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China's Approaches to Financing Sustainable Development: Policies, Practices, and Issues

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ABSTRACT

To curb the country's energy use and decarbonize its energy supply, China invested heavily in energy efficiency and clean energy in the past five years. China's investment in clean energy surpassed the amount invested during any previous Five-Year Plan period and made China the global leader in clean energy investment. The investment potential in clean energy is, however, far from being achieved in China. There are several barriers that are hindering China's ability to meet the demands for financing clean energy development. This paper reviews China's recent efforts in financing clean energy. It first reviews policies for facilitating green investments. It then describes the types and areas of green investments and activities carried out to date in China with regard to clean energy financing. A discussion follows examining key barriers to achieving investment potentials in China. The paper concludes with some recommendations for China to increase its efforts to scale up investments in sustainable development.

Keywords: China, Sustainable Development, Energy, Investment, Financing

China has achieved remarkable economic growth over the last decade. To maintain the pace of rapid industrialization and urbanization, however, China's energy consumption also grew rapidly. China's share of worldwide energy consumption increased from 11.2 percent in 2000 to 17.8 percent in 2008.¹ Coal is the dominant source of energy in China, accounting for over 70 percent of the country's total energy use.² As China becomes the world's fastest growing consumer of energy, it is also becoming world's largest carbon dioxide (CO₂) emitter due largely to its coal-dominated energy system.

For over a decade prior to 2002, China reduced its energy intensity (energy consumption per unit of GDP) by an annual average of 5%.³ Those gains, however, were eroded between 2002 and 2005 by a dramatic surge in energy consumption with an average 2 percent annual increase in energy intensity due to the fast expansion of the country's heavy industry.⁴ As a result, China experienced worsening

environmental conditions during this period, with 27.8 percent increase in SO₂ emissions from the 2000 level in the 10th Five-Year Plan (FYP) period (2001 to 2005) while the target was a reduction of 10 percent.⁵ In response, in 2005 the Chinese government set ambitious goals of reducing energy intensity by 20 percent and total discharge of major pollutants by 10 percent by 2010 from the 2005 level as part of its 11th FYP (2006 to 2010).

To curb the country's energy use and decarbonize its energy supply, China invested heavily in energy efficiency and renewable energy during the 11th FYP. In the past five years, China's investments in clean energy surpassed the amount invested during any previous FYP period and made China the global leader in clean energy investments. Between 2006 and 2010, China invested a total of 2.59 trillion Yuan (USD 411 billion) in clean energy.⁶ As a result of all the measures taken and investments made in China, the country managed to cut its energy intensity by 19.06 percent, saving 634 million tons of coal equivalent (tce) of energy, reducing SO₂ emissions by over 14 percent, and cutting the increase of greenhouse gas emissions by 1,460 million tons of CO₂ equivalent against a 2005 baseline during the 11th FYP period.^{7,8}

While the trend of reducing its energy intensity will continue in the 12th FYP (2011-2015), China is stepping up its efforts to transition to a clean energy economy, for a number of reasons. First, there is a growing recognition in China that a high carbon- and energy-intensive development path is neither sustainable nor consistent with the country's long-term economic, energy, and environmental interests. Next, China's rapid industrialization and urbanization will continue to drive the demand for more energy, which has generated a need for China to develop alternative energy sources including renewables to boost its energy supplies from traditional sources. Third, as the world's largest carbon emitter and energy user with its emissions and energy consumption continuing to rise, China needs to transform its economy to effectively address concerns ranging from environmental pollution of burning fossil fuels, to steeply rising oil imports, and to combating global climate change. Finally, Chinese policymakers see the development of the clean energy sector as not only a means to fuel its next phase of growth but more importantly as a critical strategic opportunity to become a leader in vital emerging market sector where developed countries are not yet dominant.^{9,10,11}

China is now leading the world in clean energy investment and will continue the trend.^{12,13,14} The investment potential in clean energy is, however, far from being achieved in China. The China Greentech Initiative estimated that the country's greentech market could reach US\$500 billion to US\$1 trillion by 2013.¹⁵ A recent Tsinghua University report estimates that China's new plan for new energy development would attract 5 trillion yuan (US\$800 billion) of investments during next ten years.⁶ To date, China has been relying primarily on traditional approaches through government funding and bank loans to finance green development. To support its low-carbon development in the long run, China needs to establish more diversified financing channels and employ more innovative financing approaches. China also needs to address many other issues that hinder green investments.

This paper reviews China's recent efforts in financing clean energy development. It first reviews the policies put forth by the Chinese central government in facilitating green investments. It then describes the types and areas of green investments and activities carried out to date in China with regard to clean

energy financing. A discussion follows examining key barriers to achieving investment potentials in China. The paper concludes with recommendations for China to increase its efforts to scale up green investments.

POLICIES FOR FACILITATING CLEAN ENERGY INVESTMENTS IN CHINA

To help achieve China's energy and environmental goals and promote green investment, China has promulgated laws and regulations and put forward a series of policies facilitating green development and attracting and steering investments towards clean development.

Legislation and policy roadmap for driving sustainable development

Confronting the challenges of energy security, rising concerns related to the domestic and global environment, and economic, environmental, and social costs of unchecked development, the Chinese leadership has increasingly made energy and environmental sustainability a national development priority. This profound shift in priorities has elevated energy and environmental sustainability to the top of the national policy agenda. To advance this agenda, China passed new laws and strengthened existing laws in the 11th FYP period.

Effective January 1, 2009, China's newly-enacted *Circular Economy Promotion Law* promotes the efficient use of resources by requiring reducing, reusing, and recycling activities to be conducted in the process of production, circulation, and consumption. The law mandates that circular economy development be encouraged propelled by the government, led by the market, effected by enterprises, and participated in by the public. If effectively implemented, the law will shape China's economic development in ways that conserve energy, water, and materials.

In addition, China amended its *Renewable Energy Law* on December 26, 2009 to require the government to set a specific target for the share of the electricity generated from renewable energy sources in the total electricity generation during the planned period, to establish specific regulations regarding the power dispatching priority to favor renewable energy, and to purchase all the electricity generated from renewable energy sources by the grid companies, in accordance with national programs for the development and utilization of renewable energy. The amended law also requires the electricity distribution companies to develop and apply smart grid and energy storage technologies to enable the integration of renewable energy in the electricity grids and sets up penalties if utilities fail to purchase and accommodate renewable energy. The law authorizes financial institutions to offer concessional loans with subsidized interest rates to renewable energy projects.

China also amended its *Energy Conservation Law* which took effect on April 1, 2008. The amendment has remarkable changes on two fronts. First, the amended law, which almost doubles the articles of the original law, extends from industrial conservation to other sectors and provides specific requirements for energy conservation work in industrial facilities, commercial and residential buildings, the transportation sector, and public institutions. The second aspect is that the amendment mandates the

implementation of a system of accountability for energy conservation targets and a system for energy evaluation whereby the work carried out by local government officials in energy conservation must be integrated into the assessment of their job performance. The amendment also established requirements for financial institutions to provide support for energy conservation.

China has also put forward a series of road maps directing the country's efforts in green development. The *Comprehensive Working Plan for Energy Conservation and Emission Reduction in the 11th FYP Period*, released in 2007, stated the goals, key program areas, and policy measures regarding energy conservation and emission reduction, and played a significant role in steering China's effort in meeting its energy and environmental targets in the period 2006-2010. The *Outline of the 12th Five-Year Plan (2011-2015) for National Economic and Social Development* released in 2011 established the policy orientation of promoting green and low-carbon development, and expressly articulated the goals and tasks for the next five years, which include a new carbon intensity (a reduction in carbon emissions per unit of GDP from 2010 level) target of 17 percent, an energy efficiency improvement target of 16 percent, and a non-fossil fuels in total energy mix target of 11.4 percent by 2015.

Policy promoting strategic emerging industries

China's State Council issued a directive in October 2010 to vigorously promote the development of emerging strategic sectors.¹⁶ Energy efficiency, environmental protection, and new energy are among the emerging areas that the Chinese government is promoting. This policy document has not only outlined the development goals and specific tasks for these emerging areas but also has provided guidance on expanding investment channels and innovating financing and other mechanisms to facilitate the rapid development of these emerging industries. To foster the growth of the energy conservation service industry and accelerate the implementation of energy efficiency measures, the State Council issued policy opinions in April 2010.¹⁷ The opinions not only set forth the goal for the development of the industry but also outline supporting measures including investment support, tax incentives, improved accounting procedures, and enhanced financing services.

Policy encouraging private investments in green development

To facilitate large-scale investments from the private sector in emerging areas including clean technology, the State Council issued important opinions on encouraging and guiding the expansion of private investments on May 5, 2010.¹⁸ The opinions clearly define the scope of government investments, which are mainly used for sectors that matter to national security and where the market is unable to effectively allocate resources. The opinions require governments at all levels to create a level playing field for the private sector to compete fairly in the market that is not prohibited by law. Private investments are encouraged to participate in areas that are primarily state controlled such as infrastructure, energy production, public services, and financial services. Private companies are allowed to participate in the reform of state firms by purchasing a stake in them, invest in the equity of commercial banks, and create private financial entities such as community banks, local credit unions, lending companies, loan guarantee companies, and financial intermediaries. The opinions require

governments to create a favorable environment for private investments by providing private companies with adequate administrative, financial and regulatory support while enhancing government guidance, oversight, and services related to private investments.

One clear indication of the government's intention to leverage more private investments is the most recent new interim measures jointly announced by China's Ministry of Finance and the National Development and Reform Commission on August 17, 2011.¹⁹ The interim measures call for the creation of a fund of funds that invests the public fund to form new venture capital funds or increase the equity of existing venture capital funds to target start-up companies who pursue innovation in emerging strategic industries and high-tech of transforming traditional industries.

