

# Energy Efficiency Development in China

The Successful Partnership of China and the World  
Bank Group on Energy Efficiency, 1992–2020

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Group on Energy Efficiency, 1992–2020<sup>1</sup>

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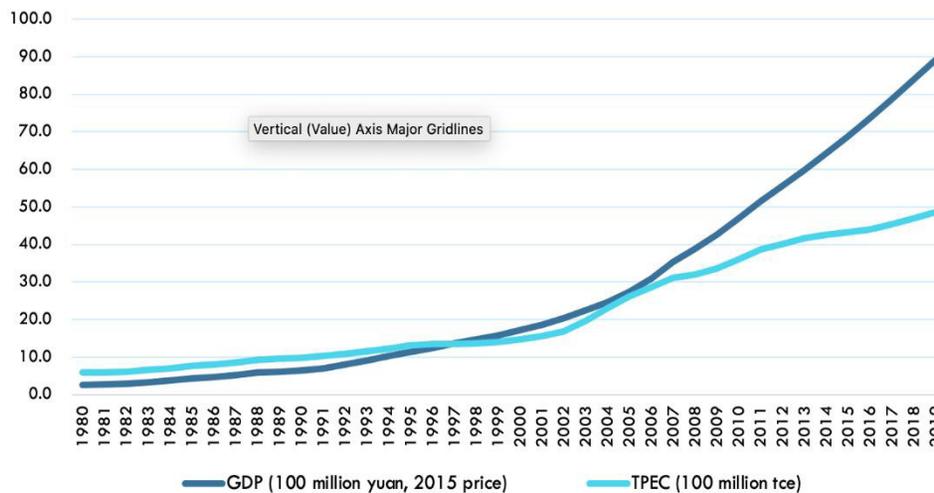
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## Overview

Entering its twenty-ninth year in 2021, the partnership between China and the World Bank (WB) on energy efficiency has been among the top success stories of the WB with any country on energy efficiency. Many billions of US dollars of energy efficiency investment have been generated, achieving streams of energy savings and greenhouse gas (GHG) emissions reductions for past, current, and future years. Yet more important, the partnership has built lasting institutional capacity which now continues to deliver new investments and savings every year. Success in building lasting institutional capacity was particularly hard earned. Given the abundance of obstacles hindering institutional development for energy efficiency in China and all countries, success was generated only through the year-in-year-out persistence of strong joint WB-Chinese teams.

**Figure 1: Delinking of China's Energy Use and GDP Growth, 1980–2019**



Source: China Statistical Yearbook, various years.

Note: GDP = Gross domestic product; TPEC = Total primary energy consumption.

China's achievements in improving energy efficiency have been among the most marked of any country and result from a particularly broad and comprehensive effort promoted from the most senior leaders down to enterprises and building owners.<sup>2</sup> China undertook energy efficiency efforts as a matter of urgency as it became obvious to senior leaders that continuing resource-intensive and polluting growth was not sustainable and China's economic growth prospects would suffer unless this path was corrected. China's success can be seen in the numerous measures of declining energy use per ton of output or occupied building area and, at the most macro level, in the increasing delinking of growth in energy use from growth in GDP (see Figure 1). China adopted a comprehensive approach, including both implementation of a stream of administrative/regulatory policies and development of market-based approaches. China's regulation of energy use is comprehensive, including macro energy consumption ceilings at the national, provincial, and many local levels and a wide range of mandatory performance standards including ceilings on energy use per ton of output for all energy-intensive industrial processes. Market-based mechanisms, then, have been developed to foster delivery of investment financing and services to end users for the practical micro-level energy efficiency gains needed.

<sup>2</sup> For a detailed review of China's energy efficiency programs and results during 1980–2020, see "China's Experience and Lessons Learned in Promoting Energy Efficiency, 1980–2020" (forthcoming).

Much of the period of the WB-China partnership has corresponded to the period of China's transition from a planned economy to a market economy. While the WB has acted as a key international adviser for China's regulatory efforts, promoting joint analytical work, cross-exchange, and attention to difficult implementation issues, the WB's largest contribution has been to the other stream of China's approach—building market-based mechanisms. Working with the Global Environment Facility (GEF), International Bank for Reconstruction and Development (IBRD) and International Finance Corporation (IFC) projects piloted and then helped scale up the two main market-based mechanisms in place in China today—the energy service company (ESCO) industry and energy efficiency financing windows in commercial banks. These institutionalized mechanisms stand to serve China for many years to come.

The sectoral and geographic scope of the WB-China energy efficiency partnership has been broad. Projects supporting market-based mechanisms have included industry as a mainstay sector, besides buildings. Special efforts were devoted to residential heating efficiency in Northern China. Project work has included national, provincial, and local area counterparts.

An important but intangible impact of the partnership has been the impact of the WB team-counterpart dialogue, undertaken through countless study, project preparation, and especially project implementation missions, covering 26 major studies and projects with counterparts at different levels. Comments by Chinese counterparts in most project Implementation Completion and Results Reports mention the importance and their appreciation of the ability of WB teams to provide expert advice, substantive inputs, and introduction to new ideas and practices.

The overall approach that ultimately proved successful is discussed in the next section. Highlights of the projects of the partnership follow, and thoughts on looking ahead to the future conclude this report. Table 1, at the end of this report, provides an overview of the partnership's main projects.

## The Approach That Achieved Results

**Achieving meaningful energy efficiency gains is a complex challenge in all countries.** National energy efficiency gains must be achieved through action by great numbers of individual enterprises, building owners and occupants, and households. Success requires sound policy and regulatory systems, steady and strong institutional capacity, and operation of technical and investment support mechanisms that can reach the thousands and even millions of needed actors.

**Although rightly assessed as highly economic and 'the first fuel' for carbon emission reduction, energy efficiency investment operations are a true headache to implement successfully.** Energy efficiency investment operations need to support a range of relatively small, diverse, and dispersed investments. This is much different from projects that involve appraisal and disbursement of large sums for just one or a few large investments. New, institutionalized energy efficiency investment delivery mechanisms must be adapted or created.<sup>3</sup> The investment delivery mechanisms also must have means to use technical capacity for identification, design, and implementation of projects involving a range of technology and settings. Further compounding the complexity, energy efficiency investment rarely ranks among the top priorities of potential clients. Benefits are calculated as operating cost reductions, as opposed to new stream of revenue from highly visible production investment. Given the complexity and potential pitfalls, program design and supervision is highly staff intensive, at least initially.

