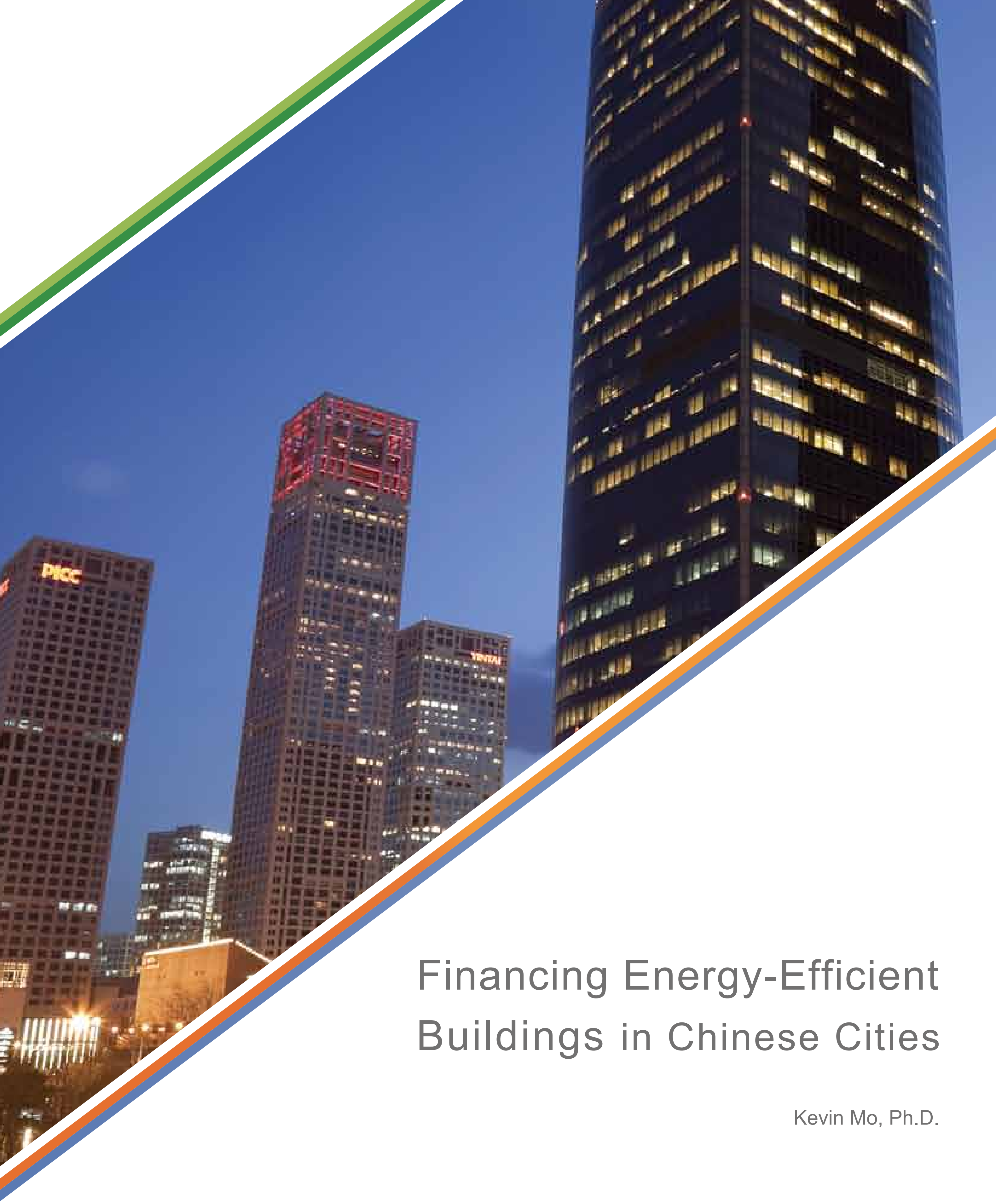

Financing Energy-Efficient Buildings in Chinese Cities

Kevin Mo, Ph.D.

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Executive Summary

In March 2016, the National People's Congress (NPC) and the Chinese People's Political Consultative Conference (CPPCC) approved the outline of the 13th Five-Year Plan for the National Economic and Social Development (2016-2020). One goal stood out among many others—a cap on national total energy consumption by five billion tonnes of coal equivalent (TCE). This is yet another national directive of China designed to combat global warming and reach its peak carbon emission level by 2030 or earlier. Indeed, the coming five years will be a critical period for China to transition towards a green and low-carbon economy.

The question is, how to stay within the energy target while growing the economy and rapidly expanding the country's cities. China's historic urbanization drive will see as many as 100 million people migrating to cities from rural areas in the next five years, and they will all need to live and work somewhere. Constructing and managing more energy-efficient buildings will be key to the country's ability to transition to a low-carbon economy.

China's green building efforts so far have been heavily reliant on government subsidies through non-market based financing mechanisms. Massive districts of green buildings are planned, but most never leave the blueprint stage because of the high costs. Retrofitting of existing buildings, meanwhile, is extremely expensive—and usually relies on government support. During the 12th Five-Year Plan period (2011-2015), although over 700 million square meters of existing residential buildings in northern China were retrofitted to improve their energy performance, more than 80 percent of the costs were subsidized by central and local governments.

Private capital is rarely invested in green buildings. The following challenges continue to hamper the development of a robust green building sector in China: inadequate long-term energy efficiency planning, outdated building energy standards and inadequate research, overreliance on state subsidies and the absence of market mechanisms, poor connection between green building labels and actual performance, and slow progress in public disclosure of building energy use.

This study shows that, **during the 13th Five-Year Plan period, Chinese cities will need to invest RMB 1.65 trillion (US250 billion)** to significantly scale green buildings and retrofit older houses and commercial buildings. Given the size of the investment required, government funds alone will not be enough. **New financing models will be needed to attract private investment to bridge the huge financial gap.**

The good news is that private investors have already shown increasing interest, with some companies investing in green buildings as a way to mitigate potential long-term carbon risks. But the question is, how to efficiently leverage fiscal budgets and develop market-based financing tools to attract private capital to green city development and retrofitting. Scaling up green finance will be the key to China's ability to create low-carbon cities.

To truly drive energy efficiency in China's buildings, new finance models and energy policy must go hand in hand. This report proposes the following recommendations to spur market-based financing mechanisms in Chinese cities:

- Adopt a long-term national plan on building energy efficiency and legislation to mandate green buildings.
- Mandate public disclosure of building energy data and establish independent third-party evaluation mechanisms for green buildings.
- Establish policies to encourage concessional loans for highly energy-efficient buildings.
- Establish building energy performance standards to encourage green building insurance and mandate insurance policies for building retrofits.
- Establish new financing mechanisms, including green building development funds and municipal bonds for urban-scale building retrofits.
- Encourage international cooperation and international green loans and funds.

CONTENTS

Foreword

China's sustained and rapid economic growth in the past three decades has made it the second largest economy in the world, but also the largest carbon emitter. 2016 marks the beginning of the 13th Five-Year Plan (FYP) period (2016-2020) and a "new normal" for the country's economic development: China has lowered its expected GDP growth rate and is under pressure that threatens further slowing of the rate. The development course that China takes during the next five years might very well determine whether it can avoid falling into the middle-income trap.

The good news is that the central government, which is firmly committed to reducing energy consumption and carbon emissions, is prepared to leverage the opportunities created by the economic slowdown to transform the country's industrial structure and energy mix, cut excess capacity of energy-intensive and high-emission industries such as steel and coal, and pave the way for China's transition to a low-carbon economy. At the annual meetings of the National People's Congress (NPC) and the Chinese People's Political Consultative Conference (CPPCC) in March 2016, the government proposed the goal of capping total energy consumption at five billion tonnes of coal equivalent (tce) by 2020. Vice Premier Zhang Gaoli signed the Paris Agreement on climate change at the United Nations headquarters in April 2016, formalizing China's commitment to peaking its carbon dioxide emissions around 2030 or as early before that as possible.

There is neither any doubt about the central government's determination to tackle climate change nor any ambiguity about its long-term climate goals. The attainment of these goals, however, hinges on the capacity of local governments at all levels to implement and enforce them. Municipal governments will be the vanguard in energy conservation and emission reduction efforts, because, as a result of rapid ongoing urbanization, cities are China's prime carbon emitters. The pressure to reduce energy consumption and air pollution prompted mid-to-large cities, most of which are concentrated in China's economically developed coastal regions, to close down or relocate high energy-consuming industries starting in the mid 2000s. Meanwhile, the shift towards a services-driven economy is underway: the share of urban GDP contributed by service industries has been steadily growing. These economic shifts, combined with the continuing resettlement of rural populations to urban areas, mean that buildings will account for a growing percentage of cities' energy consumption going forward.

China already has mandatory national building codes, requiring greater energy efficiency in new construction in particular. 2016 marks the 30th anniversary of the country's first building efficiency codes. But large-scale energy efficiency initiatives only began in 2008, in the form of retrofitting residential buildings in northern China, where heating dominates in winter. From 2011-2015, the central government set about retrofitting public buildings nationwide and buildings in hot-summer-cold-winter regions to make them more energy efficient.

The financial resources that China has poured into retrofitting buildings and the resulting achievements are unprecedented in the world. But because a market mechanism has yet to be established for these efforts, the central government and local governments at all levels have needed to invest tens of billions of RMB, with very little private capital investment. That model is unsustainable: urban building retrofits will slide into stagnation if government financial support dries up.

China is already not meeting its own goals on green buildings. Between 2008, when a voluntary green building rating system was launched, and 2015, 500 million square meters of buildings were certified with the green building labels, falling 50 percent short of the government's goal. This is partly due to the fact that the Ministry of Finance's green building subsidy program, announced in 2012, was never implemented.

Given the enormous investment required to support the construction of energy-efficient buildings and large-scale retrofits of older buildings, it is evident that government subsidies alone will not be enough. Innovative financing models must play a pivotal role in filling the huge financial gap.

This report explores how to use new, low-risk investment and financing models to attract private capital to the construction of large scale green buildings and energy efficiency improvements. Because regular new buildings are subject to mandatory building efficiency regulations, they are not eligible for government subsidies or green finance unless they perform better than the building codes. Similarly, although passive ultra-low energy buildings (a.k.a. zero carbon buildings or zero energy buildings) achieve much higher efficiency performance than building codes require, they are not ready for scaling yet due to immaturity of technologies. This report will not cover the above two building categories.

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April 2016

Chapter 1: Building Energy Efficiency in Chinese Cities

This chapter will describe how China's urbanization process and green transition have caused the building sector's share in municipal energy consumption to steadily rise; and retrace the steps Chinese cities have taken towards energy-efficient buildings.

1. Urbanization Drives Up the Number and Scale of Chinese Cities

1 Building Energy Conservation Research Center, Tsinghua University. "2016 Annual Report on the Development of Energy Efficiency Buildings in China." China Architecture & Building Press, 2016, Page 2.

2 "Circular of the State Council on the Adjustment of City Classification Standard." Xinhua, November 20, 2014, accessed at http://www.gov.cn/xinwen/2014-11/20/content_2781156.htm.

Urbanization has been the engine powering China's economic surge. As rural populations migrate to cities, both the size and number of cities have increased significantly. Starting from a mere 37.7% in 2001, China's urbanization rate has been gaining an average of more than one percentage point per year (Figure 1). More than 500 million people have migrated from the countryside to cities during the 35-year span from 1980 to 2015, and an additional 100 million are expected to follow suit in the next five years based on the target urbanization level of 60% called for in the 13th Five-Year Plan.

The growing number and scale of Chinese cities has even prompted the central government to revise how cities are classified by size. On November 20, 2014, the State Council released a circular[2] containing a new classification scheme which, when viewed in relation to the old standards, clearly demonstrates the continuing growth of Chinese cities (Table 1). In addition to raising both the upper and lower population thresholds for each category, the new classification scheme has also increased the number of city types from four to five by adding a fifth category for megacities with over 10 million residents. By the previous standard, any city with a population of one million would be deemed super-large; under the revised classification, such a number would only mark the dividing line between medium-sized and large cities.

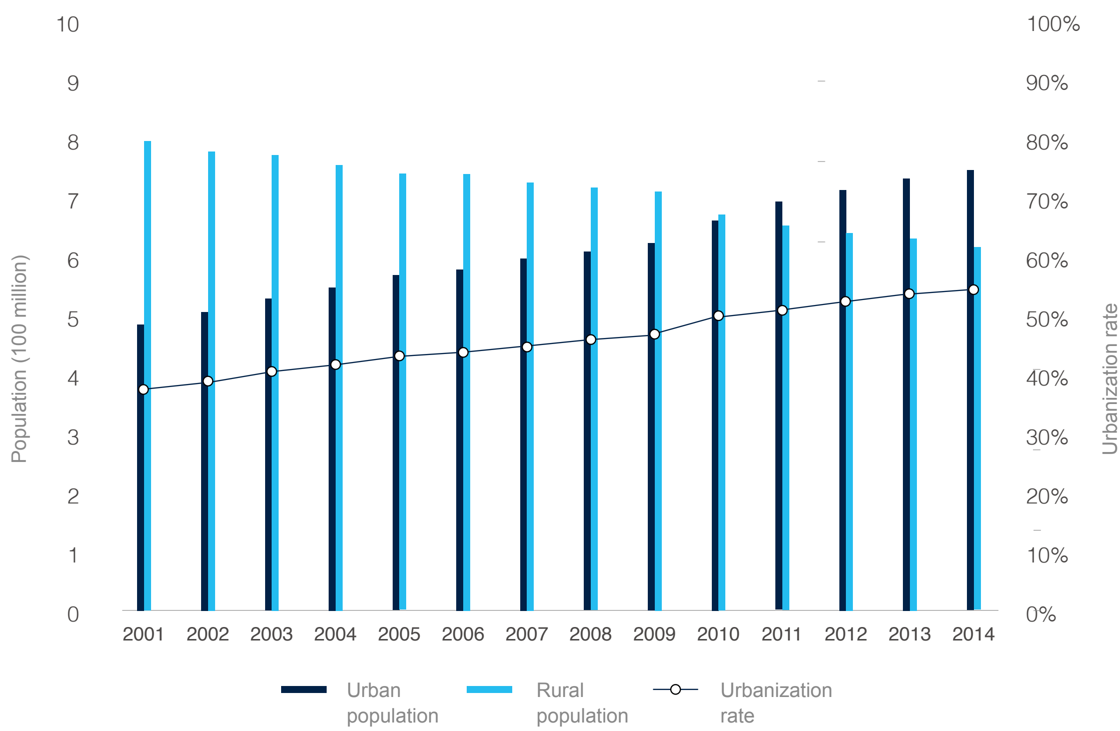


Fig. 1: Change in China's Urban and Rural Populations and Urbanization Rate (2001-2014)[1]

	New Standard			Old Standard
Small cities	< 500,000	Type I	200,000-500,000	< 200,000
		Type II	< 200,000	
Medium-sized cities	500,000-1,000,000			200,000–500,000
Large cities	1-5 million	Type I	3–5 million	500,000–1,000,000
		Type II	1–3 million	
Super-large cities	5-10 million			> 1 million
Megacities	> 10 million			N/A

Table 1: Comparison of the Old and New Standards for the Classification of Chinese Cities

In 2013, China had 11 super-large cities, with 7 of these boasting a population of over 10 million. By 2015, according to an OECD report[3], the number of megacities in China had increased to 15 (Figure 2). Data also show the size of a city is positively correlated to its per capita GDP (Figure 3). Specifically, the per capita GDP in super-large cities is almost 67% higher than that of Type I small cities, which shows the importance of urbanization to maintaining China's economic growth.

