policies and incentives aimed at stimulating investment can sometimes result in overinvestment in infrastructure or direct investments into infrastructure that cannot deliver its function. The most extreme cases are renewable energy investments that sit idle, unable to feed energy into the grid even after constructed. It is important to monitor policies over the course of implementation to ensure that they drive investments that produce the desired environmental and other outcomes on the ground, rather than only increase the investment volume.

How will China's proactive policy embrace of green finance affect its overseas investments, particularly investments that draw on public finance or involve state-owned enterprises? China has presented ambitious visions for its role in regional economic development through the One Belt, One Road plan and its sponsorship of new development finance institutions (the *Asian Infrastructure Investment Bank* and the *New Development Bank*) that are prioritizing infrastructure. These initiatives include nascent references to sustainability. For example, the One Belt, One Road plan states that "efforts should be made to promote green and low-carbon infrastructure construction and operation management, taking into full account the impact of climate change on the construction.... We should promote ecological progress in conducting investment and trade, increase cooperation in conserving eco-environment, protecting biodiversity, and tackling climate change, and join hands to make the Silk Road an environment-friendly one" (China Daily, 2015). The *New Development Bank* states that sustainability is its heart and has made some initial investments in renewables, although it has not yet introduced detailed policies (NDB, 2015). The *Asian Infrastructure Investment Bank* has begun to issue its sectoral policies and has a sustainability policy in place. Like the *New Development Bank*, it has stated that it intends to emphasise sustainability.

These new development finance institutions could use the new markets being created in China to support green projects in their international portfolios. For example, the institutions could issue green bonds in China and help apply the various tools being developed domestically within their overseas lending portfolios. China's state-owned or state-influenced investment vehicles, development funds, and other channels could also champion green investments internationally.

As China pursues the green transformation of its economy and financial system, it has a tremendous opportunity to integrate the spirit of its thinking into its vision for regional economic development and to help other countries avoid a resource-intensive and pollution-intensive development phase. There will be a significant incongruity if China is actively greening its own economy but making substantial pollution-intensive or resource-intensive investments overseas. As with its internal transformation, signals planted within its policies and plans indicate recognition of this potential—but the actual outcomes will be known only in the future.

APPENDIX

Table A.1

Estimated annual investment flows to selected sectors in China, 2011–15, US\$ billions

Sector	2011	2012	2013	2014	2015
Renewable energy					
Biofuel	0.55	0.02	0.03	1.06	0.35
Biomass and waste	2.59	2.63	1.79	1.03	0.47
Solar	10.93	21.31	26.41	35.94	54.82
Wind	23.73	25.19	26.47	39.50	45.71
Subtotal	37.80	49.15	54.70	77.53	101.36
Transport^a					
Railway	91.38	100.48	108.29	131.26	131.12
Rail transit system	29.97	32.72	39.93	52.73	59.06
Subtotal	121.35	133.20	148.22	183.99	178.87
Water^b					
Water supply	8.66	8.83	11.22	12.72	12.78
Sewerage	15.03	14.81	17.16	16.08	19.92
Subtotal	23.69	23.63	28.38	28.80	32.70
Forestry^c					
Ecological construction	20.15	25.42	30.43	31.61	—
Forestry support	4.65	3.53	3.61	3.78	—
Forestry development	8.08	13.01	17.53	26.29	—
Forestry project for people's livelihood	0.00	3.89	3.04	2.49	—
Other investment	7.85	7.12	6.92	6.03	
Subtotal	40.73	52.97	61.52	70.20	80c
Total	223.57	258.95	292.82	360.52	390.23

Notes: 1. Annual foreign exchange rates were obtained from the U.S. Board of Governors of the Federal Reserve System;

2. — Not available.

a. Data are for investment in fixed assets.

b. Data are for completed investments.

c. Authors' estimation.

