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ENERGY EFFICIENCY FINANCE: ASSESSING THE IMPACT OF IFC'S CHINA UTILITY-BASED ENERGY EFFICIENCY FINANCE PROGRAM

ASSESSING THE IMPACT OF IFC'S CHINA
UTILITY-BASED ENERGY EFFICIENCY FINANCE PROGRAM

Energy Efficiency Finance

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Assessing the Impact of IFC's China Utility-Based Energy Efficiency Finance Program

Energy Efficiency Finance

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Cover: Suntech engineers checking solar modules at Beijing National Stadium, also known as the Bird's Nest Olympic Stadium. Photo courtesy of Suntech.

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Abbreviations

BOB	Bank of Beijing
CBRC	China Banking Regulatory Commission
CEEF	Commercializing Energy Efficiency Finance Program
CHUEE	China Utility-Based Energy Efficiency Program
CO_2	Carbon dioxide
ECP	Energy Conservation Project
EMC	Energy management company
EMCA	Energy Management Company Association
EPC	Energy performance contract
ESCO	Energy service company
GEF	Global Environment Facility
GHG	Greenhouse gas
HEECP	Hungary Energy Efficiency Cofinancing Program
IB	Industrial Bank
IEG	Independent Evaluation Group
IFC	International Finance Corporation
kg	Kilogram
NSP	New suspension precalcinations
RSEF	Russia Sustainable Energy Finance Project
RSF	Risk-sharing facility
SME	Small- and medium-sized enterprise

All dollar amounts are U.S. dollars unless otherwise indicated.

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Foreword

Energy efficiency finance is an integral part of the International Finance Corporation's (IFC) focus on environmental sustainability and climate change. As IFC is planning a significant scale-up in this line of business over the next two years, it is important to review and assess its experience from past operations.

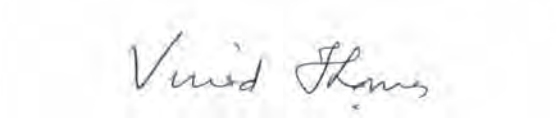
This evaluation assesses the performance of IFC's energy efficiency finance program in China aimed at stimulating energy efficiency investments through bank guarantees and technical assistance. The program's significance is underpinned by the fact that China's size, rapid economic growth, and inefficiencies in energy use make it one of the world's largest emitters of carbon dioxide (CO_2). The utilization of IFC's program has been rapid compared with other similar programs. The program started in 2006. As of June 2009, the 98 energy efficiency investments supported by the program have reduced greenhouse gas emissions by 14 million CO_2 tons per year, slightly in excess of the target set at the beginning of the program. This amount equals the annual emissions of Bolivia, for instance, but it is small for China—less than 40 percent of the annual emissions of the largest emitter of CO_2 among China's power plants.

The difference made by the program is traced along the chain of interventions: (i) at the level of banks, the program is narrowly based on one of the two partner banks, which, with the help of the program, expanded its energy efficiency lending as a new business line; (ii) at the level of energy management companies, the program's technical assistance improved the program participants' access to finance; and (iii) at the end-user level, it promoted the use of energy efficiency investments that achieved reduction of greenhouse gas emissions.

However, there is only a weak differentiation in behavior surrounding energy efficiency investment between end users supported by the program and other similar companies that were not. In China, as a result of government intervention, there are several other programs that support investments in energy savings. It appears likely that several end users supported by the IFC program would have implemented energy efficiency projects even in the absence of support from the program. The evaluation also estimates that less than 10 percent of bank clients would not have invested in energy efficiency without the loans guaranteed by the program. The relatively low additionality at the end-user level reflects the fact that most of the program's guaranteed loans were used by large companies that already had greater access to financial sources than smaller companies did; this was in contrast to the original plan of emphasizing small and medium companies.

Despite the modest additionality of the IFC program, the social benefits of the program significantly exceed its costs. This assessment is a partial and static recording of gains from efficiency improvements alone, setting aside any downside from increased use of coal that greater efficiency might lead to. A broader look is needed to also consider structural changes to measure the share of cleaner energy sources.

The evaluation recommends areas of improvement to realize greater impact. First, the program needs to emphasize areas where the potential additionality is high, such as small enterprises. Second, the program needs to concentrate more on activities that have the potential to reduce emissions significantly, such as energy efficiency for buildings. Third, the program's subsidy elements need to be reoriented to the areas of market failure, with IFC increasing its coverage of first loss from its own resources.



Vinod Thomas
Director-General
Evaluation

Executive Summary

The International Finance Corporation (IFC) and financing energy efficiency. IFC's support to energy efficiency finance started in 1997 with a program in Hungary. It has grown since then to include operations in Eastern Europe, the Russian Federation, and East Asia. Financing energy efficiency is now an integral part of IFC's strategic focus on sustainability and climate change. The Corporation's goal over the next two years is to achieve a threefold expansion of its energy efficiency investments. As IFC plans to scale up energy efficiency business, it is important to review and assess the experience accumulated through past operations.

IFC's energy efficiency finance program in China. This evaluation by the Independent Evaluation Group (IEG) looks at the experience of IFC's energy efficiency finance program in China—China Utility-Based Energy Efficiency Finance Program (CHUEE). China's soaring demand for coal to generate electricity and a surge in cement production made it one of the world's largest emitters of carbon dioxide (CO_2). Most Chinese industries are inefficient in their energy use. The Chinese government has recognized this to be a major risk to China's sustained growth and has made energy efficiency a top national priority.

The IFC program, which started in 2006, is aimed at stimulating energy efficiency investments in China through two main instruments: bank guarantees for energy efficiency loans and technical assistance to market players, including utilities, equipment vendors, and energy service companies, to help implement energy efficiency projects. Both types of interventions rely on subsides funded by donors. An initial design aimed at promoting the switch from coal to gas and centered around a gas utility failed to materialize and was abandoned because of strategic mismatches between the gas utility and the financial intermediaries.

Implementation to date. Program utilization has been rapid, compared with objectives and the experience of other similar programs. As of June 2009, the program's participating banks provided loans totaling to 3.5 billion Chinese yuan ($512 million). These loans financed 98 energy efficiency projects, such as heat and gas recovery power generation and the introduction of efficient production systems. The steel, chemical, and cement industries are the largest beneficiaries. Based on engineering calculations, IEG estimates that these investments reduced greenhouse gas (GHG) emissions by 14 million CO_2 tons per year, slightly in excess of the target set at the beginning of the program. This reduction is roughly equivalent to the annual emissions of a country such as Bolivia (USEIA 2009)[1] and amounts to 40 percent of the annual emissions of the largest emitter of CO_2 among China's power plants. Compared with other energy efficiency programs in China and elsewhere, the program stands out for the quick utilization of its guarantee facility.

Focus on impact. This evaluation goes beyond objectives and benchmarks as standards for assessing performance to look at the impact that the program has made on energy efficiency in China. It asks, "Is the program making a difference in reducing GHG emissions by helping transform the market for sustainable energy efficiency finance in China?" It examines the difference the program has made, compared with a situation without IFC intervention, traced along the chain of interventions: the effects on banks' energy efficiency lending, the actual implementation of these projects by end users, and the GHG reductions the program caused.

Impacts at the bank level. The program has been working closely with two partner commercial banks: Industrial Bank (joined in 2006) and the Bank of Beijing (joined in 2007). Driven by strong government commitment, financing energy efficiency has been booming in China in recent years. Thus, it is very likely that without the program, the participant banks would have grown their energy efficiency business.

However, with the program, Industrial Bank has grown at twice the rate of comparator banks (controlling to the extent possible for initial conditions, such as level of commitment to energy efficiency and preprogram levels of energy efficiency finance), and the quality of its energy efficiency lending portfolio has been good. Its faster growth relative to comparator banks was underpinned by the program's support for establishing a dedicated department for energy efficiency lending—a unique feature among Chinese banks—the preparation of guidelines and procedures for energy efficiency loans, and building the capacity for applying project finance tools to energy efficiency finance.

Regarding the Bank of Beijing, the program has not yet left a clear mark of impact. The Bank of Beijing has been actively engaged in a World Bank program that started before

CHUEE and focused on financing energy service companies (ESCOs). CHUEE added a few energy efficiency loans that are a fraction (less than 10 percent, by number of loans) of the Bank of Beijing's overall energy efficiency lending and are of similar type as the loans supported by the World Bank program, although somewhat larger. Furthermore, the Bank of Beijing's overall growth in energy efficiency finance has been less than that of comparator banks. Thus, the program has provided relatively weak additionality and incremental impacts to the Bank of Beijing so far. The program is therefore narrowly based on one of the partner banks as the main conduit of the guaranteed loans. The introduction of other banks has been delayed because of regulatory hurdles.

Impact at the energy management companies level. The program facilitated access to financing for the key market players—energy service companies—through technical assistance for capacity building and by brokering new relationships with banks. The CHUEE-supported energy management company (EMC) network has 135 members. Given the nature of the program, not surprisingly, the companies that participated in the program had a better chance of securing bank loans than those that did not participate. We estimate that controlling for other relevant factors, membership in the network enhanced EMCs' chances of obtaining bank financing by 31 percent. Independently of membership in the network, technical assistance (from any source) increased the probability of projects obtaining financing by 27 percent. Network participants also had a higher growth than the nonparticipants.

Impacts at the end-user level. A survey of cement companies (the third largest group of beneficiaries) that were not supported by the program but that shared the same characteristics as CHUEE's end users reveals widespread awareness of and interest in implementing energy efficiency projects. However, smaller companies are about half as likely as large companies to implement such projects. They also have significantly lower rates of using bank loans to finance energy efficiency projects than the larger companies. It is among such smaller companies that the program's impacts are found. Based on program data, interviews, and surveys among users and nonusers, an estimated 9 percent of banks' clients who benefitted from the program would not have implemented their energy efficiency investments without the loans that CHUEE guaranteed. These are relatively small companies facing constraints in their access to finance largely because of their inability to meet collateral requirements. The additionality of these loans can be linked directly to the program's guarantee, which lowered the banks' collateral requirements and facilitated access to credit for these borrowers.

In estimating the overall impact, the evaluation therefore does not discount the additionality at the borrower level given by the program's additionality at the bank level, assuming in effect that even though participating banks would have grown their energy efficiency finance business without the program, they would not have reached the type of small and medium enterprises that were facing collateral constraints in the absence of the program's guarantee. The relatively low additionality at the end-user level reflects the fact that most of the program's beneficiaries have been large companies, in contrast to the original plan to emphasize small and medium companies. The original expectation was that 60 percent of the guaranteed loans would be small (about $0.2 million). In reality, the average loan size was $5.7 million, and loans of $0.2 million or less constituted less than 10 percent of the actual portfolio.

Moving down market to smaller companies remains a key challenge, as these companies are the ones with limited access to finance for energy efficiency projects. Although the program's additionality is strong with these borrowers, the size of their projects tends to be smaller than average for the program as a whole, and their impact on GHG reduction is correspondingly more modest. Moving down market therefore needs to be accompanied by scaling up for maximum impact on CO_2 reduction.

In addition to the public benefits related to GHG reduction, the projects that were facilitated by CHUEE have also generated private benefits in the form of energy savings that are captured by the implementing enterprises, the financiers, and other involved parties.

Overall impact. The overall impact of the program consists of the GHG reduction and the private benefits generated by projects that would not have happened without the program, plus nonquantifiable benefits related to demonstration and spillover effects. The latter appear to be emerging—according to results of an IEG survey on the impact of CHUEE, the program is well known in China, and there is interest among banks to learn from its approaches to the end users—but are hard to estimate. The real quantifiable impacts from the guaranteed loans are estimated at $384 million over a 10-year period since inception of the program. It is possible that the impact is underestimated—more than 68 percent of borrowers indicated in the IEG survey that without the program they would still have implemented their energy efficiency projects but on a smaller scale or over a longer time frame. The critical factors that affect the magnitude of the benefits are the program's additionality at the bank level, banks' additionality with end users, the size of average CO_2 emission reduction per project, and the prices of CO_2 and coal (for the energy-saving calculations).

Costs. The social costs expended to derive the benefits consist of (i) project investments costs; (ii) the costs of running the program, including the costs of the technical assistance provided; and (iii) the subsidy embedded in the partial loss cover by the Global Environment Facility (GEF), which underpinned the guarantee facility.

Of these costs, the valuation of the first loss cover presents methodological difficulties. Given the lack of actuarial data, and in the absence of a market in similar guarantee or insurance products, the estimates are based on the expected default rate at the inception of the program. This represents an estimate of the willingness to pay for the protection given by GEF. The base case default rate was expected to be 4 percent, and the GEF subsidy was used to cover these potential losses. This GEF first loss cover catalyzed the IFC guarantees and supported the energy efficiency lending by Industrial Bank. The program collected $1 million in guarantee and other fees. The cost of running the program so far is $4.8 million, including $3 million in technical assistance provided, without explicit fees levied to beneficiaries.

Efficiency. The real rate of return of the program is conservatively estimated at 38 percent per annum—a high rate given the seemingly modest rate of additionality at the level of end users. The estimate assumes that 9 percent of projects are additional and reflects their net benefits, but it includes the entire costs of CHUEE and technical assistance so far, as well as the costs of the first loss cover. The private return in the form of energy savings from this program is 20 percent, based on total project costs and energy savings measured using international energy prices. Social benefits in the form of carbon emission reductions are about one-third of total quantifiable benefits. The relatively high rate of return reflects the win-win nature of energy efficiency investments, which can generate both significant social and private benefits, and indicates a functioning model focused on leveraging and mobilizing commercial-based lending for financing energy efficiency projects. Although the sizeable public benefits suggest that even a modest additionality can be sufficient to justify the subsidies involved, high private returns argue for a more discriminate use of subsidies for energy efficiency projects.

The broader setting. It is important to note that the performance of the program was heavily influenced by the government's policies and the earlier efforts of other players. The Chinese government has demonstrated a strong commitment to moderating the country's expanding energy consumption. It is putting substantial pressure on large industries to improve energy efficiency. Noteworthy is the World Bank assistance to local EMCs, which helped establish the whole energy industry. The program, relying mainly on commercial funding through IFC's guarantees, builds on these efforts.

The analysis presented here is partial and static. Given the small size of the program in the overall market for energy efficiency projects, the analysis does not attempt to capture the indirect impacts of improved energy efficiency on the final demand for energy and, ultimately, coal in China. Some energy analysts have argued that energy efficiency improvements on a large scale can lead to broader macroeconomic impacts that in turn can result in an increase in energy consumption (see Geller and Attali 2005).

Such perverse macroeconomic impacts can be achieved by two means: making energy appear effectively cheaper than other inputs and increasing economic growth, which pulls up energy use. Empirical research has found that there is validity to the claim that widespread energy efficiency improvements can lead to macroeconomic impacts that erode some of the direct energy savings from energy efficiency improvements, but these impacts tend generally to be small (Geller and Attali 2005). Nonetheless, these macroeconomic impacts need to be taken into account by policy makers and development institutions in the design of national or regional programs and interventions in energy efficiency. These macroeconomic impacts also highlight the importance of pursuing, in addition to energy efficiency, structural changes aimed at increasing the share of cleaner sources of energy, such as renewable energies and natural gas in the overall energy balance. China places strong emphasis on increasing the proportion of energy that comes from renewable sources and natural gas. IFC is supporting China's goals in this regard, and in its original design, CHUEE was intended to be part of these efforts. However, because of difficulties in matching partners' interests, CHUEE failed to implement the original plan to support the switch from coal to gas.

Summary of Lessons from the Program's Experience So Far

Careful selection of private sector partners is needed to meet strategic program objectives. The program experienced different outcomes between the two banks—Industrial Bank and the Bank of Beijing—in terms of portfolio growth and the ability to use the guarantee. Earlier IFC energy efficiency programs in other countries also experienced varied usage of financial facilities. Obviously, a guarantee by itself is not an adequate incentive to increase energy efficiency lending, and the program needs to find the right balance between the banks' strategic objectives and the program's objectives. Industrial Bank, for example, combined the marketing of energy efficiency loans with a strategy of retaining customers. Thus, it made energy efficiency loans largely to existing clients, whereas the Bank of Beijing targeted new clients and faced difficulty in growing its energy efficiency loan portfolio.