3 "International media: China has at least 15 megacities in addition to Beijing, Shanghai, Guangzhou and Shenzhen." Phoenix International, April 21, 2015, accessed at http://finance.ifeng.c1/13651513_0.shtml.

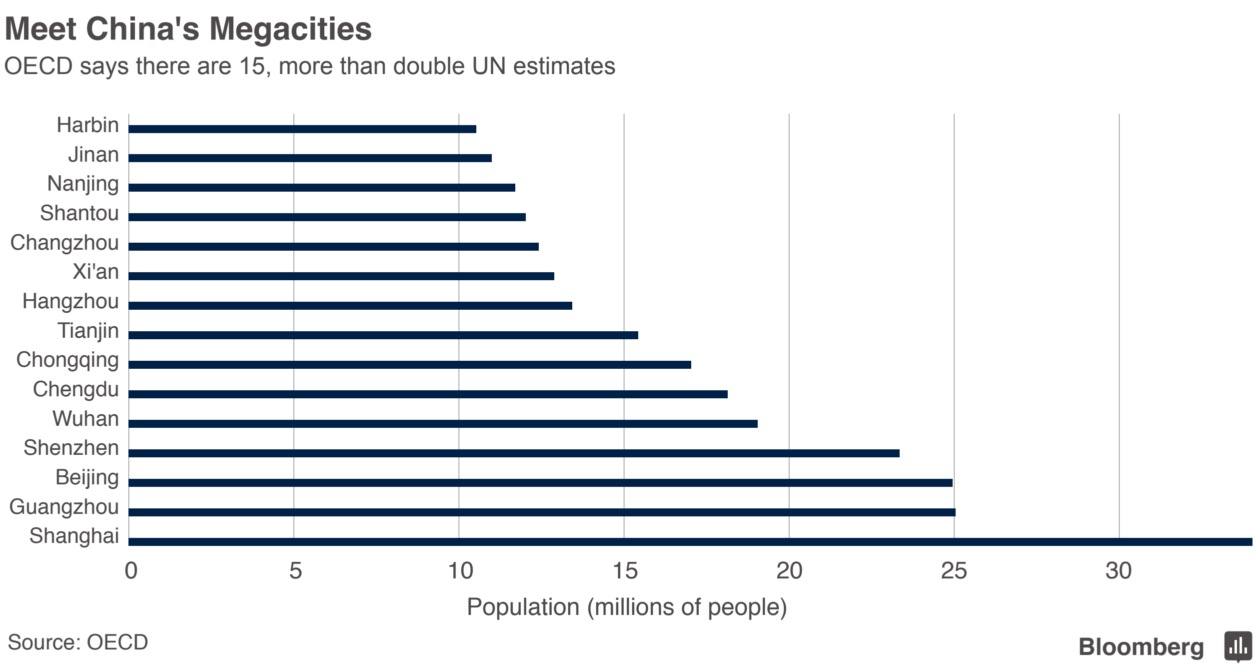
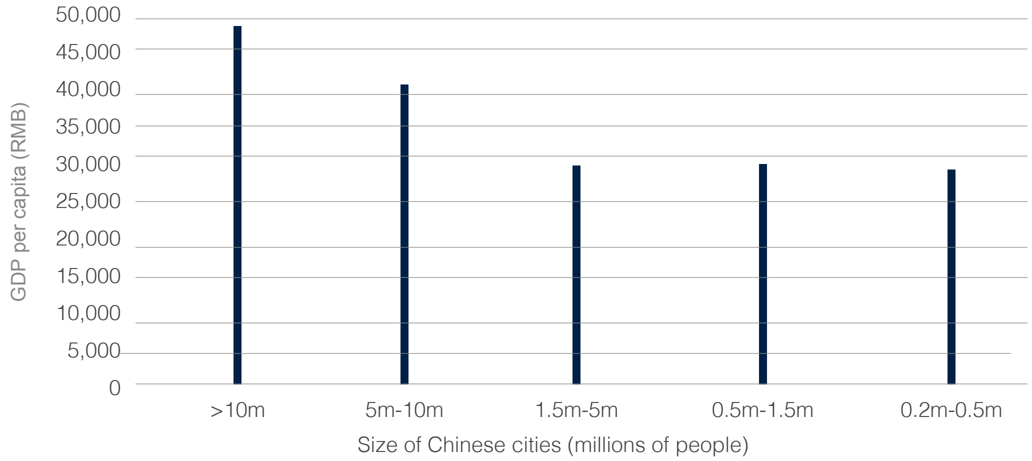


Fig. 2: Number of China's Super-Large Cities and Megacities is Double the UN Estimate[3]

Big Cities Are More Productive

The greater the population, the greater GDP per person



Source: OECD, based on data from National Bureau of Statistics of China
*Growth numbers from 2006-2010

Bloomberg

Fig. 3: Larger Cities Have Higher Per Capita GDP[3]

2. Urbanization Drives Up Total Floor Area and Energy Consumption of Buildings

Not surprisingly, rapid urbanization has spurred a building boom in China's cities.

Higher building stock and living standards are directly responsible for an energy consumption hike in construction activities and building operations. In 2014, according to a study by Tsinghua University, construction activities accounted for about 16% of total energy consumption in China while the operation of buildings made up 20%, meaning 36% of total energy consumption in China that year was attributable to the construction sector. Based on a different statistical approach, another study believes that building operations in fact consumed 28% of the energy supply in China[4] , which would make the construction sector account for as much as 44% of the total energy consumption in China.

4 Center for the Development and Promotion of Science and Technology, Ministry of Housing and Urban-Rural Development. "Report on Building Energy Efficiency in China 2010." China Architecture & Building Press, 2010, page 1.

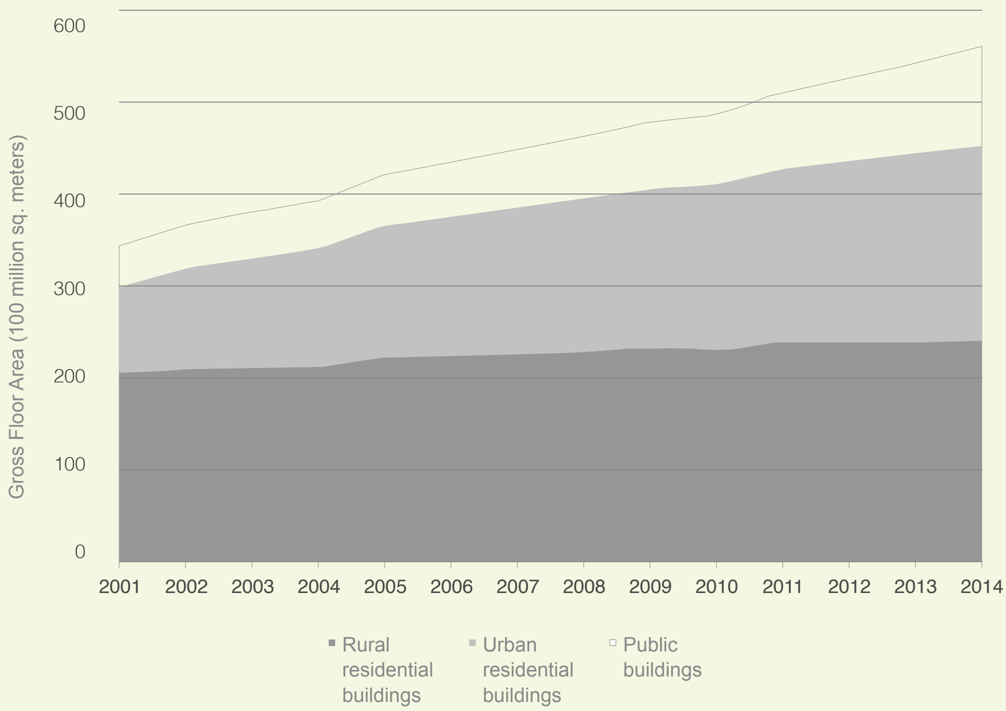


Fig. 4: Building Floor Areas in China (2001-2014)[1]

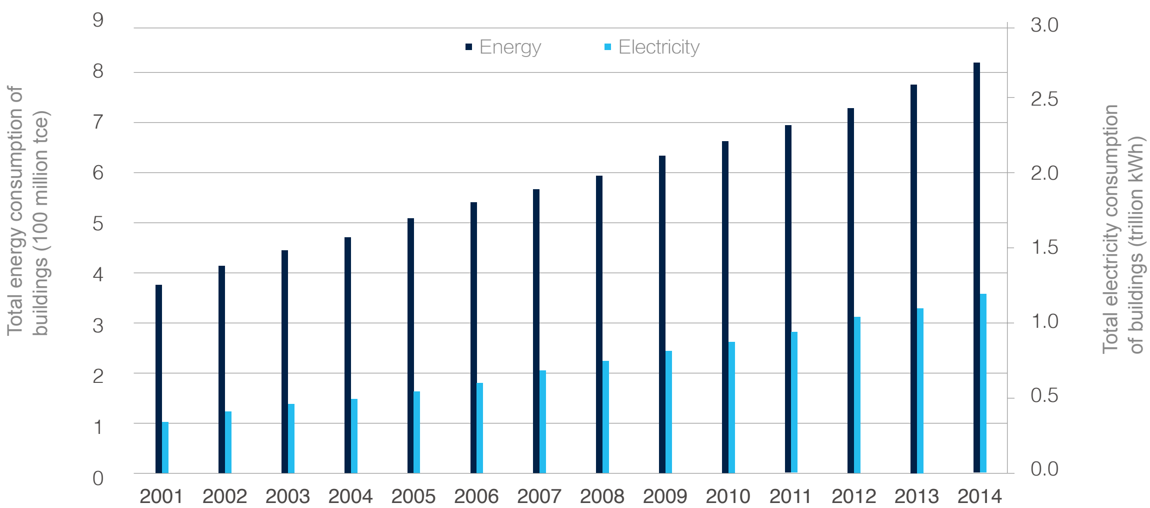


Fig. 5: Total Energy and Electricity Consumption of Buildings (2001-2014)[1]

3. Low-Carbon Transition Pushes Up Relative Carbon Emissions of Urban Buildings

5 J. Dickinson et al. "Inventory of New York City Greenhouse Gas Emissions." Mayor's Office of Long-Term Planning and Sustainability, New York, 2012.

6 Cai Weiguang. "Study on the Calculation of Energy Consumption in Buildings at the Provincial Level and Forecast of Energy Conservation Potentials." Sponsored by the Energy Foundation, 2013.

Cities are the single largest source of carbon emissions in China. As industry moves out of the cities—part of Beijing's plan to develop a services-driven economy and tackle environment pollution—buildings will account for an increasing percentage of cities' carbon emissions. As such, buildings will be key to bringing down emissions. Beijing is leading the way: the service sector, led by the financial industry, today makes up some 80% of its GDP. In most Chinese cities, where industry is still a dominant force, buildings currently account for only 20%-25% of energy consumption. By contrast, buildings account for more than 50 percent of Beijing's energy use (Figure 6). Beijing's transition illustrates the dynamic changes that will be coming to the composition of carbon emissions in Chinese cities in the next two decades. (Buildings accounted for more than 75% of the total carbon emissions of New York City in 2012.[5])

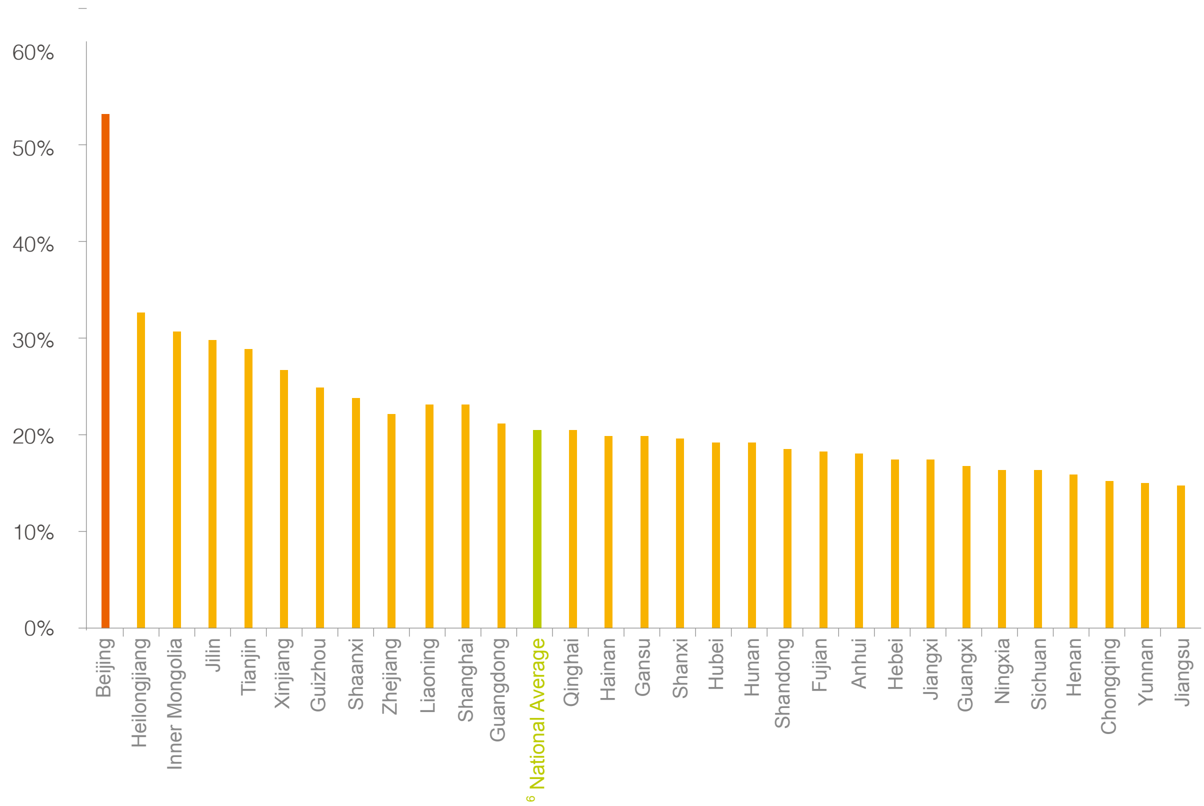


Fig. 6: Ranking of the Share of Building Energy Consumption by Province[6]

4.The Road Towards Energy-Efficient Urban Buildings

4.1 Laws and Regulations

The year 2008 marked a watershed moment for China in its trek towards law-based governance for energy efficiency in buildings. The revised Energy Conservation Law that took effect that year established the work relating to enhancing the energy efficiency of buildings. The Regulations on Energy Conservation in Civil Buildings promulgated that year provided a more specific guideline for related on-the-ground work. These two legal texts, which laid legal foundations, were followed by a string of regional regulations enacted by provincial, municipal, and local governments.