<sup>3</sup> See Taylor, Robert P., Chandrasekar Govindarajalu, Jeremy Levin, Anke S. Meyer, and William A Ward. 2008, *Financing Energy Efficiency—Lessons from Brazil, China, India and Beyond*. World Bank.

**An effective combination of joint analytical work, technical assistance, and project investment proved critical for achieving results.** The WB-China energy efficiency partnership began with several years of joint analytical work, reviewing the ongoing evolution of China's systems for promoting energy efficiency, areas of greatest potential, and benefits and costs. Project work built on the relationships and understanding thus created. Focused joint analytical work also preceded most new ventures into specific subsectors with new counterparts, for example, project work on industrial boilers, residential sector heat reform and building energy efficiency, commercial building energy efficiency, and programs operating at provincial levels. Over time, WB-sponsored and supervised, grant-financed, and recipient-executed analytical work also expanded, focusing on difficult policy and project implementation topics and generating new ideas, some of which were then jointly pursued.

Stand-alone, project pre-investment and project-embedded technical assistance components proved essential for overcoming specific obstacles, building human capacity, developing necessary new institutions, developing innovations, and exchanging ideas and experience. Virtually all technical assistance was grant financed with counterpart co-financing. The importance of technical assistance efforts often followed the heavy requirements for new institution building in support of needed new project investment delivery mechanisms. National technical assistance projects provided a vehicle for development of new policies and implementation schemes. Technical assistance projects also focused on cross-exchange of new ideas and innovations between different groups of practitioners. One major cross-country example was the five-year 'Three Country Project', involving years of operationally focused exchange between energy efficiency practitioners and WB project counterparts in China, Brazil, and India.<sup>4</sup> Operationally focused cross-exchange between domestic practitioners in China also became a common theme, such as the exchange on solutions to practical issues and development of new innovations between Chinese provinces in the China Provincial Energy Efficiency Project.

The main, but not sole, focus of WB and IFC investment projects has been on developing and scaling up market-based mechanisms to support investments by a multitude of actors. Such projects require major joint efforts in design and a great deal of capacity building. They almost always start up slowly, facing many challenges in getting the new institutional mechanisms moving. But if successful, as most were in China, these projects can leave sustainable, institutionalized mechanisms generating energy savings from new investment well into the future.

**The Government and WB took big risks in key innovative investment projects.** The risks involved in new institution building and launching new investment delivery mechanisms are notorious. The first Energy Conservation Project, aiming to develop ESCOs in China from scratch, involved huge risks on both sides. Provincial partners placed equity capital in new companies introducing a new business model that was completely untried in China. The WB approved, and China provided a sovereign guarantee for, a US\$63 million loan to three small companies which had virtually no track record. Whereas some previous efforts at developing financial intermediary operations for energy efficiency in other countries had failed, both the WB and IFC forged ahead to successfully develop the first energy efficiency lending windows with a half-dozen Chinese banks. The WB developed the first financing operation for commercial building green energy projects, a particularly difficult market for scaling up lending. The WB-China energy efficiency team also introduced the first 'Program for Results (PforR)'<sup>5</sup> operation in China and the first globally on energy.

4 World Bank and United Nations Environment Programme, "Developing Financial Intermediation Mechanisms for Energy Efficiency Projects in Brazil, China and India," implemented during 2002–2006. Both this project and the Provincial Energy Efficiency Project demonstrated the benefits of steady cross-exchange involving many events but essentially the same practitioner groups over a number of years, as opposed to organizing a few workshops.

5 PforR financing instrument developed and adopted by the WB to help improve design and implementation of policies and programs, relying on the country's own institutions. Agreed improvements are reflected in indicators. Disbursement of the loan is triggered ex post, once achievements of results measured using agreed indicators are verified. <https://www.worldbank.org/en/programs/program-for-results-financing>

Most projects had at least one ‘crisis period’ during implementation, typically early on. Typical problems included staffing issues, barriers from entrenched but counterproductive business practices, difficulties in origination of good subprojects, and just basic inertia against new ways of doing things. Some project components were cancelled and mid-course corrections were common. However, of 13 completed WB investment operations, the outcome of only 1 financial intermediary operation was assessed as moderately unsatisfactory, while the outcome of the remaining 12 projects were all assessed as satisfactory in different degrees. Most importantly, the astounding success of China’s ESCO industry and the continuing operation of many commercial bank energy efficiency lending programs launched under the partnership provide testimony of the high rewards earned from the risks taken.

**Government support and strong WB-client team partnerships were key factors in overcoming difficulties.** Especially early on, strong and timely government support was often important in overcoming project crises, typically by convening parties and helping to iron out obstacles. At times, messages from Government partners on the importance of perseverance helped overcome initial commercial frustration of counterparts. In addition, the strength of direct partnerships between WB task teams and clients and project management office (PMO) staff often made joint troubleshooting and problem solving a steady reality. Intense work together on ESCOs, on WB financial intermediary operations, and IFC’s CHUEE<sup>6</sup> operations each spanned over 10 years. This allowed a wealth of experience to be developed in the teams and built mutual trust.

**The support of the GEF was essential.** It is no exaggeration to say that most of the WB-China partnership on energy efficiency would not have developed without the operational financing of the GEF. The GEF underwrote project risks that enabled innovative projects to proceed and supported much of the labor-intensive technical assistance required to make energy efficiency project packages work. The two ESCO projects could not have been undertaken without the underwriting of risk by the GEF.<sup>7</sup> The GEF provided the risk capital to underwrite guarantees for the first Chinese bank loans to ESCOs and to finance reserves for the first loss guarantee position essential to all of IFC’s CHUEE operations (see Box 1). Of the partnership’s 20 investment projects, 16 had important technical assistance elements supported by the GEF. Some of China’s prominent current institutions in the energy efficiency practice owe their existence to early GEF support (see Box 2).

In return, although detailed historical analysis has not been undertaken, the WB-China energy efficiency partnership is likely responsible for the greatest carbon emission reductions of any energy efficiency country program in the GEF portfolio. Many of the WB and IFC projects also realized exceptionally low unit costs in carbon emission reductions, offering a good return on investment.