Flexibility is needed in program design to respond to unexpected challenges and opportunities. The program experienced complete modification of its business model and responded with additional resources when confronted with larger-than-expected market demand for investment. This situation indicates that programs require some flexibility to respond to new developments in the market or to changes in regulations.

Government policies and market readiness are important factors in determining program design and success. In China, the timing for the program was right, as the government was putting significant emphasis on promoting energy efficiency activities. It had already put various policy measures in place for energy efficiency. Also, the World Bank initiatives for the EMCs paved the way for further assistance by IFC and other development organizations. The program built on these market conditions.

The combination of private and public benefits in energy efficiency projects suggests the need for a more discriminate and dynamic approach to subsidies in the energy efficiency business. As the sector matures and certain types of energy efficiency projects become well established, subsidies need to shift to less mature areas with high growth potential and significant social benefits. Indiscriminate use of subsidies impedes the commercialization of energy efficiency finance.

Caution is needed in applying a utility-based energy efficiency finance model in emerging markets. Utilities may not have incentives to curtail energy consumption or expand their market through energy switching when there are enough potential customers. It is important to assess incentives, policy environments, and the degree of match between a utility's clients and partner banks' market strategies.

An exit plan is critical. Many of the efforts to promote financing of energy efficiency focus on generating investments rather than on the sustainability of maintaining energy efficiency investments after a program has completed. Moreover, there is little practical information on how to terminate a program or how to shift its focus when commercial energy efficiency operations are emerging and starting to compete with the program. One of the factors behind the quick build-up of Industrial Bank's energy efficiency loan portfolio was the technical reviews of external consultants funded by CHUEE. However, the overreliance on external consultants has undermined the program's sustainability by reducing incentives to build internal capacity for such reviews.

Areas for Improvement and Recommendations

Although the social benefits exceed costs by a significant margin, the relatively modest additionality indicates room for improvement. The analysis of the factors affecting return suggests several ways to enhance impact and efficiency:

1. **Increase additionality at the level of banks and end users.**
   The program has supported substantial emission eductions mainly through projects by larger companies, but not all reductions can be counted as impact. The program needs to orient activity to the areas where additionality is potentially most significant. The program activity should be more strategically focused on areas where IFC could have a unique role, such as working with small and medium enterprises, residential housing, and commercial buildings. This requires that IFC consider and design new approaches and work with different types of partners, not just extend already existing types of program activities.
2. **Enhance the CO_2 emission reduction impact of projects financed through the program by moving into areas identified as having high potential, but not addressed currently by market participants.**
   Despite the explosive growth of energy efficiency finance in China, the most important areas for emission reductions are currently not adequately addressed by market participants. The China National Development Reform Commission showed that the most significant emission reduction should come from industrial boiler retrofitting, followed by energy savings in building (for example, using less energy because of better insulation). Banks so far have not provided financing in those areas identified as having high potential. Moreover, in these areas there are many small and dispersed users, and access to finance and technical services is more challenging than for the large enterprise energy users. Thus, additionality is also high in these areas of high energy saving potential.
3. **Reorient subsidies to areas with a market failure and increase IFC's involvement in first loss guarantee.**
   The program has reduced the first loss cover under the GEF grants, but IFC continues to rely on GEF to provide first loss guarantees. Furthermore, there is no assurance that the banks will continue to lend without substantial collateral in the absence of the program's guarantees.

Efforts are also being made to charge for technical assistance. These measures need to be pursued with existing and new partners, as they can both provide a market test of additionality and enhance sustainability. The program should prepare a plan to ensure the sustainability of energy efficiency lending activities. It should design a workable plan to hand off technical appraisal functions to client banks and encourage risk taking. These efforts need to be supplemented by policy work of the World Bank Group to promote market-based practices in financing energy efficiency and more discriminate use of subsidies at the sectoral level.

Chairman's Summary: Subcommittee on Development Effectiveness (CODE)

On March 31, 2010, the Informal Subcommittee of the Committee on Development Effectiveness (CODE) considered an Independent Evaluation Group (IEG) report entitled *Energy Efficiency Finance: Assessing the Impact of IFC's China Utility-Based Energy Efficiency Finance Program*.

Summary

The Committee welcomed the IEG impact evaluation report, which provided useful insights and is relevant to the growing energy efficiency initiatives that are part of the overall effort to address climate change. In considering the International Finance Corporation's (IFC) involvement in the China Utility-Based Energy Efficiency (CHUEE) program, the critical need to keep in mind its additionality—particularly in terms of knowledge, capacity building support, and financial leverage—was highlighted. While acknowledging the importance of addressing energy efficiency of small and medium-sized enterprises (SMEs) and the building sector, some members wondered whether IFC should shift its focus to them as recommended by IEG. They saw the benefit of working with a limited number of larger, higher emitters of CO_2, where results achieved may provide a positive demonstration effect for both end users and participating banks. Moreover, concerns were raised about the relative complexity of reaching large numbers of SMEs and residential housing and commercial buildings. Other comments and questions raised included, among others, IFC's role in addressing market failures, the need to adjust the program during implementation, assumptions used to assess impact and IFC contribution, and replicability of the CHUEE program. More generally, members emphasized the importance of tailoring support to the country environment and ensuring government ownership of and commitment to achieve positive results.

Recommendations and Next Steps

The Subcommittee recommended that management keep in mind IFC's additionality in its future support for energy efficiency initiatives.

Main issues discussed

Findings from the IEG impact evaluation report

Many members noted the role of country ownership and commitment in achieving the overall results of the CHUEE program. A few members observed that the report could have elaborated on the lessons learned regarding the role of the state in the context of market failures and regulatory frameworks to promote energy efficiency. Some members sought clarification regarding overall methodology to analyze the impact of the program, the basis of determining the reduction in CO_2 emissions, and the rates of return. A member suggested the need for modesty and caution regarding project impact, given the challenges of determining the counterfactuals. On the question of whether the original project design could have anticipated the mismatch between the utility and financial intermediary partners of the initial utility-based model, management stressed the importance of flexibility in project design to adjust to the changing market context, which allowed the initiative to ultimately achieve the positive results. Regarding the delay in effectiveness of the second guarantee facility approved by the Board in December 2007, this was attributed to the time needed to register the guarantees with the State Agency for Foreign Exchange.

IFC's additionality

Many members emphasized the importance of ensuring IFC's additionality through its interventions, based on its comparative advantage. Interest was expressed in learning about IFC's approach toward achieving the highest level of additionality, taking into consideration the operational challenges and risks. With regard to future IFC interventions, some members suggested that IFC should focus on a limited number of large producers of CO_2, especially where energy efficiency initiatives are at a nascent stage; IEG recommended that IFC's follow-up support focus on SMEs, residential housing, and commercial building to increase additionality. It noted the high potential development impact in terms of reducing CO_2 emissions and the positive demonstration effect through such successes.

Future support

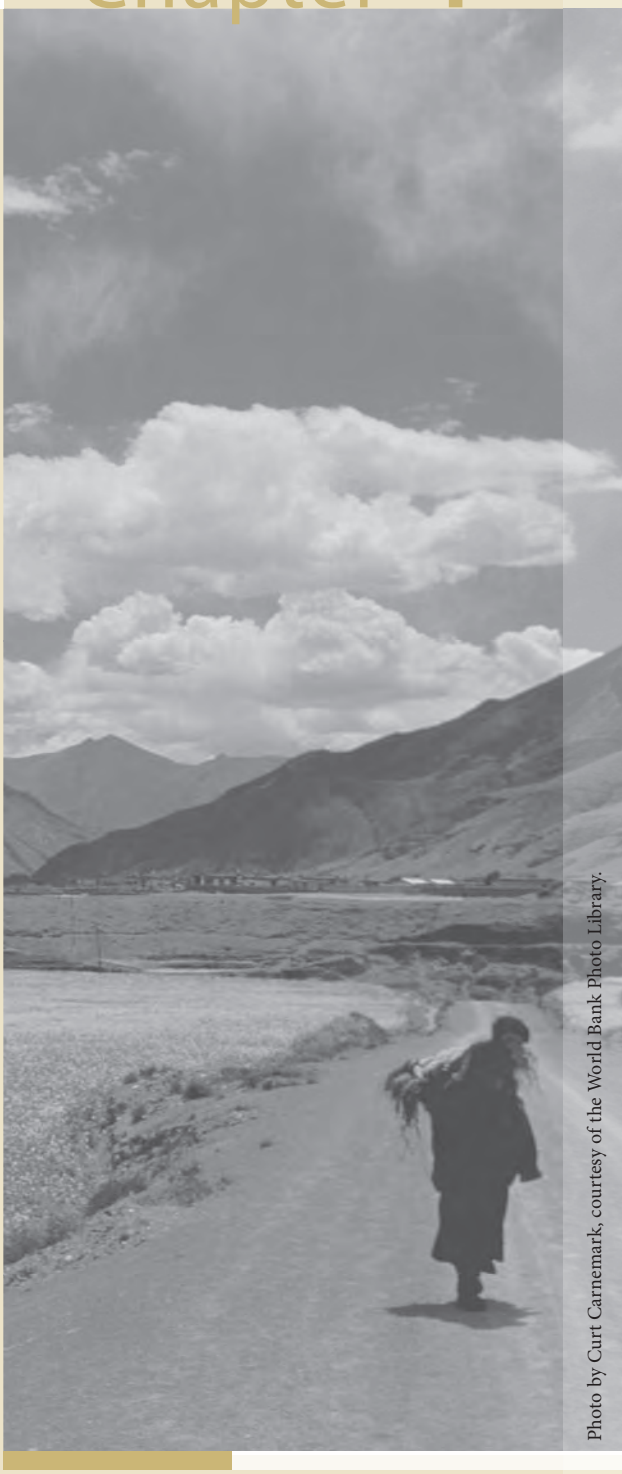
Many members remarked on the increased complexities and higher costs of working at the level of SMEs and with the housing/building sector and expressed interest in the direction of future IFC engagement. They commented on the possibility of lower total CO_2 reductions achievable per intervention, longer time needed to achieve results, and higher transaction costs. Management acknowledged the challenges of working with SMEs and the housing/building sector and the possible lower outcomes. At the same time, they noted the growing interest of smaller banks in working with SMEs and changes in the regulatory framework that allow for short-term assets to be taken as collateral. In this context, management commented on the opportunity to help the government broaden the acceptance of financing greater energy efficiency among SMEs and to address policies to incentivize energy efficient buildings, which are expected to have an overall long-term impact in reducing CO_2 emission. IFC was encouraged to compare different models of engagement in other countries and to draw lessons from them for consideration in other countries.

Replicability

Responding to some members' interest regarding the replicability of the CHUEE program, management commented on its ongoing work in Indonesia, the Philippines, and Vietnam. In addition, management is reviewing the possibility of applying the CHUEE finance and risk-sharing method to support financing of water saving investments in enterprises to address water scarcity issues in China. The potential use of funds other than the Global Environment Facility (for example, from the Clean Development Fund or the Climate Investment Fund) to support similar initiatives was encouraged.

Giovanni Majnoni, Chairperson

Chapter 1



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Climate Change and Financing Energy Efficiency

Improving energy efficiency in developing countries can increase energy availability while reducing greenhouse gas (GHG) emissions. However, it faces many obstacles, including financing constraints. Consequently, many energy efficiency projects with prospects of good financial return remain unimplemented.

There is a need for market development assistance in designing, packaging, and financing projects that would help realize such investment. The International Finance Corporation (IFC) has been developing and implementing programs aimed at promoting commercial financing of energy efficiency projects through local financial institutions since 1997. Financing energy efficiency is now an integral part of IFC's strategic focus on sustainability and climate change. IFC's goal over the next two years is to achieve a threefold expansion of its energy efficiency investments. As IFC is planning to scale up energy efficiency business, it is important to review and assess the experience accumulated through past operations.

Climate Change and Energy Efficiency

Access to energy is critical to economic development and poverty reduction. However, continued economic growth results in rising energy demand. Use of fossil fuels for energy generation is highly correlated with human-induced climate change, which is having broad-reaching effects on the planet. A 2007 assessment report compiled by the United Nations Intergovernmental Panel on Climate Change confirms that global warming is a reality, which is evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC 2007). The report concludes that increases in anthropogenic GHGs such as carbon dioxide (CO_2), methane, and nitrous oxide, which absorb and emit infrared radiation and trap heat within the Earth's surface-troposphere system, have caused most of the increases in average global temperatures since the mid-20th century. In 2004, the global annual emissions of anthropogenic GHGs increased by 70 percent from the 1970 level. CO_2 accounts for about 70 percent of GHGs, and CO_2 from fossil fuel use for energy is the single largest source of GHG (57 percent of total greenhouse gas in 2004) (IPCC 2007, p. 5).

Energy efficiency improvements have the potential to reduce GHG emissions. Improvements are possible in the whole energy chain, from generation (supply-side energy efficiency), to transmission, to distribution to energy consumers (demand-side energy efficiency). Examples of demand-side energy efficiency measures include fuel-efficient transportation, building more energy-efficient buildings (that use better lighting, electric appliances, heating/cooling, and insulation), and more efficient use of heat and power in industrial plants. Efficiency gains that generate more economic outputs with less energy input are beneficial not just for cost savings and climate change mitigation, but also for reducing emissions that are harmful to human health (such as particulate matter and sulfur and nitrogen oxide). Also, lowering the cost contributes to improving energy supply security and economic competitiveness.

Such benefits have the potential for win-win solutions in terms of economic and environmental impacts. There is a wealth of straightforward energy saving investment opportunities that many energy users can afford to adopt. Most of these demand-side opportunities are in industrial (40 percent), residential (26 percent), and commercial (13 percent) sectors (Farrell and Remes 2009). Developing countries can benefit from such investment in particular, as 65 percent of available positive-return opportunities to boost energy productivity are located in developing regions (Farrell and Remes 2009).

However, many energy efficiency projects with prospects of good financial return remain unimplemented. In many rapidly industrializing countries, such as Brazil, China, and India, the key impediments to energy efficiency investments are the intertwined market failures: problems of high transaction costs, perceived high risks that may

drive up the discount rates associated with projects, and difficulties in structuring workable contracts for preparing, financing, and implementing energy efficiency investments. Many argue that these constraints are institutional. Such investments thus require market development that addresses the constraints to designing, packaging, and financing energy efficiency projects. Taylor and others suggest three requirements that must be fulfilled within that environment: marketing/technical assessment, financing, and incentives (Taylor and others 2008, p. 65).

First, sufficient technical capacity is needed to identify, design, and implement energy efficiency operations. Second, investments in energy efficiency improvement require financing, in particular to capture the flow of benefits that can be converted into investment opportunities. Third, there must be sufficient incentives for energy users as well as other involved parties to make the investment. Efforts to promote energy efficiency investments, therefore, require devising new institutional mechanisms that can bring together technical and financial specialties in aligned interests and incentives.

IFC Engagement in Financing Energy Efficiency

IFC support to energy efficiency started with its advisory services operations and then expanded through partnership programs with commercial banks, utility companies, energy management companies (EMCs), and energy efficiency equipment suppliers. The first such program was launched in Hungary in 1997 through the Hungary Energy Efficiency Co-financing Program (HEECP). Subsequently, these activities were expanded to include similar programs such as Commercializing Energy Efficiency Finance (CEEF) in Eastern Europe, and Russia Sustainable Energy Finance. IFC is planning to further expand such operations to other countries and regions, including the Philippines Sustainable Energy Finance (approved in 2008), Indonesia, Vietnam, and so on.

These programs are aimed at addressing market failures by promoting commercial financing of energy efficiency projects through local financial institutions such as banks and leasing companies. IFC's approach is to address the market failures by combining both investment and advisory services to local financial institutions with advisory services for capacity building to companies and EMCs. The intervention is to reduce information gaps about the benefits of energy efficiency. The program is also expected to generate demonstration effects. The programs are typically cofinanced by the Global Environment Facility (GEF) and other donors. So far, all programs are supported by GEF, especially those that provide technical assistance and a guarantee facility to banks. IFC is also providing a standalone energy efficiency credit line and guarantees to individual banks and EMCs (appendix H).