4.2 Building Standards and Codes

Given China's vast expanse of land and diverse climate, the standards for energy-efficient designs for residential buildings depends on which of the three climate zones the buildings are located within. These climate zones are the cold-severe cold zone in the north, hot-summer/cold-winter zone along the middle and lower reaches of the Yangtze River, and hot-summer/warm-winter zone in southern China. Energy efficiency standards for public buildings, by contrast, are uniform across the country regardless of the climatic zones. The standards, developed based on 1980s energy consumption levels, and by regulation, should be updated every five years. But in practice these updates often fail to meet this timeline.

Major Standard		1986	1995	2001	2003	2005	2006	2010	2012	2015
Design Standard for Energy Efficiency of Residential Buildings	Cold-Frigid Zone	Issued (30%)	Revised (50%)					Revised (65%)		
	Hot-Summer-Cold-Winter Zone			Issued (50%)				Revised (65%)		
	Hot-Summer-Warm-Winter Zone				Issued (50%)				Revised (65%)	
Design Standard for Energy Efficiency of Public Buildings						Issued (50%)				Revised (62%)
Evaluation Standard for Green Buildings							Issued			Revised

Note: percentages in parentheses indicate how much energy is saved versus baseline figure.

Table 2: Revision Timline of National Building Energy Efficiency Standards

4.3 Raising Energy Efficiency of Urban Buildings

China's efforts on improving buildings' energy efficiency are mainly concentrated in the following areas: raising the energy efficiency standards for new buildings and subsequent supervision of their implementation; energy retrofits of existing buildings; application of renewable energy in buildings; and development of green buildings and green ecological districts. Among these options, constructing new energy-efficient buildings and building retrofits present the largest carbon emission reduction potential.

4.3.1 Improving Energy Efficiency of New Buildings

Imposing energy efficiency standards on new buildings is widely regarded as the most effective policy tool for energy conservation and carbon reduction – provided that the standards are compulsory and enforced through adequate local-level supervision of their implementation. Additionally, every update to the energy efficiency standards should mandate more stringent requirements over previous versions while permitting provincial and municipal governments to enact even tougher standards than the ones imposed at the national level. In northern parts of China such as Beijing and Hebei Province, a mandatory standard for new residential buildings requiring a 75% energy use reduction from the baseline is now in effect.

Non-compliance continues to be a challenge. Real estate developers often don't comply with national energy efficiency standards in order to cut cost. The key to increasing compliance lies in monitoring and enforcement by local authorities—not subsidies or financial incentives. In fact, subsidies and incentives tend to have a counter-productive effect, giving developers the option not to comply.

4.3.2 Improving Energy Efficiency of Existing Buildings

Retrofits of existing buildings in China started in 2008 with residential buildings in the northern heating region. During the 11th FYP period, the Ministry of Housing and Urban-Rural Development (MOHURD) called for retrofitting 150 million square meters of the region's existing residential buildings. The central government planned to subsidize the retrofits, with a subsidy from the Ministry of Finance at RMB 55 yuan/m^2 for severe-cold regions and RMB 45 yuan/m^2 for cold regions,[7] supplemented by subsidies at provincial and municipal levels. However, due to the lukewarm response from local governments and residents, only 39.65 million square meters of existing buildings were retrofitted by the end of 2008, falling short of the target of 50 million square meters. Under pressure to meet the initial target, the Ministry of Finance and MOHURD changed the funding model by setting up a startup fund in 2009 to jump-start retrofit projects and assigned the task of retrofitting 150 million square meters of building to 15 provinces and cities in northern China.

During the winter of 2008, retrofitted residential buildings demonstrated considerable energy savings and improved comfort level. Indoor temperatures increased by 3 to 5 degrees Celsius across the board; walls were no longer eroded by condensation and mold; noise levels dropped; heating-related energy consumption reduced sharply; and resale prices of retrofitted homes generally went up by RMB 300 to RMB 1,000 per square meter. These benefits kindled the enthusiasm of local authorities to redouble their efforts. By the end of the 11th FYP period, the 15 provinces and municipalities in northern China had retrofitted a total of 182 million square meters of residential buildings, beating the initial target and cutting energy consumption by 3.45 million tonnes of coal equivalent, CO_2 emissions by 8.83 million metric tons and SO_2 emissions by 430,000 metric tons. The central government dispensed RMB 9 billion in financial incentives, attracting RMB 45 billion of investment in relevant industries and creating 300,000 jobs.

During the 12th FYP period, MOHURD proposed an expanded program to retrofit another 400 million square meters of residential buildings in northern China. Boosted by the experience and success from the 11th FYP period, local governments in northern China actively sought greater allotment from MOHURD rather than waiting passively for their assignment. All in all, 347 million square meters of residential building underwent retrofits in 2011 and 2012, bringing the cumulative subsidies paid by the central government to more than RMB 17 billion.[8] Because the dedicated funds became exhausted much faster than expected, MOHURD had to postpone its retrofitting plan for the next few years; related activities came to a screeching halt as a result. The sharp contrast in how enthusiastically local governments in northern China responded in the 11th FYP period versus the 12th FYP period underscores the pivotal role of fiscal subsidies in building retrofits.

Also during the 12th FYP period, MOHURD set another goal to retrofit 50 million square meters of residential buildings in the hot-summer-cold-winter zone and 60 million square meters of public buildings nationwide, backed by another injection of subsidies in collaboration with the Ministry of Finance.[9, 10] Specifically, subsidies of RMB 20 yuan/m^2 were provided for retrofitting residential buildings in the hot-summer-cold-winter zone as well as for retrofitting public buildings in key cities.

By the end of 2014, the central government had invested RMB 40 billion to retrofit 700 million square meters of residential buildings in the northern heating region. For residential buildings in the hot-summer-cold-winter zone, fiscal investments from all levels of government for building retrofitting totaled RMB 477 million; and for public buildings, state and local governments had invested RMB 460 million towards building retrofits.[8]

As of the end of 2012, China's building stock reached 50 billion square meters, only 20% of which met energy efficiency standards. Indeed, there are more than three billion square meters

7 "Interim Measures for Heat Metering of Existing Buildings in the Heating Zones of Northern China and the Management of Energy Retrofitting Incentives." Cai Jian [2007] No. 957, the Ministry of Finance, 2007.

8 Report on Building Energy Efficiency Improvement in China (2014), Center for the Development and Promotion of Science and Technology, MOHURD, China Architecture & Building Press, March 2014. ISBN 978-7-112-16507-0.

9 "Interim Measures for the Management of Energy Retrofitting Subsidies for Existing Buildings in Hot-Summer-Cold-Winter Zone", Cai Jian [2012] No. 148, Ministry of Finance, 2012.

10 "Circular of the Ministry of Finance and MOHURD on Further Advancing the Energy Conservation Project of Public Buildings", Cai Jian [2011] No. 207, Ministry of Finance, 2011.

of residential buildings with low energy efficiency in the cold regions in northern China alone. Over the past seven years, China has retrofitted some 700 million square meters of buildings, bankrolled by an estimated RMB 100 billion of public funds, consisting of a few tens of billions of yuan from the central government and the rest from local governments. Even if spending continues at the current magnitude and pace, the goal for an early peak of energy consumption by urban buildings still looks elusive. Therefore, public finance must tap into the potential of the financial market by encouraging the entry of private capital.

4.3.3 Green Buildings

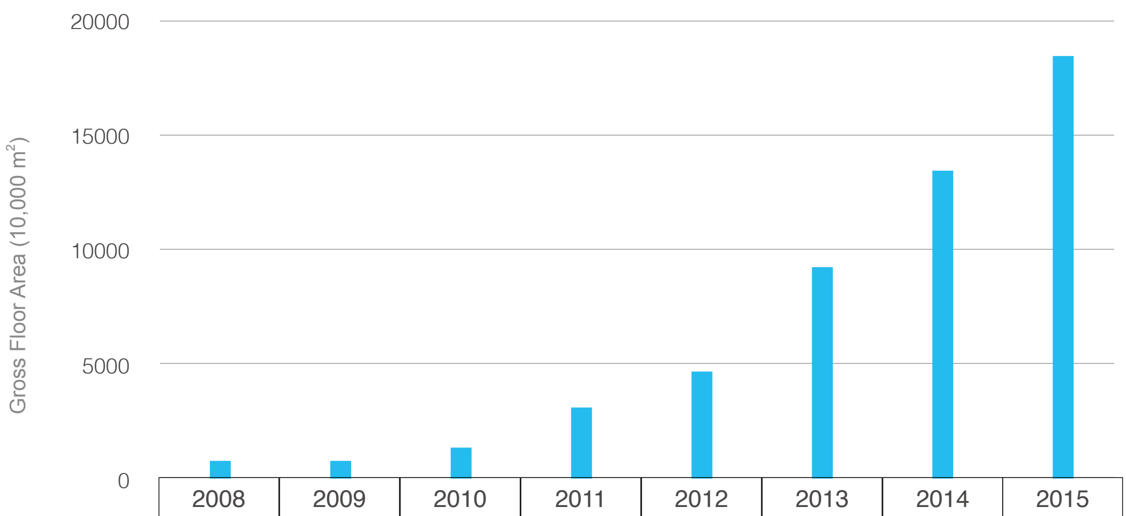
To meet China's government standards for green rating, green buildings generally incur higher upfront costs. The Green Building Evaluation Standard was released in 2006 as a voluntary national standards. According to the standard, "green buildings," throughout their entire lifecycle, must maximize conservation of energy, land, water, and materials; protect the environment and reduce pollution; provide healthy, habitable, and efficient living space; and promote residents' harmonious coexistence with nature. Green buildings are classified into 1-Star, 2-Star and 3-Star ratings. Related rating labels include one for design and one for operation.

As revealed by one cost analysis on projects that have received green building labels [11], the incremental cost for 3-Star rated buildings may exceed that of 2-Star rated buildings, while the incremental cost for 1-Star buildings is limited. Indeed, a 1-Star green building that is intelligently designed in the context of its environment might incur no additional cost.

In 2008, MOHURD launched a voluntary evaluation system for green building projects. In 2012, China set the goal of constructing one billion square meters of green buildings by 2015 and creating an

11 Ye Zuda. Low-Carbon Green Buildings: From Policy to Economic Cost-Benefit Analysis, China Architecture & Building Press, January 2013.

incentive plan for green buildings of 2-Stars and above [12], in which 2-Star buildings are incentivized at 45 yuan/m^2 and 3-Star buildings at 80 yuan/m^2. But because verifying that buildings with green design ratings can still meet the green building requirements during actual operations is so difficult, this incentive plan never took off. The goal of constructing one billion square meters of green buildings by 2015 collapsed as well (Figure 7), with only 472 million square meters completed. To encourage the large-scale development of green buildings, in 2012, the Ministry of Finance provided a subsidy of RMB 50 million to green ecological district with more than 30 percent of 2-Star green buildings. A total of RMB 400 million in subsidies was given to eight green ecological cities in 2013. The subsidy program was discontinued thereafter.



	2008	2009	2010	2011	2012	2013	2014	2015
GFA	141.22	99.47	723.43	2523.52	4096.67	8707.1	12943.71	17982.2

Fig. 7: Total Floor Areas of Evaluated Green Buildings (2008-2015)

12 "Opinions on Accelerating the Development of Green Buildings in China." Cai Jian [2012] No. 167, Ministry of Finance, 2012.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5. Challenges to Scaling Energy Efficiency Buildings in Chinese cities

Efforts made by the government to promote energy-efficient buildings and green buildings have not gone unnoticed. According to the survey of the American Council for an Energy-Efficient Economy (ACEEE) on major world economies, which is conducted once every two years, China ranked first for two consecutive rankings in the area of building energy efficiency (2012[13], 2014[14]). Nevertheless, the following challenges still exist:

1) Lack of Mid- and Long-Term Planning

At present, domestic projects relating to energy-efficient and green buildings are chiefly designed and implemented through Five-Year Plans. Yet building energy efficiency goals often require planning beyond five years. A clear, long-term policy should be established to encourage private capital to invest in the development of building-related energy efficiency products and technologies. The United States and the European Union have already finalized long-term timetables and roadmaps for achieving zero-energy buildings or nearly zero-energy buildings, while China's energy efficiency policy has yet to recognize or incorporate nearly zero-energy targets. Moreover, updates to Chinese standards on building energy efficiency only come once every five years and are often out of sync with Five-Year Plans. As a result, such updates are often developed without established targets providing clear guidance and are prone to veering off course.