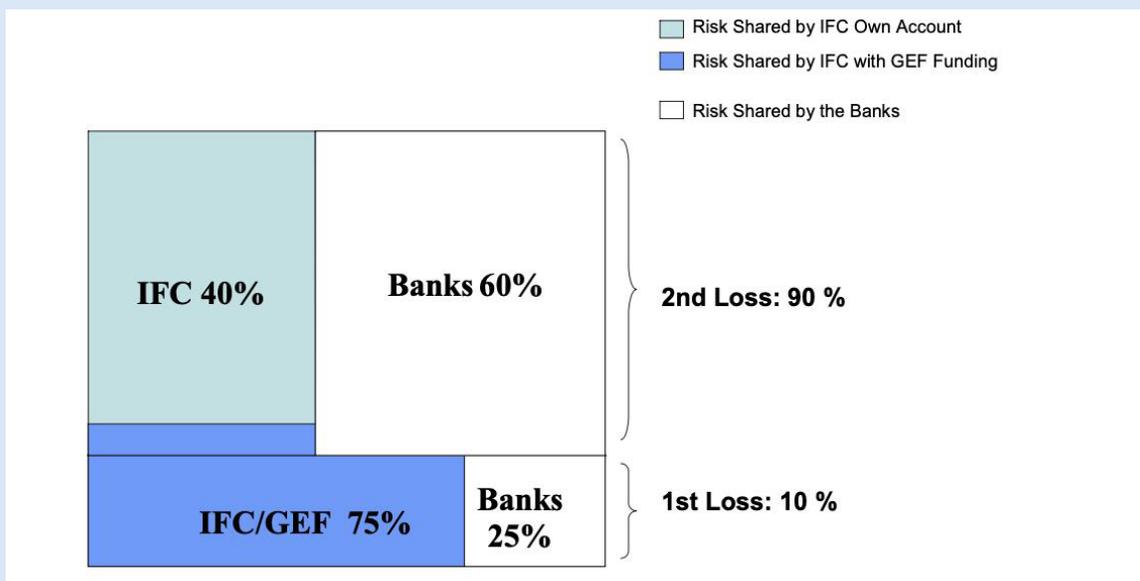
<sup>6</sup> CHUEE = China Utility-Based Energy Efficiency Finance Program. As this program was adjusted early on to focus virtually exclusively on commercial bank financing, rather than utility financing, it is commonly known just as ‘CHUEE’.

<sup>7</sup> A senior official of the Ministry of Finance (MOF) told the task team during preparation of the first project, “Don’t even think about trying to process this WB loan without GEF project financing as well.”

### Box 1: Using GEF Funds for Loan Risk Guarantees

GEF funds were used to backstop commercial loans to ESCOs and energy efficiency projects in two ways. Under the WB's Second Energy Conservation Project (2002–2010), US\$22 million of GEF funds were placed in a fund held by the MOF to backstop partial guarantees of commercial bank loans to emerging ESCOs by China's National Investment and Guaranty Co. (I&G). Commercial banks were understandably reluctant to lend to these small companies engaged in a new business, which also required creativity to recognize the loan security value of executed energy performance contracts. This project brought 12 commercial banks into ESCO lending business for the first time and loans to 42 different ESCOs, most of whom received their first bank loan ever through the program. At the end of the project, slightly more than the original US\$22 million of GEF funds remained in the MOF's fund, as actual default losses were small, and fund interest and guarantee fee revenue compensated for a little more than the guarantee program's operating costs. Given the time value of money, conservative estimates of carbon abatement costs were US cents per ton of carbon rather than US dollars per ton.

IFC's CHUEE 1 and 2 Projects (2006–2012) placed US\$10 million of GEF funds in a risk-sharing fund held by IFC for first-loss loan guarantee protection in IFC's partial risk guarantee partnership with three major Chinese banks to develop energy efficiency loan programs. The risk-sharing arrangement for CHUEE 1 is depicted below. While first-loss reserve calls turned out to be minimal, the first-loss coverage arrangement was critical both to provide partner bank management with comfort in a new business and for IFC's board to agree to place IFC funds in a second-loss position. By project closure in 2012, the participating banks had financed 178 new energy efficiency and renewable energy investments, totaling US\$783 million. Most important, energy efficiency lending continues in all three banks to this day (2020).



Source: IFC. 2006. *China Utility-Based Energy Efficiency Finance Program GEF Project Document*. January 2006.

Following closure of the WB's Second Energy Conservation Project, and with agreement between relevant parties, China's MOF allocated US\$20 million of the remaining GEF funds from that project's guarantee fund to new IFC projects. Included was placement of US\$13 million in first-loss position for a new IFC CHUEE 3 Project, focused on partnering with Chinese banks for energy efficiency and renewable energy loans to small and medium enterprises (SMEs). The CHUEE 3 Project was launched in 2012 and closed in 2018. As a result, the US\$22 million of the GEF originally placed for the Second Energy Conservation has now been used for a second time, generating yet more GHG emission reduction.

None of the abovementioned projects could have proceeded without the GEF's US\$32 million initial financial support.

### Box 2: Institution Building: The Development of EMCA

EMCA—the nickname for China’s national ESCO association—has now been the active advocate and member service provider for China’s world-leading ESCO industry for 18 years.<sup>a</sup> Sponsored by the WB and the Energy Conservation Project PMO, preparations for the creation and operation of EMCA began in 2001, with the support of the Department for International Development of the United Kingdom (DFID). The GEF followed DFID by providing seed funding through the WB totaling US\$1.6 million for EMCA to develop and deliver capacity for technical assistance to newly emerging ESCOs, especially through various types of training. Formally established at the end of 2003, EMCA’s membership and services grew steadily during the 2000s. Over time, self-generated revenues grew to replace outside support, as planned. When the last GEF disbursements were made in 2008, EMCA had become financially self-sustaining.

EMCA played a key role in advocating for additional government support for the ESCO industry at the turn of the decade, culminating in the State Council’s enactment of new government policies in support of the industry in 2010. Ever-engaged, EMCA helped further support the ESCO industry as it continued to grow rapidly over the following decade.

As of 2018, EMCA’s membership had grown from 89 members (including just 40 ESCOs) at the beginning of 2004 to 1,188 members. The number of people employed by the ESCO industry in China had grown 80 times to almost 730,000, while the project investment of the ESCO industry had grown 137 times.

*Note:* EMCA = Energy Management Company Association.

a. EMCA’s formal name is the ESCO Committee of the China Energy Conservation Association.

## The Projects of the Partnership

The projects of the WB-China energy efficiency partnership involved major joint studies, investment projects, and stand-alone technical assistance efforts. In addition to the creation of new market-based investment mechanisms, the projects also focused on a series of specific sectoral challenges.