GEF grants play an important role. All of IFC's energy efficiency programs include grants from GEF for risk-sharing facilities (RSFs; see box 1.1) and technical assistance. Actually, GEF solely funded the first operation in 1997—HEECP I. IFC has been cautious about the energy efficiency lending operation because of lack of experience and expertise, an unfamiliar business model, and high transaction costs.

Earlier project documents indicated that IFC would not engage in this business because of the risk, and grants from GEF were critical to providing services, in both guarantees and technical assistance. Moreover, IFC would not provide the riskiest type of guarantee, the first loss coverage, unless the risk was passed to the other parties. GEF's monitoring and evaluation requirement also helped IFC accumulate project performance records and revise the business model for the subsequent operations. Energy efficiency finance is now a mature product line, and IFC now has seven standalone energy efficiency finance projects in addition to the dedicated the energy efficiency programs.

Energy efficiency finance is now an integral part of IFC's strategic focus on sustainability and climate change. IFC's goal over the next two years is to achieve a threefold expansion of its energy efficiency investments. As IFC is planning to scale up energy efficiency business, it is important to review and assess the experience accumulated through past operations. IFC commissioned external reviews of the first program, the CEEF. Based on the assessments, IFC decided to mainstream the energy efficiency finance line of business by giving it "developed" status. Some lessons from past operations are summarized in box 1.2.

BOX 1.1

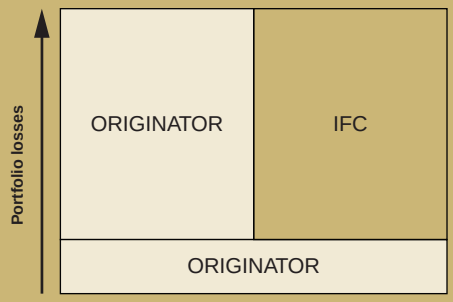
RISK-SHARING FACILITY AND FIRST LOSS GUARANTEES

An RSF is one of the structured and securitized products that IFC offers. It is a bilateral loss-sharing agreement between IFC and an originator of assets—a bank or a corporation—in which IFC reimburses the originator for a portion of the principal losses incurred in a portfolio of eligible assets. The RSF allows a bank or corporation and IFC to form a partnership with the goal of introducing a new business or expanding an originator's target market.

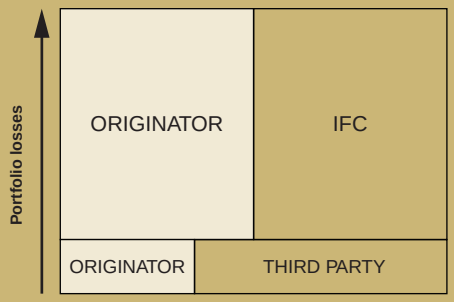
An IFC RSF typically reimburses an originator for a fixed percentage of incurred losses that exceed a predefined threshold (or first loss). The originator and IFC agree prior to signing the RSF on eligibility criteria that specify the assets to be covered under the RSF. All newly originated assets must be added to the facility portfolio during a ramp-up period that generally lasts two to three years, or until the portfolio reaches a predefined maximum volume. The originator monitors the portfolio performance and reports to IFC on a regular basis. Once the losses exceed the first loss threshold, IFC will reimburse the originator in accordance with the agreed risk-sharing formula.

Normally, an IFC RSF does not cover the first loss portion of the losses. However, IFC's role in structuring and sharing the credit risk of an asset portfolio may attract third-party sponsors. These sponsors often work together with IFC and potential originators to design RSFs intended to mobilize lending to sectors in which the sponsors are involved. The first loss guarantee by the third-party sponsors effectively covers the part of the losses that the originator should cover by itself.

RSF with Originator Covering First Loss Tranche



RSF with Third-Party Sharing In First Loss Tranche



Sources: IFC structured and securitized products, product description (www.ifc.org/structuredfinance).

BOX 1.2

LESSONS FROM PAST OPERATIONS

- **Pairing of investment and technical assistance has been the key feature of these energy efficiency interventions.** IFC found that the guarantee alone did not provide an adequate incentive to make banks offer energy efficiency loans (Obibuaku 2007). The financial package needed to have complementary advisory services, which often enabled the bank to assess the risks associated with the underlying loan products. In some eastern European cases, the assistance for capacity building of marketing agents, such as an energy service company, might have been needed to generate sufficient deal flows for the banks to start lending for energy efficiency investment.
- **Fit with financial institutions' strategic orientation is an important dimension that IFC needs to consider when designing and marketing its energy efficiency programs.** Some banks found that the design of the program fit well with their corporate strategic orientation. For example, one bank wanted to expand SME lending activities and found that the IFC's energy efficiency program, including guarantee

(*continues on next page*)

and technical assistance, met its needs. For other banks, the focus of the programs did not have an obvious fit with their strategic orientation. Uptake varied significantly among banks depending on strategic fit.

- **The introduction of government actions, regulatory reforms, and provision of subsidies to certain activities actively shapes the energy efficiency (and renewable energy) markets and drives banks' behavior.** In Hungary, regulatory changes and promotion of energy efficiency in the housing sector created a big push for banks to market to this particular segment. In the Czech Republic, regulatory change and a European Union subsidy on renewable energy was an important boost for investment and helped CEEF increase the renewable section of its portfolio. However, energy efficiency is an area where Russian public institutions are doing very little, and energy policy (including energy subsidy) does not provide strong support or incentives for energy efficiency investment. The Russia Sustainable Energy Finance Project survey on energy efficiency in the Russian Federation revealed that 81 percent of companies believe that current legislation does not promote energy efficiency.
- **Sustainability depends on banks' changing their culture and strategic orientation.** In HECCP/CEEF, there are indications that client banks were taking the energy efficiency projects on their own and requesting lower levels of collateral and lower down payments as they became increasingly familiar with the risk of such projects (Taylor and others 2008, p. 175). In Russia, some participants have started to finance energy efficiency projects using their own funds. However, as programs in Eastern Europe are winding down, and in light of heightened risks in the aftermath of the recent global financial crisis, some participating banks are indicating that they are returning to old practices, which rely heavily on collateral.
- **The lessons from other programs indicate that energy efficiency finance schemes need financial incentives that match bank needs and technical assistance that targets certain market failures (technical skills, regulatory); and they need the right context (policy and market readiness).** Programs may have to adjust their operations in the face of market development. Investment results have been promising (there have been no calls on guarantees so far), and IFC itself should become comfortable taking more risks with this type of investment. At the same time, emphasis needs to be maintained on cost recovery of advisory services, as such programs involve heavy staff and technical inputs (technical reviews, market studies, and administrative costs).

Source: IEG.

Chapter 2

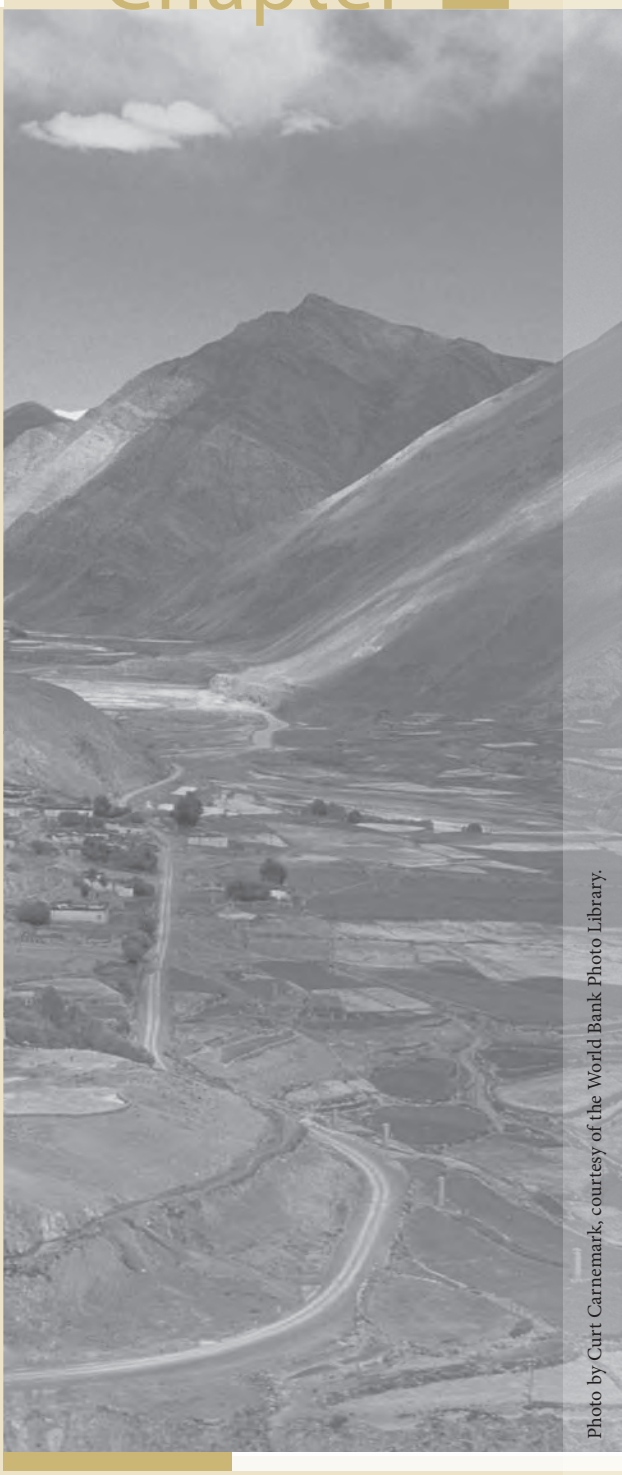


Photo by Curt Carnemark, courtesy of the World Bank Photo Library.

The China Utility-Based Energy Efficiency Finance Program

The China Utility-Based Energy Efficiency Finance Program (CHUEE) was launched in 2006. The program was expected to catalyze energy efficiency investments in China, thus supplementing China's efforts to conserve energy and reduce gas emissions. The program had two components: a guarantee for energy efficiency loans and the provision of technical assistance to market players.

Although the program operated with just two banks, these banks quickly utilized the loan guarantee facility to build up a large loan portfolio of energy efficiency projects. As of June 2009, the program guaranteed loans amounting to 3.5 billion Chinese yuan ($512 million). These loans financed 99 energy efficiency projects, such as heat and gas recovery power generation and the introduction of an efficient production system. The steel, chemical, and cement industries are the largest beneficiaries of the program. Based on the engineering calculation, these investments reduced GHG emissions by 14 million CO_2 tons per year. This is more than the target set at the beginning of the program (up to 13.6 million tons per year).

The program implementation faced some operational issues associated with a complicated internal reporting line, weak coordination between investment staff and the program management office, and the lack of a monitoring and evaluation system at the program level.

Energy Efficiency Challenges in China

China is now one of the world's largest emitters of GHGs. In 2007, the country's estimated GHG emission was 7.5 gigatons—about 21 percent of the world's emissions in that year (USEIA 2009). China's emission volumes are projected to rise by another 65–80 percent by 2020.

China has been increasing its energy use to support its economic growth during the past decades. Since the turn of the 21st century, China's energy demand has nearly doubled, from around 40 quadrillion[1] British thermal units in 2000 to nearly 75 quadrillion in 2007. China's source of energy also contributed to its GHG emissions; its power generation is dominated by coal—coal provided 77 percent of China's energy in 2007 (the world average was about 30 percent), and its demand exceeds 2 billion tons a year, which is nearly double the demand in the United States (Pew Center on Global Climate Change 2007). Coal's carbon content per unit of calorific value is 36 percent and 61 percent higher than oil and natural gas, respectively (National Development and Reform Commission 2007, p. 20).

China has been reducing its emission intensity (emission per unit of gross domestic product). From 1999 to 2005, China's energy intensity went from 268 to 143 tons of coal equivalent per US dollar, decreasing by an average annual rate of 4.1 percent. However, there are also significant efficiency gaps in China, primarily because of lack of advanced technologies. According to China's National Climate Change Programme, its energy efficiency is about 10 percent lower than that of developed countries, and its per unit energy consumption is about 40 percent higher than in industrialized industries (National Development and Reform Commission 2007).

There are many opportunities to adopt new energy efficiency technologies in China. For example, utilization of industrial waste as a fuel for the cement production process began very late: in 2003, the industrial waste used as fuel was 0.01 kilograms (kg)/ton cement in China. This is minuscule compared to 43 kg/ton in Germany and 11 kg/ton in the United States (IFC 2007).

Chinese government policy supports energy efficiency. The Chinese government has demonstrated a strong commitment to moderating the country's expanding energy consumption. Since 2006, government policies have been increasingly conscious about energy efficiency and pollution reduction. China's 11th Five-Year Plan for Social Economic Development (2006–2010), the country's national economic planning document, represented a turning

point for government support for energy conservation. It stipulates that the country's energy consumption per unit of gross domestic product nationwide be reduced by 20 percent during the planned five-year period, or by about 4.4 percent annually. This was the first time that quantitative targets for energy efficiency were included in a five-year plan; since then, various measures have been introduced to achieve this goal. The government's policy includes a program to improve energy efficiency in China's 1,000 largest enterprises (these represent one-third of the country's energy consumption) in 2006. The government also plans to retire inefficient power plants and industrial plants in sectors such as cement and steel. Detailed progress on government policy actions is outlined in appendix A.

Market-driven action would supplement the policy. Government policy measures rely on administrative regulations and subsidies to reach the stated objectives on consumption. Weak regulatory enforcement (especially at provincial and municipal levels) can undermine such efforts (Bank of Tokyo Mitsubishi UFJ 2007, p. 6). In any case, government measures are putting substantial pressure on large industries by providing subsidies and transfers from the government budget. However, given the scale of the challenge to moderate energy consumption growth, sustainable mechanisms to address market failures—including financing and technical services—would improve the chance of realizing energy efficiency investments based on sustainable market activities.

Efficiency efforts are part of the solution. Improvement in the efficiency of using energy is only one of several variables in reducing GHG emissions. Efficiency efforts need to be assessed in the wider context of overall energy and climate policy, where issues such as energy pricing and promotion of renewable energy industries are major and important variables.

Overall, when policy conclusions are drawn in a dynamic setting, there is a clear need to look at not only the efficiency effects (as is done in this study), but also the scale effects on the use of coal and fossil fuels. In this context, the government of China's pricing regime for coal and the regulation of its use can have significant impacts. Although the encouragement that the financing subsidies provided through guarantees and technical assistance may stimulate investments in more efficient coal combustion and reduce the emissions intensity of industrial production, it can also reduce the effective price of using coal and thus contribute overall to greater absolute coal consumption. The efficiency gain achieved from conservation might be cancelled out, if the scale of coal production and its use are expanded, and if the social costs from the scale of coal energy are not closely monitored and regulated to ensure that the expanded use of coal does not offset the gains achieved by energy efficiency. In this connection, the government's emphasis on the greater use of more sources of renewable energy is a welcome development.

Design of the Program

Constraints to energy efficiency in China. The government of China made a request to IFC in January 2004 for assistance in developing new private sector initiatives in financing renewable energy and/or energy efficiency. After two years of research, IFC launched the CHUEE program, which was approved by the IFC Board in May 2006. The research identified market failures and barriers to energy efficiency investments in China, which the program would address—

- An information barrier, which limited end users' ability to gain adequate knowledge on energy efficiency technologies and equipment and to assess the risks to financing such projects.
- A lack of awareness and experience among Chinese commercial banks about financing energy efficiency projects.
- Risk aversion in the Chinese banking sector, which customarily makes credit decisions based on fixed asset collateral. Consequently, energy efficiency players such as equipment suppliers and energy service companies (ESCOs) that have a weaker asset base are financially constrained by a lack of credit.