2) Slow Update of Energy Efficiency Standards and Inadequate Fundamental Research

Although the rule governing national standards stipulates that standards for building energy efficiency should be updated every five years, this rule is not strictly observed in practice. For example, the national standard on the energy efficiency design of public buildings that came into effect in 2015 had not been revised for a decade. During those ten years, China's urbanization reached a crescendo, and the outdated energy efficiency standards not only failed to meet market demand, but in some instances even hampered progress and innovation. In addition, the drafting team for building energy efficiency standards is only convened on an ad hoc basis for a couple of years and then disbanded after the completion of the standard. Due to the lack of research on fundamental issues that require long-term and continuous study, the quality of standards has also been impaired.

3) Overreliance on Fiscal Subsidies and Absence of Market Mechanisms

The most fruitful effort to improve the energy efficiency of China's urban buildings has been the retrofit of existing residential buildings in northern China, which has also received the most fiscal support. However, when using such financial

13 Sara Hayes et al. "International Energy Efficiency Scorecard." ACEEE Report, 2012, accessed at http://www.ssti.us/wp/wp-content/uploads/2012/07/internation-energy-efficiency-scorecard.pdf.

14 Rachel Young et al. "The 2014 International Energy Efficiency Scorecard." ACEEE Report Number E1402, July 2014.

tools as fiscal subsidies, market mechanisms and private capital were wholly ignored, meaning that projects—no matter how successful—were not built upon a sustainable financing models. Additionally, over-reliance on public finance led to excessive government intervention, deterring private capital from entering the building energy efficiency market.

4) Disconnection of Two Green Building Labels

At the moment, there are two evaluation labels for green buildings—one for design and one for operation. After receiving green label certification in the design stage, which only requires an assessment of construction drawings, most developers tend to avoid applying for operational green certification, because they run the risk of failing on-site operational tests after the properties have already been sold. Without the ability to verify the "green performance" of green buildings in operation, the Ministry of Finance has not been willing to gamble on introducing a subsidy program for green buildings.

5) Slow Progress in Public Disclosure of Building Energy Data

Energy usage data are an important building block in the formulation of energy efficiency policies and standards. But for the longest time, the building sector has neglected to collect these data and failed to follow the mandatory requirements on the disclosure of energy saving information. This lack of detailed and reliable building energy usage data has severely limited the national and local governments' ability to draft more effective standards and policies on building energy efficiency.

It must be emphasized that improvement of the energy efficiency of urban buildings needs to be driven not only by mature policies and rigorous standards, but also by a complete set of investment and financing mechanisms and tools. Both components are essential, and neither is optional.

This report primarily focuses on the study of investment and financing mechanisms and tools for energy-efficient buildings. Chapter 2 provides an estimate of the financing needs and financing gap for improving energy efficiency of urban cities during the 13th FYP period. Chapter 3 reviews the existing investment and financing models for citywide energy conservation projects. Lastly, Chapter 4 proposes several comprehensive green financing schemes for the construction sector.

Chapter 2: Financing Demand for Scaling Building Energy Efficiency in Chinese Cities

China introduced its first building energy efficiency standard exactly 30 years ago. Over the past three decades, China has made remarkable progress on improving the energy efficiency of buildings, but that achievement has been possible mostly because of government financial support—primarily in the form of subsidies and monetary rewards. Missing from the picture are effective financial instruments and market-based financing models. The Third Plenary Session of the 18th CPC National Congress, held in November 2013, called for "letting the market play a decisive role in resource allocation," thus setting a general guideline for how works relating to building energy efficiency should be carried out during the 13th FYP period (2016-2020). China's rapid urbanization and commitment to peaking carbon emissions as early as possible demand that sweeping progress be made on the development of green buildings and retrofit of existing buildings, a tall order for funding by public finance alone. Only by encouraging financial innovation and private capital participation will the market be able to assert a decisive role in resource allocation.

While MOHURD has yet to release its 13th FYP, we have estimated the financing demand for promoting more efficient buildings and green buildings in the 13th FYP period based on relevant study reports[15] , with particular attention given to the following areas:

- Developing high-star green buildings
- Retrofitting residential buildings in the northern heating region
- Retrofitting residential buildings in the hot-summer-cold-winter zone
- Retrofitting public buildings

1. Financing Demand for Green Buildings

As demonstrated by the directives issued in 2012 and 2013[12,16], the National Development and Reform Commission (NDRC), MOHURD, and the Ministry of Finance have been unanimous on the target for the development of green buildings: construct one billion square meters of green buildings during the 12th FYP period. According to the Center for the Development of Industry, Science and Technology under MOHURD[17] , by the end of 2015, a total of 472 million square meters of buildings had been issued green building evaluation labels— less than half of the target. This figure includes retrofitted buildings and a few projects that received green building labels during the 11th FYP period. That said, the target is vague about whether the figure should only include new buildings; and there are no national statistics on the number of projects that meet green building requirements but did not apply for evaluation.

Although the Ministry of Finance announced a subsidy program for green buildings rated 2-Star and above, the program was never implemented, which has to some extent stymied the goal set out in the 12th FYP. Generally, green buildings with high-star ratings incur an incremental greening cost, making their large-scale promotion particularly challenging without government support or suitable financing channels. Some provincial and municipal governments offered subsidies to green buildings.[18] For instance, Shandong Province adopted the following incentive levels in 2013: 15 yuan/m^2 for 1-Star buildings, 30 yuan/m^2 for 2-Star buildings and 50 yuan/m^2 for 3-Star buildings, while Qinghai Province offers incentives in the form of reimbursing a certain percentage of urban infrastructure surcharges.

The 13th Five Year Plan calls for an additional 2.1 billion square meters of public buildings and 6.7 billion square meters of residential buildings. Regulations[16] dictate that public buildings larger than 20,000 square meters, government-invested public-interest buildings, and low-income housing must all meet the 1-Star rating of green buildings at a minimum. Looking at the share of each building

15 Tianjin University. "Study on the Roadmap, Gradient, Upgrade Strategy and System for the Energy Efficiency Improvement of Buildings in China." Study report sponsored by the Energy Foundation, 2015.

16 "Circular of the State Council General Office on Publishing the Action Plan on Green Buildings by NDRC and MOHURD." The State Council General Office Document [2013] No. 1, the State Council General Office, 2013.

17 Green Building Evaluation Label Web, Center for the Development of Industry, Science and Technology under MOHURD, May 2016, accessed at http://www.cngb.org.cn/.

18 Center for the Development and Promotion of Science and Technology, MOHURD. "Survey Report on the Development of Green Buildings in China." Study report sponsored by the Energy Foundation, 2013.

type in the 12th FYP period, we find that, in terms of area, 15% of newly constructed public buildings are above 20,000 square meters, and government-invested buildings account for approximately another 30%, giving these two building types an aggregate share of around 45%.

We assume that during the 13th FYP period, newly constructed green public buildings and green residential buildings (including all low-income housing) will each represent a 50% share in their respective building types, and that 1-Star, 2-Star and 3-Star green buildings respectively will account for 30%, 40% and 30% of the total. Because 1-Star green buildings have negligible incremental cost, additional financing support is only required for 2-Star and 3-Star green buildings, implying that the financing needs for new green buildings are at least RMB 224.8 billion (Table 3).

	Gross Floor Area in the 13th FYP period (100 million m^2)	% share	Area of newly constructed green buildings (100 million m^2)	Cost of meeting 2-Star green requirements (40%)		Cost of meeting 3-Star green requirements (30%)		Total (100 million yuan)
				Unit Cost	Cost (100 million m^2)	Unit Cost	Cost (100 million m^2)	
Publicl buildings	21.16	50%	10.58	136.42 yuan/m^2	577.33	163.23 yuan/m^2	518.09	1,095.42
Residential buildings	66.89	50%	33.44	35.18 yuan/m^2	470.57	67.98 yuan/m^2	681.98	1,152.55
Total					1,047.9		1,200.07	**2,248**

Table 3: Financing Demand for Greener Buildings during the 13th FYP Period (by 100 million yuan)

2. Financing Demand for Retrofitting Residential Buildings in Northern China

The domestic building energy efficiency program was first introduced to cities in northern China, and this is also the region where the program has achieved the most success. Thanks largely to the incentives provided by central and local governments, during the 12th FYP period, this region was able to retrofit more residential buildings than planned. Central, provincial and municipal government subsidies covered 70% to 80% of the retrofitting costs. Market-based financing mechanisms remained absent. In 2015, Qingdao,[19] for example, carried out energy retrofits for its historical urban districts at an estimated cost of RMB 260 per square meter, RMB 135 of which came from the central, municipal and district government, with each awarding RMB 45. Additionally, the municipal and district government further offered a five-year bonus based on the amount of energy saved after retrofitting was completed. In the end, each household paid RMB 60 per square meter for the retrofit, amounting to only 23% of the total cost.

To date, the central government has not specified an energy efficiency target for buildings that have undergone retrofits; it has only established the technical means for carrying out building retrofits and has provided subsidies solely on that basis. Consequently, both the retrofitting cost and the resulting energy savings vary across regions. Most retrofit projects fell short of the existing design standard for building efficiencies. At the same time, very few projects attempted the greening of historical districts, which on top of energy retrofits, also require enhanced water conservation, utilization of renewable energy, and indoor environmental improvement – all of which incur further expenses.

Our estimate divides the northern heating region into two categories, the first of which includes Beijing, Tianjin and Jilin Province, which either have a highly developed economy or are the most proactive in retrofit projects. During the 13th FYP period, these regions should be the first to green residential buildings, and we estimate that 200 million square meters of residential buildings can be greened during this time span. Their initiative will also help catalyze similar efforts in other northern regions at a more modest scale, where an estimated 150 million square meters, also at an average cost of RMB 800 per square meter, can be greened during the same period. The second category includes other provinces in the northern heating region. The energy performance of residential buildings in these provinces after retrofit must meet the existing building efficiency standard (65%) at an average cost of about RMB 400 per square meter, and the total area of regions in the second category to be retrofitted may reach 580 million square meters (Table 4). Therefore, the total financing demand for energy efficiency retrofits in both region types will come to RMB 512 billion.

19 "Three million square meters of old residential compound received policy subsidies for wall insulation retrofits." Sina Real Estate, Oct 2015, accessed at http://news.dichan.sina.com.cn/2015/10/10/1123924.html.

	Category One (Beijing, Tianjin, Jilin Province)	Category Two (all other provinces in northern China)
Effect	Green retrofitting	Meet existing 65% energy efficiency standard
Cost	800 yuan/m^2	400 yuan/m^2
Area	350 million square meters	580 million square meters
Subtotal	RMB 280 billion	RMB 232 billion
Total	**RMB 512 billion**	

Table 4: Financing Demand for Retrofitting and Greening Residential Buildings in Northern China during the 13^{th} FYP Period

3. Financing Demand for Retrofitting Residential Buildings in the Hot-Summer-Cold-Winter Zone

The hot-summer/cold-winter zone mainly refers to the regions along the middle and lower reaches of the Yangtze River, where the climate alternates between bitter winters and scorching summers. The perceived temperature swings even more wildly between the two extremes due to the chronic high humidity in the regions. Building energy consumption from the hot-summer-cold-winter zone has not been incorporated into China's macro policy on energy conservation, because historically, this region is without district heating and air conditioning and is thus considered to have very low energy consumption from buildings. However, once winter or summer comes, the indoor environment of residential buildings in these regions becomes extremely harsh, with temperatures sometimes dropping below zero degrees Celsius in the winter and reaching above 35 degrees Celsius in the summer. Compounded by the high humidity level, living conditions are poor. It is fair to say that the low energy consumption in these regions was achieved at the expense of the health and comfort of local residents.

The middle and lower reaches of the Yangtze River have also been the most vibrant part of China during the rapid development of the Chinese economy. With rising urban living standards in these regions, there have been frequent public outcries for district heating systems like those in northern China. As the municipal infrastructure is not equipped to supply such amenity, residents in the region have turned to various types of heating appliances to improve indoor comfort. The use of air conditioners is even more prevalent, causing the grid to regularly hit higher peak load during summer. One study[20] warns that, assuming the current disorderly development persists, heating-related energy use in winter will rise unabated in the hot-summer-cold-winter zone, possibly by nine times of current heating energy (about 67 million tonnes of coal equivalent) by 2020. If this estimate is accurate, it will mean that the progress made by building retrofit projects in the northern heating region will be largely cancelled out by the regression in the south. Therefore, priority should be given to the retrofit of buildings in the

20 Building Energy Conservation Research Center, Tsinghua University. "Study on the System of Suitable Heating Technologies for the Urban Housings in the Yangtze River Basin." Study report sponsored by the Energy Foundation, 2014.

hot-summer-cold-winter izone during the 13th FYP period in order to curb the encroaching energy usage.

Retrofit projects for residential buildings in the hot-summer-cold-winter zone lag behind their northern counterparts by as much as one FYP period. Between 2012 and the end of 2015, 50.9 million square meters of buildings in these regions underwent retrofit, slightly surpassing the target of 50 million square meters set for the 12th FYP period. Despite that, this figure is less than 10% of the retrofitted area in northern China during the same period. If the pace of retrofitting the north can be replicated in the south and adequate policy and financing support are sufficient and timely, it is reasonable to believe that building retrofits in the hot-summer-cold-winter zone will experience an explosive growth during the 13th FYP period, considering that a similar program in the north surged 700% in the second FYP period compared with the first.

The plan calls for the retrofitted area of residential buildings in the hot-summer-cold-winter zone during the 13th FYP period to increase by seven times compared with the 12th FYP period, to 350 million square meters. Based on government calculations of the cost of meeting green star ratings, if 40% of these retrofitted buildings reach 50% energy efficiency, 30% reach 65% energy efficiency and the remaining 30% meet the standard for green buildings, the total financing demand will stand at some RMB 138.2 billion (Table 5).