Policy steering investments towards energy conservation and pollution reduction

During the 11th FYP period, China adopted a series of policies that have become a powerful force of influencing and spurring green financing in China. These policies mark an entirely new way of addressing energy and environmental problems in China, in which environmental enforcement has been shifted from regulatory measures to using market influence by enlisting the power of the financial sector to force companies to meet energy and environmental standards and comply with relevant laws and regulations. These green policies include a "Green Credit" policy, a "Green Security" policy, and a "Green Insurance" policy, implemented by the Ministry of Environmental Protection (MEP) in partnership with various financial regulatory commissions in China.^{20,21,22}

The "Green Credit" policy – issued in July 2007 – requires banks to cease lending to companies who are listed in the MEP blacklist for environmental violations and to projects that are out of compliance with relevant regulations. The "Green Security" policy – adopted in February 2008 – calls for strengthening the implementation of environmental performance verification for public-listed companies in polluting industries. It also requires the security regulatory agency to reject or suspend Initial Public Offering (IPO) or refinancing requests from companies that failed to pass a government environmental evaluation. In addition, the policy mandates listed companies to disclose their environmental information to shareholders so that investors can avoid potential financial loss resulting from possible violations. The "Green Insurance" policy – also issued in February 2008 – calls for the use of environmental liability insurance as an effective leverage to prompt enterprises to take measures to minimize environmental risks. These market-based green policies play an important role in helping China curb financial resources for polluting companies and redirect investments into clean and green development.

Another powerful policy tool that China has applied in redirecting the country's investments towards green development is the requirement for relevant government entities to conduct both an environmental impact assessment and an energy conservation evaluation for fixed-asset investments. China's *Environmental Impact Assessment Law*, which took effect on September 1, 2003, requires that the planning and construction of all projects affecting the environment be subject to a mandatory environmental impact assessment. The amended *Energy Conservation Law*, which took effect on April 1,

2008, requires all new fixed asset investment projects must undergo independent assessments and government reviews on whether the project is energy efficient or not as a prerequisite for government approval. This policy tool could be forceful in curbing inefficient energy use, minimizing environmental damage, and guiding investments towards clean and green development.

TYPES, AREAS, AND ACTIVITIES OF GREEN INVESTMENTS IN CHINA

During the 11th FYP period, China invested a total of 2.59 trillion yuan (US\$ 411 billion) in clean energy, comprised of 859.2 billion yuan (US\$ 136 billion) in energy efficiency improvements and 1.73 trillion yuan (US\$ 275 billion) in new energy and renewable energy.⁶ Figure 1 is an illustration of the composition of China’s green energy investment portfolio.

China’s investments in clean energy have come from several sources, including direct government investments and incentives, internal capital of businesses, bank loans, public equity markets, venture capital, private equity, and carbon financing. Figure 2 provides a schematic description of primary financing mechanisms for green energy development in China.

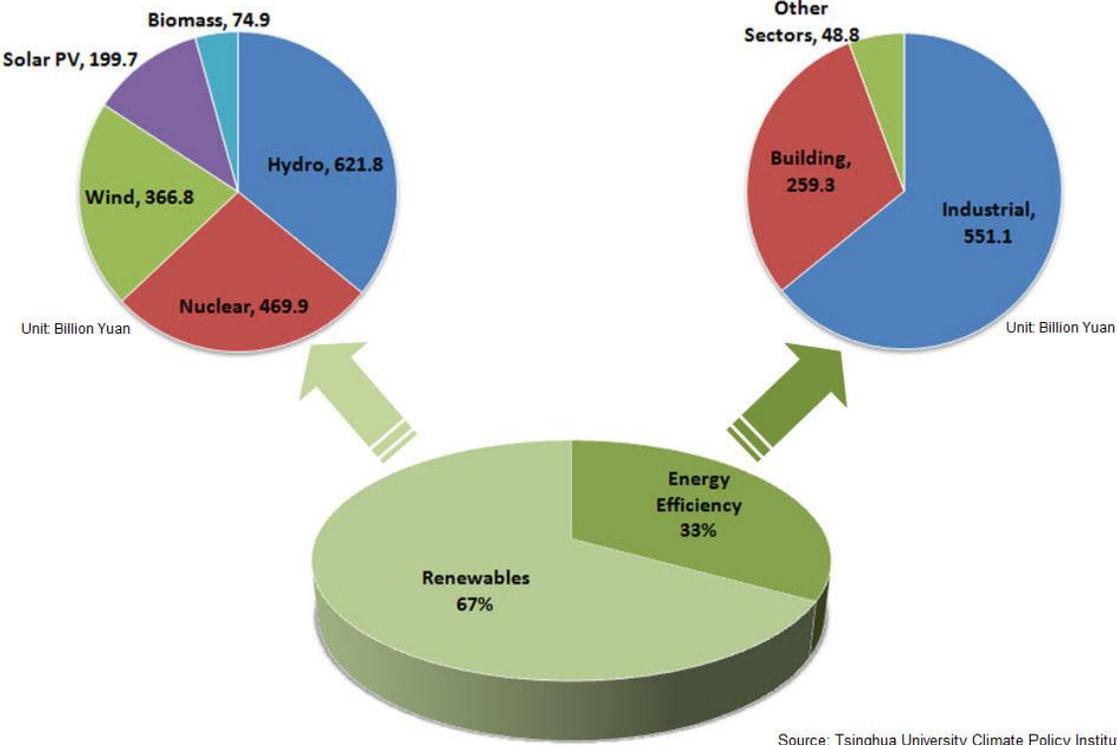


Figure 1. Composition of China’s green energy investment portfolio

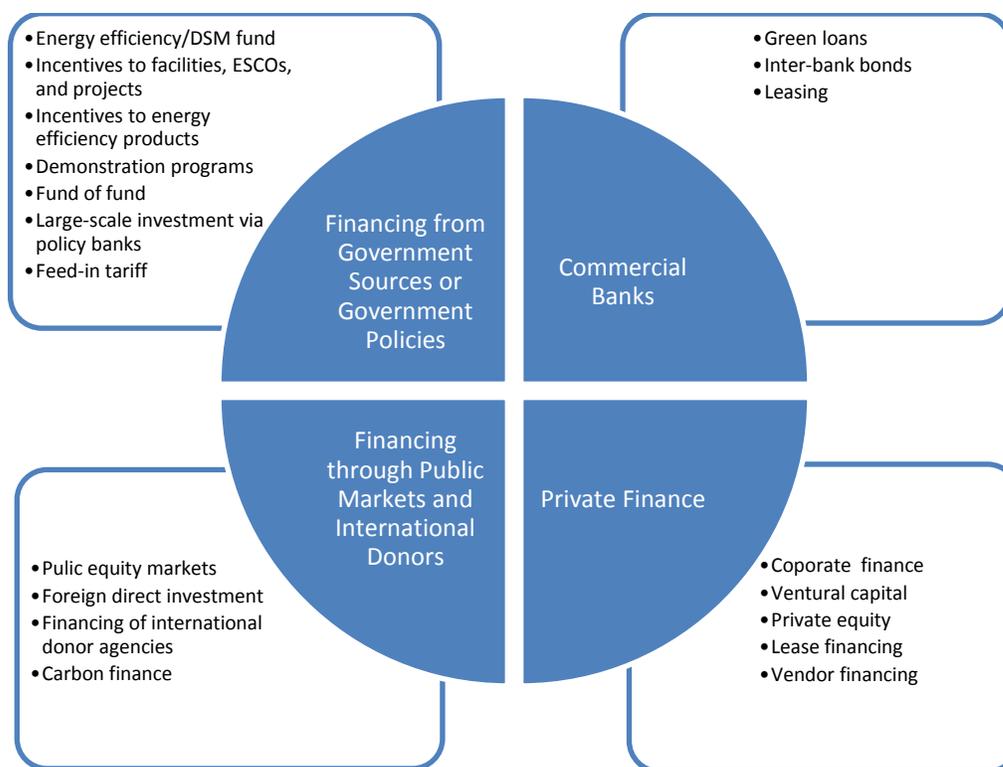


Figure 2. Key financing mechanisms for green energy development in China

Direct government support

During the past five years, Chinese governments – at both central and provincial level – have undertaken significant efforts to support and incentivize clean energy development and energy efficiency improvement. A significant amount of public funding has been utilized to support a series of implementation and demonstration programs such as the *Ten Key Projects* for the use of more energy efficient technologies, the *Top-1000 Program* targeting the largest industrial energy users, the phase-out of outdated industrial capacity, various environmental protection measures, the *Golden Sun Photovoltaic Demonstration Project*, the *Green Energy County Demonstration Project*, as well as low-carbon city and small town demonstration programs.

Government support to industrial facilities, ESCOs, and projects

To support industrial customers in retrofitting their facilities, China's central government offered financial incentives during the 11th FYP to qualified industrial facilities who achieved verified savings of over 10,000 tce (293TJ). The awards were 200 yuan per ton of coal equivalent (tce) (US\$1 per GJ) for facilities in the East region of China and 250 yuan per tce (US\$1.3 per GJ) for facilities in less developed Middle and West regions, respectively.²³ The incentives to the country's industrial facilities are continued in the current FYP period (2011-2015); but the amount has been increased to 240 yuan per tce (US\$1.3 per GJ) for facilities in the East region and 300 yuan per tce (US\$1.6 per GJ) for facilities in

Middle and West regions. The new incentive has also expanded its coverage to include smaller facilities, making achieving verified savings of 5,000 tce (147TJ) eligible for the award.²⁴

Provincial and local governments have also awarded energy-consuming enterprises for energy efficiency improvements. The Shanghai Municipal Government, for example, awards 300 yuan per tce (US\$1.6 per GJ) of saved energy to enterprises that have achieved measured savings of 5,000 to 10,000 tce (147-293TJ). The Shanghai government is currently considering raising the level of the award to 500 yuan per tce (US\$2.7 per GJ).²⁵

To accelerate the implementation of energy efficiency measures, the Chinese central government announced a new incentive program in June 2010 that is a combination of a cash reward and favorable tax treatment offered to qualified energy service companies (ESCOs). This program targets smaller projects with energy savings anywhere between 500 and 10,000 tce (15-293 TJ) for industrial projects and between 100 and 10,000 tce (2.9-293 TJ) for projects in other sectors.