Source: BNEF, 2016; National Bureau of Statistics, 2012; National Bureau of Statistics, 2013; National Bureau of Statistics, 2014; National Bureau of Statistics, 2015; Ministry of Transport, 2014; Ministry of Transport, 2015; Ministry of Transport, 2016; Ministry of Railways, 2012; Ministry of Railways, 2013; Ministry of Housing and Urban-rural Development, 2014; Ministry of Housing and Urban-rural Development, 2015; Ministry of Housing and Urban-rural Development, 2016

Table A.2

Green bonds issued in China in 2016

Issuer	Issue date	Face value		Coupon rate
		RMB billions	US\$ billions	
Shanghai Pudong Development Bank	1/27	20	3.06	2.95
Industrial Bank	1/28	10	1.53	2.95
Qingdao Bank	3/10	3.5	0.54	3.25
Qingdao Bank	3/10	0.5	0.08	3.40
Shanghai Pudong Development Bank	3/25	15	2.30	3.20
Century Concord Wind Power	4/6	0.2	0.03	6.20
BAIC Motors	4/22	2.5	0.38	3.45
Zhejiang Jiahua Energy	5/23	0.3	0.05	4.78
Goldwind	5/24	1	0.15	5.00
Huaneng Renewables Corporation Ltd.	7/8	1.14	0.17	2.95
Jiangxi Bank	7/12	3.5	0.54	3.41
Jiangxi Bank	7/12	1.5	0.23	3.70
Shanghai Pudong Development Bank	7/14	15	2.30	3.40
Industrial Bank	7/14	20	3.06	3.20
New Development Bank	7/18	3	0.46	3.07
Beijing Enterprises Water Group Ltd.	8/2	0.7	0.11	3.25
Jiangxi Bank	8/4	1.5	0.23	3.20
Jiangxi Bank	8/4	1.5	0.23	3.48

Issuer	Issue date	Face value		Coupon rate
		RMB billions	US\$ billions	
China Energy Conservation and Environmental Protection Group	8/16	1	0.15	2.89
China Energy Conservation and Environmental Protection Group	8/16	2	0.31	3.13
China Three Gorges Corporation	8/26	3.5	0.54	2.92
China Three Gorges Corporation	8/26	2.5	0.38	3.39
Goldwind	9/1	0.5	0.08	4.20
Beijing Enterprises Water Group Ltd.	9/12	2.8	0.43	3.68
China Energy Conservation and Environmental Protection Group	9/23	1	0.15	3.11
China Energy Conservation and Environmental Protection Group	9/23	1	0.15	3.55
China Datang Corporation Renewable Power Co. Ltd.	9/27	0.5	0.08	3.15
Poten Enviro	10/12	0.3	0.05	4.67
State Grid Corporation of China	10/20	5	0.77	2.80
State Grid Corporation of China	10/20	5	0.77	2.99
China Datang Corporation Renewable Power Co. Ltd.	10/20	0.5	0.08	3.10
Wuhan Metro Group Co. Ltd.	10/26	2	0.31	3.35
Shenzhen Green Eco-Manufacture Hi-Tech Co. Ltd.	10/28	0.5	0.08	4.47
Beijing SPC Environment Protection Tech Co. Ltd.	10/28	1.09	0.17	3.70
Beijing Enterprises Water Group Limited	11/2	2.8	0.43	3.70
Yunnan Energy Investment Group	11/7	0.5	0.08	3.98
Industrial Bank	11/17	20	3.06	3.40

Issuer	Issue date	Face value		Coupon rate
		RMB billions	US\$ billions	
Bank of Communications	11/21	10	1.53	2.94
Bank of Communications	11/21	20	3.06	3.25
Qingdao Bank	11/22	1	0.15	3.40
Qingdao Bank	11/22	3	0.46	3.30
Dun An Group	11/29	1	0.15	4.56
Urumqi Bank	12/6	0.5	0.08	3.95
Export Import Bank of China	12/6	1	0.15	3.28
Jiangsu Guoxin Investment Group	12/7	0.2	0.03	3.30
Jiangsu Nantong Rural Commercial Bank	12/9	0.5	0.08	4.00
Guangdong Huaxing Bank	12/19	1	0.15	3.98
China Agriculture Development Bank	12/21	6	0.92	3.79