**Table-setting analytical studies.** The WB-China energy efficiency partnership began with two joint studies. The first was a basic stocktaking study, following an intensive WB mission. The second was a major, multisector effort, discussed in Box 3. The main Chinese counterpart for both was China’s cross-cutting and powerful State Planning Commission (SPC), which was in charge of economic planning under the planned economy. These studies set the stage for future project work.

**Introducing new technology.** The High-Efficiency Industrial Boiler Project (1996–2004) was the first major GEF project in China, using US\$35 million of GEF funds and counterpart funds mainly from commercial boiler manufacturers. The project was identified as an immediate priority during the GHG Control Study process and was the only project in the partnership focused squarely on transfer and adaptation of technology from abroad. With detailed analytical work on the coal-fired industrial boiler sector completed under the GHG Control Study providing a jump start, the project aimed to purchase technology, adapt this in new designs in Chinese manufacturing plants with expert assistance, and put the new designs in mass production. The project succeeded in developing and producing eight upgraded boiler designs, in eight boiler works, and upgrading and producing a variety of types of boiler auxiliary components. A key and difficult challenge during project implementation, which was eventually overcome, was procurement of the proprietary technology under WB procurement guidelines.

**Piloting and developing ESCOs in China.** Following on from the completed GHG Control Study, the government, WB, and GEF chose an ambitious topic for their first broad energy conservation operation—piloting, adapting, and developing the commercial ESCO concept in China. ESCOs are specialized companies that develop and implement energy efficiency projects in other companies according to ‘energy performance contracts’ which stipulate their remuneration based on the energy efficiency results achieved. With the shift of China’s planned economy toward a market economy, Chinese authorities were looking for a way to adapt the country’s strong technical capacity in energy efficiency work to the new market system.

A first project was approved in 1998 focused solely on developing the concept in three pilot ESCOs, aiming to demonstrate that the new business model could be profitable and generate strong energy savings under Chinese conditions. When that project succeeded, a second project, anticipated from the beginning, focused on scaling up ESCOs with lending to the new, small companies from Chinese commercial banks and a large-scale training and technical assistance program operated by a new national ESCO association.

Two key and timely donor-supported, WB-executed side projects provided critical start-up and continuity before and between the two WB/GEF projects. A US\$4.5 million grant was provided by the European Community and became operational 18 months before the Energy Conservation Project became effective. This provided means for essential training, technical assistance, and piloting of small energy performance contracts in the first three start-up companies before the larger project commenced. DFID provided a US\$2.5 million grant which enabled technical assistance services to be provided to about two dozen new ESCOs that were emerging in the market before the Second Energy Conservation Project as well as the buildup of the new ESCO association.

### **Box 3: The WB-UNDP-China 1992–1994 Issues and Options in a GHG Control Study**

During 1992–1994, a large joint team launched and completed one of the world’s first major country studies on how to reduce GHG emissions. The study was led by the WB, the United Nations Development Programme (UNDP), China’s SPC, and China’s National Environment Protection Agency (NEPA). It was financed by the GEF as one of its first efforts during its pilot phase. About 20 ministries and other leading Chinese agencies worked on the study. Chinese experts worked with the WB team for several months at WB headquarters to complete the macroeconomic modeling. In 1994, team leaders from the WB, UNDP, SPC, and NEPA together wrote highly-substantive conclusions and recommendations of the study in Washington.

The study resulted in 11 reports on different topics. The study’s conclusions included among the first rankings of different interventions according to net unit costs of GHG reduction. Energy efficiency efforts were assessed as generally the lowest net cost options (involving ‘negative net costs’ as they produced net benefits), and promoting of energy efficiency was identified as the top priority for follow-up, including use of new GEF funds.

Pipelines of projects through the turn of the decade were built upon the study’s findings, including WB and UNDP GEF projects and IBRD energy efficiency and renewable energy investment projects.

#### **Box 4: Developing China's First Three ESCOs**

Following a call for expressions of interest from China's existing provincial energy conservation technical centers, the State Economic and Trade Commission (SETC, later merged into the NDRC) selected Liaoning, Shandong, and Beijing to pilot three ESCOs to use energy performance contracting (EPC) for the first time.

Provincial supporters mobilized a minimum of US\$2.4 million in equity capital to form the new companies in 1996. During 1997 and half of 1998, the companies developed model EPC contracts suitable to China and business plans and launched a few early, small projects, all with support from a timely European Commission grant. Both positive and negative lessons were learned. For example, a newly arrived Chief Executive Officer (CEO) at a host enterprise refused to honor its EPC, such that the ESCO had to remove the insulation it had installed at a substantial loss. The lesson learned was the importance of stability at host enterprises.

The 1998 Energy Conservation Project brought both GEF grant funds for some further pilot projects and substantial IBRD funds at commercial rates to the three ESCOs. Hence, each company was provided up front with a large line of credit. The concept was that the companies should concentrate on the key challenge of making the new mechanism work, with project financing already assured. The challenge of securing commercial credit financing from Chinese banks for ESCOs would be addressed in the second WB project (2002).