Central government's funding for ESCOs is matched by incentives from local governments. For every tce of verified energy savings, the provincial governments are required to offer a minimum of 60 yuan (US\$9.52) to match the national incentive of 240 yuan (US\$38), making the combined award no less than 300 yuan per tce (US\$1.6 per GJ).²⁶ The level of the local matching fund varies depending on the local situation. Shanghai, for example, has announced that it will match 360 yuan per tce (US\$1.9 per GJ), making the combined incentive to ESCOs 600 yuan for every tce (US\$3.2 per GJ) of energy saved.²⁷ Beijing announced that the city will match 260 yuan for each tce (US\$1.4 per GJ) of energy saved to supplement the national award. For ESCOs that are not qualified for the national incentive, the municipal government in Beijing will either offer an award of 450 yuan for per tce (US\$2.4 per GJ) or provide an incentive that is equivalent to 15-20% of the project cost.²⁸

In addition to direct financial support, the Chinese central government has developed a favorable taxation policy and streamlined accounting rules to strengthen the support for the ESCO industry. As a result of strong government support, the number of ESCO companies increased from 80 to over 800, the number of employees in this sector increased from 16,000 to 180,000, the industry scale was enlarged from 4.7 billion yuan-worth (US\$ 746 million) to 84 billion yuan-worth (US\$ 13 billion), and the annual energy-saving capacity rose from some 600,000 to more than 13 million tce during the 11th FYP.²⁹

To support the rapid development and deployment of renewable energy technologies, the Government of China has created a renewable energy development fund which includes both direct subsidies and interest payment support. The subsidies include 1,350 yuan (US\$214) for producing each ton of fuel ethanol, 20 yuan (US\$3.17) per watt for building integrated photovoltaic systems, and a fund covering a maximum of 70 percent of the construction cost of an independent photovoltaic system.³⁰ As of September 2011, the Chinese central government has provided a total subsidy of 10.2 billion yuan (US\$1.6 billion) supporting photovoltaic applications.³¹ In addition, the fund also provides interest payment support that discounts the interest rate for a renewable energy project by up to 3 percent for one to three years.³²

For many years China lacked incentives to foster domestic solar energy use. As a result, merely 10 percent of solar panels produced by Chinese photovoltaic (PV) manufacturers were installed in China in 2010. However, China's first nationwide feed-in tariff scheme, announced in August 2011, could fuel the rapid growth of the domestic solar market. The newly issued feed-in tariff will allow project developers to sell solar generated electricity to utilities at a price of about US\$0.15 per kilowatt-hour, which could guarantee a payback in seven years and cash yields for nearly another two decades. In just several months, the new feed-in tariff has increased estimated solar panel installation to 2,000 megawatts in 2011 in China, twice the country's total installed capacity to date.³³

Government support for demonstration programs

The Chinese central government is increasingly giving attention to funding demonstration programs to build experience and create best practices in developing and deploying clean energy. The *Golden Sun Photovoltaic (PV) Demonstration Program* is one of several national initiatives underway. Under this program, qualified PV projects including distributed PV applications, large PV facilities, stand-alone PV and PV hybrid applications in remote or unelectrified areas, commercialization of PV and PV related technologies, and capacity building and standardization related to PV systems are eligible for government incentives equal to 50 percent of the total project invested capital (70 percent for projects in un-electrified areas).³⁴

The Government of China is also investing 4.6 billion yuan (US\$730 million) to create a *Green Energy County Demonstration Program* in 108 rural counties to encourage green energy technologies and application in rural China. The types of qualified projects under this program range from centralized methane gas supply to biomass gasification, biofuel, rural renewable energy applications, and the development of rural energy service infrastructures.³⁵

In addition, the central government is providing up to 80 million yuan (US\$13 million) to each participating city that is selected as a pilot for the national demonstration program of renewable energy application in buildings. Cities that have taken early actions to adopt supporting policies in promoting the use of renewable energy in buildings will be given preferential treatment. In order to receive funding, large cities are required to cover at least 3 million square meters (32 million square feet) of building area by renewable energy while smaller cities need to cover a minimum of 2 million square meters (21 million square feet). To augment the impacts of the government funding, pilot cities are encouraged to utilize the incentive to leverage private investment through credit enhancement and other market approaches.³⁶

Furthermore, the Government of China is providing an unspecified amount of funding to support comprehensive measures targeting all sectors with integrated solutions from policies, planning, structural changes, to technology applications and the use of market-based approaches. The *Green and Low-Carbon Small Town Demonstration Project* and the *Demonstration Project of Utilizing Comprehensive Fiscal Policies to Promote Energy Conservation and Pollution Reduction* are two major

national initiatives launched by the Chinese Government for identifying integrated solutions. To date, seven small towns and eight cities have been selected, respectively, as the first round of pilot sites under the two demonstration projects.^{37,38}

Government support for promoting the use of energy efficient products

As part of the government's nationwide campaign for energy conservation and emission reductions, the Chinese government has provided significant incentives to promote the use of energy efficient products. In 2008, for example, China launched a nationwide compact florescent lighting (CFL) promotion program to increase the use of energy-efficient light bulbs. Under this program, the government offers a 30 percent subsidy on wholesale purchases and a 50 percent subsidy on retail sales of energy-saving light bulbs.³⁹ A total of 360 million subsidized CFLs were sold to consumers between 2008 and 2010. This helped the market share of high-efficiency illumination products to reach 67 percent in China during the 11th FYP period.²⁹

In May 2009, the Chinese government launched a nationwide program promoting energy-efficient appliances and equipments. The *Energy-Efficient Products for the Benefit of the People* program promotes the widespread use of energy-efficient appliances and equipments including air conditioners (ACs), refrigerators, washers, TV, computer displays, and electric motors. For example, the central government offers subsidies of 500-850 yuan (US\$79-US\$135) per unit for grade 1 AC products and 300-650 yuan (US\$47-US\$103) per unit for grade 2 AC products. Local governments provide an additional subsidy of 150 yuan (US\$24) for grade 1 AC units and 100 yuan (US\$16) for grade 2 units.⁴⁰ These subsidies have helped promote 30 million high-efficiency air conditioners.²⁹ Within just two years, the market share of high-efficiency AC units in China increased 13 fold to 70 percent from 5 percent.³¹ In June 2010, the Chinese government launched a pilot program in six Chinese cities to provide direct subsidies to buyers of electric and hybrid cars. The pilot provides a discount of 60,000 yuan (\$8,800) for purchasing electric vehicles and 50,000 yuan (\$7,320) for plug-in hybrids. In addition, the Chinese government offers a nationwide subsidy of 3,000 yuan (US\$476) on purchases of cars with 1.6-litre engines or smaller and that consume 20 percent less fuel than the current fuel economy standards.⁴¹ So far, the central government has allocated 4.3 billion yuan (US\$683 million) to support the energy-efficient automobile program.³¹

In addition, Chinese governments at all levels have invested directly in energy efficient products through the green procurement program. According to data released by the Ministry of Finance, in 2010 alone governments at different levels in China spent a combined 72.1 billion yuan (US\$11.4 billion) in procuring energy efficient supplies, accounting for 77.3 percent of the total supplies of the same types.³⁹

Government support for developing strategic emerging industries

To enable the country become a leader in vital emerging market sectors, China has made the development of seven key strategic emerging industries the country's strategic focus of economic development in the 12th FYP period and beyond. The strategic emerging industries include energy efficiency, information technology, biotechnology, high-end equipment manufacturing, new energy,

advanced materials, and new energy vehicles. The Chinese government has created a special fund and allocated 4 billion yuan (US\$634 million) supporting the development of these emerging sectors in 2011. The Government's allocation can be used as venture capital investment, subsidies for accelerating commercialization, and incentives for spurring consumption in these strategic emerging sectors.³¹

Investment by state-owned enterprises

The role of China's state-owned enterprises (SOEs) in clean energy investments should not be overlooked. For example, from 2007 to 2008, China's largest industrial enterprises participating in the country's *Top-1000 Program* – many of them are SOEs – invested a combined 140 billion yuan (US\$22 billion) in innovation and retrofit projects that resulted in a total of energy savings of 50 million tce (1,469 PJ).^{42,43} SOEs have also dominated China's solar power project market by underbidding private developers. In the second round of solar concession that occurred in the summer of 2010, for example, SOEs won all 13 of the projects with winning tariffs between 0.70 and 1.09 yuan (US\$0.11-0.17) per kilowatt hour. Even though the price was too low to keep the return on investment at 10 percent, SOEs are capable of taking on these projects with their sizeable balance sheets and ability to give up short-term profits for long-term gains.¹⁵

The role of China's Banks

In addition to the direct incentives, the Chinese Government also offers low-interest loans and large credit lines through its policy bank, the China Development Bank (CDB), to finance the country's clean energy development. The CDB is primarily responsible for raising funds for large infrastructure projects and serves as the engine that powers the national government's economic development policies. In 2010, the CDB lent a total of 232 billion yuan (US\$36.8 billion) in financing for energy-saving and pollution control projects.⁴⁴ It also provided China's major solar panel manufacturers with a combined total of 203 billion yuan (US\$32.2 billion) in loans to assist them in increasing production capacity and expanding overseas operations. This expansion could double global solar cell production capacity and enable these Chinese companies to gain larger shares in important markets.¹⁵ Governments' financial support to foster the growth of domestic clean energy business is common outside China. The U.S. Department of Energy (DOE), for example, created a loan guarantee program as part of the *Energy Policy Act of 2005* to support clean energy development. The program leverages federal dollars by allowing the DOE to guarantee the debt of clean energy developers and manufacturing companies. To date, the DOE has finalized or issued conditional commitments for nearly \$36 billion in loan guarantees and has supported a diverse portfolio of over 40 projects.⁴⁵

Despite strong financial support from China's governments at both the central and local levels, the majority of the green investments in China during the 11th FYP period have come from domestic financial institutions. In the area of energy efficiency investment, for example, public funding accounted only for 14.7 percent while the majority (85 percent) came from the commercial sector.⁶ Loans made by China's commercial banks have played an essential role in meeting the financial needs of the clean energy development in China and at the same time have helped phase out the inefficient operations.