The program had three elements: technical assistance to market players, a loan guarantee mechanism, and outreach and dissemination. The $215.5 million program, including a GEF grant of $16.5 million and $3 million in donor contributions (see appendix B for program funding), set the target GHG emission reduction directly from the projects implemented by CHUEE at between 4.1 million tons (high defaults, low volume scenario) and 8.6 million tons of CO_2 (base case volume and defaults).[2]

The program provided loan loss guarantees. To give the banks incentives to lend, CHUEE featured loan guarantees for partner banks. Commercial banks were supposed to be selected to provide loans for the energy efficiency equipment and projects. Bank lending would be supported by IFC's guarantees. The guarantee facility was designed to partially compensate participating banks for losses from this line of business.

For example, 75 percent of the first 10 percent loss of the principal loan amount would be guaranteed by IFC/GEF, and the remaining 25 percent of the loss would be covered by the participating banks. For the remaining portfolio of energy efficiency lending (90 percent), IFC was to cover 40 percent of the losses and the participating banks the remaining 60 percent. The purpose of the RSF was to provide incentives for participating banks to experiment with energy efficiency financing, as well as to build their capacity to undertake this kind of business as a standard business line.

The program also featured technical assistance. Advisory services are another important pillar of the program, as with other IFC energy efficiency programs. They consist mainly of studies supporting energy efficiency activities and technical assistance to key players in energy efficiency (banks, market partners, and end users). In particular, IFC was supposed to conduct various market studies that were to be used to sharpen the program's sector targets. Technical assistance was to be provided to both the formal CHUEE partner entities (Xinao Gas, Industrial Bank, and Bank of Beijing) and to market players in focused "networks."

The technical assistance to banks was supposed to supplement the guarantee facility. IFC's technical assistance to the banks helped them become familiar with energy efficiency appraisal, deal structuring, and the role of ESCOs or EMCs, which provide services to help implement energy efficiency projects. The program encourages the project finance approach, or loan repayments based on projected cash flows instead of a project's balance sheet.

Another important channel of influence was demonstration effects. The program was expected to disseminate information about energy efficiency technology and services and the benefits of new ways to finance energy efficiency. This was expected to fill the information gap and catalyze energy efficiency investment demand for sustainable energy efficiency market development.

The initial utility-based model was abandoned. The program initially identified three partner companies. All three were existing IFC clients: (i) Xinao Gas Holdings Ltd., a private natural gas distribution company; (ii) China Minsheng Banking Corp., Ltd., based in Beijing; and (iii) Industrial Bank (IB), based in Fuzhou in the Fujian Province. IFC was supposed to provide guarantee and technical assistance to the banks, market partners, and end users (customers). However, Minsheng Banking Corp. decided not to participate in the program, and there was a mismatch between IB and Xinao Gas Holdings Ltd. (see box 2.1). Consequently, the initial utility-based business model was abandoned. Instead, the program was implemented featuring financial institution partners that provide loans to end users, shown in figure 2.1. Other partners that provided energy-saving services to the end users played a supporting role.

The logic model of the program can be subdivided into three categories corresponding to the distinctive stakeholders, which contribute to the program's ultimate goal of reducing greenhouse gas emission, as shown in table 2.1.

Banks have financing and information roles in energy efficiency. Banks could not only provide financing for energy efficiency investments, but they could also disseminate knowledge and information about potential savings from energy efficiency and identify technical partners. Project-based financing (which recognizes the key financial benefit streams of energy cost savings derived from energy efficiency projects) would be a suitable instrument for energy efficiency projects, but because of certain market failures, such financing does not take place on a significant scale. Major constraints in financing energy efficiency concerning banks are summarized in table 2.1.

Finance for energy efficiency is exotic in Chinese banks. Chinese banks' mainstream lending to private business is working capital finance backed by the entire corporate assets. Loan tenure is typically short (one to two years); payment schedules are often interest only, with a balloon repayment of principal. Banks assess risk and make credit decisions based on the value of a company's fixed asset collateral as security.

Energy efficiency lending requires a certain understanding of the technology, and Chinese banks are not familiar with technology-based lending. This is particularly true for energy efficiency projects, where the benefits are seen mainly as avoiding some costs. The financing of energy efficiency projects based on higher reliance on a project's cash flow and on project assets is unconventional, especially if the project's target is operational cost savings. Furthermore, the transaction costs may be high because of both the highly customized nature of project finance packaging and the legal documentation associated with any relatively new investment scheme.

BOX 2.1

ECONOMICS OF IFC GUARANTEES IN FINANCING ENERGY EFFICIENCY

Because of lack of experience among banks and the perception of high risk, energy efficiency loans (financing for future energy savings rather than lending based solely on corporate collaterals) are supplied at a higher interest rate, if they are offered at all. On the demand side, the demand for energy efficiency loans will reflect private benefits only, and private demand will be lower than social demand. IFC's intervention with the guarantee program is rationalized by these imperfections in the credit market. The following model provides an overview of the intended economic effects of the program.

The supply curve (Sc) in Figure A represents banks' supply of collateral-based corporate loans. This supply curve meets the private demand curve (D) at quantity (Qc) with price (interest rate) (Rc). Compared to this supply curve of corporate loans, the supply curve of hypothetical energy efficiency loans without or lower collateral would be upper left of Sc (Seeh), corresponding to a higher interest rate (Reeh) that reflects higher risks. As a result, fewer energy efficiency loans may be supplied compared with the social optimum level, which should be somewhere between QSI and QSC.

FIGURE A Demand and Supply of Corporate Loans and Energy Efficiency Loans

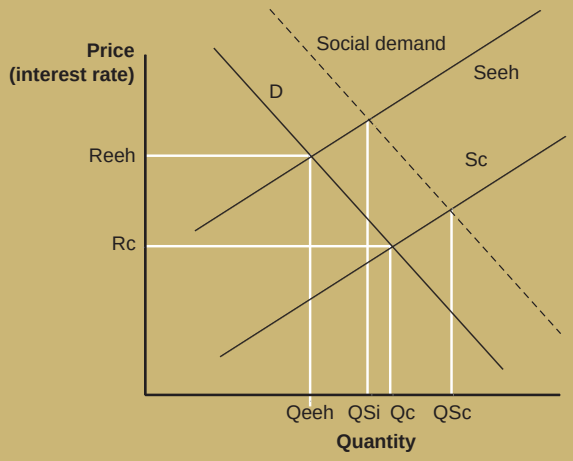
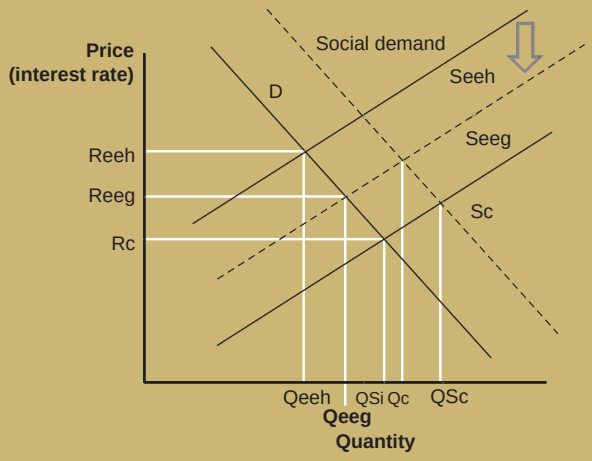


FIGURE B Introduction of Guarantees under the Program



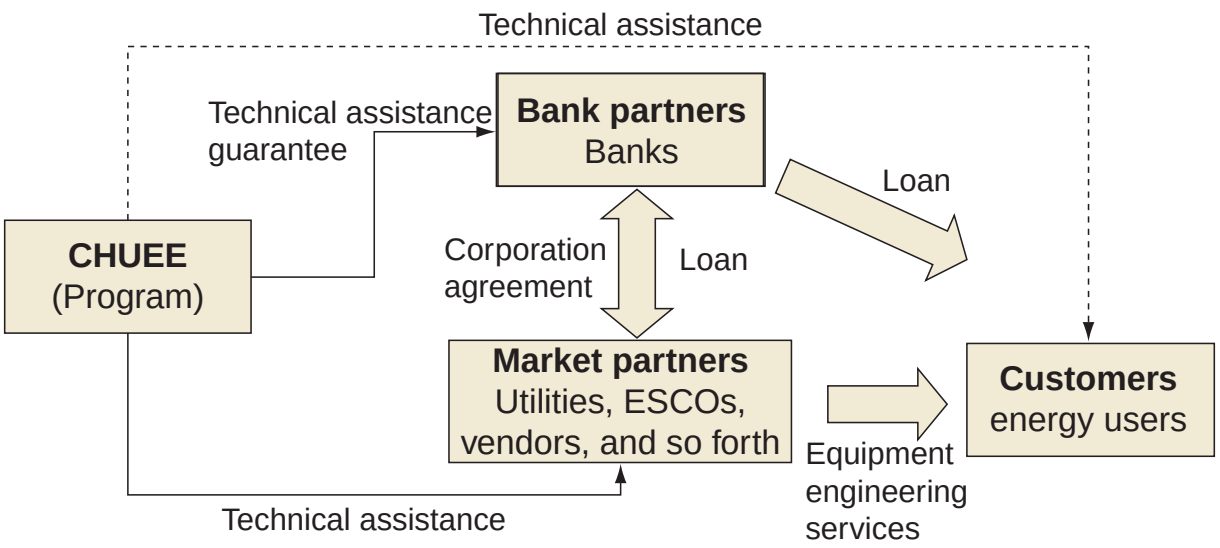
Source: IEG.

Introducing a loan guarantee (possibly supported by a subsidy) will lower the interest rate of energy efficiency loans and will increase the supply of energy efficiency finance. As shown in Figure B, the guarantee pushes the supply curve down from Seeh to Seeg, closer to the social optimum quantity. For small and medium-size enterprises (SMEs) without strong collateral to cover the loans, the new guarantee-generated supply curve Seeg creates opportunities to obtain loans with more affordable interest rates.

The economic benefits of the guarantee would be sustainable if the intervention fixed the market failure-information asymmetry about the risk of the energy efficiency projects. If banks learn through experience the true risk profile of energy efficiency projects and begin to accept the additional risk in financing energy efficiency as part of their conventional business without IFC guarantees, the supply curve will approach the guarantee-induced supply curve Seeg. However, if the intervention fails to fix the market failure, this temporal shift in supply curve will disappear when the guarantee program ends, and the market will return to its original status. In this case, the program benefits will not be sustained.

A commercial guarantee industry has emerged in China, and banks have grown accustomed to receiving guarantees. However, these guarantee companies do not currently address the needs of the energy efficiency finance market,

FIGURE 2.1 Program Design



Source: IEG.

Note: CHUEE = China Utility-Based Energy Efficiency; ESCO = energy service company.

which needs three- to seven-year term loans, underwritten more on the basis of borrower/project cash flows, with installment principal payments and innovative credit structures, for a range of borrowers (MacLean 2008).

CHUEE combines guarantees and technical assistance with the idea that this should allow banks to try new types of investment (longer-term loans based on project cash flows, with installment principal payments schedules and other credit structures involving energy savings performance). The guarantee was expected to provide some comfort to participating financial institutions, as it was intended to limit losses from unfamiliar risks. Furthermore, technical assistance to financial institutions was supposed to help them build capacity and develop institutional practices to handle this new type of business.

Market partners

Energy efficiency projects often require marketing partners to act as technical consultants, facilitators, and aggregators. Utility companies, equipment suppliers, or technical consultants can play these roles, but the ESCOs specialize in performing these functions. ESCOs are market-based companies providing technical services to clients to reduce energy usage; they install new equipment or refurbish existing equipment, often on the basis of energy performance contracts (EPCs) between an ESCO and its clients. The contract determines the terms under which the cost savings created by new technologies will be shared between the ESCOs and the client over a predetermined period. In mature markets such as the United States and Europe, investments through ESCOs are significant. One estimate indicates that in the United States these investments reached $1.8–$2.1 billion in 2000, following a decade of strong growth (Goldman, Hopper, and Osborn 2005). One of CHUEE's objectives was to remove constraints to the energy efficiency investments, so promotion of sustainable ESCO business became a strategic priority.

In China, the ESCO concept was introduced and promoted by the World Bank Energy Conservation Project. Initiated in 1998, this project supported the establishment and development of three pilot ESCOs in Beijing municipality, Liaoning, and Shandong provinces.[3] The energy efficiency-related business in China has been growing rapidly; by one estimate, the country is projected to spend as much as 2.1 trillion yuan ($300 billion) over the 2008–12 period on products and services to reduce energy use (Cheung and Kang 2008). Nevertheless, the business faces particular challenges, especially in accessing finance (see table 2.1). Such constraints are typical for SMEs in China (such as small size, weak asset base, and limited track records) but are also caused by banks' lack of familiarity with the business and their inability to take risks on such credits.

For the marketing channels (especially ESCOs), CHUEE was supposed to open access to financing to facilitate ESCOs' response to the growing demands for such

TABLE 2.1 Logic Model for Banks, Market Partners, and End Users

	Constraints for realizing energy efficiency investment	Program intervention	Expected outcome	Expected impact
Banks	1. Lack of suitable appraisal methodologies for banks to quickly and accurately appraise energy efficiency loan applications 2. Risk aversion of Chinese banks 3. Banks' lack of knowledge of energy efficiency technology 4. Cost-saving project finance being considered nonconventional 5. Potential high cost of doing business 6. Strong preference for larger borrowers and loans—Energy efficiency finance may be too small to justify its own business	• Guarantee to banks • Technical assistance for capacity building, business development, relationship brokerage	• Direct loans to energy efficiency projects • Enhanced capacity to take energy efficiency business as a part of banks' business	Energy efficiency markets that are funded by private business without implicit subsidies
Market partners	Access to finance is constrained for several reasons: 1. Unique financing requirements of EPC projects 2. Lack of familiarity with the EMC business model among bank lenders 3. High level of risk aversion among lenders, especially given the lack of familiarity 4. Limited track records of many new EMCs 5. Limited balance sheet strength of new EMCs 6. Relatively small size of projects 7. Credit risk associated with many potential project host enterprises	• Guarantee to banks that is sponsored by market players • Technical assistance to broker relationships between banks and end users, capacity building to market players	• Gain access to finance to bank loans • Implement more energy efficiency projects	
End users	1. Weak awareness of energy efficiency potential 2. Weak capacity to identify, structure, and implement energy efficiency investments 3. Access to finance constrained for several reasons: • Unique financing requirements of EPC projects • Lack of familiarity with the EMC business model among bank lenders • High level of risk aversion among lenders, especially given the lack of familiarity • No specific consideration of energy efficiency benefits in lending terms and collateral	• IFC taking ultimate risks through guarantee to banks • Technical assistance to broker relationship with banks and market players and to increase awareness of energy efficiency opportunities and benefits	• Higher awareness of energy efficiency opportunities • Energy efficiency investments • Greater access to finance to energy efficiency projects	

Source: IEG.

Note: EMC = energy management company; EPC = energy performance contract; IFC = International Finance Corporation.

services. The program seeks to enhance ESCOs' management capacity; enhance loan preparation capacity of these companies; and strengthen networks among banks, energy management companies, and other players (such as equipment suppliers) to increase their familiarity with the subsector. This is expected to lead to better access to financing for ESCOs.

BOX 2.2

WHY THE UTILITY-BASED MODEL FAILED TO MATERIALIZE

As the name suggests, at the beginning, the program featured a utility as the central focus of the promotion of energy saving investments. However, this did not materialize. The main reason for that was the strategic mismatch between the utility and the financial institution partners:

Different client bases: The gas utility had mostly small (third-tier) clients such as hotels, shopping malls, and restaurants. At the time of appraisal, IFC expected that the program would be implemented through an SME-oriented bank. However, that bank decided not to participate. The banks that did decide to participate found that the utility partner's client base was too small; thus they perceived transaction cost and risks as rather high. There was little overlap between the geographic distributions of the client bases of the participating banks and the utility. The utility partner indicated that a leasing company would have been a more suitable partner than a bank.