	Share	Area	Unit Cost	Financing Demand
30-50% energy savings	40%	140 million m^2	200 yuan/m^2	RMB 28 billion
65% energy savings	30%	105 million m^2	350 yuan/m^2	RMB 36.7 billion
Greening	30%	105 million m^2	700 yuan/m^2	RMB 73.5 billion
Total				**RMB 138.2 billion**

Table 5: Financing Demand for Retrofitting and Greening Residential Buildings in the Hot-Summer-Cold-Winter Zone during the 13th FYP Period

4. Financing Demand for Retrofitting Public Buildings

Similar to the retrofit of residential buildings in the hot-summer-cold-winter zone, the retrofit of public buildings began midway through the 12th FYP period, with 116 million square meters completed by the end of 2015. Public buildings harbor tremendous energy saving potential as they consume eight to ten times more energy per unit area versus residential buildings. Currently, retrofit projects for public buildings are only aiming for an efficiency improvement of 10 percent to 20 percent, meaning retrofitted public buildings still fall short of the applicable national energy efficiency standard. In the 13th FYP period, more investment should be steered to the retrofit of public buildings to further raise their efficiency. Additionally, retrofitting works should be augmented by greening efforts for a subset of public buildings to enhance their green performance in such areas as water conservation and use of renewable energy to further reduce their carbon footprint from building operations.

Assuming that retrofit will be completed for 15%, or 800 million square meters, of existing public buildings in the 13th FYP period and that 30% of this total will achieve energy savings of 50%, 40% will achieve savings of 65%, and the remaining 30% can meet the standard for green buildings, then the total investment needs will amount to RMB 776 billion.

	Share	Area	Unit Cost	Financing Demand
50% energy savings	30%	240 million m^2	600 yuan/m^2	RMB 144 billion
62% energy savings	40%	320 million m^2	1,000 yuan/m^2	RMB 320 billion
Greening	30%	240 million m^2	1,300 yuan/m^2	RMB 312 billion
Total				**RMB 776 billion**

Table 6: Financing Demand for Retrofitting and Greening Public Buildings during the 13th FYP Period

5. Total Financing Demand for Scaling Building Energy Efficiency during the 13th FYP Period

As Figure 8 shows, **scaling building energy efficiency in China requires a total investment of RMB 1.65 trillion during the 13th FYP period**. The financing demand breaks down to RMB 224.8 billion for newly constructed green buildings rated 2-Star or above, RMB 512 billion for the retrofit of residential buildings in the northern heating region, RMB 138.2 billion for the retrofit of residential buildings in the hot-summer-cold-winter zone, and RMB 776 billion for the retrofit of public buildings.

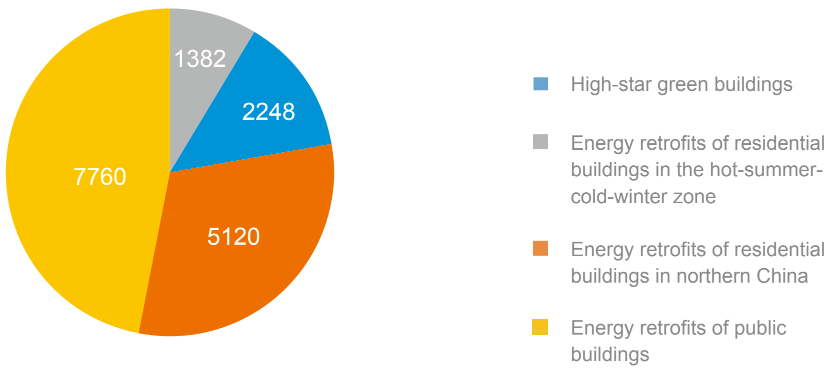


Fig. 8: Breakdown of Financing Demand for Scaling Building Energy Efficiency during the 13th FYP Period (in RMB 100 million)

6. Financing Gap

Between the 11th and 12th FYP periods, the central government steadily ramped up its funding support for building efficiency projects, including implementation of subsidies and incentives for the following programs: retrofit of residential buildings in the northern heating region, application of renewable energy in buildings, retrofit of residential buildings in the hot-summer-cold-winter zone, retrofit of public buildings, development of urban ecological districts of green buildings, and creation of energy usage monitoring platforms for provincial level buildings, university buildings, and hospital buildings. Annual central government investment in energy efficient buildings and green buildings averaged between RMB 7 billion to 9 billion during the 12th FYP period. Combined with the 1:1 matching funds from various levels of local government, fiscal investment on building energy efficiency amounted to an average of RMB 20 billion per annum at most, or a total of RMB 100 billion for the five-year period.

Even if the Chinese government increases its investment in building efficiency programs by 20% during the 13th FYP period, the total investment will only come to RMB 120 billion, or 7.3% of the total financing demand. Therefore, **the financing gap is expected to reach RMB 1.53 trillion in the next five years.** To alleviate its burden, the government will need to attract private capital to invest in and finance urban building efficiency programs.

7. Financing Risks

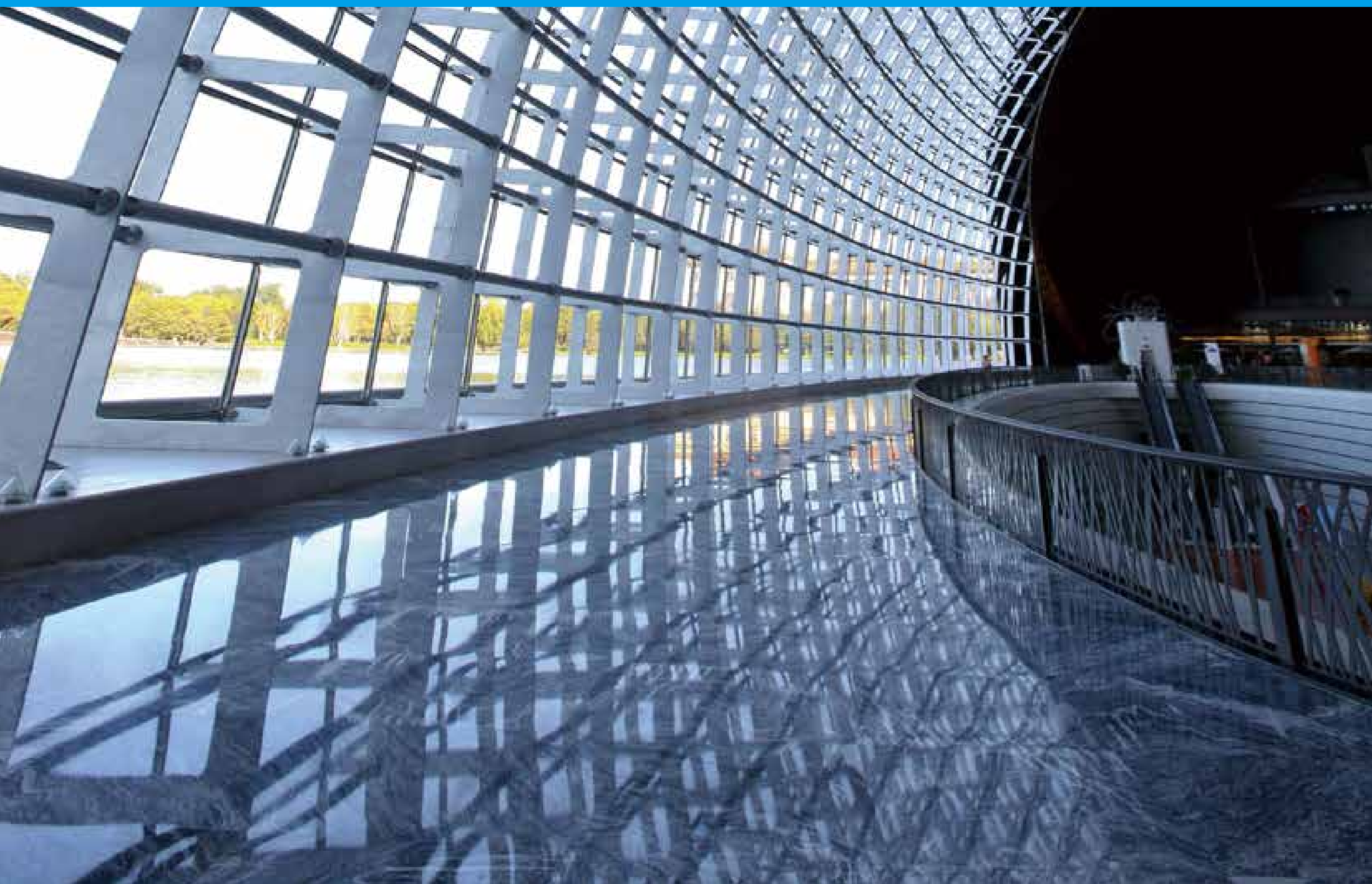
Real estate developers, energy service companies, and district heating companies tend to have the greatest financing needs in relation to building efficiency programs. And for those economically developed regions whose local governments have recognized the retrofit of historical residential blocks as social welfare projects, such governments will also take on some financing duties. Financing for high-star green buildings and building retrofits involve certain risks, most of which are related to whether the benefits resulted from energy efficiency improvement can justify the incremental or retrofitting cost, and how long it will take to recoup the initial investment. In addition, most energy service companies are asset-light companies without sufficient amount of collateral to take out loans from banks. Furthermore, financial professionals are often unfamiliar with the characteristics of the energy efficiency sector, and traditional investment and financing tools are not positioned to address the specific financing dilemmas and challenges confronting the building efficiency sector. What is urgently needed is a set of new financing tools co-developed with professionals from the building efficiency sector. Table 7 below summarizes the specific risk categories and corresponding response measures.

Risk	Description	Mitigation Measures
Market risks	1) Property owners are reluctant to perform retrofit and market demand is weak; 2) Sluggish demand for high-star green buildings; 3) Limited energy savings from retrofit of individual buildings, making the payback period unduly lengthy.	1) Enhance the transparency of energy usage data to demonstrate the economic benefits of energy-efficient buildings; 2) Consider a legislative approach to order mandatory retrofit of inefficient buildings; 3) Modify the energy pricing mechanism to compel property owners in energy-intensive buildings to retrofit; 4) Offer appropriate subsidies to high-star green buildings to attract private capital; 5) Implement large-scale building retrofit projects to aggregate the potential energy savings, so as to give investment a more appealing return profile and to reduce the risks of individual building projects.
Credit risks	1) Inadequate credit rating of energy service companies, denying access to loans; 2) Contract cannot be performed due to change of property owners; 3) Disagreement on the amount of energy savings achieved; 4) Energy savings promised by energy service companies did not materialize; 5) Star level promised by real estate developers for green buildings did not materialize.	1) Introduce a green insurance credit enhancement mechanism; 2) Boost the standardization and legal force of retrofit contract; 3) Establish a standard for the determination of energy savings.
Liquidity risks	1) Energy service companies need to advance the retrofit cost, resulting in high debt ratio and insufficient cash flow; 2) Retrofit funds cannot be raised at a reasonable cost in the market.	1) Prioritize building efficiency projects in green finance schemes and implement preferential lending rates; 2) Capital injection by green funds through equity investment and exit after an agreed period.
Sector risks	1) Poor professional capabilities of energy service companies; 2) Evaluation of green buildings lacks a fair third-party; 3) Conflict of interest with green building evaluation agencies who also provide green building consulting services.	1) Promote market competition; 2) Give preferential financing policies to energy service companies with superior performance; 3) Eliminate the monopoly in the green building evaluation sector, create an independent evaluation mechanism and strengthen market supervision rules; 4) Separate green building consulting services from evaluation agencies.
Policy risks	1) Payback period is long and there is no long-term policy support; 2) Policies have poor continuity and are not very practical.	1) Formulate medium- and long-term building efficiency policies and a roadmap to achieving zero-energy buildings; 2) Provide fiscal incentives to the R&D of new, efficiency-related technologies and products.
Financial risks	1) Long payback period gives rise to interest rate risks; 2) Foreign capital investment is exposed to exchange rate risks.	1) Explore the collateralization and securitization of future earnings; 2) Leverage financial instruments such as forex futures to reduce exchange rate risks.
Environmental risks	1) Adverse environmental impact from construction noise and dust.	1) Incorporate environmental assessment of construction works into the tendering documents and strictly enforce environmental monitoring.

Table 7: Risks in Financing Urban-scale Energy-Efficient Buildings and Mitigation Measures

Chapter 3: Existing Financing Models for Urban Building Efficiency Projects

China's present shortage of financing channels and tools to support large-scale building efficiency projects in its cities – a symptom of the absence of a mature investment and financing marketplace – has become the largest roadblock for Chinese cities looking to make the low-carbon transition. At present, green building and retrofit projects are chiefly funded by financial subsidies or incentive funds from each level of government, plus a smattering of policy-based loans disbursed by foreign governments or intergovernmental banks, exposing the dearth of choice and lack of innovation in financing tools. Nevertheless, it is encouraging to see that some Chinese cities have conducted meaningful explorations of large-scale building retrofits, and this chapter will summarize and analyze the investment and financing models of some illustrative projects.



1. Energy Performance Contracting: the Basic Market-based Model for Retrofit Projects

Energy Performance Contracting (EPC) or Energy Management Contracting (EMC) is, at present, the most popular market-based model used for retrofitting a single building. In this model, all retrofitting costs are advanced by energy service companies (ESCOs), which recoup this investment plus profit with the energy savings the property owners will have gained from the retrofitted building, paid on an annual basis over the term of the contract. More specifically, the business models for EPC in China are shared savings, energy management outsourcing, guaranteed savings, finance lease, and hybrid of these models.

Originated in the United States, EPC has been successfully applied in retrofitting federal office buildings. In China, by contrast, the most resounding success of EPC is found in industrial retrofits because industrial projects enjoy a large savings potential, high return on investment, short payback period, and relatively easy financing process. In comparison, single-building projects save far less energy after retrofit, incur high transaction costs, and the exact amount of energy savings is often hard to determine. Additionally, the longer EPC contract terms associated with building retrofit projects often mean a higher default risk. Due to these factors, ESCOs have great difficulty in securing bank loans for retrofitting a single building.

The central government set up an incentive fund[21] in 2010 to promote EPC and the development of the energy service industry. For retrofit projects that employ EPC, the fund awarded RMB 240 per tonne of coal equivalent saved, while matching incentive programs run by provincial governments added another RMB 60 or more per tonne of coal equivalent saved. The effectiveness of these incentive policies, however, was diminished by the rigorous qualification reviews for ESCOs, strict filing and review standards, and time-consuming application processes. As a result, less than 10% of the projects that received the funding were building retrofit projects. In May 2015, the State Council canceled the EPC fund, marking the end of these incentive policies.