Actions taken by domestic financial institutions in restricting the expansion of highly polluting and highly inefficient (*liang gao*) industries and promoting green development have been largely driven by the adoption of a “Green Credit” Policy that mandates lenders to link banks’ lending decisions with borrowers’ energy and environmental performance. The “Green Credit” policy had helped to move loans away from the *liang gao* sectors. According to the China Banking Association, the share of commercial loans issued to major energy consuming and environmental polluting industries such as iron and steel, cement, glass, coal chemical, calcium carbide, and shipbuilding in China’s total commercial lending was only 3.57% in 2010.⁴⁶ In 2009 alone, the total loan amount supporting energy conservation and pollution reduction reached 856 billion yuan (US\$135 billion). The loan volume of China’s commercial banks in financing energy efficiency and environmental protection projects has quadrupled in 2010 from the 2006 level.⁴⁷

To meet the growing demands for financing and to address the barriers to accessing financing (discussed in a following section), some Chinese banks have taken innovative approaches. The Bank of Beijing, for example, announced in April 2011 that it signed a strategic collaboration agreement with the nation’s ESCO industry trade group, the China’s Energy Management Company Association (EMCA), to provide EMCA’s member companies with a special line of credit worth a total of 10 billion yuan (US\$1.6 billion) for the next five years.⁴⁸ A special loan program has recently been created in some banks, through which industrial facility owners or ESCOs that have limited equity/asset can pledge their entitled shared-savings as collateral. As of February, 2011, for example, the Pudong Development Bank has issued 47.4 million yuan (US\$7.5 million) of this type of loans.⁴⁹

Other types of financing

Compared with traditional funding sources, new types of investment through public equity markets, venture capital, and private equity were relatively insignificant in China. Combined funding from these sources accounted for only 14.28% of China’s total clean energy investment of \$51.1 billion in 2010, a year in which the country has set the record with so far the largest investment figure in any year and for any country.^{13,50} Figure 3 shows the total amount and number of cases related to public offerings and private investments in the forms of venture capital and private equity during the 11th FYP period.

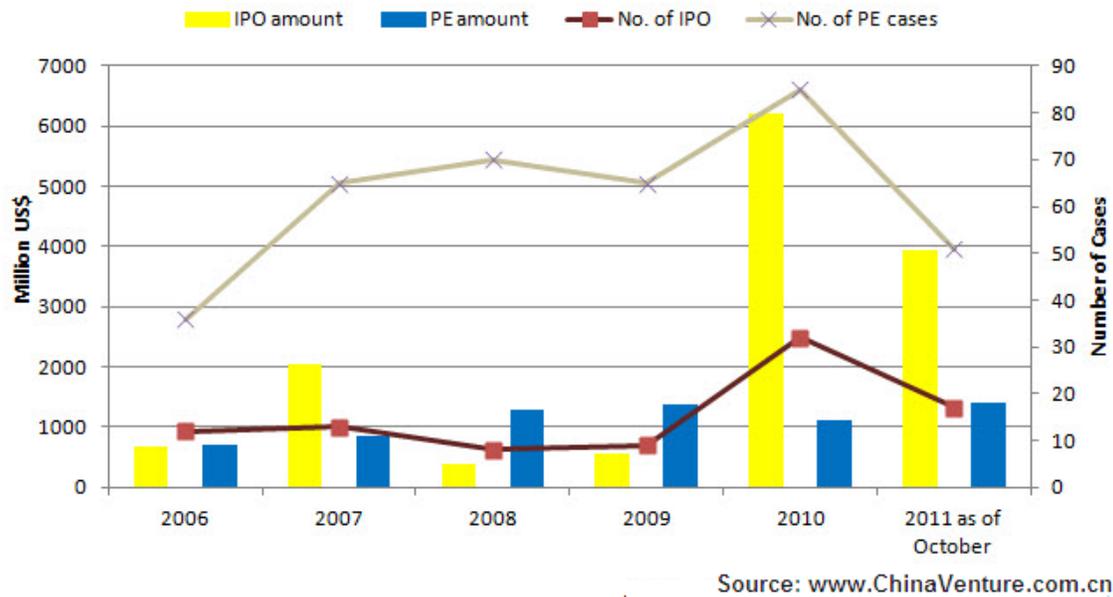


Figure 3. China’s IPO and VC/PE Investment in the 11th FYP Period

Financing through public equity markets

The total amount of clean energy financing through China’s public equity markets between 2006 and 2010 was around 62 billion yuan (US\$9.9 billion). China set a record in 2010 in raising funds to finance clean energy development through its stock markets with the number of Initial Public Offerings (IPOs) reaching 32. Investment through the country’s stock markets in 2010 was 1.67 times the amount raised in the four years combined from 2006 to 2009. China’s public equity market investments accounted for 35% of world’s combined clean energy stocks in 2010.^{50,51} This share, however, does not include the funds that Chinese clean technology companies raised from public offerings outside of China.

Even though funding through the stock market has been relatively small in China’s total share of green investments, the public equity market has played an important role in helping curb the country’s growing environmental problems. The most notable example is the China’s “Green Security” policy that has made it harder for *liang gao* industries to raise capital from the public equity market. Since the implementation of the policy in February 2008, 20 out of 38 companies who did not pass the government’s review of energy and environmental compliances had their IPOs rejected or delayed subject to further review by China’s environmental regulators.⁵²

Venture capital and private equity investments

Venture capital and private equity have played a smaller role in financing clean energy development in China. The total amount of investments under this category was merely 33 billion yuan (US\$5.3 billion) during the 11th FYP period.⁵⁰ Investment through venture capital and private equity accounted only for 2.2% of China’s total clean energy investment of \$51.1 billion in 2010.^{13,50} Despite the small share of

venture capital and private equity investments in the total green energy investments in China, investments through this private source made up about 13 percent of the world's total venture capital and private equity investments in clean energy in 2010.^{50,51}

The top three areas that attracted the most venture capital and private equity investments in China in 2010 were wind energy (with a share of 25.12% in total), battery and energy storage technology (20.02%), and environmental protection and energy conservation (19.57%). In 2011, however, the share of private investments in wind energy shrunk to 3.93% while pollution monitoring and control (35.94%), solar energy (29.23%), and battery and energy storage (16.80%) became the top three areas that attracted most venture capital and private equity investments.⁵⁰

Carbon financing

Carbon financing such as the Clean Development Mechanism (CDM) has played a positive role in directing China's investment to green development. The interaction between the CDM and renewable energy development is an indication of this. Despite questions about the additionality of a number of renewable energy projects, CDM has in fact become a tool for fulfilling the country's policy, particularly in the wind sector, where the capacity of all CDM projects in the pipeline was twice the 5GW target.⁵³

China has become the world's largest and most active market for CDM. By the end of 2010, a total of 1,560 Chinese projects were successfully registered with the United Nations Clean Development Mechanism Executive Board, accounting for 46 percent of all combined registered programs in the world, and their estimated certified emission reduction (CER) reached an annual issuance volume of 328 million tons of carbon dioxide equivalent, comprising about 64 percent of the world's total. With regard to the types of China's CDM projects, hydropower projects are ranked the first followed by wind projects and energy efficiency projects. Other types of CDM projects being developed in China include coal bed methane, landfill gas, biomass energy, industrial gas capture projects, fossil fuel switching, biogas, reforestation, and solar energy.^{29,53,54}

Lease financing

Lease-financing is an arrangement under which the lessor purchases an asset from a supplier at the determination of the lessee and provides the use of this asset to the lessee against payment of a leasing fee.⁵⁵ While China's leasing market is currently under-developed, it has entered into a stage of rapid development, with a business value reaching 650 billion yuan (US\$103 billion) in 2010, an 8-fold jump between 2006 and 2010.⁵⁶ Lease-financing has increasingly become an important vehicle for marketing energy efficient technology with a viable financing solution. There is a good fit between lease-financing option and energy-efficiency projects. The costs for the lease are typically lower than the saved energy costs, so the financing pays for itself and brings additional cost savings, producing a win-win for customers, equipment manufacturers/vendors, leasing companies, and the environment.