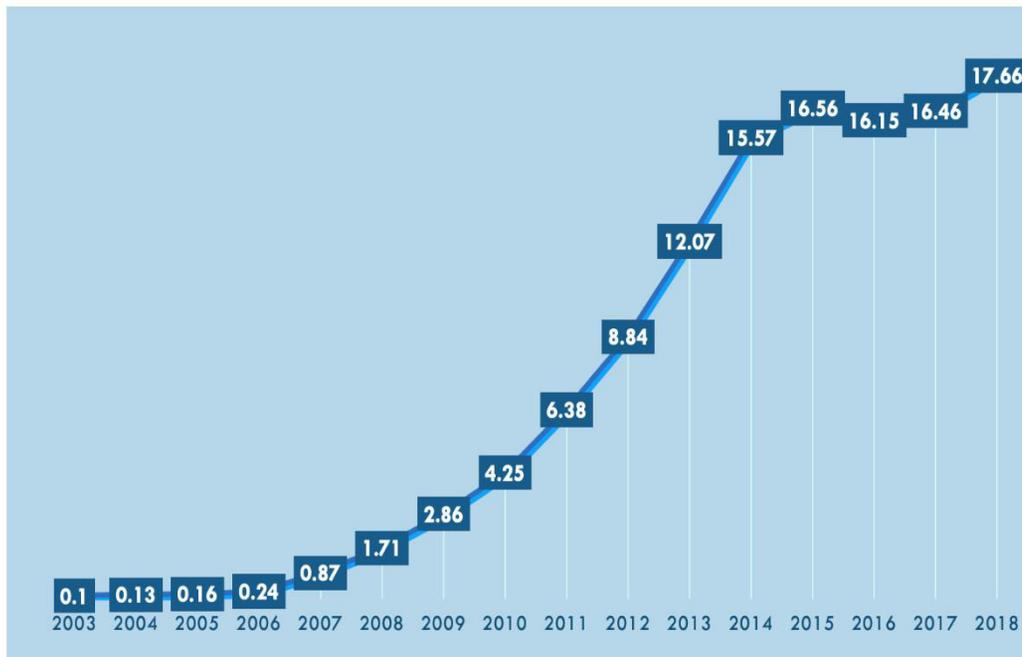
The three companies each developed a series of 'project lines', within which the companies sought to line up technically similar investments in a series of host enterprises. All projects were implemented with the 'shared savings' EPC model. Each company began with a mix of simple commercial lighting projects, industrial boiler and furnace renovations, industrial variable speed drive motor applications, and various relatively simple industrial equipment retrofits. Within one to two years, the simple lighting retrofit market was conceded to lighting manufacturers. Each company began to develop its own personality and market approach. Liaoning's ESCO focused on industrial boilers and kilns and began to expand its roster of technical staff to develop increasingly diverse and sophisticated industrial projects. Beijing's ESCO began to focus less on industrial projects and more on commercial and residential building energy savings and coal substitution projects. Shandong's ESCO maintained its strong focus on industry and gradually increased the size and sophistication of its projects, with an emphasis on developing long-term relationships with key industrial clients.

The new business encountered a host of problems in the first three years. Some stemmed from lack of familiarity with the idea in the marketplace. Others stemmed from difficulties the financial and legal regulatory systems had in categorizing the business, which combines service aspects, equipment procurement and sale, and project financing. Some financial auditors had difficulty with the notion that the companies' assets were located on the premises of other enterprises. Arguments began as to how accounting should be done and how the companies should be taxed. At one point, each of the three had reported their accounts using a different business classification: one as a service company, one as an equipment vendor, and one as a financing entity. Some local authorities began to declare that the EPC business was illegal. As these problems surfaced, senior authorities in the SETC worked with local officials to research the issues and find solutions. Without this strong and steady central government support, the nascent ESCO industry would have floundered.

The business of the three ESCOs began to stabilize during 2001–2003. When the project closed, the three ESCOs had shown how the business could work and be profitable in China. New ESCOs were beginning to form, and many in the energy efficiency practice in China were keen to try the new business. The Second Energy Conservation Project built on this foundation, helping to build the piloted ESCO concept into a new industry.

Over the 12 years from the first technical assistance in 1997 to the completion of the Second Energy Conservation Project, energy efficiency investments made by ESCOs grew from zero to US\$2.9 billion in 2009. In April 2020, China's State Council gave a ringing endorsement of the new ESCO industry and launched new support policies.<sup>8</sup> With this support and legitimization from the highest level of China's government, ESCO investment tripled from 2010 to 2014 (see Figure 2). In 2018, ESCO energy efficiency project investment in China stood at about US\$17.7 billion.

**Figure 2: Energy Performance Contracting Project Investment in China, 2003–2018 (US\$, billions)**



Source: EMCA, various reports.

Note: The role of the WB-China energy efficiency partnership in this growth story was the creation of the first ESCOs in 1997 and their demonstration of profitability followed by support for developing the pilots into an established industry during 2003–2010. The ESCO industry was then able to grow without explicit WB-China partnership support.

**Developing energy efficiency lending windows in domestic banks.** In the mid-2000s, both IBRD and IFC began partnerships in China to launch another market-based energy efficiency investment mechanism—new energy efficiency project lending businesses in domestic banks. This typically requires special staff attention, alliances to accelerate loan origination and project technical appraisal, perhaps some adjustments in appraisal methodology, and special marketing strategies. Yet, it is generally a niche business.

<sup>8</sup> State Council, *Opinions on Accelerating the Promotion of Energy Performance Contracting and the Development of the Energy Efficiency Service Industry*, April 2010.

### Box 5: Partnering with Huaxia Bank

Huaxia Bank was founded in the early 1990s. Operating first as a joint stock commercial bank and then publicly traded since 2003, Huaxia is a national bank with branches in almost all provinces. The WB-Huaxia collaboration began in the early 2000s with Huaxia's participation in cross-exchanges on financial intermediation for energy efficiency between China, India, and Brazil. Huaxia Bank was one of two banks piloting new energy efficiency lending with US\$100 of IBRD funds and GEF-supported technical assistance under the WB's first China Energy Efficiency Financing (CHEEF) project, launched in 2008 and closed in 2013. Huaxia also garnered support and funds for energy efficiency and renewable energy project onlending from France's Agence Francaise de Developpement (AFD), roughly in parallel. In 2016, Huaxia became the WB partner bank for onlending US\$500 million of IBRD funds, plus US\$500 million of its own funds, for energy efficiency and clean energy projects under the 'Innovative Financing for Air Pollution Control in the Jing-Jin-Ji Region Program for Results'. The program supports IBRD disbursements based on the verified performance of the subproject portfolio, rather than on subproject loan agreements themselves. The region covered includes Beijing, Hebei, and Tianjin and several surrounding provinces. The GEF's technical assistance support for this ambitious new effort is supported with a component under a different project.

In the beginning, during the first two years of the CHEEF project, Huaxia experienced serious problems originating energy efficiency loans with creditworthy enterprises and slow funds disbursement. The unit charged with the new business operated in virtual isolation in bank headquarters. Faced with emerging poor results, senior bank management organized an overhaul, buttressed with new internal policies in 2010. The new framework relied on branches for loan origination, screening and review at headquarters, and then processing and implementation at local levels. Training of branch staff was rolled out, assisted with GEF funds, with the participation of over 300 managers and middle-level cadres and 900 customer manager and appraisal staff in the first year. New incentives were provided to branch staff for successful loan origination and processing. At headquarters too, processing flows between departments were streamlined and key staff were trained. Outside partners were engaged to help with loan origination as well, and the bank began to develop a number of new, specialized financing products. The rollout of the new systems in 2010–2011 was then met with strong success. Huaxia completed both the IBRD and AFD projects robustly.