21 "Interim Measures for the Management of Fiscal Incentive Fund for Energy Performance Contracting." Cai Jian [2010] No. 249, NDRC and Ministry of Finance, 2010.

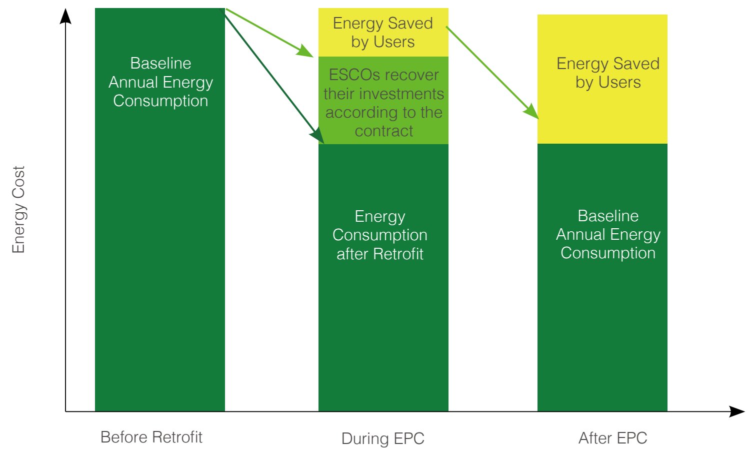


Fig. 9: The EPC Model

2. The Tonghua County Program: Financed by Government Credit-backed Loans

Retrofitting buildings in China's northern heating region has always been a priority in urban retrofitting plans, due to the fact that heating in this region accounts for 40% of the total energy consumed by buildings in China. Moreover, because 90% of this heating energy is generated by coal-fired power plants, air quality in northern China worsens rapidly whenever district heating begins. After almost eight years of continuous retrofitting efforts, coupled with higher standards for new residential buildings, energy use intensity for heating in northern China has declined considerably (figure 11).

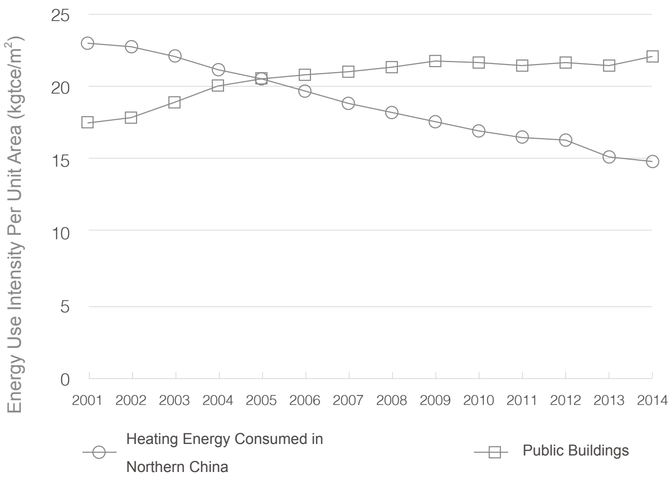


Fig. 10: Per-Square-Meter Energy Consumption for Heating in Northern China and Public Buildings (2001-2014)[1]

Located in southeastern Jilin Province, Tonghua has a population of 57,600 and an urban area of 4 square kilometers. Before the retrofit program began, the county had 388 inefficient buildings, including 1.3 million square meters of residential buildings and 340,000 square meters of public buildings. A central coal-fired heating system was used for the entire urban area. From 2009 to 2011, Tonghua completed retrofitting and installing heating meters for all 1.64 million square meters of existing buildings and started meter-based billing for the heating of 1.1 million square meters. After the energy upgrades, room temperatures during the heating period rose by 3.5 degrees Celsius on average, and energy consumption fell by 13.7 kg of standard coal equivalent per square meter of heating, saving 20,000 tonnes of standard coal equivalent each year and raising the total energy savings rate to 40%.

The entire Tonghua retrofit project cost an estimated RMB 181.89 million, which was funded by an inclusive financing method that taps into national incentive funds, matching funds from the local government, and funds raised by district heating utility companies and residents who would benefit from the project. Specifically, the central government provided RMB 74.18 million in financial subsidies, while the finance bureau of Tonghua, after negotiating with Jilin Province Trust Company, 22 This diagram is courtesy of Xin Jianan, building efficiency project manager at the Energy Foundation.

Ltd., disbursed an unsecured loan of RMB 51 million as the matching funds. The remaining funding gap was filled by the district heating companies and residents.

Because the well-thought-out design of the metering and billing system for district heating was projected to generate considerable profits for the district heating companies, they welcomed the county government's retrofit program with open arms. These companies appropriated RMB 12.37 million from their own accounts and took out RMB 10 million in secured loans from banks, investing an aggregate of RMB 22.37 million in the project. The residents contributed RMB 7.34 million for replacing windows with more efficient ones. The remaining RMB 27 million funding gap was covered by property owners of commercial buildings.

The Tonghua County completed the energy upgrading and heating meter installation in all existing buildings in just two years. Although as much as 70% of the total investment was still financed by subsidies from the central and local governments, this project is still a landmark building retrofit program for its urban-scale size of program, flexible heating billing system, use of a wide array of financing channels, and ability to elicit an enthusiastic response from both heating companies and residents, and offers valuable lessons.

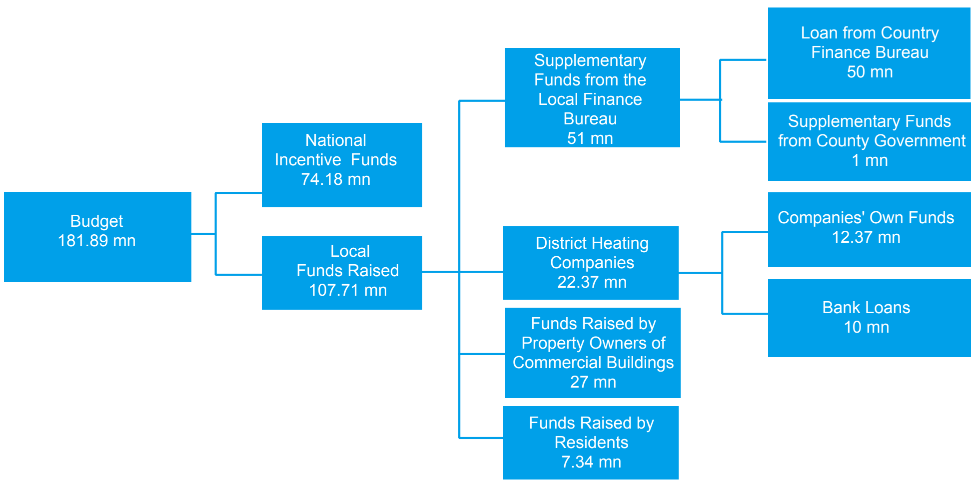


Fig. 11: Fund-Raising Model for Retrofit Project in Tonghua[22]

3. The Chongqing Program: Financed by Bank Credit and Implemented by a General Contractor

Public buildings are distinguished by their high energy intensity and substantial potential savings from retrofitting efforts. The retrofitting of these buildings, however, requires the ESCOs to have robust financial strength, strong financing capabilities, and to be highly competent in performing comprehensive retrofitting works. In China, Chongqing has always been at the forefront of advancing the energy performance of buildings.

Since 2011, the city has been exploring the large-scale retrofit of public buildings, covering office buildings, shopping malls, hospitals, hotels and schools. The program's goal is to retrofit four million square meters of public buildings and reduce energy use per unit floor area by 20% or more.

To secure the funds necessary for completing the retrofit project, Chongqing elected to partner with Tongfang Company Ltd., a listed company with an established reputation in the field of building efficiency, and took out a loan of RMB 2 billion from the Bank of Chongqing. The city's finance bureau also offered supplemental financial support in the form of a differential incentive regime: 15 yuan/m^2 for retrofit projects that achieved a 20-25% reduction in energy use intensity and 20 yuan/m2 for those that reduced energy use intensity by more than 25%.

Tongfang served as the general contractor for the entire retrofit program and subcontracted the actual retrofitting work to its subsidiary Technovator International, Ltd. To foster Chongqing's energy service market, Technovator hand-picked 30 or so energy service start-ups, transferred to them its energy and retrofitting technologies as well as practical experience, with the plan to merge or acquire them after they grew mature. Moreover, Technovator shared 20% of the energy savings and government incentive funds with property owners in the hope of stimulating their participation in energy retrofits. The sharing of energy savings lasts from five to seven years.

By the end of 2015, Chongqing had successfully completed the energy improvement of 107 public buildings totaling 4.4 million square meters, all of which have passed the inspection of both the Ministry of Finance and MOHURD. An RMB 88 million incentive award, calculated on the basis of 20 yuan/m^2, was subsequently granted by the central government, augmented by an annual RMB 40 million from shared energy savings. Encouraged by its discovery of a viable model (Figure 13) for the large-scale retrofit of public buildings, Chongqing decided in 2015 to retrofit another 3.5 million square meters of public buildings.

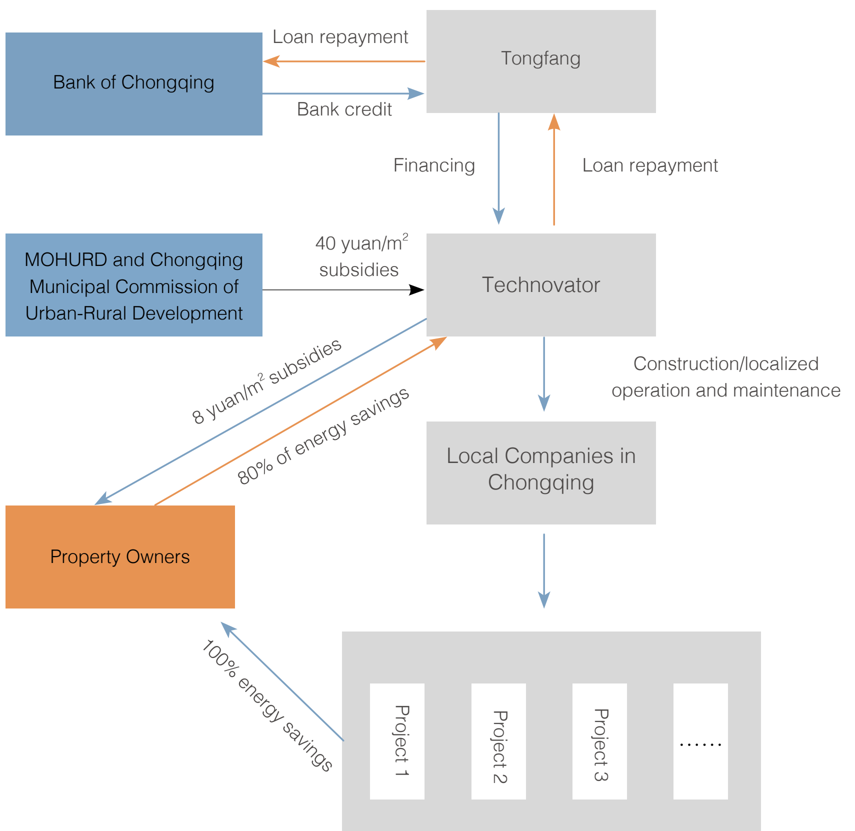


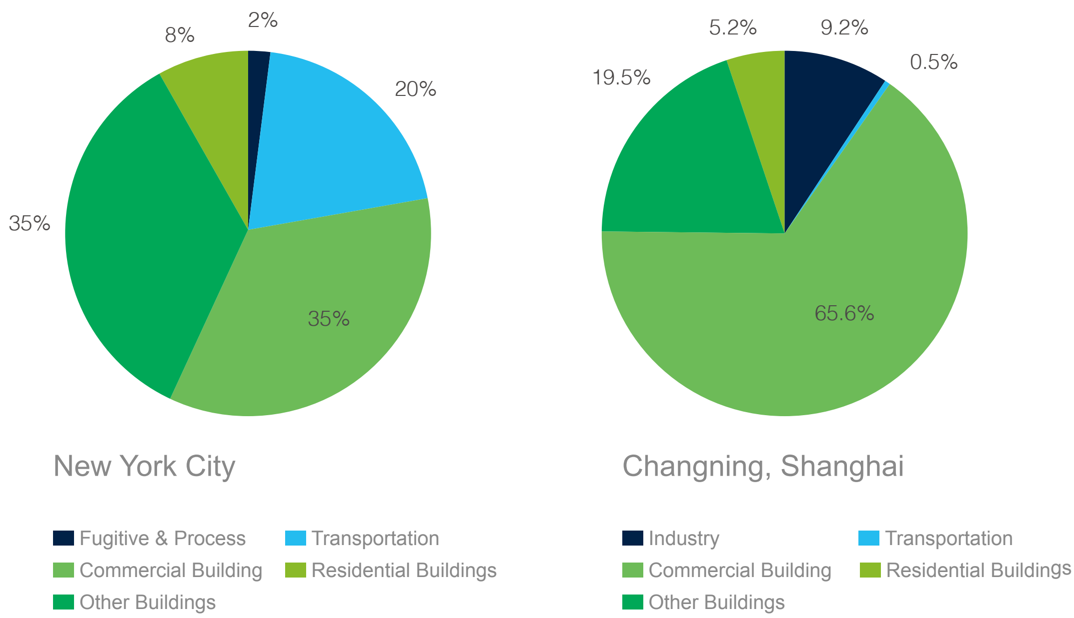
Fig. 12: Model for the Public Building Retrofit Project in Chongqing

The success of the retrofit project in Chongqing suggests the following experience:

- **Bank Credit:** The entire 4-million-square-meter retrofit project was undertaken by a single company, Tongfang, which stood to gain considerable profit from the sheer amount of aggregate energy savings. This earning potential, coupled with the creditworthiness of Tongfang as a listed company, means the company had little difficulty in obtaining bank credit. Moreover, compared with loans, bank credit encourages a more efficient utilization of funds and can therefore boost the overall returns of the project.
- **Profit Sharing:** To encourage property owners to participate in the project, the ESCO offered them 20% of the energy savings and government subsidies.
- **Technological Strength:** Tongfang is highly experienced in managing urban building retrofit projects, has an open channel of communication with governments, and a vast repository of energy technologies. As a result, the company enjoys a commanding position when choosing projects with the highest energy savings potential and negotiating for lower construction cost.
- **Nuturing Local Companies:** Tongfang's partnership with more than 30 local ESCOs not only accelerated the local retrofit projects but also shortened the project duration.