Information disclosure to facilitate green financing and investment

In 2006, China's central bank, the People's Bank of China, created a nationwide credit database which today consists of credit information as well as information on administrative penalties for 600 million individuals and 16 million businesses across China.⁵⁷ The database allows various government agencies to share information and it is accessible to all banks and financial institutions that rely upon the information to make their investment decisions. Most significant information in the database is related to environmental compliance of businesses. At the end of 2010, 40,000 entries on environmental violation information and 3,000 environmental assessment results were entered into the database by the Ministry of Environmental Protection. To a significant extent, the information sharing and disclosure has helped Chinese financial institutions to make informed decisions regarding their investments and direct their financing toward environmentally sound projects.^{57,58}

Support from international donor agencies

International donors have also played an important role in facilitating green financing and building capacity for domestic financial institutions in providing green financing in China. As early as 1998, the *China Energy Conservation Project* was launched with a grant from the European Commission and the Global Environment Facility (GEF) and a loan from the World Bank. This project provided lines of credit to three Chinese ESCOs and helped them adapt energy performance contracting to China's market. It also created a loan guarantee program to help build a three-party investment mechanism involving project hosts, banks, and ESCOs. In addition, it supported the creation of China's ESCO association, EMCA, to build the institutional support for ESCOs and make it a representative of this emerging industry in China.⁵⁹

During the 11th FYP period, the World Bank and the GEF launched a five-year *China Energy Efficiency Financing Project* (CHEEF) with multiple goals. The first goal is to provide energy conservation investment lending to industrial enterprises or ESCOs through carefully selected domestic financial intermediaries (DFIs) who in turn will on-lend the World Bank/GEF funds along with equal amount of loans committed from their own resources. The second goal is to demonstrate to China's domestic banks effective business models and institutional arrangements for the preparation and financing of energy conservation projects, focusing primarily on pre-investment activities, such as feasibility studies, due diligence, development of new financing mechanisms, and institutional arrangements. Other goals of CHEEF include strengthening the government's capacity in implementing national energy conservation policies and programs and supporting program monitoring and reporting.⁶⁰

The Export-Import Bank of China (EXIM), one of China's policy banks that normally serves large customers, and the Huaxia Bank, a joint stock bank that traditionally serves smaller customers, were selected as the two DFIs participating in the CHEEF project. As of March 31, 2011, CHEEF phase I has disbursed US\$95 million and leveraged investments of US \$177 million from EXIM and Huaxia and US\$216 million from industrial facilities, which is estimated to result in 1.5 million tons of coal equivalent of energy savings and 4 million tons of CO2 emissions reductions every year once these projects are in operation. The World Bank has approved loans of US\$100 million for each of two

following phases of CHEEF and selected EXIM and the private Min Sheng Bank, separately, as the implementing DFIs.^{61,62}

The French Development Agency (FDA) signed a collaboration agreement with China's Ministry of Finance (MOF) in 2007 to jointly launch a green loan project under which the FDA provided 60 million euro (US\$78 million) to the Ministry of Finance (MOF) for carrying out a financial intermediary lending operation for energy efficiency retrofit and renewable energy development projects. Three Chinese joint stock banks –Huaxia, China Merchants Bank, and Pudong Development Bank – were selected as the three DFIs to provide the FDA loan to qualified projects at below-market rates. The goals of the FDA loan are not only to finance green energy but also to enhance the capacity of China's banks in assessing energy efficiency and renewable energy potentials and improving their lending practices in green energy. The development and dissemination of a guidebook on energy efficiency and renewable energy project financing was an important output in this collaboration. Because of the initial success in implementing this project, the FDA and MOF decided in 2010 to extend the operation to the second phase and increase the FDA loan to 120 million euro (US\$156).⁶³

In addition to providing loans to support China's green development, international donors have also provided China with other support. In March 2011, the World Bank launched the *Provincial Energy Efficiency Scale-Up Program* in China, assisting three Chinese provinces to meet their energy efficiency goals by strengthening their institutional systems, improving local implementation capacity, and deploying more market-based incentive mechanisms for energy efficiency investments. One of the three provinces, Shandong, was offered a loan of US\$150 million to improve its energy efficiency, particularly through lease financing.⁶⁴

International donors have also provided China with significant support in mitigating the financial risks associated with green lending. As part of its *China's Energy Conservation Project*, the World Bank/GEF launched a major loan guarantee program in China in late 2003 with a total of US\$26 million in GEF grant financing. Unlike traditional guarantee programs which support broader energy efficiency investments, this guarantee program was designed solely to support the development of the local Chinese ESCO industry. The program was operated by China's largest guarantee company, the China National Investment & Guaranty Co. (I&G), using GEF resources held by the Government of China as reserve resources to back the loan guarantees issued.⁶⁵ As of the end of 2009, I&G had worked with 12 banks and 6 provincial guaranty companies to provide a total of 516 million yuan (US\$82 million) guarantees to 148 energy efficiency projects carried out by 42 ESCOs.⁶⁶

The International Finance Corporation (IFC), a member of the World Bank Group, launched the six-year *China Utility-Based Energy Efficiency Finance Program* (CHUEE) in 2006. The CHUEE program was jointly funded by the IFC, the GEF, the Ministry of Employment and Economy of Finland, and the Norwegian Agency for Development Cooperation. The primary goals of this program are to reduce greenhouse gases emissions by financing energy efficiency projects in China and to create an effective financial system for Chinese enterprises and project developers to invest in energy efficiency projects. Under this program, the IFC would provide a combined package of risk-sharing facility, technical assistance and

advisory services to multiple players including commercial banks, ESCOs, energy efficiency equipment suppliers, and utilities.⁶⁷

As an important part of CHUEE program, IFC cooperates with Chinese commercial banks, offering them a risk-sharing facility under which IFC bears a certain portion of the loss for all loans made by Chinese banks within the energy efficiency financing portfolio. Since the launch of the program, three Chinese banks have participated in the CHUEE program – the Industrial Bank, the Bank of Beijing and the Shanghai Pudong Development Bank. With the support of CHUEE, the program’s participating banks jointly provided loans totaling 3.5 billion yuan (US\$555 million) as of June 2009, which financed 98 energy efficiency projects, such as heat and gas recovery power generation and the introduction of efficient production systems. While the steel, chemical, and cement industries have benefited the most from these targeted investments, China’s financial institutions have learned a great deal in risk-based lending. In addition, an independent evaluation of CHUEE’s program found that members in the CHUEE-supported ESCO network enhanced their chances of obtaining bank financing by 31 percent and technical assistance to ESCOs independent of membership increased the probability of projects obtaining financing by 27 percent.⁶⁸

BARRIES TO ACHIEVEING CHINA’S FINANCING POTENTIALS

Despite the efforts to date, there remains a large potential for green energy investments in China. However, the country is facing several key barriers which have impeded the development of a sizeable market suitable for addressing China’s needs for green investments. These barriers are particularly evident in the area of energy efficiency improvement since financing renewable energy projects has faced fewer hurdles given the revenue certainty brought by the country’s advantageous feed-in-tariff policy. The section below discusses specific barriers to scaling up energy efficiency investments in China.

Lack of long-term policy mechanisms and effective policy design

Despite strong political and financial commitments to energy efficiency improvement by the government, several problems are present in China indicating that the country needs to develop more effective policy mechanisms and sufficient institutional capacity necessary to create long-lasting impacts on energy efficiency investments.

For example, there is ineffectiveness in the policy design. Taking China’s green policies (i.e., green credit, green security, and green insurance) as an example, these policies focus on restrictive rather than incentive measures, which have led to some counterproductive results. The lack of supporting guidelines for the implementation of green financing policies is also indicative of an ineffective policy design. While the government issued policies to link financing with enterprises’ energy and environmental performance, it failed to put out evaluation criteria to guide financial institutions in making effective decisions. The lack of proper evaluation guidelines has created a situation in which those affected by the policy merely understand why but do not know how to implement the green financing policy. In addition, the lack of a system capable of monitoring and overseeing policy compliance also indicates a

flaw in the policy system. To a certain extent, policy is compulsory by design. However, it acts in a more voluntary way when being implemented, due to the lack of effective monitoring and control mechanisms. This shortcoming of no distinction between good and bad performers dampens the enthusiasm of financial institutions that proactively implement the policy and discourages them from undertaking larger efforts and building a system of facilitating the economic transition towards sustainability.⁵⁸

Despite China's enormous foreign currency reserves and Chinese currency deposited in Chinese banks (US\$ 3.2 trillion and US\$12.6 trillion, respectively, at the end of September 2011),^{69,70} financing for energy efficiency is still difficult to obtain in China. Restrictions in China's legislations and regulations have allowed this to occur. First, the promotion of diversified financing vehicles such as bond and leasing financing has not been reflected in China's laws. For example, China's local governments are barred by law from issuing debt. Second, energy efficiency obligations on utilities are an effective policy instrument to support energy efficiency investments since the utilities often have the strongest technical and institutional capacity and ability to carry out the energy efficiency investments. However, in China, both legislative efforts and regulatory mechanisms are not in existence to spur utilities' interests in investing in energy efficiency implementation.

If not designed comprehensively, policies could bring unintended consequences for energy efficiency investments. For example, to curb inflation China has tightened its control on lending since 2010. The statutory reserve requirements set for the country's banks were adjusted 12 times, increasing from 16 to 21.5 percent within 17 months,⁷¹ forcing banks to reduce lending. At the same time, interest rates were adjusted upward, making the rate for a 3-year term loan stand between 8% and 12%. The small and medium-sized enterprises (SMEs) were hit the hardest. Facing growing difficulties obtaining most needed financing, many SMEs scrambled for funds from private lenders who charged up to 18 times the benchmark loan rate (up to 120 percent in contrast to the 6.65 percent benchmark rate).⁷² Persistent high loan rates could have serious consequences for SMEs including ESCOs, increasing their borrowing costs, eroding their profits, and even driving them out of business. To make it worse for energy efficiency investments, higher loan rates have allured more institutions into the private lending business, including investment consulting firms, credit guarantee firms, pawn shops and unlicensed micro-credit organizations, because the business offers a higher return between 40 to 50 percent.⁷² This further reduces the funds available for energy efficiency investments.