As of 2016, before the launch of the new WB-Huaxia Jing-Jin-Ji project, green credit projects accounted for 7 percent of Huaxia Bank's entire business. The bank was in the process of setting up a new Green Finance Center at its headquarters.

IBRD and IFC adopted different approaches, with both achieving results. In its CHEEF projects, IBRD provided lines of credit and GEF-financed technical assistance to a state bank (Export-Import Bank of China), a joint shareholding bank (Huaxia Bank), and a private bank (Minsheng Bank). In its CHUEE projects, IFC provided GEF and IFC partial risk guarantees (see Box 1) and GEF and other donor-financed technical assistance. IFC's CHUEE 1 and 2 Projects included partnership with three joint shareholding commercial banks—Industry Bank, Bank of Beijing, and Shanghai Pudong Development Bank (SPD Bank). The CHUEE partner banks lent to ESCOs as well as project host enterprises. The CHUEE 3 Project then added several more partner banks, focusing on loans to SMEs. IFC has also undertaken some substantial advisory service projects, paid by client banks interested in expanding energy efficiency lending, such as the Agricultural Bank of China.

Combined, these projects supported over US\$4 billion in new energy efficiency project investment by the time they closed in 2013–2017.<sup>9</sup> Even more important, however, 6 to 10 national-level banks continue sustainable and substantial energy efficiency lending windows, some now organized as special units or centers in their

<sup>9</sup> The latest WB-Huaxia project is excluded as it has not yet closed. Estimate is based on the Program Appraisal Document (PAD) of the China Market-Based Energy Efficiency Program (p. 2) and CHUEE sources.

banks. Virtually all of them started with some type of World Bank Group support. Emphasis between ‘green’, ‘clean’, ‘resource saving’ or other foci change, following ever-changing market trends, and new financial products to meet client needs are still being developed accordingly. The knowledge, skills, and innovation in dealing with the challenge of energy efficiency lending in these banks are strong.

**Promoting improved efficiency in urban residential heating.** At the turn to the twenty-first century, coal-based urban residential heating was a leading source of air pollution and highly inefficient. Inside of buildings, heating systems used roughly double the energy of buildings in similar climates in Western Europe or North America and still provided less comfort. This was due in part to excessive building shell heat loss in Chinese buildings built previously and to the Soviet-era coal-based centralized heat/district heating supply system designs, which allowed no consumer control and no household metering and hence required billing based on heated area rather than heat consumption. Outside of buildings, antiquated district heating systems and heavy use of inefficient, polluting, and small heat-only boilers were common. Since 2001, the WB has been an active partner to help address these issues.

Collaboration with China’s Ministry of Housing and Urban/Rural Development (MOHURD) (formerly the Ministry of Construction) began with an issues and options study in 2001. This study concluded with a joint call for combining work on heating system reform with building energy efficiency improvements. The major GEF Heat Reform and Building Energy Efficiency Project was launched to promote that through demonstration efforts in Tianjin and other cities. The project overachieved its building energy efficiency goals and energy savings targets. However, the rollout of the complex chain of reforms required to achieve heat billing based on actual consumption and shift to demand-driven district heating proceeded somewhat slower than hoped. Although the central government has consistently pushed this reform, implementation is the responsibility of municipalities, some of whom have succeeded while others have not.

The WB has undertaken three district heating investment projects, with the third scheduled to close in 2021. Focus has been particularly on modern reconfiguration and upgrading to eliminate small boilers, improve efficiency, and reduce air pollution. Besides Urumqi in Xinjiang Province, the projects have supported district heating upgrades in 9 and 4 medium-size cities in Liaoning and Hebei, respectively.

Aside from the energy savings and pollution abatement from specific investments, innovations in this part of the WB-China partnership have included

- Review of options and provision of guidance to localities on suitable heat metering systems, including in older buildings using Soviet-era heat supply designs;
- Provision of the methodology to localities on how to set a two-part consumption-based heat tariff, replacing existing pricing based on heated area alone;<sup>10</sup>
- Joint promotion of consumption-based billing, with most new construction adopting the reform in both Urumqi and Chengde (Hebei Province), where the WB also promoted district heating upgrades; and
- Introduction and scale-up of building-level substations, and metering system modernization, to improve efficiency, especially with shift to demand-driven systems.

**Addressing thorny implementation topics at provincial levels.** Provincial governments are the level responsible for the actual implementation of many of China’s energy efficiency programs and policies. Following extensive issues and options review and cross-exchange discussions between provinces, the GEF-financed Provincial Energy Efficiency Scale-Up Project provided a platform for analytical and technical

<sup>10</sup> ESMAP. 2008. *China: Development of National Heat Pricing and Billing Policy*. March.

assistance efforts to overcome difficult implementation challenges, develop new innovative approaches (many of which could be used elsewhere), and share results. Shandong, Shanxi, and Jiangxi Provinces were immediate beneficiaries. Topics for focus were selected by the provinces and agreed with the WB. Work in all provinces included organizational support for local ESCOs, energy savings monitoring and supervision platforms, and capacity building for energy efficiency management in local enterprises and supervising agencies. A range of additional topics selected by one or more provinces included fiscal policy, statistical systems, building energy efficiency, promotion of energy management systems in industry, and systems for energy efficiency appraisal of large and new fixed asset investments in industry. The project produced a wealth of new but practical ideas and measures to strengthen national program implementation, which were shared by the three provinces to wider audiences.

The Shandong Energy Efficiency Project ran parallel to the GEF project, successfully developing financial leasing businesses for energy efficiency projects.

**Improving energy efficiency in public and commercial buildings.** As with the industrial sector, work in the WB-China energy efficiency partnership on the buildings sector was included in a variety of cross-cutting projects and programs. China's ESCOs have long included projects in both sectors, and residential building energy efficiency in the heating zone was an important part of the partnership's urban residential heating effort. Although anticipated follow-on project work did not commence, a major study on issues and options for improving energy efficiency in the buildings of public institutions was completed in 2012, with a special focus on introducing experience from abroad to Chinese counterparts. Then, in 2013, two projects were approved focusing primarily on energy efficiency and some renewable energy in commercial buildings.