4. The Changning District Program: Financed by a Loan from the World Bank

Changning district, in central Shanghai, features a predominant tertiary industry that is the heart of the local economy. Correspondingly, the overwhelming majority of local energy consumption and carbon emissions comes from public and residential buildings. This is illustrated by Figure 13, which shows the similarity between Changning and New York City in terms of their carbon emission profile – that buildings are responsible for over 75% of the district's total carbon emissions. It was with this consideration that drove Changning to elevate the retrofit of existing buildings to the top of its agenda when it planned for the low-carbon demonstration area. At the same time, the district also started optimizing district traffic, exploring demonstration projects of low energy buildings and introducing distributed renewable energy.



Source: Carbon Emissions Report of New York, 2012 and the Cost Curve Study Report for the Low-Carbon Experiment Area of Changning District, Shanghai Municipality

Fig. 13 Carbon Emission Sources in New York City vs. Changning District, Shanghai

Because the low-carbon transition of Changning was to be implemented through large-scale building retrofits that could replicate in other districts of Shanghai, the World Bank decided to offer a loan of $100 million to the district, along with a grant of $4.345 million from the Global Environment Facility. Two local on-lending banks (Shanghai Pudong Development Bank and Bank of Shanghai) were responsible for providing a $100 million matching loan; the borrowing companies were required to pool together $46 million; and the district government of Changning was to disburse a loan of $5.655 million as the local matching fund. The total investment was $256 million (RMB 1,612.8 million).

The Changning project aims to curb the growth rate of local carbon emissions and serve as a model for the low-carbon development of Shanghai through the following initiatives: large-scale retrofit of public buildings, demonstration of ultra-low-energy buildings, promotion of green transport, improvement of the energy mix, enhancement of systems and mechanisms, formulation of incentive policies, and boosted energy conservation efforts. The loan agreement for this project entered into effect in September 2013; the scheduled closing date is December 2018.

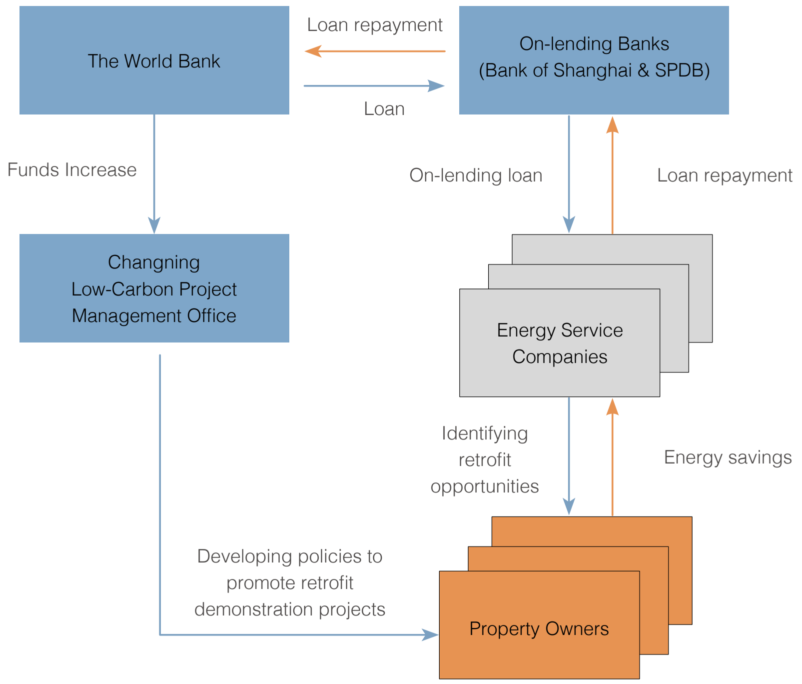


Fig. 14: Model for the Retrofit Project in Low-Carbon Demonstration Area of Changning District, Shanghai

23 "Audit Result of the 2014 Financial Accounts and Implementation Status of Green Energy Schemes for Low-Carbon City Project Managed by Shanghai Changning District Low-Carbon Project Management and Development Center under World Bank Loan and Global Environmental Facility Grant", Shanghai Municipal Audit Bureau, 2015.

24 "Green Energy Schemes for Low-Carbon City in Shanghai, China – Implementation Status & Results Report." The World Bank, Public Disclosure Copy, 2016.

According to information published by the Shanghai Municipal Audit Bureau[23] , the project has not been progressing as planned. By the end of 2014, the two on-lending banks had each disbursed the World Bank's loan to a different company, at a combined RMB 4.61 million. The borrowing companies only put together RMB 5.67 million in matching funds, and the two on-lending banks had not made any matching loans. The total investment of two sub-projects stood at RMB 10.28 million, representing a mere 0.66% of the planned figure of $246 million (translated to RMB 1,549.8 million). According to data released by the World Bank in 2015[24], only 4% of the World Bank loan was disbursed from 2014 to the end of 2015. Considering that the project is three years from closing in 2018, the World Bank downgraded its rating of the overall implementation progress to "moderately unsatisfactory."

A number of factors have contributed to the slow progress of this project:

- **Property owners have little interest in energy retrofits.** Since energy is relatively cheap in China, property owners of commercial buildings lack the motivation to improve the buildings' energy performance. This problem had been anticipated by the World Bank, which requested the local government to formulate policies to impel owners of inefficient buildings to carry out retrofits. These policies, however, never saw the light of day due to the fact that the district government of Changning does not have legislative power, and the Shanghai municipal government had no impetus to develop the policies and drive them through the lengthy legislative process.

- **Uncompetitive on-lending rate.** The lending model used by the World Bank took the conventional on-lending approach. Although the World Bank loan was offered at a relatively low interest rate, the rate that end customers would eventually see might not be competitive once the profit margins of the two on-lending banks were added on top.
- **Lack of building energy specialists.** The two on-lending banks do not have experts in the building efficiency sector and therefore are not able to review and approve loan applications from EPC companies in an expeditious manner, causing the companies' project development process to bottleneck.

5. The Wuhan Program: Financed by a Loan from the Agence Française de Développement (AFD)

In 2006, AFD and the Department of Housing and Urban-Rural Development of Hubei Province signed a cooperative framework agreement on the design of a demonstration project for retrofitting government buildings and the associated financing mechanism. In 2009, Wuhan was designated as the city for project implementation. AFD and the Ministry of Finance then entered into a formal loan agreement in November 2011, and later in December, the project commenced with 30 city-level government buildings as well as the city library—624,000 square meters of gross floor area altogether—targeted for the retrofitting effort. Per the arrangement, AFD would extend a loan of 20 million euros (translated to RMB 174 million) with an interest rate of Euribor + 0.25%; and the Chinese side would provide matching funds of RMB 26.122 million. The project adopted the EPC approach, whereby the energy savings generated would be shared over a period of 12 years. The principal and interest for the static investment over the 12-year period is RMB 229.4 million, whereas the static returns from energy savings over the same period would be 232.6 million yuan, generating a very modest return. After the retrofit, the overall energy saving rate was expected to reach 30%, accompanied by an anticipated annual carbon emissions reduction of 15,000 metric tons and electricity savings of 1.7 MWh each year.

In 2014 when the project was in progress, it was discovered that only 15 out of the original 30 government buildings designated for retrofit were fit for energy upgrading. As a result, another 18 public buildings were added to the project as replacement. By the end of 2014, two buildings had been retrofitted, with another five under retrofitting and six going through the design, bidding, and procurement process. Clearly, the overall implementation of the project was slow [25]. In May 2016, after a discussion with AFD[26], the project was revised to retrofitting a total of 25 government buildings, increasing the area to 1.43 million square meters and shortening the payback period from 12 to 8 years. At the time, one building had been retrofitted and was in operation, five buildings were retrofitted and going through acceptance inspection, and two more were still under retrofitting work.

The most obvious difference between this project and the ones in Changning and Chongqing is that, in this project, the property owners are the municipal authorities of Wuhan, so there is no difficulty with motivation or project development. On the other hand, it is exactly because the owners are the local government and the loan was granted by a foreign government that the Wuhan project had to go through a more rigorous review and approval process (figure 15) with respect to project budgeting, filings as well as project implementation and supervision, all of which prolonged the project review and approval timeline.

25 "Audit Result of the 2013 Financial Accounts and Implementation Status of AFD-Wuhan Public Building Retrofit Project." Wuhan Municipal Audit Bureau, October 2014, accessed at http://www.whaudit.gov.cn/id_4028281a4f02b8af014f02e7301501a0/news.shtml.

26 Senior Project Official Sui Hong of AFD discussed the latest project status with the research team through an email dated May 18, 2016.

27 “Feasibility Study Report for AFD-Wuhan Public Building Retrofit Demonstration Project.” Urban Construction Fund Management Office of the People’s Government of Wuhan, December 2010.

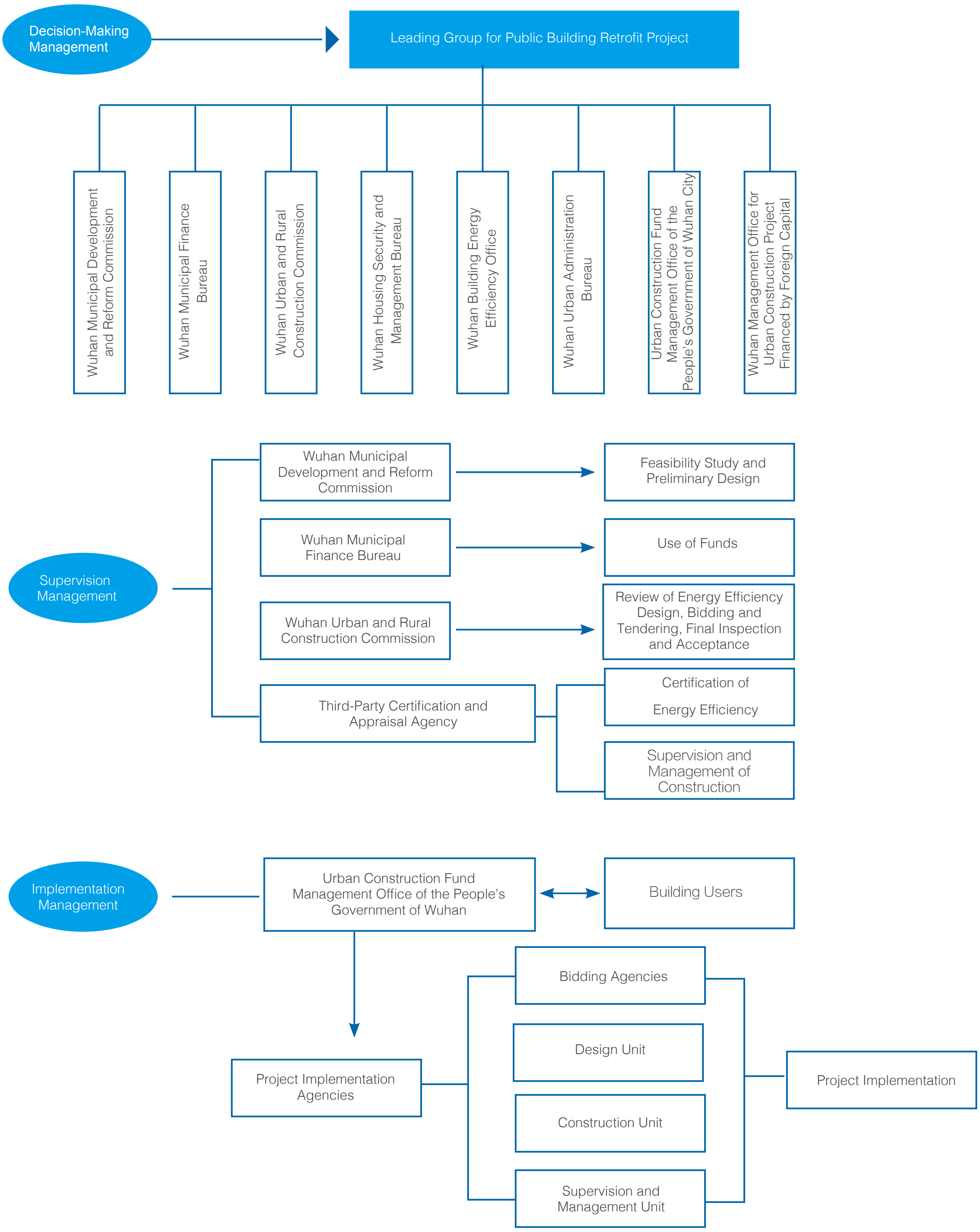


Fig. 15: Flowchart of AFD-Financed Energy Retrofit Project in Wuhan[27]

The following factors have hindered the progress of the AFD-Wuhan project:

- **Long program cycle led to foreign exchange risk.** Even though the project was financed by a French loan, the budget plan had failed to take foreign exchange risk into account. Due to the long duration of this project, fluctuations in exchange rates led to funding gaps in some projects.
- **Review and approval procedure was complex and time-consuming.** The complexity of both the project's organizational structure and the related review and approval procedures led to "incessant coordination between the parties and ever widening disconnect between the actual project progress and the amount of construction work demanded,"31Moreover, the fairly laborious bidding process of AFD has also affected the construction speed to some extent. Therefore, the financing model of this project is not easily adaptable to large-scale commercial building retrofit projects.
- **Lack of Criteria for MR&V energy savings.** The measurement, reporting, and verification (MR&V) of energy savings is a vital part of any building retrofit project. For projects that rely on energy savings for loan repayment and profit-sharing, uncertainty with the actual amount of energy saved can be debilitating to both the distribution of energy savings and the evaluation of retrofitting benefits.

6. Summary

These four large-scale retrofit projects are both unique and similar. They have not only offered valuable lessons but also exposed the potential pitfalls for urban-scale building retrofits.