Source: China Finance Information, 2016

Table A.3

Use of proceeds of Chinese green bonds issued in 2016, US\$ millions

Use	Shanghai Pudong Development Bank	Industrial Bank ^a	Qingdao Bank	Jiangxi Bank	Export-import Bank of China	Total	Percent of total
Clean transportation ^b	1,384	1,119	26	107	—	2,635	23
Pollution prevention and control	1,707	197	252	11	—	2,166	19
Ecological protection and climate change adaptation	983	541	74	521	—	2,119	18
Resource conservation and recycling	1,662	234	58	—	—	1,954	17
Energy saving	549	955	240	—	—	1,744	15
Clean energy	698	94	42	3	31	837	7
Total	6,984	3,140	691	642	31	11,456	100

Notes: — Not available.

a. Data are as of the end of October 2016.

b. The banks do not disclose the details of these investments. However, China's green bond standard recognizes railway, urban rail transit, public transportation vehicles and operating facilities, water transportation, production and operation facilities for new-energy vehicles, and clean gas and diesel refineries.

Source: China Finance Information, 2016

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ENDNOTES

- ¹ Numerous economists inside and outside China argue that this level of investment will increasingly be incompatible with China's level of development and will likely result in an inefficient allocation of capital.
- ² The set of agencies included the People's Bank of China, the Ministry of Finance, the National Development and Reform Commission, the Ministry of Environment Protection, the China Banking Regulatory Commission, the China Securities Regulatory Commission, and the China Insurance Regulatory Commission.
- ³ Financial assets consist of claims arising from contractual relationships entered into when one institutional unit provides funds to another. Major financial assets include cash, debt securities, loans, equity and investment fund shares, insurance, and financial derivatives (IMF, 2016).
- ⁴ Enterprise bonds in China are usually issued by non-listed, non-financial state-owned enterprises; corporate bonds are issued by listed companies. (J.P. Morgan Asset Management, 2009; Jingu, 2015).
- ⁵ The PBoC serves as China's central bank and regulates its financial institutions. The NDRC plays a broad role in economic planning and is the lead agency on climate change and reduction of emissions in China. It has authority to develop related guidelines for industry.
- ⁶ Energy savings includes four subcategories: industrial energy saving, sustainable building, energy management center, and urban and rural infrastructure construction with energy-saving efficiency. Pollution prevention and control includes three subcategories: pollution prevention and control, environmental restoration project, and clean utilization of coal.
- ⁷ The employment of 2 million people in China is linked to overcapacity in the steel and coal sectors alone (China News, 2016).
- ⁸ Transportation projects under green credit are likely to be considered green. Subsectors under transportation include: 10.1 Railway transportation projects, 10.2 Waterway management and vessel purchasing projects, 10.3 Urban public transportation projects, 10.4 Transportation environmental protection projects.
- ⁹ Other barriers to greening the financial system (e.g., the legal system, institutional arrangements, capacity building) are beyond the scope of this paper. For more discussion, see Wang (2015).
- ¹⁰ One example is renewable energy projects that have differing profiles in terms of capital needs, maturation times, and ongoing operating costs/cash flows than coal power. Another is the case of energy service companies, which often struggle to secure bank financing in China because of their low capitalization and banks' uncertainty in estimating reliability of their cash flows.

ABOUT THE NEW CLIMATE ECONOMY

The Global Commission on the Economy and Climate and its flagship project The New Climate Economy were set up to help governments, businesses and society make better-informed decisions on how to achieve economic prosperity and development while also addressing climate change.

In September 2014, the Commission published *Better Growth, Better Climate: The New Climate Economy Report*. Since then, the project has released a series of country reports on the United States, China, India and Ethiopia and sector reports on cities, land use, energy and finance. In July 2015, the Commission published *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. In 2016, it released *The Sustainable Infrastructure Imperative: Financing for Better Growth and Development* (title italicized), which identifies the barriers to financing sustainable infrastructure and suggests measures to overcome them. It has disseminated its messages by engaging with heads of governments, finance ministers, business leaders and other key economic decision-makers in over 49 countries around the world.

The authors

Sean Gilbert, Senior Associate, Sustainable Finance Program at World Resources Institute

Lihuan Zhou, Research Analyst, Sustainable Finance Program at World Resources Institute

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