The Shanghai Green Energy Project (Green Energy Schemes for Low-Carbon City in Shanghai, China) was an ambitious effort employing financial intermediation by two banks to support commercial building clean energy projects, combined with organizational, management, and technical assistance support from the key participating district government of Changning. Thus, the project built upon past WB-China projects in both its use of banks as financial intermediaries and the participation of ESCOs as project development borrowers from the banks. When borrower incentives to borrow for building retrofits proved lower than hoped, without other policy measures yet in place, the project was able to successfully pivot to add projects in new buildings and expand further into distributed generation. The two banks developed a systematic approach to loan origination and reduced technical risks in retrofit projects with technical assistance and capacity building for sub-borrowers. Counterpart financing by the partner banks and project developers exceeded expectations, enabling the project to generate 35 percent more investment than originally planned. The project developed a series of innovative 'schemes' to generate business and results. Evolving experience, successes, and lessons learned in the project's various green energy schemes have been introduced and further discussed both nationally and internationally.

**Online energy monitoring platforms to originate and monitor EE investments in buildings.** The online building energy monitoring platform developed by Changning District before the project, and further upgraded under the project, proved to be a key tool for originating projects and monitoring results. Changning instituted innovative benchmarking and a subsidy program built upon the platform. Other districts in Shanghai subsequently developed similar online monitoring platforms as well. One district developed a power demand response program through its platform to shave load during times of peak load shortage, with compensation to participating building owners.

**From Green Buildings to Low Carbon Urban forms.** The WB-China partnership's most recent building energy efficiency project moved yet further to foster low-carbon urban development forms, in addition to other innovations. The 'Urban-scale Building Energy Efficiency and Renewable Energy Project',

financed by the GEF and counterpart resources over 2013–2019, provided support to Ningbo City, Beijing Municipality, and the WB’s long-standing counterpart, MOHURD, for development of new policies and regulations on energy efficiency in public and commercial buildings, improved energy efficiency of buildings through new urban forms in design of new urban areas, and expansion of rooftop solar electric systems. Promotion of low-carbon, adaptive, and livable (LOCAL) urban forms in new development was a first, and important, project effort for the WB’s energy team in China and usefully involved both national and local governments. The project included data-intensive studies with real-time monitoring of both international experience and Chinese cities. These studies demonstrated that higher density, fine grain compact urban forms can reduce energy consumption in buildings by a factor of two or more compared to superblock-based urban forms. Recognizing these benefits, MOHURD and the two project cities produced a series of regulations and standards at the national and municipal levels for LOCAL urban planning regulations. The new regulations were reflected in the planning of five new urban zones<sup>11</sup> and informed the State Council’s<sup>12</sup> ‘Several Opinions on Further Strengthening the Urban Planning, Development, and Management Work’, issued in 2016. The State Council’s policy document highlighted open blocks and narrow roads in dense networks as important concepts to improve overall building and urban energy efficiency. Pilots were also conducted to integrate community planning and design, transportation, energy and other infrastructure systems, and green buildings.<sup>13</sup>

**Continuing national policy dialogue, evaluation of progress, and developing new innovations.** The first CHEEF project included a US\$2.8 million GEF-financed technical assistance component with the NDRC for national-level policy support and capacity building. The NDRC’s new National Energy Conservation Center (NECC), established in 2006, housed the PMO. When the CHEEF project was extended, due to additional financing, this GEF component was also extended and ran from 2008 to 2016. The technical assistance work played key roles in new analytical work necessary for development of new policies and programs and efforts to improve project and program implementation. Originally envisioned to focus mainly on issues in the 11th Five Year Plan (FYP) 2006–2010), the national technical assistance work also played important roles in the 12th FYP (2011–2015) and development of energy efficiency efforts in the 13th FYP (2016–2020). Recommendations of many of the policy studies were adopted in the policies and regulations promulgated by the government.

National-level policy, program development, and implementation support now continues with the NDRC with US\$8.8 million of GEF technical assistance support under the ‘Developing Market-Based Energy Efficiency Program’, approved in 2016.<sup>14</sup> Special emphasis is placed on analytical work for new policy efforts and improved program implementation; strengthening of China’s energy efficiency measuring, reporting, and verification system (which is critical for either emissions trading or energy efficiency results trading); and exploration of trading in certified energy efficiency results.

11 These include three sets of standards: ‘Standards for Planning and Design of Urban Residential Areas GB50180-2018’, ‘Urban Drainage Planning Standard GB50318-2017’, and ‘Standards for Planning of Urban Integrated Transportation System GB/T51328-2018’. This also includes the formation or revision of 11 policies and 11 standards for the capital under the Beijing Housing and Urban-Rural Development Commission (BHURDC).

12 World Bank Implementation Completion and Results Report of the ‘Urban Scale Building Energy Efficiency And Renewable Energy Project’ financed by the GEF.

13 These include Damuwan transportation planning based on LOCAL principles completed under the Ningbo Housing and Urban-Rural Development Committee (NBHURD) to be further applied to long-term development of Damuwan New Town and Xiangshan Urban Area. ‘Application demonstrations’ were also carried out at the Western Technological Innovation Harbor in Shaanxi Province (Shaanxi Xixian New Area) and at the New Campus Town of Xi’an Jiaotong University of Shaanxi Fengxi New Town’ where planning integrated these principles.

14 With US\$17.8 million of total GEF financing, this project also provides technical assistance support relating to IBRD’s Green Energy Financing Project and the Jing-Jin-Ji Region and the Results-based Environmental Program in Hebei Province.

## Looking Ahead

The WB is in a good position to develop innovative initiatives focusing on new and emerging challenges, should opportunities arise where government counterparts feel the WB can add strong value. The ongoing technical assistance project component with the NDRC allows both sides to review current substantive issues in China's energy efficiency program, and options to address them, and to flesh out possible approaches. While new joint project work would help meet needs, the institutionalized tools developed together over the years provide means to deliver challenging projects which would not be possible in many other settings.

An increasingly important area for joint work is to effectively introduce China's experience in energy efficiency to practitioners in other countries. A detailed report on the China experience in developing energy efficiency has been elaborated in parallel to this paper, which could possibly be a tool to help practitioners in other countries benefit from the China experience.<sup>15</sup> However, to yield results in terms of high value to other practitioners, this work is more difficult than it might first appear. Simply introducing interesting aspects of China's experience is insufficient. The common reaction is likely to be, "that is interesting, but our conditions here are different, and that won't work here."<sup>16</sup> Work must be built on a good understanding of the issues faced in the client countries. Then specific needs can be identified where China's experience could be most insightful. China's experience must be interpreted and presented in ways that are meaningful and resonate with the (different) local institutional setting and in terms of ongoing and different in-country initiatives. Finally, and probably most important, discussions must be undertaken on how elements of Chinese experience could actually be adapted to the local setting.