Misalignment of business interests among utility and financial partners: The utility-based model could have worked if interests among the parties were aligned. For the utility partner, the program supported a number of its core strategic objectives: helping customers acquire gas-using equipment, building gas loads, increasing gas sales, and strengthening staff capacity and customer base. But the gas utility had already surpassed targets for new clients, had received a substantial amount of technical assistance from IFC, and did not have a strong incentive to form a partnership with the CHUEE banks. Furthermore, there was little pressure from the government and the public on gas utilities to improve energy efficiency. The government's focus was on large industrial and energy companies. Finally, the two parties did not agree on banks collecting utility fees in addition to the loan repayments, which was one of the key features of the utility-based finance model.

Source: IEG.

Through CHUEE, IFC's intervention created an EMC network that provides a match-making and brokerage role between these companies and banks; if interests and criteria are met, the guarantee can support bank lending to these companies for energy efficiency projects. IFC has also helped partner banks establish relations with a number of high-profile energy efficiency equipment suppliers by facilitating partnerships between equipment suppliers and banks so that banks can better market loans, diversify risks, and replicate deals.

End users

China needs to invest heavily in energy efficiency to meet its national goals. To meet the national goals of reducing the energy intensity by 20 percent within the five years between 2005 and 2010, China requires an investment of at least $170 billion in energy efficiency and renewable energies, according to the National Development and Reform Commission. About half of these investments need to be in the area of energy efficiency. Reducing petroleum use provides the largest potential gain, followed by coal-fired industrial boiler retrofitting and energy saving buildings.

There are many constraints for energy efficiency projects. For the end users, constraints for investing in energy efficiency projects include lack of awareness about potential benefits from such projects, lack of technical expertise to implement and actualize energy efficiency benefits, and unavailability of finance. Such impediments depress the demand for energy efficiency investment. CHUEE intervenes directly and indirectly through guarantees and advisory services to banks and advisory service/technical assistance targeted at end users to promote energy efficiency technology and investment schemes (such as clean development mechanisms) and at indirect marketing channels (utilities, ESCOs, and suppliers) to enhance their capacity to reach industrial end users.

Comparing CHUEE with other energy efficiency programs

Table 2.2 compares CHUEE with three previous IFC programs in energy efficiency. Some of CHUEE's differentiating characteristics include loose targeting of the type of energy users, a relatively small number of partner banks, and a separate project management unit with loose reporting lines to both investment and advisory services management structures.

Implementation of CHUEE

Guarantees in support of energy efficiency loans

CHUEE had three partner banks for the loan guarantee program. The first bank, Industrial Bank (IB), joined the program at the beginning in 2006. The second, Bank of Beijing (BOB), joined a year later, and the third bank, Shanghai Pudong Development Bank, joined in 2008. However,

TABLE 2.2 Summary of IFC's Energy Efficiency Programs (before CHUEE)

	HEECP	CEEF	Russia Sustainable Energy Finance Program	CHUEE/CEE
Countries	**Hungary**	**Czech Republic, Slovakia, Latvia, Lithuania, and Estonia**	**Russian Federation**	**China**
Time	**HEECP I:** February 1997–2001, $5 million (GEF) **HEECP II:** 2001–05, $16 million ($12 million IFC, $4 million GEF) **HEECP III:** 2005 (merged with CEEF)	2005–08, June 2002, initial guarantee of $30 million, increasing to $75 million over time. GEF $15 million	November 2005–May 2010, $20 million loan and $2 million partial guarantee from GEF approved (not used); later increased to $100 million	**CHUEE I:** April 2006, $41.4 million IFC, GEF $16.5 million, Finland $3 million **CEE:** December 2007, $167 million IFC, $1 million Finland, $3 million Norway
Financial instruments	**HEECP I:** Partial risk guarantees to financial intermediaries providing credits in the form of commercial loans or financial leases. Technical assistance provided to fiscal intermediaries (marketing, capacity development) and project developers. **HEECP II:** Expanding on HEECP I	Partial risk guarantees to fiscal intermediary **Technical assistance:** Advisory services to fiscal intermediaries, energy efficiency companies, including ESCOs and energy end users	Loan (guarantee not used) **Technical assistance:** Advisory services to fiscal intermediaries (since 2007 no requirement to be IFC investment client) and improve the capacity of the local energy service companies	**Guarantee:** Guarantee (loss sharing facility) to Banks **Technical assistance:** Engineering and marketing technical assistance to utilities and ESCOs Credit underwriting technical assistance to banks
Sector (targeted and realized)	**HEECP I:** Heating systems (gas boiler). **HEECP II:** Targeted the residential, commercial, industrial, and institutional sectors, including lighting, motors, space conditioning (heating and cooling), and automated control systems, congeneration systems that produce electricity from waste heat generated for industrial uses): most projects related to street lighting, block house windows, and lighting.	Target areas: lighting, motors, space conditioning (heating and cooling), automated control systems, as well as cogeneration systems that produce electricity from waste heat generated for industrial uses. Realized projects mostly on wind systems (biomass), heating	Process technology, energy generating equipment and energy savings in the buildings, renewable energy sources and manufacturing of the energy efficiency equipment	**CHUEE:** Utility (gas, electricity and heat) **CEE:** Energy efficiency and renewable energy, but no sector specified
End-user profile	Variety of clients targeted but mostly ESCOs, leasing companies, and SMEs. Block house, SME facility, and renewable energy	Wind farms and hydropower stations	26 subprojects financed as of end 2007, including bakery, typology, plastic factory (midterm review)	**CHUEE:** There are 41 CHUEE subprojects (38 IB and 3 BOB). Most end users industrial. **CEE:** SMEs and industrial corporate (target).
Program components	**Investment:** Partial guarantee **Technical assistance:** Supporting end users, ESCOs, and fiscal intermediaries	**Investment:** The guarantee program to address the credit risk barriers to energy efficiency finance **Technical assistance:** Technical assistance program to address high transaction costs and marketing barriers to energy efficiency project development	**Investment:** Credit lines for energy efficiency investment and partial credit guarantees **Technical assistance:** Technical assistance to help to start investment in the energy efficiency segment	**CHUEE:** Investment-equipment loan mechanism technical assistance **CEE:** Investment: RSF and technical assistance

(*continues on next page*)

TABLE 2.2 *(continued)*

	HEECP	CEEF	Russia Sustainable Energy Finance Program	CHUEE/CEE
Banks	Raiffeisen Leasing The National Savings Bank The Hungarian Foreign Trade Bank (HEECP 2 PAD) Bank Austria Creditanstalt Hungary/Hypovereinsbank Hungary Budapest Bank Axon Leasing Innotrade Leasing Kereskedelmi es Hitelbank ABN Amro (Magyar) Bank	Ceska Sporitelna (Czech Rep.) Dexia (Slovakia) Hansabanka (Latvia) SEB-Unibanka (Latvia) Hansabankas (Lithuania) SEB Vilniaus Bankas (Lithuania) Hansapank (Estonia)	CIB (Center Invest Bank) NBD Ursa Bank MDM Bank	• IB • BOB • Shanghai Pudong Development Bank (SPDB)-CEE
Regulatory framework	Strong	Mixed	Weak	Strong
ESCO readiness	Yes	Mixed	Not relevant	Mixed
Streamlined decision making (credit approval system)	No	Yes	Not applicable	Yes
Managed by IFC Investment Department (implemented)	Yes (but no other operations)	Yes (but no other operations)	Joint (CGF-PEP ECA)	No (project management office)
Local office	Newly established project management office	Newly established project management office	Within existing PEP ECA	Project management office within local office, separate
Fast utilization	No	No	No	Yes

Source: IEG, based on IFC data.

Note: BOB = Bank of Beijing; CGF = Global Financial Markets Department (IFC); CEE = China Energy Efficiency Finance Program; CEEF = Commercializing Energy Efficiency Finance Program; CHUEE = China Utility-Based Energy Efficiency Program; ECA = Eastern and Central Europe; ESCO = energy service company; GEF = Global Environment Facility; HEECP = Hungary Energy Efficiency Cofinancing Program; IB = Industrial Bank; IFC = International Finance Corporation; PAD = Project Assessment Document; PEP = Private Enterprise Program; RSF = risk-sharing facility; SME = small and medium-size enterprises; SPDB = Shanghai Pudong Development Bank.

because of delays in obtaining approval from the Chinese government's State Administration of Foreign Exchange,[4] the guarantee program became effective only recently (on October 26, 2009).

The first banking partner, IB, rapidly built up its portfolio of energy efficiency project lending. The first IB loan guaranteed by CHUEE was approved in January 2007. Within less than a year, IB fully utilized the guarantee facility of 460 million yuan, or about $60 million, financing 50 loans to 35 companies. Consequently, IFC modified the program in December 2007 to enhance the guarantee program by reallocating GEF resources from technical assistance to additional guarantees and putting additional IFC resources (referred to as the second guarantee facility or CHUEE II[5]). Although this expansion of the guarantee facilities was not technically effective because of the delay in government approval, IB continued its lending in energy efficiency in anticipation of the program's effectiveness.[6] See table 2.3 for the banks' utilization of the guarantee.

Advisory services

The program conducted studies, training, and marketing support to various energy efficiency players. The marketing studies helped to fine-tune the target areas of intervention—this was important, as the program's target sectors shifted when the utility-based approach was abandoned.[7] Moreover, consultants hired by the program provided a project-by-project review of the energy efficiency projects for the banks that used the RSF. Thus far, the program has done a technical review of all the projects in the program; it also made 31 site visits for energy efficiency marketing and technical support, 3 industrial and regional energy efficiency opportunities studies, and 4 project case studies.

Other than banks, CHUEE emphasizes three distinct marketing partners. The program established six networks

TABLE 2.3 Utilization of the Guarantee by Banks under CHUEE (as of June 30, 2009)

	IB (first guarantee facility)	IB (second guarantee facility)	BOB	Total
Effective date	December 26, 2006	January 1, 2009	November 29, 2007	
Number of loans	50	40	8	98
Number of client company	35	38	5	78
Total project	¥1,917million ($262 million)	¥4,460 million ($651 million)	¥161 million ($23 million)	¥6,538 million $936 million
Total loan amount	¥893 million ($130 million)	¥2.5 billion ($365 million)	¥117 million ($17 million)	¥3.5 billion ($512 million)
Covered by guarantee (original principal amount)	¥597 million ($87 million) (this includes repaid loans)	¥656 million ($96 million)	¥93 million ($13 million)	¥1,346 million ($197 million)
Maximum reference portfolio balance	¥460 million	¥1,313 million (Target ¥1,500 million)	¥300 million	¥ 760 million (first facility) ¥ 2.5 billion ($333 million) (second facility)

Source: IEG.

Note: BOB = Bank of Beijing; IB = Industrial Bank.

to promote energy efficiency activities and access to finance for such projects (table 2.4). Network activities involve capacity building and networking/brokering among energy efficiency players. Capacity-building activities include training and advice to project developers so they can be credible partners for financial institutions. The program has conducted the following:

- A seminar on obtaining bank loans: How to Prepare a Loan Application
- Training on business and management—direct help to access finance by brokering EMCs to banks or other financing windows (clean development mechanisms, carbon trade)
- Annual meetings and various fairs, which provided briefings on new foreign technology.

Specifically for marketing partners, the program provided eight training sessions on marketing, building staff capacities, and assisting customers in preparing energy efficiency projects for financing and marketing their equipment in partnership with banks. This includes two training sessions to Xinao Gas, so its staff could prepare for new ESCO business.

Direct funding from loans supported by the program's guarantees

The loans given to energy efficiency projects by both IB and BOB, using the guarantee facility, amount to nearly 3.5 billion yuan (figure 2.2). This growth occurred much faster than the original target: the cumulative investment volume target had already been achieved in 2009 (figures 2.3 and 2.4).

TABLE 2.4 Summary of CHUEE Network Participants

	Number
Banks and other financial institutions	47
Utilities	14 companies
EMCs	135 companies
Energy efficiency equipment suppliers	76 companies
End users	72 companies

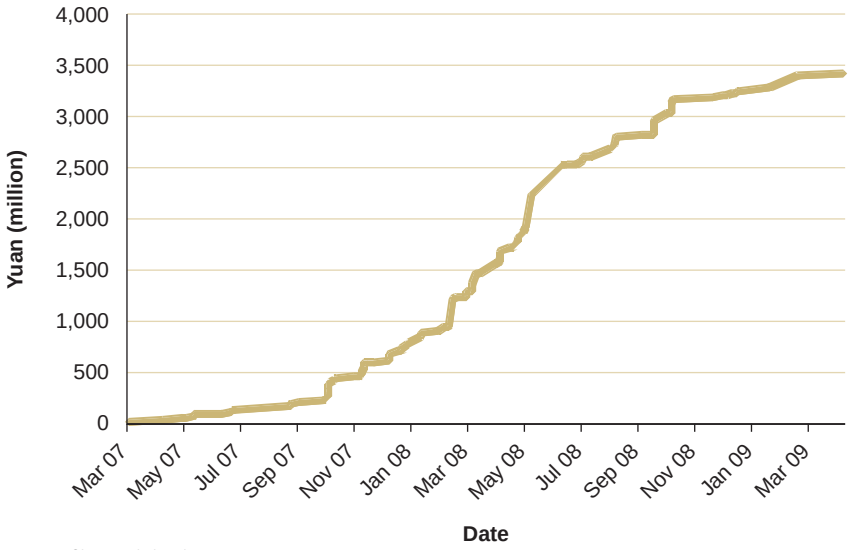
Source: IEG, based on CHUEE files and database.

Note: As of March 31, 2009.

CHUEE's End Users

Overall, the steel industry has been the largest beneficiary (37 percent) in terms of the total loan amount supported by the guarantee facility. This is followed by chemicals (20 percent), cement (18 percent), and coking (the removal of volatile materials from coal by distillation; 4 percent). Other industries served include power, food, and glass. The share of municipal and hospital construction energy efficiency projects has been small. The original expectation was that CHUEE's guarantee portfolio would have a large number of smaller loans that would provide good sectoral diversification. However, because of the dominance of larger loans, there is a significant sectoral concentration, as well as large exposures to a handful of big companies with multiple loans.

FIGURE 2.2 Cumulative Disbursement Amount of Loans Supported by CHUEE Guarantees (million yuan)



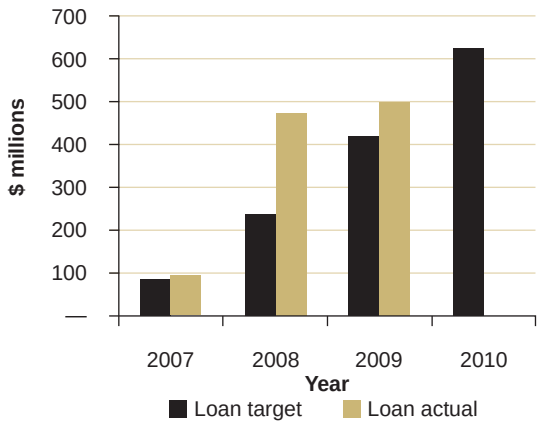
Source: IEG, based on CHUEE files and database.

Nearly half of the investments were for power generation, often associated with heat and gas recovery. About 20 percent involved investing in process improvement. There were few air conditioning, building-related activities or renewable energy projects.

About a quarter of the loans under CHUEE were ESCO related. The average size of EMC projects was $3 million, which was financed with an average loan of $1.8 million. This is far smaller than the loans without EMCs, which were $9 million on average for projects with an average size of $19 million. Loans to EMCs are usually backed by personal guarantees, and then by equipment mortgages. Loans from BOB were predominantly associated with EMCs (7 of 9), whereas 7 of 50 (14 percent) IB loans were EMC related (table 2.6).

No loan losses were expected at this point. Despite the current global financial crisis, loans guaranteed by the program are performing well. At the start of CHUEE, default rates were assumed at 4 percent (base case), which was subsequently revised to target nonperforming loans—not more

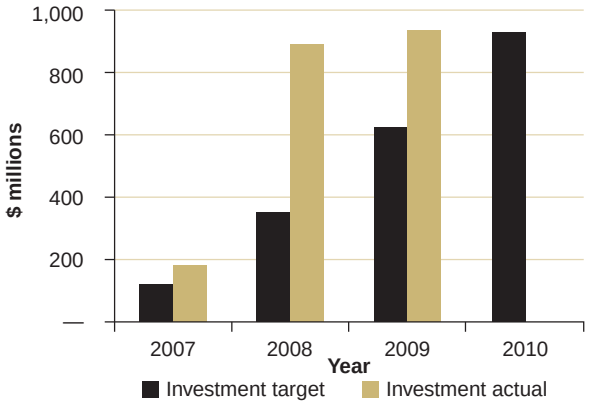
FIGURE 2.3 Cumulative Loans under Guarantees against the Original Target



Sources: Targets are taken from CHUEE presentation as of May 26, 2008; actual figures from IFC files as of March 2009.