China's control of the expansion of heavy industries as well as the restraint on foreign exchange also brings unintended consequences for energy efficiency investments. The green loan and green security policies are aimed at slowing the fast expansion of heavy industry, but the policy puts an inadvertent ban on financing energy efficiency in this sector, effectively blocking a vital pathway for the energy-intensive sectors to be more efficient. The control on foreign exchange was intended to control a sharp rise in the inflow of speculative "hot money," or foreign capital entering the country to seek quick profits. It could, however, have an unintended effect on energy efficiency investments since it adds another layer of risk and uncertainty to foreign investors, driving them away from investing in China.⁷³

Insufficient capacity and inadequate institutional support

In addition to the issues associated with regulatory policies, the lack of sufficient institutional capacity further aggravates the problem of scale-up. In China, energy efficiency projects are often carried out separately by individual project developers or ESCOs. This common practice makes it hard, if not impossible, to aggregate and develop large clusters of viable projects. Outside China, there are different types of institutions such as utilities, NGOs, or government entities playing a market aggregator role in administering and implementing large-scale energy efficiency programs. One good example is the Sustainable Energy Utility model pioneered in Delaware in the U.S. that serves as a one-stop shop for energy efficiency and renewable energy solutions from bundling projects, bringing cluster of projects to the financial market, and administering the project implementation.⁷⁴ Aggregation is attractive to financiers, allowing them to finance a portfolio of energy efficiency projects rather than individual projects, thus significantly lowering transaction costs; aggregation can also create economies-of-scale and attract large suppliers and service providers. Bulk purchases, bulk discounts, and other aggregation strategies will bring down incremental costs of energy efficiency measures, helping overcome the first cost barrier and creating a larger, more sustained market demand.

Inadequate institutional support further aggravates the problem for implementation. Under the green financing programs, financial institutions make financing decisions based on firms' environmental performance information provided by the Ministry of Environmental Protection and its local environmental protection bureaus. However, insufficient institutional capacity, especially at the national level, has posed significant constraints for green financing policies to be fully effective. A comparison of the Environment Protection Agency of the United States (with approximately 18,000 staff members) to China's Ministry of Environmental Protection (currently 311 employees at the central government, approximately 2800 staff in total including all employees at sub-national governments and public institutions) would illustrate the seriousness of this issue.⁷⁵

Lack of focus on green development in China's lending practices

With the adoption of the Green Credit policy, Chinese banks view energy and environmental issues as a matter of policy compliance. Even though China's banks are increasingly promoting sustainable development as a matter of corporate social responsibility (actions taken beyond what is mandated), many Chinese banks still portray sustainability as charity work rather than a core business strategy.⁵²

In addition, green lending, especially lending for energy conservation and environmental protection, is a new business line for Chinese lenders. It is also perceived to be a riskier business by the risk-averse lenders compared with their traditional lending activities, as energy efficiency improvement is often regarded as an activity that does not contribute directly to the business' production expansion and revenue generation. The unfamiliarity of the benefits of pursuing energy efficiency and perceived risks of energy efficiency lending have created a compounding effect, leading to a lack of institutional focus on promoting energy efficiency lending activities by Chinese lenders especially commercial banks.⁶⁵ As a

result, lending for energy efficiency and environmental protection accounts only for a tiny fraction — less than 3 percent — in the country’s total commercial loan portfolio.

There is a disconnect between current lending practices of local financial institutions (LFIs) and the needs of energy efficiency projects, which has created significant difficulties in granting the access to available funds at LFIs. This is caused by several factors. First, commonly accepted asset-based lending requires significant asset value which cannot be created through energy efficiency projects which value is energy-savings. Second, savings are not acknowledged as a way to increasing credit capacity. The lack of understanding about the complexity of energy-saving projects and the scarcity of experience to properly evaluate their risks and benefits raise the hurdle of accessing financing. Finally, LFIs are unwilling to invest in building proper capacity due to the insignificant share of energy efficiency financing in their lending portfolio⁷⁶

Lack of motivation for energy efficiency in China’s enterprises

In spite of the fact that energy efficiency is a national priority in China, many enterprises are reluctant to take aggressive actions to materialize enormous energy-saving opportunities, especially those beyond low-hanging options. Several factors are considered to be the cause for this reluctance. First, constraints of internal capital have made investing in energy efficiency less likely when competing with investing in production expansion. A lack of internal funding for energy efficiency is the top barrier in China. The 2011 Johnson Controls Energy Efficiency Indicator Survey found that 40 percent of 450 Chinese respondents indicated that they had insufficient internal capital for energy efficiency projects.⁷⁷ It is also the case that energy efficiency projects, especially those carried out by external developers are not welcomed by many enterprises in China, particularly industrial facilities, due to the fear about the loss of trade secrets and possible business interruptions. As a result, many industrial energy efficiency projects focus primarily on replacing equipment rather than on materializing larger saving opportunities in the industrial processes. In addition, in state-owned enterprises in China, job performance of executives is evaluated according to the achievements during their tenure, but energy efficiency improvements can have payback periods beyond their tenures. Projects are less welcomed if the energy-savings would only add value to their successors.

Formidable hurdles for small and medium-sized ESCOs

China’s small and medium-sized enterprises (SMEs), long the most dynamic and vital part of the Chinese economy, continue to face significant hurdles in accessing commercially viable capital. The state-owned enterprises that produce merely a quarter of China’s GDP have access to a large share of the country’s credit while SMEs that combine to produce 60 percent of the country’s GDP and absorb 80% of employment only gain about one-quarter of new investments channeled through China’s financial system, indicating a declining productivity of investment.^{78,79} Among 400,000 SMEs in Shanghai, for example, there are merely 37,000 that have a credit relationship with local banks, making the vast majority the city’s SMEs out of banks’ service coverage.⁸⁰

Except for a very few large peers, the majority of China's ESCOs are SMEs, with characteristics that prevent them from accessing much needed capital. Generally, there are several key factors contributing to the difficulties China's ESCOs are facing. First, the bank-dominated financing structure offers very limited financing options for ESCOs. Next, the ESCO business is service-oriented and relies primarily on shared energy-savings as the revenue source and thus lack collateral and predictable cash inflow, which are basic requirements under the traditional lending. Furthermore, ESCOs' lack of credit history due to being in the start-up stage hurt their creditworthiness which is critical for securing financing. Fourth, most ESCOs in China focus on niche markets with unproven and limited technology solutions. The lack of diversified technology offerings from ESCOs coupled with the unfamiliarity of banks with energy efficiency measures have raised financiers' concerns on the successful rate of their investments and increased the perceived risks that result in less capital availability or place more stringent requirements on obtaining capital. Finally, under the current energy performance contracting model, ESCOs are responsible for seeking financing and bearing the financial risks and they get paid only after savings are realized, which takes time. This to a large extent limits ESCOs' ability to take on multiple projects. All these factors have worked together to hamper the larger growth of the energy service market.

Lack of diversified sources of financing

Despite the existence of diversified financing alternatives to bank loans, sizes and available funding from these diversified sources have been small and limited, making them very hard to fill the financing gap for energy conservation investments.

Venture capital and private equity investments could play an important role in financing green development. However, in China these investments often favor late stage projects where the risk is small and earnings are fast, while many green energy projects need the most support at the early stage.⁸¹ China's bond market remains small in size. This market was valued at 20.4 trillion yuan (US\$ 3.2 trillion) at the end of 2010, merely one-tenth of the size of the U.S. bond market.⁸² The scale of China's public equity market is also limited. At the end of 2010, companies listed on China's stock exchanges issued over 3.31 trillion shares with a total market valuation of 26.54 trillion yuan (US\$ 4.21 trillion).⁸³ By comparison, the market capitalization of all companies listed on the New York Stock Exchange alone was around US\$13.39 trillion in December 2010.⁸⁴

Despite the fact that China is by far the largest beneficiary of carbon financing through CDM, less than 8 percent of China's approved CDM credits in 2010 were for energy efficiency projects.⁷³ This is due to the typical problems that energy efficiency projects face — such as measurement and verification of energy savings — which are further exacerbated by complex and demanding CDM rules and procedures. In addition, foreign investments in clean energy development are severely confined by China's stringent policy governing foreign investors.

Lack of technical capacity in clean energy investment

There is a large gap between the capacity of and the needs for scaling up green energy financing, especially energy efficiency investments, in China. For China's financiers, energy efficiency is a completely new area; there is a general lack of familiarity with energy conservation technologies and practices, leading to a weak capability on the part of financiers to properly assess the risks and potentials of energy efficiency investments. The lack of such an important capacity would not only impede financiers' ability to effectively perform credit evaluation and risk management for energy efficiency projects but also prolongs the process and increases the transaction costs of developing those projects. To make things worse, financiers are unwilling to develop internal capacity for energy efficiency because it is not their core business focus.

The capacity of other participants in energy efficiency is also weak in China. There is not only a lack of sufficient technical, market, financial, and business development skills but also a scarcity of experience in dealing with financiers and customers on the part of project developers and energy service providers. Customers, facility owners, managers, engineers, or architects lack information about energy efficiency project characteristics and potentials, technical merits of energy efficiency products, equipments, and services, economic and financial costs and benefits associated with energy efficiency activities, and possible impacts of these activities on operations and productions. The lack of skills and information may increase perceived uncertainties and impede decisions.

Lack of effective M&V protocol and implementation for documenting energy savings

The success of the energy performance contract (EPC) model very much relies upon reliable and transparent measurement and verification (M&V) of cost savings, the absence of which could lead to contract disputes between the project hosts and project developers/service providers and thus hinder the scale-up of energy efficiency investments.

There is no legally enforceable national standard governing the evaluation of the savings of energy efficiency projects in China. Despite the existence of a national standard providing a general guidance on calculating energy-savings, the protocol is relatively old (issued in 1997), has limited scope (merely covering industrial facilities), and has been too simple to satisfy the contractual requirements of an EPC. Due to the lack of a well-designed M&V protocol, clients and contractors often could not reach an agreement on the savings. The lack of reliable measurement equipment and baseline data add another layer of difficulty to the problem of building an effective M&V system.⁸⁵ In addition, China's implementation of M&V work is further hindered by a lack of a third-party M&V scheme that could provide independent and impartial services of verifying energy savings, which is essential to develop a robust energy service market.