- **Funding availability is key.** All four projects were financed by loans or bank credit and **there was scarcely any involvement of private capital,** demonstrating the lack of diversity in source of funds. Both the Changning project and Wuhan project were backed by foreign loans that must be repaid on time since they are sovereign-backed loans, and yet these two projects also saw the slowest progress. As a result, there is considerable uncertainty on whether all their retrofitting goals can be achieved and whether the loans can still be repaid with energy savings.
- **Market development should be valued.** Fund availability alone does not guarantee that a project can proceed as planned. Large-scale retrofit projects affect many property owners, whose different expectations and interests must be managed individually, making project development a time-consuming process. The Chongqing project deployed over 30 local ESCOs to drive project development and, by sharing government subsidies and the revenue from energy savings, incentivized property owners to participate in building retrofits. Tonghua county achieved the same goal by promoting and reforming its heating billing system through district heating companies. These two projects enjoyed relatively smooth progress, which probably did not occur by chance given that their construction contractors were also responsible for market development. In contrast, the Changning project did not specify which party is responsible for market development, and the much-anticipated policies for impelling property owners to retrofit their buildings have yet to promulgate, thus resulting in overall slow progress.
- **Technical Capacity is Crucial.** Chongqing retrofitted 107 public buildings with a total of 4.4 million square meters in four years. Tonghua completed its project in two years, improving energy performance of 388 residential and public buildings, a total of 1.64 million square meters. These results highlight the importance of the professional competence brought by Tongfang and of the multi-project management capability of the district heating companies, both of which are crucial to any project aiming to retrofit urban-scale buildings.

Chapter 4:
Comprehensive Financing Solutions for Urban Building Efficiency Projects

1. Investment and Financing Approaches for Urban Building Efficiency Projects

Investment and financing approaches for green buildings generally include fiscal financing, debt financing, equity financing, finance leasing, and carbon trade financing, each with its own qualities and scope of application. Currently, fiscal financing and debt financing are still the dominant financing approaches for urban building efficiency projects in China. Equity financing is rarely seen, and finance leasing is seldom applied to EPC projects. Meanwhile, carbon trade financing is expected to become a viable approach following the launch of a nationwide carbon trading market in 2017.

	Investment/Financing Tool	**Application**
1. Fiscal financing	Central government appropriation	Building retrofit; high-star green buildings
	Local government appropriation	Building retrofit; high-star green buildings
	Deduction and exemption of urban infrastructure surcharge	High-star green buildings
	Deduction and exemption of land transfer fees	High-star green buildings
	Refund of urban infrastructure surcharge	High-star green buildings
	Special fund for green buildings	High-star green buildings
	Special fund for efficient buildings	Building retrofit
2. Bond financing	Loans with preferential interest rates	Building retrofit; high-star green buildings
	Foreign government loans	Building retrofit
	Loans from international development financial institutions	Building retrofit; high-star green buildings
	Local government bonds	Building retrofit
	Corporate bonds	Building retrofit; high-star green buildings
	Asset-backed securities (ABS)	High-star green buildings
3. Equity financing	Public investment funds	Building retrofit
	Private investment funds	Building retrofit
	Industry investment funds	Building retrofit; high-star green buildings
4. Finance leasing	Direct lease	Building retrofit; high-star green buildings
	Sale-leaseback	Building retrofit; high-star green buildings
5. Carbon market financing	Carbon trading	Building retrofit

Table 8: Investment and Financing Methods for Building Energy Efficiency in Cities

Aside from the standard financing tools listed in Table 8, some local governments have introduced certain innovative policies for the promotion of green buildings, including:

- Fast approval channels for green projects
- Bonus of floor area ratio for high-star green buildings
- Incremental gross floor area as a result of the application of green building technologies is not factored into floor area ratio
- High-star green building evaluation label as a prerequisite for receiving prestigious national awards of high quality building projects, such as the Luban Prize or Guangsha Prize
- Certified high-star green buildings enjoy priority in national and local industry prizes and awards.

2. Credit Enhancement through Green Insurance: A Proposed Model for Scaling High-Star Green Buildings

The fizzling out of the subsidy program for green buildings introduced by the Ministry of Finance in 2012 both upset and confounded the construction industry. Actually, the serious deficiencies in the current green building evaluation system (on which the subsidy program heavily relies) are deterring both subsidies from the **central government** and investment from the private sector. The cause of this aversion is that green evaluation results for a building are mostly based on its design drawings and may greatly diverge from the building's actual performance.

This problem is not unique to the green building industry in China but represents a common challenge facing the industry worldwide. Given that the green building performance labels do reflect the actual green performance of buildings and are harder to obtain, **real estate developers** are only willing to perform evaluation for the design stage. Some of them are even known to modify the drawings and lower the standards after receiving the evaluation label. In addition, **average home buyers** are indifferent to green building labels and thus unwilling to pay a premium for certified green properties, making it hard for developers to recoup the additional greening investment. Concerned with the investment return from green buildings, **investors** are cautious about financing green buildings. And due to the lack of public confidence in **evaluation institutions**, the green building evaluation label has limited added value.

Figure 16 shows our proposed green financing mechanism that uses insurance and independent evaluation institutions to provide credit enhancement for high-star green buildings. This mechanism addresses the concerns of various stakeholders in the green building market in the following way:

1. Insurance companies design and provide green building policies for high-star green buildings;
2. Developer purchases an insurance policy for high-star green buildings and commits to constructing a green building to deliver specified green performance;
3. By presenting the green building insurance policy, the developer receives a concessional construction loan from a bank committing to green finance;

4. The developer constructs a green building with the bank loan;

5. The developer presents the green building insurance policy to a consumer who prefers guaranteed green performance;

6. The consumer purchases the green property with a preferred mortgage rate from the bank, because the consumer has lower default probability due to more cash flows from energy and water savings;

7. After the consumer has moved into the building for one year, an independent third-party evaluation institution designated by the insurance company evaluates the green performance of the building;

8. The third-party evaluation institution submits the evaluation result to the insurance company and is accountable to the evaluation result;

9. If the evaluated result falls short of the commitment made at the purchase of the insurance policy, the insurance company will compensate the consumer and file a report with the government;

10. The government periodically subsidizes insurance premiums with its green building fund, announced but never implemented, without having to worry about inadvertently rewarding dishonest developers.

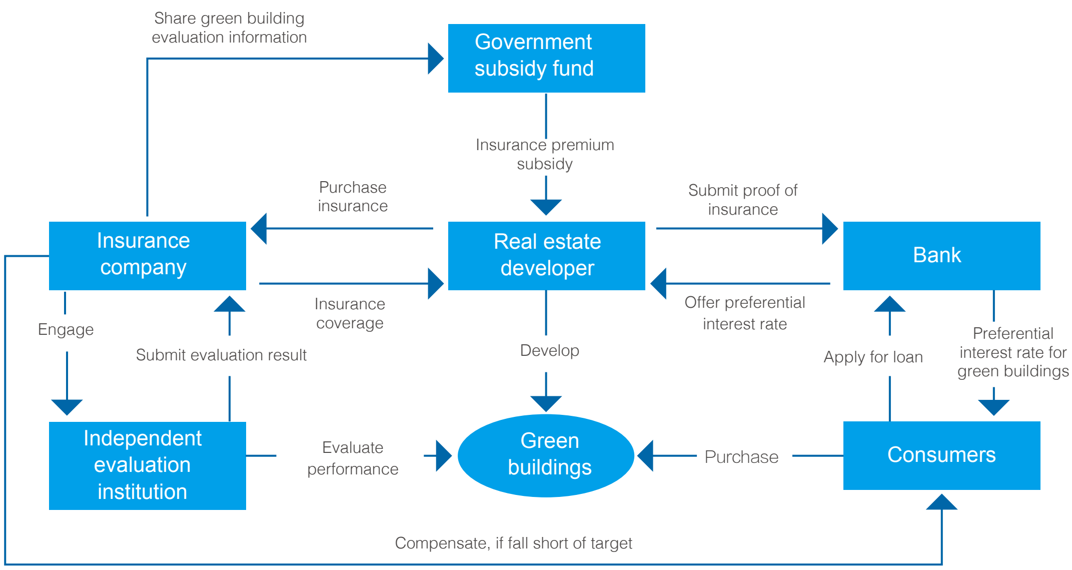


Fig. 16: Insurance-Based Credit Enhancement Mechanism for High-Star Green Buildings

3. Policy Recommendations for Financing Urban-Scale Energy Efficiency Buildings

While it can't be overstated how vital appropriate investment and financing tools are to the large-scale promotion of efficient urban buildings and green buildings, a set of complete, well-designed policies and evaluation mechanisms are just as important.

The following measures would spur innovation in investment and financing mechanisms for the energy upgrade of urban buildings in China:

1. **Green building legislations.** The Energy Conservation Law should be revised to establish the supervision, management, and scope of work of green buildings. The existing Regulations on Energy Conservation in Civil Buildings should be expanded into Regulations on Green and Energy-Efficient Civil Buildings to provide a legal basis for the promotion of green urbanization and green buildings, allowing green urban planning, green urban infrastructure and green construction to take root and flourish.
2. **A medium- and long-term national plan on energy efficiency buildings.** The central government should determine the building efficiency targets from the present to 2030. Such targets would foster medium- and long-term market expectations among stakeholders including government agencies, real estate developers, construction material and component suppliers, as well as integrated energy service providers, thus promoting the advancement of green and energy efficiency technologies, products, and capabilities.
3. **Mandatory disclosure of building energy data.** A disclosure system for building efficiency data would have a meaningful and positive impact on fostering the market demand for more efficient buildings. Many European countries have formalized such systems through legislation. Although similar provisions can be found in China's 2008 edition of Regulations on the Energy Conservation of Civil Buildings, they have never been duly enforced.
4. **An independent third-party evaluation mechanism for green buildings.** An independent evaluation system is essential to attracting private investment in green buildings. Strictly speaking, the current crop of green building evaluation institutions are not bona fide third-party agencies – many of them not only hold near-monopolistic market positions, but are also highly susceptible to conflict of interest as they serve concurrently as consultants to and evaluators of green buildings. The government has yet to establish strict supervision mechanisms for green building evaluation institutions.
5. **Concessional loans to high-star green buildings.** To encourage real estate developers to construct more green buildings for the benefit of the society, the government should provide subsidies on the bank loans taken out for independently certified green buildings, and develop policies that incentivize banks to offer loans to green housing buyers at preferential interest rates.

6. **An insurance guarantee mechanism for green buildings.** Currently, the evaluation of green buildings mainly relies on design drawings, which are not indicative of the actual green performance of the building once put into operation. As a result, the central government is reluctant to disperse incentive funds to encourage the development of green buildings. A performance guarantee mechanism working in tandem with an independent evaluation system would create a credit enhancement framework for green buildings, thereby attracting private investment and removing the central government's concerns about offering various incentives and subsidies.

7. **A compulsory insurance system for building retrofit projects.** Retrofit contracts and benefit-sharing arrangements are set prior to the start of a building retrofit. However, energy savings that provide the basis for the benefit-sharing arrangement cannot be accurately determined without actual measurements after the completion of a retrofit. Hence, introducing a compulsory insurance system for building efficiency ratings will help reduce contract disputes between property owners and the energy service companies and protect the rights and interests of both parties.

8. **A green building industry fund.** The promotion of green buildings will be a long-term endeavor, involving the entire industry chain from planning, design, construction, and operation to material production and technological innovation. Setting up an industry fund for green buildings is conducive to fostering and energizing every link in the green building industry chain.

9. **Municipal bonds for urban-scale building retrofits.** At present, large-scale urban retrofit projects primarily rely on bank or government loans. We suggest that municipal governments be permitted to issue urban upgrade bonds to support citywide building retrofits.

10. **International cooperation and international green loans and funds.** The current investment quota and capital flow quota can be relaxed for qualified foreign institutional investors (QFIIs) if they invest in urban-scale building retrofits or green building projects in China.

Postscript

Low-carbon urbanization is critical to China's sustainable economic transition. Since the Paulson Institute's Beijing representative office was opened in China three years ago, sustainable urbanization has been a priority. We focus on the economic, financial, and investment sectors to identify solutions and provide policy recommendations, while leveraging the influence of business leaders to create models for sustainability.

Last year, the Paulson Institute published a series of research reports on energy savings and carbon reduction in cities, including China's Next Opportunity: Sustainable Economic Transition; Building Energy Disclosure: How Energy Reporting for Buildings Can Reduce Costs and Improve Efficiency; Carbon Emissions Trading: Rolling Out a Successful Carbon Trading System; and Climate Change, Air Quality and the Economy: Integrating Policy for China's Economic and Environmental Prosperity.

Investment and financing of urban-scale energy efficient buildings is a global challenge. Europe and the United States, which started focusing on scaling energy efficiency before China, are still seeking solutions. The main questions are:

- How to invest in building energy efficiency retrofits at scale?
- How to standardize, and securitize if possible, building energy efficiency projects?
- How to improve the capacity of the financial industry to finance building energy efficiency projects?
- How to motivate owners to join building energy retrofit initiatives?
- How to truly solve the long-term problem of public disclosure of building energy data?

The importance of seeking solutions to the above challenges is obvious, however, answers are often elusive. It is important for policymakers, energy experts, financial experts, and others to work together, to find new models and develop appropriate financial products.

We hope this report can initiate discussion on investment and financing for urban-scale energy efficient building projects in China.

Great thanks are due to Dr. MA Jun, Chief Economist of the People's Bank of China, for his support for this report. Also, I'd like to thank Ms. YANG Ailun of Bloomberg Philanthropies for her kind invitation to write this report. In addition, I received great support from Prof. WANG Yao and her team at the Central University of Finance and Economics (CUFE), especially Mr. MA Wen. Thanks also go to Ms. HU Shan of the Building Energy Research Center of Tsinghua University, Ms. XIN Jianan, program associate of the Building Program at Energy Foundation China, and WANG Zhaoxia, a doctoral student of China Association of Building Energy Efficiency (CABEE). My colleagues at the Paulson Institute, Anders Hove, Hortense Halle-Yang, and Cindy JIANG, assisted in data inquiries; YE Zexi, my intern at the time, helped proofread the report. The Paulson Institute communications team, in partnership with Bloomberg Philanthropies, played a key role in ensuring the smooth publication and dissemination of this report.

This report is unable to cover everything relevant due to time limits. The opinions and views expressed herein may not reflect consensus of all parties, but rather are more of my preliminary understanding in the field of building energy efficiency. Further comments or input are very welcome.

Kevin Mo, Ph.D.

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