**Table 1: Overview of All of the WB-China Partnership's Main Projects in the Area of Energy Efficiency**

Themes	Dates	WB/GEF Project Finance	Key Chinese Partners	Main Focus
<b>1. Table-Setting Strategic and Analytical Work</b>				
China Energy Conservation Study	1992–1993		SPC	Historical analysis, institutional and program scoping study
China Issues and Options in GHG Emissions Control (11 reports)	1992–1994		SPC, NEPA	Establishing China's GHG control and WB-GEF support strategy through the 1990s
<b>2. Technology Transfer</b>				
High-Efficiency Industrial Boiler Project	1996–2004	US\$32.8 million GEF	MMI, SETC	Partnering of international boiler designers with Chinese boiler manufacturers for design and manufacture of more efficient Chinese coal-fired industrial boilers
<b>3. Developing Energy Service Companies</b>				
Energy Conservation Project	1998–2006	US\$63 million IBRD, US\$22 million GEF	SETC/NDRC, 3 provinces and ESCOs	Developing and successfully operating China's first three ESCOs
Second Energy Conservation Project	2002–2010	US\$26 million GEF	NDRC, China I&G, EMCA	Expanding China's ESCO industry, by developing commercial bank lending to the industry and developing a national ESCO association

<sup>15</sup> World Bank. 2021. China: 40-Year Experience in Energy Efficiency Development - Policies, Achievements, and Lessons Learned, 80.

<sup>16</sup> Note that when foreign experts simply introduced their experience to Chinese audiences in the past years, this was a common reaction of the Chinese audience.

Themes	Dates	WB/GEF Project Finance	Key Chinese Partners	Main Focus
<b>4. IBRD and IFC Financial Intermediary Projects</b>				
CHEEF projects 1, 2, and 3	2008–2013	US\$300 million IBRD US\$13.5 million GEF	3 banks, NDRC	Two projects, one with additional financing, developed new energy efficiency lending windows in three banks. GEF support enabled technical assistance to banks and national policy and innovation development
CHUEE 1, 2, and 3 (IFC)	2006–2017	About US\$30 million GEF; IFC 2nd loss guarantee	Partner banks	GEF funds and IFC provided partial risk guarantees to three banks to develop energy efficiency lending, accompanied by intensive technical assistance. New banks were added for energy efficiency lending to SMEs
Shandong Energy Efficiency	2011–2018	US\$150 million IBRD	2 leasing co., 1 ESCO, 1 DH developer	Energy efficiency investments in Shandong were supported through financial leasing operations, broadening the financing options for projects in the market
Innovative Financing for Air Pollution Control in Jing-Jin-Ji Project	2016	US\$500 million IBRD	Huaxia Bank	Reducing air pollution in Northern China mainly by reducing coal use through energy efficiency and clean energy development. First China project using a PforR disbursement and results monitoring mechanism
<b>5. Urban Heating Efficiency</b>				
Opportunities to Improve Energy Efficiency in Buildings Study	2001		Qinghua University, MOHURD	First Analytical Advisory Activity (AAA) on building energy efficiency, concluding with focus on combining heating system efficiency, reform, and energy efficient building design in northern residential buildings
Joint Studies on Heat Metering, Pricing, and Billing	2002–2008		MOHURD	A first study compared practical options for installing household heat metering for the first time. A larger, second study provided analysis and recommendations for heat pricing reform
Heat Reform and Building Energy Efficiency Project	2005–2013	US\$18 million GEF	MOHURD, Tianjin, other cities	Simultaneous support for improving residential building energy efficiency and reforming residential heat use measurement, pricing, and billing systems
Liaoning Third Medium City Infrastructure Project	2008–2016	US\$191 million IBRD	Liaoning government, 6 cities	District heating system upgrades in 6 municipalities in Liaoning Province
Urumqi District Heating Project	2011–2015	US\$100 million IBRD	Urumqi Municipality	Integration and upgrading of the Urumqi City district heating system

Themes	Dates	WB/GEF Project Finance	Key Chinese Partners	Main Focus
Hebei Clean Heating Project	2015-	US\$100 million IBRD	Hebei cities and counties	Energy efficiency and pollution control through expansion and upgrading of district heating systems in 4 Hebei cities/counties
<b>6. Provincial-Level Energy Efficiency</b>				
Study on Accelerating Energy Efficiency in China's Provinces	2010		NECIDC, ERI, provinces	Issues and options for program and capacity improvements for provincial-level energy efficiency entities, the key level for actual implementation of China's energy efficiency policies and programs
Provincial Energy Efficiency Scale-Up Program (linked with Shandong Energy Efficiency Project)	2011–2016	US\$13.4 million GEF	Shandong, Shanxi, Jiangxi	Technical assistance and new program design for specific energy efficiency efforts, focusing especially on practical implementation. Substantial cross-exchange between provinces
<b>7. Stand-Alone Industrial Energy Efficiency</b>				
Energy Efficiency Promotion in Industry	2011	US\$4 million GEF	MIIT	Industrial energy manager training and promotion of industrial energy management systems
<b>8. Building Energy Efficiency</b>				
Study on Improving Energy Efficiency in Public Institutions	2012		GOA of the State Council	Issues and options for accelerating energy efficiency efforts in public institutions (for example, government offices, hospitals, and schools)
Green Energy Schemes for Low-Carbon City in Shanghai Project	2013–2018	US\$100 million IBRD US\$4.3 million GEF	Changning District, SPD Bank, Bank of Shanghai	Investment support, through two participating banks, and technical assistance for energy efficiency and clean energy development projects in commercial buildings. Retrofits and new buildings were both included
Urban-Scale Building Energy Efficiency and Renewable Energy Project	2013–2019	US\$12 million GEF	MOHURD, Beijing, Ningbo City	Promotion of LOCAL urban forms; public and commercial building energy efficiency; and rooftop solar development
<b>9. National Policy Development</b>				
Developing Market-Based Efficiency Program	2017	US\$17.8 million GEF	NDRC	Technical assistance support for national-level energy efficiency policy and program innovation, especially for market-based mechanisms and improving energy savings monitoring and verification

Note: Only joint studies authored by WB and Chinese joint teams are listed.

ERI = Energy Research Institute of the NDRC; GOA = Government Offices Administration; MIIT = Ministry of Industry and Information Technology; MMI = Ministry of Machinery Industry; NECIDC = NDRC's Energy Conservation Information Dissemination Center (1998–2009).