Issues related to international donor agencies

Investment support from international donor agencies has had mixed results. While some donor programs were successful in facilitating lending from local financial institutions, more have experienced low deal flow. Under the *China Energy Efficiency Financing Project* (CHEEF) supported by the World Bank and GEF, for example, for two years, only half of the allocated loan of US\$ 200 million from the World Bank was lent out by Chinese domestic financial intermediaries (DFIs) who merely provided US\$100 million of matching loan in energy efficiency projects. In stark contrast to this, Min Sheng Bank, one of the DFIs participating in CHEEF project, issued a total of 900 billion yuan (US\$143 billion) in commercial loans in 2009.⁶²

Several reasons have contributed to the less than satisfactory outcomes. First, the local market may not have been sufficiently developed with strong institutional capability of bundling and delivering high quality projects for financing. In addition, donor programs were not well designed to be properly adapted to meet local needs. In addition, some donor programs were not developed to meet the local financial partners' core business objectives and thus failed to obtain their full and sustained participation. Finally, donor programs were not intensively and continually marketed.⁸⁶

CONCLUSION AND RECOMMENDATIONS

China has made sustainable development the country's top policy priority and has invested heavily in energy efficiency, clean energy, and environmental protection during the 11th FYP period. Despite these efforts, however, the size of China's green energy market could continue to be limited due to impediments to green investments, especially the financing of energy efficiency.

China could consider of taking a series of actions to remove the barriers that prevent it from scaling up green energy investments. It is important for China to strengthen policy and regulatory support, enhance monitoring and supervision of policy compliance, motivate financial institutions to focus more on energy efficiency, and create effective institutional framework and enabling environment to convert energy efficiency opportunities into real investments and large-scale implementation. It is also imperative for China to diversify its financing resources and investment options, reduce the perceived risks and bring down transaction costs of energy efficiency projects and incremental costs of energy efficiency measures, pursue proactive resolutions of legal, financial, tax, accounting, and other issues relative to the performance contracting, develop and implement an effective energy-saving measurement and verification system, and build strong capacity and disseminate best practices in scaling up energy efficiency financing.

In addition to these general ideas of actions China could take to scale up its green energy investments, three specific recommendations are offered below to enhance the credit of energy project developers and service providers and reduce the risks associated with energy efficiency investments:

- a. *Credit information verification for SMEs*: the government in China could help create credit information and scoring system that tracks and documents credit history of all businesses including SMEs and converts the tracked information into credit scores that could help financial institutions determine the level of individual business' creditworthiness. SMEs should be allowed to receive a credit certification from the system for use in the application of loan or loan guarantees.
- b. *Provision of performance guarantee of energy efficiency projects*: the government could facilitate the development of such a mechanism that energy efficiency projects could receive performance guarantees from energy efficiency service providers just like products receiving a termed guarantee after being purchased. Such a mechanism would assure that if service providers failed to deliver the promised savings, they are required to either make effort to correct the problem or to refund the shared savings.
- c. *Building risk-sharing mechanism*: the government could take the advantage of the experiences from international donor-supported risk-sharing programs to create mechanisms such as a risk-sharing facility, performance guarantee insurance, and re-guarantee program of providing a guarantee to the guarantee companies.

To achieve its energy and carbon reduction targets set up for the 12th FYP period, China will no doubt significantly increase its investments in low-carbon, sustainable development. However, the challenges may be even more daunting in the new FYP period as many low-hanging opportunities have already been seized during the 11th FYP period. The work would be harder if the country is to improve its energy efficiency by 16 percent by 2015 from the 2010 level, which indicates that removing the barriers to green energy investments is even more pressing and necessary than before. By scaling up its investments in energy efficiency, renewable energy and clean technologies, China will make significant contributions to fight against local and regional pollution as well as global climate change.

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REFERENCES

- ¹<http://data.worldbank.org/indicator/EG.USE.COMM.KT.OE> (accessed December 30 2011)
- ²<http://www.stats.gov.cn/tjsj/ndsj/2010/indexch.htm>
- ³Levine M.D., Price L, Zhou N, Fridley D, Aden N, Lu H.Y., McNeil M, Zheng N, Qin Y.N., Yowargana P, 2011, *Assessment of China's Energy-Saving and Emission-Reduction Accomplishments and Opportunities During the 11th Five Year Plan*, Berkeley, CA: Lawrence Berkeley National Laboratory. http://china.lbl.gov/sites/china.lbl.gov/files/LBNL-3385E.Ace_Study_Report_FINAL.Rev_.pdf
- ⁴Sun Guoshun, "China's Efforts to Address Climate Change," Presentation in US-China Green Symposium, World Bank, Washington, D.C.: June 10, 2011
- ⁵State Council, China National Environmental Protection Plan in the Eleventh Five-Years, <http://www.caep.org.cn/english/paper/China-National-Environmental-Protection-Plan-in-11th-Five-Years.pdf>
- ⁶Climate Policy Institute and Tsinghua University, Annual Review of Low-Carbon Development in China (2011-2012), http://www.climatepolicyinitiative.org/generic_datas/view/publication/123
- ⁷<http://english.cbcsd.org.cn/news/news/10554.shtml> (accessed December 30 2011)
- ⁸Li JF. Energy and Environment in China. A Report to TEKES. May 2011. http://www.finnode.fi/files/37/Energy_and_Environment_in_China.pdf (accessed December 30 2011)
- ⁹<http://www.ema.gov.sg/page/655/id:172/> (accessed December 30 2011)
- ¹⁰Zhang ZX. China in the transition to a low-carbon economy *Energy Policy* 2010, 38:6638-6653
- ¹¹http://www.americanprogress.org/issues/2011/08/china_energy_competitiveness.html (accessed December 30 2011)
- ¹²<http://green.blogs.nytimes.com/2010/03/29/china-leads-in-renewable-investments/>
- ¹³<http://bnf.com/Download/pressreleases/134/pdf/>
- ¹⁴Pew Charitable Trusts, *Who's Winning the Clean Energy Race?* Washington, D.C.: Pew Charitable Trusts, 2011
- ¹⁵China GreenTech Initiative, *The China GreenTech Report 2011*. <http://www.china-greentech.com/report> (accessed December 30 2011)
- ¹⁶State Council. Decision on Accelerating the Fostering and Development of Strategic and Newly Emerging Industries (国务院关于加快培育和发展战略性新兴产业的决定, 国发〔2010〕32号). [2010]#32. October 10, 2010. http://www.gov.cn/zwggk/2010-10/18/content_1724848.htm
- ¹⁷State Council. Opinions on Accelerating Energy Performance Contracting to Promote the Development of Energy Service Industry(国务院办公厅转发发展改革委等部门关于加快推行合同能源管理促进节能服务产业发展意见的通知,国办发〔2010〕25号). [2010]#25. April 2, 2010. http://www.gov.cn/zwggk/2010-04/06/content_1573706.htm

-
- ¹⁸State Council. Several Opinions on Encouraging and Guiding the Healthy Development of Investments from the Private Sector (国务院关于鼓励和引导民间投资健康发展的若干意见, 国发〔2010〕13号), [2010]#13. http://www.gov.cn/zwgk/2010-05/13/content_1605218.htm
- ¹⁹Ministry of Finance (MOF) and National Development and Reform Commission (NDRC). Notice on the Interim Measures of Administrating the Participation of Emerging Sector Venture Capital Investment Program in the Equity Investment of Venture Capital Funds (关于印发《新兴产业创投计划参股创业投资基金管理暂行办法》的通知, 财建〔2011〕668号). [2011]#668. August 17, 2011. http://www.gov.cn/zwgk/2011-09/09/content_1944275.htm
- ²⁰Ministry of Environmental Protection (MEP), People's Bank of China, China Banking Regulatory Commission. Opinions on Implementing Environmental Protection Policies and Regulations and Minimizing Credit Risks (关于落实环保政策法规防范信贷风险的意见, 环发〔2007〕108号). [2007]#108. http://www.gov.cn/gzdt/2007-07/18/content_689085.htm
- ²¹Ministry of Environmental Protection (MEP). Guidance on Strengthening Environmental Protection Supervision of Public Listed Companies (关于加强上市公司环境保护监督管理工作的指导意见, 环发〔2008〕24号). [2008]#24. http://www.gov.cn/zwgk/2008-02/25/content_900324.htm
- ²²Ministry of Environmental Protection (MEP). Guidance on Liability Insurance of Environmental Pollution (关于环境污染责任保险工作的指导意见, 环发[2007]189号), MEP[2007]#189. http://www.mep.gov.cn/info/gw/huanfa/200802/t20080220_118389.htm
- ²³Ministry of Finance (MOF), 2007. Notice from Ministry of Finance and National Development and Reform Commission on Interim Management Measures on Fiscal Incentives for Energy Conservation Technological Renovations. [2007]#371. August 10, 2007.
- ²⁴Ministry of Finance (MOF), 2011. On the issuance of "Incentive Fund Management Guideline for Awarding Energy-Saving Technology Retrofit", [2011]#367, June 21, 2011, http://www.ndrc.gov.cn/zcfb/zcfbqt/2011qt/t20110701_421413.htm (accessed December 30 2011)
- ²⁵Shanghai Energy Conservation Supervision Center. Personal interview conducted on April 13, 2010
- ²⁶Ministry of Finance (MOF), 2010. Notice on Interim Management Regulations on Financial Rewards of Energy Performance Contracting Projects, June 3, 2010. http://jjs.mof.gov.cn/zhengwuxinxi/zhengcefagui/201006/t20100609_321884.html (accessed December 30 2011)
- ²⁷ Wei YJ. "Introduction of Work Done by Shanghai Energy Conservation Supervision Center," *Proceedings of 2010 China Industrial Energy Efficiency Workshop*, August 19-20, 2010 Xi'an, China.
- ²⁸ Beijing Evening News, 2010. *Establishment of Special Funds for Energy Management Contracting*. December 5, 2010.
- ²⁹State Council. China's Policies and Actions for Addressing Climate Change. November 2011. http://www.china.org.cn/government/news/2008-10/29/content_16681689.htm