Note: Effective guarantee only (that is, not covering CHUEE II).

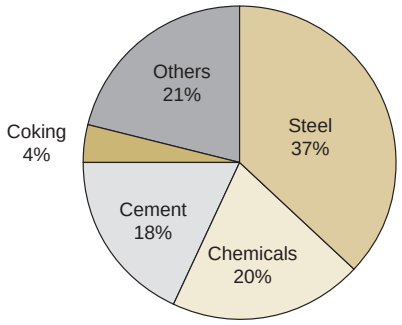
FIGURE 2.4 Cumulative Investment Supported by Guarantees against the Original Target



Sources: Targets are taken from CHUEE presentation as of May 26, 2008; actual figures from IFC files as of March 2009.

Note: Effective guarantee only (that is, not covering CHUEE II).

FIGURE 2.5 Sector Distribution of Guaranteed Loans, by Amount



Source: IEG, based on CHUEE program database.

TABLE 2.5 Type of Activities under CHUEE

Activities	Total (%)
Power generation	46
Heat recovery	31
Efficient production	21
Gas recovery	18
Biogas	5
Air conditioning	5
Hazardous waste	2
Renewable energy (solar, hydropower)	2

Source: IEG, based on CHUEE database.

Note: Some projects have multiple activities.

than 2.5 percent of the guarantee portfolio. So far, there are no defaults in the portfolio; and based on the current assessment of IB and BOB, no defaults are expected in the near future—although some companies that have received loans are having financing difficulties, this is not expected to impact the repayment of their loans. However, high concentrations in certain industries (steel, chemicals, and cement) would make the program's loan exposure vulnerable if there were an economic slowdown in China.

Energy Efficiency Performance of Projects Supported by the Guarantees

The ultimate goal of the program was to reduce GHG emissions. The program set a target for GHG emission reduction from implemented energy efficiency projects at the time of original approval: between 4.1 million tons of CO_2 (high defaults, low volume scenario) and 8.6 million tons (base case volume and defaults). The second guarantee facility's target was a reduction of 5 million tons of CO_2 per year directly from projects supported by the RSF (between 2011 and 2015). Therefore, total target emission reduction from the program was 9.1 million–13.6 million tons of CO_2 per annum.

Although some projects are still under implementation, the client survey showed that no client had below-expectation returns on investment on CHUEE-supported energy efficiency investments, in terms of cash savings from energy use. About a quarter stated that the results exceeded expectations, and 65 percent said the results met their expectations.

The program has reduced GHG emissions as targeted. This conclusion is based on aggregating the engineering calculation for each project and on answers given by the companies that implemented the projects. Projects supported by the guarantee will generate total annual GHG emission reductions of 14 million CO_2 tons, which is higher than the high end of the target, 13.6 million. This is less than half of the annual emission from China's biggest emission-contributing coal fuel power plant[8] and about equal to the annual CO_2 emissions of a small country such as Lithuania.

Forty percent of GHG reductions are from 14 projects in the chemical industries, followed by 23 projects in steel (22 percent), one clean development mechanism project (15 percent), and 23 cement projects (7 percent) (see table 2.8). Energy efficiency projects in the chemical industries include some waste heat recovery for

TABLE 2.6 Summary of Loans Related to EMCs

	IB	BOB	Total
By number of loans	7/50 (14%)	7/8 (88%)	14/58 (24%)
By total	Project $18.5 million (7% of total) Loan $9 million (7% of total)	Project $21 million (91% of total) Loan $12 million (71% of total)	Project $39.5 million (14% of total) Loan $21 million (14% of total)
Average	$3 million project, loan $1.8 million	$3 million project $1.8million loan	$3 million project $1.8 million loan (non-EMC average) $19 million project $9 million loan

Source: IEG, based on CHUEE data.

Note: Only for the first guarantee facility (59 loans). BOB = Bank of Beijing; EMC = energy management company; IB = Industrial Bank.

TABLE 2.7 GHG Emission Reduction Targets and Estimates of Results

	CO_2 tons per year		
	First guarantee facility	Second guarantee facility	Total
GHG emission reductions target at approval	4.1 million–8.9 million	5 million	9.1 million–13.6 million
Estimated by engineering calculation	3.5 million	10.7 million	14 million
Number of projects	58	40	98

Source: IEG, based on CHUEE database.

steam generation as well as power savings from fermenting tank agitator improvements, biogas production from acid waste water treatment for power generation, process optimization, and nitrous oxide emission control. Most of the energy efficiency projects in steel industries are blast furnace gas power generation. The clean development mechanism project involves coal mine methane development.

It is important to point out that other than CHUEE, none of IFC's past energy efficiency programs met their original target volumes of emissions reduction. This is partly because of the uneven uptake of programs by market participants, as well as shifts in emphasis on intervention targets (for example, from industries to residential) during the implementation.

Only a handful of banks in previous IFC energy efficiency programs extensively used the guarantee facilities. Some banks had a few initial deals and established enough confidence to conduct the business themselves and stopped using the guarantee facility. In Russia, IFC found that there was no demand for guarantees among the targeted banks and restructured the package to provide liquidity (a credit line) as well as technical assistance. In other markets in Eastern Europe, where there was substantial interest in renewable energy rather than energy efficiency, the guarantee instrument was not suitable, as the banks were looking for sponsors' equity rather than guarantees. Utilization tended to be slower than anticipated. It took seven years for HEECP to see significant usage of IFC guarantees (figure 2.6). The Russia Sustainable Energy Finance program took more than two years to reach half of the planned loan commitment volume (figure 2.7).

In China, despite the rapid growth in energy efficiency finance, not all actors and initiatives are experiencing a surge of demand. The World Bank/GEF Energy Conservation Project (ECP) II, which has a guarantee scheme targeted to loans to ESCOs, has not been utilized much (figure 2.8). The scope of the ECP II covers only EMCs or ESCOs that are implementing EPC projects. Regarding the low utilization of guarantees, relatively mature ESCOs are often able to arrange financing from partners or financial institutions without needing to pay for the program's loan guarantees: many ESCOs obtained their first commercial loan financing through the China National Investment & Guarantee Co. program, and then, as they matured, utilized the guarantee program more selectively while obtaining much of the required finance through other channels (Taylor and others 2008, p. 167).

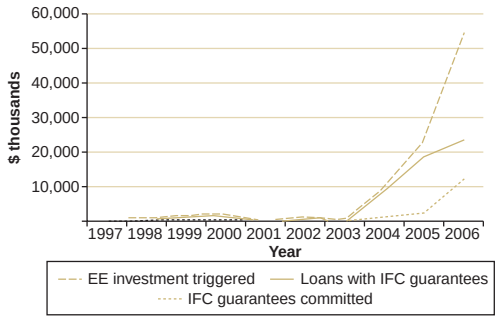
TABLE 2.8 GHG Emission Reduction by Industry

	First guarantee facility			Second guarantee facility			Total		
Industry type	Emission reduction	Percent	No. of projects	Emission reduction	Percent	No. of projects	Emission reduction	Percent	No. of projects
Chemical	312,812	9	6	5,389,788	51	8	5,702,600	40	14
Steel	1,386,499	40	16	1,743,000	16	7	3,129,469	22	23
Clean development mechanism	None			1,650,000	15	1	1,650,000	15	1
Cement	464,469	13	14	495,260	5	9	959,729	7	23
Others	1,338,978	38	22	1,374,643	13	15	2,713,621	19	37
Total	3,502,758	NA	58	10,652,691	NA	40	14,155,449	NA	98

Source: IEG, based on CHUEE database.

Note: NA = not applicable.

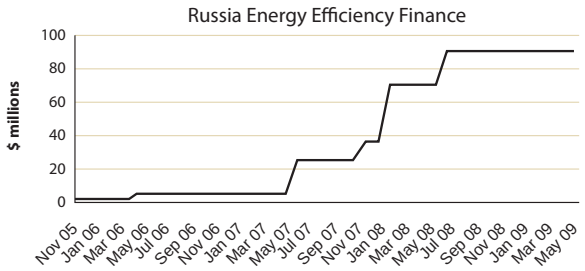
FIGURE 2.6 Use of HEECP Guarantee Facilities



Sources: Taylor and others 2008.

Note: HEECP = Hungary Energy Efficiency Cofinancing Program.

FIGURE 2.7 RSEF Commitment Amount



Source: IEG, based on IFC data.

Note: RSEF = Russia Sustainable Energy Finance Project.

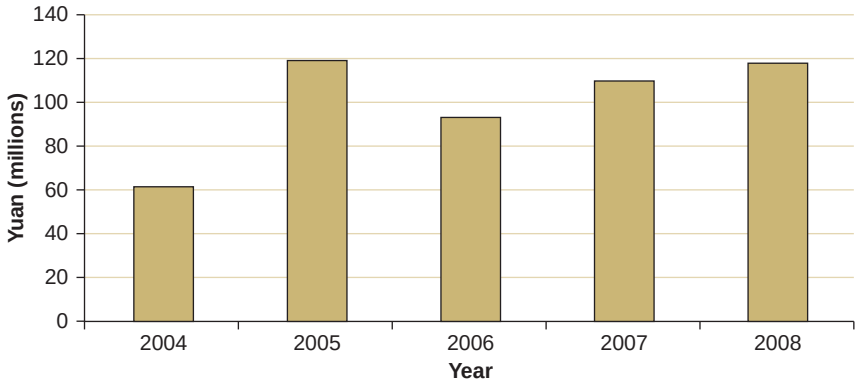
Management and Organizational Aspects

CHUEE has been operated by the designated project team within the IFC's Beijing office and has been comanaged by the regional financial markets and environment departments. Managerial controls and oversight were weak, and the RSF was mainly handled by the program team, with little involvement of investment officers from the financial market department. IFC's advisory services team only played a minor role in the program design.

This lack of oversight and accountability framework contributed to some irregular processing in project approval and service provisioning. For example, IFC was supposed to conduct a technical review of only the first five projects and then hand over the responsibility for technical review to the client banks. This handover did not take place, as IB requested more reviews by the program team, and the legal agreement was not clear about the arrangement. Moreover, the partner bank did not strictly adhere to exposure limits. The maximum loan limit amounts were specified in the agreement as a loan limit, but not per obligator. This contributed to significant exposure to one of the borrowing companies against the original intention of a diversified portfolio.

There was no credit department involvement in any review or interpretation of the conditions. Furthermore, IFC's conventional credit and project monitoring systems barely captured the program-related exposures. The guarantee was not properly accounted as IFC's exposure until June 2009, when it back-filled the commitment records. This situation left IFC exposed to various operational risks.

FIGURE 2.8 World Bank ECP II Loans from ESCO Loan Guarantee Component, Actual (million yuan)



Sources: National Development and Reform Commission, World Bank, Global Environment Facility China Energy Conservation Project (April 2009).

Note: ECP II = Energy Conservation Project II; ESCO = energy service company.

Furthermore, the monitoring and evaluation framework of the program has been inconsistent. Records were filed under multiple projects. The corporate project database records three separate entries for the program investments (the guarantee facility), and there are separate entries for advisory service operations. These are not related to the various portfolio supervision information filed for each partner bank, as records and performance indicators for conventional, non-CHUEE investment projects are tracked separately. In each entry system, there are different monitorable indicators, and not all are necessarily consistently tracked. Moreover, staff turnover in the program project management unit and among the Beijing-based investment officers has meant that each new officer started inputting data in a manner inconsistent with the past entries. Only in late 2008 did the IFC advisory services results measurement team start revising the logical project framework. At the same time, an investment portfolio officer also started to fix the records. Thus, for most of the period the program has been operating without an overall monitoring and evaluation system.

Summary

The program, originally designed as a utility-based equipment financing operation, experienced significant design changes. Although it operated with just two banks for three years and had substantial delays in establishing the second guarantee facility, the banks quickly utilized the loan guarantee facility to build up a large loan portfolio of energy efficiency projects. The program achieved its loan financing target as well as the gas emission reduction targets set at the beginning of the program. Nevertheless, it is important to review the program's achievement in comparison with the hypothetical "without the program" situation.

Chapter 3

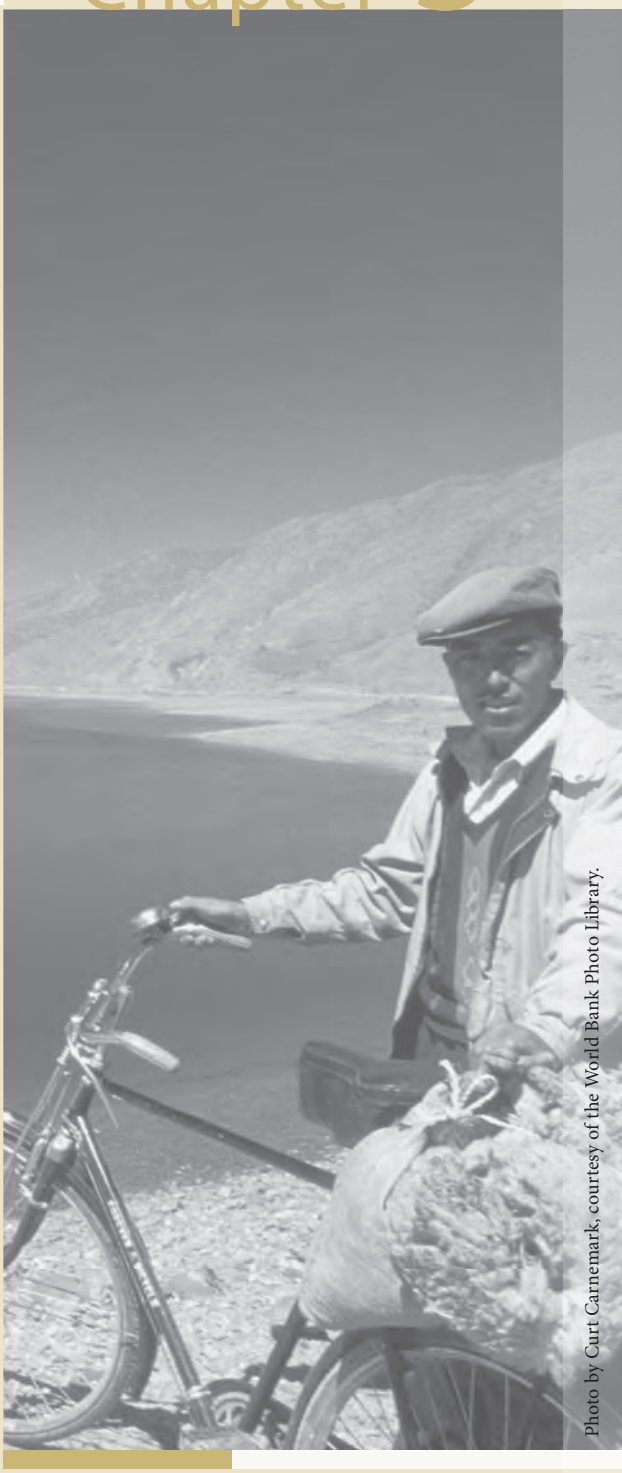


Photo by Curt Carnemark, courtesy of the World Bank Photo Library.

CHUEE's Impacts

The overarching question for this evaluation is whether CHUEE has made a difference in catalyzing energy efficiency finance for GHG emission reductions. The assessment of impact is based on comparisons of energy efficiency activities and access to financing between groups that accessed the program and control groups, at three distinctive levels: banks, market players, and end users.

Recently, the energy efficiency market in China experienced significant growth, and the investment supported by the program's guarantees might have been realized even in the absence of the program. Nevertheless, counting only for a small portion of end users that would not have implemented their projects without the program, the rate of return (emission reduction and energy savings compared with project and program costs) is estimated at 38 percent.