-
- ³⁰ Ding ZM. China's Energy Policies and Regulations and Implementation Effect. National Energy Administration. April 12, 2011
http://ec2.rec.org/documents/04_Ding%20zhimin_Key%20Drivers%20for%20Future%20Energy%20Development%20in%20China.ppt
- ³¹ National Financial Weekly. Special Interview with Vice Minister of Finance Zhang Shaochun.
http://www.nbzy.com/article.aspx?&article_id=0000034002&article_dm=66603
- ³² Ministry of Finance. Interim Measures for the Administration of Renewable Energy Development Special Fund. <http://www1.china.com.cn/chinese/PI-c/1248915.htm>
- ³³ New York Times. China Uses Feed-In Tariff to Build Domestic Solar Market. September 14, 2011
- ³⁴ Ministry of Finance (MOF), 2009. Notice on the Implementation of Golden Sun Demonstration Project, July 16, 2009. [2009]#397. http://www.gov.cn/zwggk/2009-07/21/content_1370811.htm
- ³⁵ http://ny.china.com.cn/2011-05/13/content_4195999.htm
- ³⁶ <http://www.bjleanju.cn/hyxx/html/356.html>
- ³⁷ Ministry of Finance. Notice on the Conduction of Demonstration Work of First Batch of Key Green and Low-Carbon Small Towns. September 26, 2011 [2011]867.
http://jjs.mof.gov.cn/zhengwuxinxi/zhengcefagui/201110/t20111024_601489.html
- ³⁸ Ministry of Finance. Notice on the Conduction of Demonstration Project of Utilizing Comprehensive Fiscal Policies to Promote Energy Conservation and Pollution Reduction. June 22, 2011. [2011]383.
http://jjs.mof.gov.cn/zhengwuxinxi/zhengcefagui/201106/t20110628_568103.html
- ³⁹ Ministry of Finance. Status on the Financial Support for Energy Conservation, Pollution Reduction and Renewable Energy Development.
http://www.mof.gov.cn/zhuantihuigu/czjbqk2010/4czzc/201110/t20111031_603392.html
- ⁴⁰ Wang, Geng, 2010. "Energy Efficiency Progress in China." Presentation made at 35th EGEE&C Meeting, February 4 2010, Wellington, New Zealand
- ⁴¹ Reuters, 2010. China to subsidise hybrid, electric car purchases, June 1, 2010.
<http://www.reuters.com/article/idUSTOE65007Z20100601>
- ⁴² National Development and Reform Commission (NDRC), 2008. Public Notice of Evaluation Results of Top-1000 Program Energy Saving Targets in 2007 (《2007年千家企业节能目标责任评价考核结果及有关情况公告》), [2008]58, August 27, 2008.
<http://zfxgk.ndrc.gov.cn/PublicItemView.aspx?ItemID={6980dc20-e1aa-4de5-a9e8-dd40baca4a45}>
- ⁴³ National Development and Reform Commission (NDRC), 2009. Public Notice of Evaluation Results of Top-1000 Program Energy Saving Targets (《千家企业节能目标评估考核结果的公告》), [2009]18, November 16, 2009.
- ⁴⁴ <http://www.cdb.com.cn/Web/NewsInfo.asp?NewsId=67>

-
- ⁴⁵ https://lpo.energy.gov/?page_id=45
- ⁴⁶ China Banking Association. 2010 Social Responsibility Report of China's Banking Industry. June, 2011. <http://www.china-cba.net/bencandy.php?fid=65&id=7611>
- ⁴⁷ The Climate Group, China's Clean Revolution IV: Financing Strategies. http://www.theclimategroup.org.cn/news_and_events/tcg_news/2011-11-07
- ⁴⁸ <http://www.emca.cn/bg/rzfw/qtrzfw/20110408023357.html>
- ⁴⁹ <http://www.china-esi.com/Industry/11009.html>
- ⁵⁰ <http://www.chinaventuregroup.com.cn/research/DetailFree.aspx?id=444>
- ⁵¹ World Economic Forum, Green Investing 2011: Reducing the Cost of Financing, April 2011. www.weforum.org/reports/green-investing-2011
- ⁵² Matisoff A. and Chan M. The Green Revolution: Environmental Policies and Practice in China's Banking Sector. November 2008 http://www.banktrack.org/show/news/china_adopts_sustainable_lending_laws
- ⁵³ EcoFYS and Azure International. The Value of Carbon in China: Carbon Finance and China's Sustainable Energy Transition. http://wwf.org.hk/eng/pdf/references/pressreleases_hongkong/WWFcarbon_report_FINAL_20080630_ENG.pdf
- ⁵⁴ Lewis JI. The Evolving role of carbon finance in promoting renewable energy development in China. Energy Policy 38 (2010): 2875-2886
- ⁵⁵ PRC Contract Law. chapter on finance lease contracts
- ⁵⁶ <http://www.chinaleasing.org/doc5/doc6814.htm>
- ⁵⁷ <http://finance.sina.com.cn/hy/20100903/09238597734.shtml>
- ⁵⁸ Policy Research Center for Environment and Economy of Ministry of Environmental Protection. China Green Credit Development Report 2010. December 9, 2010. <http://www.prcee.org/hjzc/hjjjzc/yjbg/>
- ⁵⁹ The Asia Sustainable and Alternative Energy Program (ASTAE). The Development of China's ESCO Industry, 2004-2007. June 28, 2008. <http://siteresources.worldbank.org/EXTEAPASTAE/Resources/ASTAE-China-ESCO-2004-2007-Note.pdf>
- ⁶⁰ World Bank. Project Appraisal Document on a Proposed Loan in the Amount of \$200 Million and a Proposed Grant from the Global Environment Facility Trust Fund in the Amount of \$13.5 Million to the People's Republic of China in support of the Energy Efficiency Financing Project. April 21, 2008. Report No. 38641-CN

-
- ⁶¹ World Bank. Implementation Status and Results: China Energy Efficiency Financing. Report No. ISR3563
- ⁶² <http://www.emca.cn/bg/rzfw/newsinfo.aspx?cid=53&id=8659>
- ⁶³ <http://www.emca.cn/bg/rzfw/newsinfo.aspx?cid=53&id=6215>
- ⁶⁴ The World Bank. World Bank to Help Improve Energy Efficiency in Shandong. June 8, 2011. <http://www.worldbank.org/en/news/2011/06/09/china-world-bank-to-help-improve-energy-efficiency-in-shandong>
- ⁶⁵ Taylor RP, Govindarajalu C, Levin J, Meyer AS, and Ward MA. Financing Energy Efficiency: Lessons from Brazil, China, India, and Beyond. Washington, DC: The World Bank. 2008
- ⁶⁶ Zhou LJ. Guarantee: the Catalyst for Business Financing. *China Energy Service*. August, 2011
- ⁶⁷ International Finance Corporation. China Utility-Based Energy Efficiency Finance Program. <http://www.ifc.org/ifcext/chuee.nsf/AttachmentsByTitle/CHUEE+brochure+2008-Eng-V2.pdf>
- ⁶⁸ Independent Evaluation Group. Energy Efficiency Financing: Assessing the Impact of IFC's China Utility-Based Energy Efficiency Finance Program. 2010. Washington, DC: The World Bank
- ⁶⁹ http://www.safe.gov.cn/model_safe/tjsj/tjsj_detail.jsp?ID=110400000000000000,22&id=5
- ⁷⁰ <http://finance.people.com.cn/bank/h/2011/1116/c227925-2780797202.html>
- ⁷¹ <http://finance.sina.com.cn/g/20110614/15319989309.shtml>
- ⁷² China's Daily. SMEs scramble for funds from private lenders. July 29, 2011. http://www.chinadaily.com.cn/bizchina/2011-07/29/content_13010333.htm
- ⁷³ Chandler W., Gwin H., and Chen SP. Financing Energy Efficiency in China: 2011 Update. Annapolis, Maryland: Energy Transition Research Institute.
- ⁷⁴ Rahim S. "State and Local Governments Innovate to Cut Energy Waste," *The New York Times*, February 11, 2010 <http://www.nytimes.com/cwire/2010/02/11/11climatewire-state-and-local-governments-innovate-to-cut-92596.html>
- ⁷⁵ Science and Technology Daily, <http://www.it.sohu.com/20080416/n256338672.shtml>
- ⁷⁶ Dreessen, TK. Scaling up Energy Efficiency Financing: A Practitioners Perspective. June 2009. <http://www.adb.org/documents/events/2009/CCEWeek/Presentation-Thomas-Dreessen-Energy.pdf>
- ⁷⁷ Johnson Controls. China Increases Focus on Energy Efficiency. News Release. August 4, 2011
- ⁷⁸ <http://e-mag.emca.cn/n/20110830045147.html>

⁷⁹Chandler W. and Gwin H. Financing Energy Efficiency in China. Carnegie Endowment for International Peace. 2008.

⁸⁰ http://news.emca.cn/n/20110907101225_1.html

⁸¹ <http://fw.xinhua08.com/a/20110418/460014.shtml>

⁸² Shanghai Financial News. Create Prosperous Bond Market in China. May 24, 2011.
<http://finance.sina.com.cn/money/bond/20110524/00569885965.shtml>

⁸³ http://www.csrc.gov.cn/pub/zjhpublic/G00306204/zqscyby/201112/t20111208_203026.htm

⁸⁴ http://en.wikipedia.org/wiki/New_York_Stock_Exchange

⁸⁵ Xu, PP, Chan, HW. Barriers to implementing energy performance contracting (EPC) mechanism into hotel buildings retrofit in china. Management and Innovation for a Sustainable Built Environment, June 20-23, 2011, Amsterdam, The Netherlands

⁸⁶ Sarkar, A and Singh, J. Financing energy efficiency in development countries – lessons learned and remaining challenges. Energy Policy 38(2010): 5560-5571