The program established an institutional set-up for energy efficiency lending in the participant banks. It also improved access to financing for energy efficiency projects and for the key market players—ESCOs—through technical assistance for capacity building and by brokering new relationships with banks.

To enhance its impact, CHUEE needs to enhance the sustainability of the project benefits, as participant banks still rely heavily on the program's technical assessment. Similarly, there is no assurance that the banks will continuously lend without substantial corporate collateral in the absence of CHUEE guarantees. The program's beneficiaries have been mainly large companies, contrary to the original emphasis on small and medium companies as the target. Moving down market to small companies is needed, as they face challenges in access to financing. Finally, there are many potential energy saving opportunities that the Chinese banks do not yet adequately address, such as energy saving buildings.

Evaluative Questions

This evaluation focuses on the difference made by the IFC intervention to energy efficiency investments in China. Although the ultimate impact is on actual GHG emission reduction, the evaluation looks at effects along the chain of interventions, focusing on three levels: (i) the level of financial institutions that adopt and sustain energy efficiency financing on a commercial basis; (ii) the level of market players, such as providers of energy efficiency equipment and services; and (iii) the level of enterprises that are implementing projects with bank financing to reduce GHG emissions. It is important to stress that the review is partial and static, as it focuses on emission reduction of supported emitters, but not on some of the dynamic effects that the program can bring in. For example, as mentioned earlier, the efficiency gains by energy users could be offset by the scale of coal use, leading to greater absolute coal consumption. Therefore, this analysis does not capture the complete social costs from the scale of coal energy being possibly expanded by the subsidies, such as those embedded in the guarantees and technical assistance. For a complete assessment of the program, it is important to look at not only the efficiency effects but also at the scale effects, when policy conclusions are drawn in a dynamic setting.

Evaluation methodology

In this evaluation, with a view to highlight whether the program made a difference, the Independent Evaluation Group (IEG) selected comparison groups that closely resemble "without" scenarios of the intervention in energy finance. This was supplemented by a before-and-after comparison of the participating banks and their borrowers for energy efficiency projects. This evaluation employs both quantitative and qualitative data collection and analysis methods. Quantitative data, such as bank energy efficiency lending activities, energy management companies' access to financing, and end users' energy efficiency investments, are gathered by structured surveys covering a representative sample of the population.

Table 3.1 shows the specific comparison groups, with the approach taken for each group at the different levels and the methodology for data gathering.

Limitation of methodology

This evaluation faced some limitations in applying the strongest method in assessing the impacts. Strong conclusions about the assessment of the impact, or differences made on final outcomes, can be derived from strict comparisons between what actually happened and what would have happened in the absence of intervention (the coun-

terfactual). This evaluation attempts to select comparison groups that are like the treatment groups in every way, except that they were not subject to the intervention. However, several practical limitations inhibit strict identification of counterfactuals: lack of baseline data, selection bias, and contaminations.

Lack of baseline data

There were no relevant baseline data collected at the beginning of the program. There were no industrywide statistics on energy efficiency finance in China or on the activities by the end users. Some industry reviews were carried out at the program appraisal stage; however, because of the changes in program design, these became irrelevant, as these industries were no longer the main target of the intervention.

Selection bias

Selection was an important feature of the program. CHUEE did not operate in the basis of random allocation of resources. Participant banks, EMCs, and end users were chosen by some screening and market tests. Therefore, this evaluation cannot rely on impact evaluation methodologies such as random assignment of treatment. The program contains two types of selectivity: one is selection from IFC, and the other is self-selection. In identifying banking partners, IFC initially selected possible candidates based on certain criteria, such as their match with the utility company or IFC client relationship, as well as credit on risk criteria. CHUEE also made conscious and unconscious selections in marketing its service to EMCs. The end users were selected by the banking partners based on, among other things, credit assessment and likelihood of success in implementing projects.

Self-selection is another source of bias in assessing this program. Banks should be willing to participate, and they are increasingly asked to contribute fees for the program's services. The EMCs that are joining the program's network may have higher aspirations regarding their business growth than those that did not bother to apply in the first place. End users taking loans self selected to implement the energy efficiency projects. As IFC approaches rely on markets, clients' ability and willingness to pay is also a source of self-selection bias.

TABLE 3.1 Summary of Three Levels of Impact Evaluation

Levels	Treatment groups	Comparison groups	Data sources and methodology
Financial institutions	Program participant banks (IB, BOB)	Nonparticipant banks with similar characteristics to participant banks IB comparator: Joint stock bank with nationwide operations, with similar asset size and client base at the end of 2006—5 of 32 banks surveyed BOB comparator: City commercial banks in major Chinese cities, with similar asset size and client base—3 of 32 banks surveyed	IFC portfolio records Past IEG project evaluations (XPSR records, environment and social field reviews for both participant banks and nonparticipant banks) Literature reviews World Bank records Interviews Survey on energy efficiency finance among Chinese banks
Subprojects: Marketing channels focusing on EMCs	EMCs supported by the program—41 members of the CHUEE network	EMCs not supported by the program—59 non-CHUEE members randomly selected from a population of 179 members of the National Association	World Bank project records Interviews Survey of EMCs, in collaboration with the national industry association
Subprojects: Industries focusing on cement industry	Cement companies that obtained loans from participant banks. Guaranteed loan targeted to companies with NSP cement production line with production capacity of 2,500 tons per day or more—15 clients	Comparable companies that have not received loans from participant banks—with NSP cement production lines with production capacity of 2,500 tons per day or more—38 companies randomly selected in three Chinese provinces	Interviews Survey of program's end users Survey of cement companies in collaboration with China Cement Association

Source: IEG.

Note: BOB = Bank of Beijing; CHUEE = China Utility-Based Energy Efficiency Program; EMC = energy management company; IB = Industrial Bank; IEG = Independent Evaluation Group; IFC = International Finance Corporation; NSP = new suspension precalcination; XPSR = Expanded Project Supervision Report.

Contamination

Contamination can come from the intervention itself, as a result of spillover effects, and from other interventions similar to CHUEE. One of the objectives of the program is to demonstrate its achievement, so that the spillover effects are part of the design. Moreover, as indicated in appendix H, there are sizable outside interventions in climate change in China, and some of them are very similar to the program. The contamination effects reduce the comparability of comparison groups as a nontreatment scenario.

Dealing with these limitations

The evaluation tried to minimize the problems. The surveys collected data on interventions in the comparison groups to identify sources and intensity of contamination. Furthermore, in the case of EMCs, the comparisons were done within those EMCs affected by the large-scale World Bank program, which started earlier than CHUEE. A small number of banks makes it impossible to use statistical approaches to estimate impacts at the level of the banks. Attempts were made to control selection bias by trying to match observables between the treatment and comparison group as much as possible. In particular, propensity score matching methods (by estimating a statistical model of the probability of participating using a regression mode with participation as the zero-one dependent variables, and a set of observable characteristics, which must be unaffected by the intervention, as the explanatory variables) are used where applicable. For EMCs and cement companies, a lack of baseline data made the model less robust. Because of the data limitation, this evaluation may not meet many requirements for strict impact evaluation based on quasi-experimental design, but the evaluation made best efforts to match the two groups and used supplemental information to derive the findings.

Photo by Curt Carnemark, courtesy of the World Bank Photo Library.

Methodology and data for banks

IFC selected participant banks to match its strategic objectives. The original program design was centered around the utility company, so IFC tried to find matching banks. IFC also focused on existing banking clients. However, the program and banks' interests had to be aligned, and one bank (Minsheng) decided not to participate because of changes in its corporate strategy. Later, IFC approached BOB, and BOB was selected because of its high use of China National Investment & Guarantee Co. guarantees of loans to EMCs.

The two participant banks, IB and BOB, had different characteristics in geographic coverage, client base, and size (see appendix D for a summary). IB is a medium-size joint stock commercial bank with nationwide operations. Its main business is corporate banking, particularly industrial clients. BOB is a smaller, city-level joint stock commercial bank established through the consolidation of the 90 urban credit cooperatives in the Beijing municipality. BOB is expanding beyond Beijing, but its main client base is in the Beijing capital area. Its main clients are local corporations, supplemented by retail companies.

Eight banks altogether were identified as comparators for the participant banks, selected from 32 surveyed banks by taking into account such factors as ownership/governance structure, geographical coverage, bank type, size as measured by total assets, and target market/client base. In general, IB is compared against the other major, national joint stock commercial banks with a client base of industrial firms. BOB is compared against other city commercial banks in major urban centers. No baseline data for the banks were collected at the beginning of the program (2006), but the survey of banks helped gather historical performance records of both treatment and comparison group banks.

The impacts of the program on banks are mainly reflected in three dimensions: growth and quality of the energy efficiency loan portfolio; improved capacity of participating banks to finance energy efficiency projects commercially, as manifested by the transfer of know-how on innovative financing methods; and the demonstration effects of the program on nonparticipating banks. The first two dimensions are examined by comparing the behavioral and performance changes in IB and BOB with corresponding changes in China's banking industry as a whole and with the comparison banks. The third dimension is examined through analysis of comparison banks and the banking industry as a whole.

Data are gathered by review of project files; interviews with program team members, IFC investment management and staff, and clients banks; investment project data for IFC investee client banks in China that are not in the program; interviews with the China Banking Regulatory Commission (CBRC) and other financial market actors in China; and interviews with non-IFC client banks in China. A key source of information is the survey of financial institutions conducted in collaboration with CBRC (see table 3.1; see also appendixes C–F) for the purpose of this evaluation. The survey covered 32 banks, which collectively represent about 80 percent of China's banking sector assets.

Methodology and data for EMCs

The evaluation focuses on EMCs' access to financing. Because no baseline data were collected by the program, the impact evaluation methodology is restricted to postimplementation project and comparison groups.

CHUEE established an EMC network, and members were accepted following a simple application process. As of March 2009, the network had 135 members.

Membership in the network is obtained after application and a simple screening by CHUEE. Originally, the program team considered establishing a list of "qualified" companies but found it risky to imply any assurance from the program. Therefore, the program decided to subject applicants to "reputation checks," based on information provided by the applicants. The application consists of basic information about the company, such as name, type of business, type of products, previous achievements (past projects), and financial figures (such as capital, total and net assets, and annual sales). The program conducts a quick investigation, looking for reputational risks. Only a small number of applicants have been rejected so far. The process is similar to the one used by the Energy Management Company Association (EMCA)—the Chinese national association of EMCs.

The comparison group comprised EMCs from the EMCA membership. The 135 companies in the network contain foreign-based ESCOs or Hong Kong, China-based operations in mainland China. IEG paid particular attention to the companies based in China that are not part of larger industrial groups or that do not benefit from other forms of external support that could affect their access to finance.

To establish a comparison group, IEG reviewed current EMCA member companies. Of EMCA's 220 core members, 41 also belong to the CHUEE network. The IEG evaluation team then randomly sampled the remaining 179 companies to select 59 as a comparison group. They conducted a survey with 100 companies (the 41 network members and the 59 nonnetwork members), asking for company profiles, access to finance, and descriptions of experiences with technical assistance, if any. The response rate was 86 percent. An important consideration is the effect of other interventions, especially by the World Bank's Second Energy Conservation Program (ECP II), which has been providing technical assistance and a loan guarantee program via the China National Investment & Guarantee Co., Ltd., the implementation agency. The data from the World Bank help isolate the effects of this and other similar programs.

Methodology and data for end users: Cement

Because of changes in program design, the baseline studies conducted before the actual implementation of the program were not relevant for this evaluation. The baseline market studies were done for gas utility customers, which are different from the bulk of current end users such as steel, cement, chemicals, and coking companies. This evaluation focuses on the cement industry. This industry has been one of the most inefficient in China in terms of their energy use. According to the Beijing Energy Efficiency Center, China's cement industry produces 40 percent of the world's cement output and uses nearly 40 percent more energy per ton than comparable facilities in industrialized countries.[1]

Cement is one of the priority sectors targeted by the government for energy efficiency measures. Since 2006, the government has treated the cement industry as a "high-pollution, high energy consumption" sector. The government policy emphasizes three areas: (i) closing down or phasing out small, inefficient, and polluting facilities; (ii) supporting consolidation of the sector through ergers and acquisitions; and (iii) regulatory and financial support for large cement companies' investment in energy efficiency projects, especially projects that address waste heat recovery for power generation, one of the government's top priority energy efficiency technologies.

The cement sector had a detailed marketing study at the beginning of the program (IFC 2007), which can be treated as baseline information. The market study identified the specific target for intervention: energy efficiency projects involved with recovery of waste heat from a new suspension precalcination (NSP) cement production line. The study also specified companies with production capacity of 2,500 ton per day or more per production line as prime targets for intervention. Target capacity is the equivalent of at least 900,000 tons per year. In contrast, the average of the total cement production capacities for all cement companies in China is about 400 tons a year.

This industry is the third largest recipient of CHUEE's guaranteed loans. A total of 18 cement companies have benefitted from loans guaranteed by the program. Twenty-four projects with an aggregate cost of $184.8 million were financed with $88 million in loans. These companies are relatively large. Eight of the 12 national large

TABLE 3.2 Amounts of IB Loans Made to Energy Efficiency Projects (billion yuan)

	2007	2008	Growth rate (%)
IB	0.64	2.45	284.6
Comparison banks' average	2.54	5.22	139.9

Source: IEG/CBRC survey on energy efficiency finance in China.

Note: These two years are selected because they are the only ones in which a relatively large number of banks each had data, to ensure data comparability.

TABLE 3.3 Number of Client Companies for IB Energy Efficiency Loans

	2007	2008	Growth in 2008	Growth rate (%)
IB	25	46	21	84
Comparison banks' average	35	40	5	14

Source: IEG/CBRC survey on energy efficiency finance in China.

Note: These two years are selected because they are the only ones in which a relatively large number of banks each had data, to ensure data comparability.

cement companies or their affiliates have projects with the program, and of the top 50 cement companies in China, the program serves 18. CHUEE's lending in the cement sector has been following the target identified by the sector study: the projects recover waste heat from an NSP cement production line with the production capacity of 2,500 ton per day or more per production line.

The comparison group was randomly selected from cement companies that meet the program's target criteria on technology and production capacity, including companies located in provinces in which lending from the program was not active. The data gathering was done through interviews of selected firms, as well as through a wider survey of firms identified as comparators for the companies that received loans supported by the program. IEG collaborated with the China Cement Association to conduct the survey.

Comparisons between Program Beneficiaries and Nonbeneficiaries

The program allowed IB to grow faster than the comparator banks, but other banks provided more loans on average. Although starting from a relatively low level, loans that IB made to energy efficiency projects saw a 284.6 percent growth from 2007 to 2008. In comparison, during the same period the average growth rate of energy efficiency loans by the six comparator banks was 139.9 percent (table 3.2). Similarly, IB achieved stronger growth in expanding loans to new clients than comparator banks did. From 2007 to 2008, the number of IB client companies under the program soared; IB added 43 companies, a 172 percent increase over 2007.

In contrast, comparator banks on average saw an increase of merely one client company, or a 4 percent increase over 2007 (table 3.3). It is also noteworthy that in just two years, IB's client base for energy efficiency loans, starting from zero, became the largest among all comparator banks. Indeed, IB now has clients for its energy efficiency loans across 14 of the country's 32 provinces, encompassing all major regions of the country. Regarding the composition of IB's energy efficiency finance, the main differences with comparator banks are the higher shares of new clients and smaller companies. Both features can be linked with CHUEE's interventions—guarantees and technical assistance—which were designed to alleviate the risks associated with new and smaller clients.

The growth rate of IB's energy efficiency finance compares well with industry norms when taking into account initial conditions such as level of commitment to energy efficiency and preprogram levels of energy efficiency finance. IB has grown faster than comparator banks that have a similar level of commitment to financing energy efficiency, as evidenced by participation in other energy efficiency programs prior to CHUEE. The bank has grown its energy efficiency finance practice from a lower initial level than comparators. All energy efficiency programs supported by the public sector are predicated on the assumption that initial growth is difficult and slow—hence, their focus on jump-starting the line of business. The market for energy efficiency finance in China has grown rapidly but is still in an early stage of development (Taylor and others 2008).

BOB has been a significant player in energy efficiency among its peers but has not grown in the program yet. It is important to note that, unlike IB, which has no energy efficiency activities outside the program, BOB is the largest user of the guarantee program for loans to energy management companies under the World Bank's ECP II. Since the program's start in 2004, BOB has given 81 loans, totaling about 320 million yuan. This is 64 percent of total loan guarantees provided under the ECP II program and bigger than the IFC program (117 million yuan so far). BOB experienced lower growth in energy efficiency loans than its comparator banks (table 3.4).

TABLE 3.4 Amounts of BOB Loans Made to Energy Efficiency Projects (billion yuan)

	2007	2008	Growth in 2008	Growth rate (%)
BOB	2.1	2.5	0.4	19
Comparison banks' average	1.9	2.5	0.6	30

Source: IEG/CBRC survey on energy efficiency finance in China.

It provided a total of 2.5 billion yuan loans in 2008, which is the same as the comparator banks' average (although there are some issues on the strict comparability of data).

The CHUEE loans are therefore only a fraction of BOB's energy efficiency lending (table 3.5). This indicates that it is difficult to attribute BOB's overall performance to the IFC program, except in the areas that are unique to the program's approach.

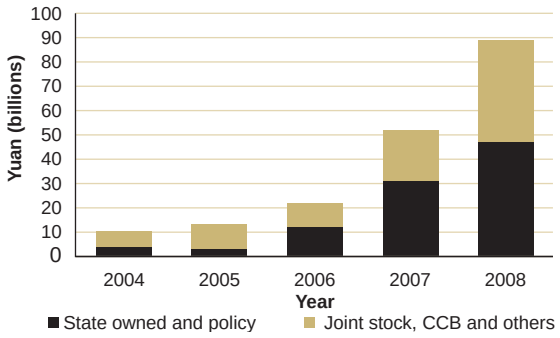
The participating banks are not unique in terms of providing energy efficiency loans: there was significant growth in China's energy efficiency finance outside of the program. China's energy efficiency finance market leaped in 2007. As indicated in figure 3.1, as of 2008, total energy efficiency loans accounted for about 90 billion yuan ($13 billion). This is almost a fourfold growth from 2006 (figure 3.2).

The key driver of the expansion of energy efficiency lending was the public sector banks. Their lending in energy efficiency projects more than doubled, and their client bases almost quintupled over the period. Public sector banks were responsible for more than half of energy efficiency loans by volume, serving more than two-thirds of energy efficiency clients.

Some comparable banks have been active in energy efficiency activities, and participants' scale of operation does not stand out. As shown in the table 3.6, for both IB and BOB, comparable banks with energy efficiency operations, on average, had bigger weights of energy efficiency finance within their new lending.

The loans guaranteed by the program were small compared with total energy efficiency loans in China. The program's 3.5 billion yuan in loans supported by the guarantee were about 2 percent of the total energy efficiency loans by yuan. Outside the participating banks, most of the 24 nontreatment banks that answered the survey said they had started lending to projects whose primary objectives were to achieve energy efficiency savings. Many of them claimed that they started this type of lending more than five years before (appendix D). However, it is important to note that there is a potential source of bias: these energy efficiency projects that claimed to have support from nontreatment banks include some more general-purpose, large capacity expansion investments.[2] Moreover, the data on energy efficiency lending are from 2007, when China's banking regulator was instructed to gather such information. The earlier data have underreported energy efficiency lending.

FIGURE 3.1 Total Energy Efficiency Loans (billion yuan)



Source: IEG/CBRC survey on energy efficiency finance in China.

Chinese energy management companies are also rapidly growing, especially since 2007. The number of these companies grew exponentially in the last five years, and the membership in the national association reached 317, compared to just 59 in 2003 (figure 3.3). The total investments in projects with energy performance contracts in China grew more than threefold in 2007, and in 2008 the total was at least $1.46 billion (figure 3.4), yielding about 66 million tons of energy savings over the lifetime of the projects and a reduction of about 47 million tons of CO_2 emissions. Intensified implementation of the 11th Five-Year Plan target helped this sharp increase of EMCs in China.

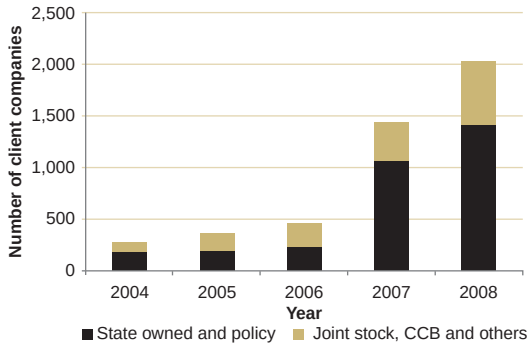
TABLE 3.5 Number of Client Companies for BOB Energy Efficiency Loans

	2007	2008	Growth in 2008	Growth rate (%)
BOB	33	38	5	15
Comparison banks average	55	66	11	20

Source: IEG/CBRC survey on energy efficiency finance in China.

Note: These two years are selected because they are the only ones in which a relatively large number of banks each had data, to ensure data comparability.

FIGURE 3.2 Number of Companies that Have Received Energy Efficiency Loans



Source: IEG/CBRC survey on energy efficiency finance in China.

TABLE 3.6 Share of New Energy Efficiency Loans within Total New Loans among Banks with Energy Efficiency Lending (percent)

	2005	2006	2007	2008
IB	0	0	1	2
Comparison banks' average (8)	2	6	4	5
BOB	0	0	2	2
Comparison banks' average (3)	3	9	5	4

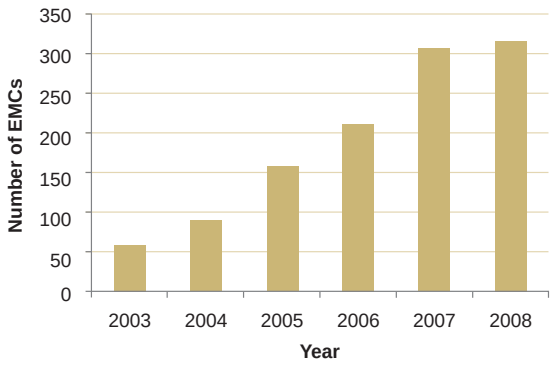
Source: IEG/CBRC survey on energy efficiency finance in China.

End energy users have developed an interest in energy efficiency investments, and many energy efficiency projects are being implemented outside the program. Among the companies that have received loans guaranteed by CHUEE, more than half (59 percent) responded that they have implemented or were considering energy efficiency projects other than those financed by the program. Nearly a quarter of users indicated that they would implement the same project even if they did not receive the loans guaranteed by the program (table 3.7). The majority of them would have had projects with limited scope or longer implementation times. However, 9 percent of end users did not invest in an energy efficiency project if they did not receive a loan supported by the program. These companies were relatively smaller in asset size, and their project sizes were also relatively small compared with the majority of the end users.

There is a considerable uptake on energy efficiency investments within the cement industry. All companies surveyed indicated that they had either invested or were planning to invest in a waste heat recovery system on at least one production line. The cement companies are fully aware of the benefits of energy efficiency projects, and most of them have enough technical capability to implement them, or can obtain adequate help from parties such as industry associations and government agencies. Some companies responded that the waste heat recovery technology was mature and there was enough information available, including examples from other countries. Moreover, as suggested by the high incidence of self-financing projects, these companies are willing to spend money for these projects.

Other than waste heat recovery, which all companies had been involved in, 68 percent were investing in energy conservation refit of a motor-driven system, 42 percent were investing in the application of high-efficiency grinding equipment and technologies, and 10 percent were renovating old NSP production lines. These projects were financed

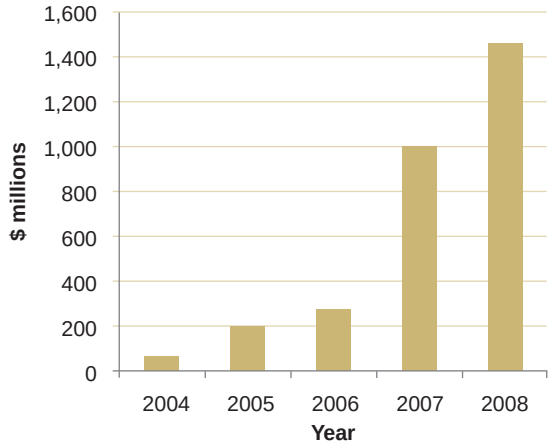
FIGURE 3.3 Number of EMCA Members in China



Sources: China Energy Management Company Association, National Development and Reform Commission, and World Bank.

Note: EMC = energy management company; EMCA = energy management company association.

FIGURE 3.4 Total EPC Investment



Sources: China Energy Management Company Association, National Development and Reform Commission, and World Bank.

Note: EPC = energy performance contract.

TABLE 3.7 Most Companies Would Invest in Energy Efficiency Irrespective of CHUEE Loans

If you have not received a loan supported by the program, would you still undertake the energy efficiency project?

	All companies (n = 34) (%)	Cement companies (n = 11) (%)
Yes, for identical scope as the loan supported by the program	24	9
Yes, but limited scope and/or longer time	68	81
No	9	9

Source: IEG survey of CHUEE end users.

Note: Cement companies' response (n = 11) is from survey sent to all 16 cement companies (15 returned). Of those, 11 companies responded to this question.

TABLE 3.8 Implementation Status of Waste Heat Recovery Projects

Status	Cement companies that received loans guaranteed by the program (%)	Cement companies that have *not* received loans guaranteed by the program (%)
Investing in waste heat recovery projects	100	100
Completed	93	63
Under implementation	7	16
Preparation/ planning	0	21

Sources: IEG survey of CHUEE end users (second column) and IEG surveys of Chinese cement companies (final column).

TABLE 3.9 Small Companies' Projects and Loans

Company size by total assets among cement companies *not* receiving loans guaranteed by the program	Company-completed waste heat recovery projects (%)	Company-obtained loans for energy efficiency projects (%)
Small	45	36
Medium	58	50
Large	86	64
Average	63	53

Source: IEG surveys of Chinese cement companies.

by the company's own resources, bank loans, and—sometimes—government subsidies. About 30 percent of waste heat recovery projects were fully funded by companies' internal resources (see table 3.8), and 55 percent of projects involved loan financing. Only 7 percent of projects obtained some government subsidies. With regard to bank loans, 63 percent of the companies applied for a loan, and 83 percent of them were successful. Thus, about 50 percent of the companies actually obtained loans for energy efficiency projects.

Small cement companies outside the program had lower implementation of energy efficiency projects and less access to financing for the projects. Although many companies outside of the program have been investing in energy efficiency projects, most of the realized investments were from relatively larger companies. Nearly all large cement companies (86 percent) have already completed the waste heat recovery projects, but less than half of small companies had completed such investments (table 3.9). Such gaps among small companies are also evident in access to bank loans. A majority of the large companies obtained loans for energy efficiency projects, whereas only about one-third of small companies obtained loans for their projects.

Government Policy and Energy Efficiency Investments

The government has been active in promoting energy efficiency in China. The Chinese government now recognizes its energy use as a risk to the country's sustained economic growth, and it has committed to conserve its energy and gas emissions, especially through the enactment of the 11th Five-Year Plan and Renewable Energy Law. This was accompanied by a large-scale public campaign on energy conservation. One of the measures included direct loans from state-owned banks to large state-owned enterprises for energy efficiency investments. Furthermore, the government banned loans to steel and cement industries unless the loans were for energy efficiency or pollution reduction. It also introduced a measure to retire old and inefficient plants in many heavy industries. Because of these actions, lending to energy efficiency projects by public sector banks soared in 2007, particularly the policy banks.

Private sector banks followed the trend. Awareness among the Chinese financial sector regarding renewable energy and energy efficiency projects increased substantially after the publication of the 11th Five-Year Plan (China, Government of, 2006). Significant government interventions created an environment where many market actors found opportunities and incentives to invest in energy efficiency projects. According to the IEG survey of Chinese banks, the top two drivers for banks to engage in energy efficiency lending were government policies and market opportunities. About 95 percent of banks that had started energy efficiency lending (21 of 22) cited that enhanced government policies were an important reason they decided to make energy

TABLE 3.10 Factors Influencing Decisions on Energy Efficiency Investment (part I)

Why have you decided to invest in an energy efficiency project? (Check all applicable answers)

	Cement companies that received loans guaranteed by the program (%)	Cement companies that did *not* receive loans guaranteed by the program but actually implemented energy efficiency projects (%)
Government regulation on emission reduction	87	80
Price of energy too high	80	77
Energy cost savings	100	100
Competitive pressure to reduce cost	87	93

Source: IEG survey of Chinese cement companies.

efficiency loans, and 91 percent of the banks (20 of 22) said market opportunities for energy efficiency lending were an important reason. Financial incentives provided by the government were third in the ranking of reasons, cited as an important factor by about 59 percent of the banks. Support from international organizations was rated as important by 32 percent of the banks and ranks fourth.

The cement industry has been one of the key sectors in which the government has addressed energy efficiency measures. In early 2006, the government set a goal of reducing energy consumption per ton of cement output by 25 percent and increasing the share of NSP production lines with waste heat recovery to 40 percent by 2010. This goal has been integrated into the annual "must-meet" target on environmental protection performance of local government officials and executives of key large companies. The government also set financial incentives by providing subsidies to any project conserving the equivalent of the energy of 10,000+ standard grade coals, which is equivalent to about 15–20 percent of a project's capital cost. Similar incentive funds were established or were being formed at the provincial and city levels, with subsidies accounting for 10–30 percent of project costs. Also, a state bond of 5.4 billion yuan was issued; its proceeds were used to provide loans to energy efficiency projects at subsidized interest rates.

These intensive government actions uniformly influenced the cement industry to invest in energy efficiency. More than 80 percent of the cement companies that had invested in energy efficiency projects responded that the importance of competitive pressure, government regulations, and energy costs and savings are the important factors in their decision to implement energy efficiency projects (table 3.10). There are no significant differences between the companies reached by the program and those that were not.

Unique Contributions of the Program

Although the program is a small and relatively new actor, it has already left several unique marks in China's energy efficiency field: (i) establishing an institutional set-up for energy efficiency lending in participating banks; (ii) introducing new lending products to Chinese banks that are different from conventional lending based on corporate assets; and (iii) facilitating access to financing for key market players—ESCOs—through technical assistance for building their capacity and by brokering relationships with banks.

Institutional set-up for energy efficiency lending

The program helped the partner banks set up institutional arrangements for energy efficiency lending. There is a strong commitment to financing energy efficiency in both banks, and they market themselves as "green banks," partly based on their experiences with the program. IB established a dedicated department for energy efficiency lending in 2008 and prepared special procedures and guidelines for processing such loans. BOB has not yet created a dedicated unit, but it has dedicated staff for energy efficiency operations and has prepared guidelines and procedures for energy efficiency lending. IB stated in its 2008 annual report that it would use its own resources to make 10 billion yuan in new loans on energy conservation and effluent reduction in the next three years, starting in 2009.[3] Furthermore, IB is one of the first Chinese banks to adhere to various international sustainability finance standards; it is the first Chinese bank to adopt the Equator Principle.[4]

Such institutional capacity is rare among nonparticipating banks. Only one comparator bank had a dedicated department for energy efficiency lending. Another had no dedicated unit but dedicated professionals working on energy efficiency lending, because of its direct cooperation with international aid agencies (table 3.11). However, the latter bank has not yet provided stand-alone energy efficiency loans.

Some state-owned banks have dedicated professionals or both dedicated professionals and special guidelines for energy efficiency lending, but they do not provide stand-alone energy efficiency loans, let alone project finance-based energy efficiency loans, according to the survey answers. In terms of spreading energy efficiency activities outside bank headquarters and delegating authority to branches, IB has been ahead of its comparison banks. It is providing energy efficiency loans in both headquarters and branches. In con-

trast, all but one comparator bank process energy efficiency loans in headquarters only.

Loan products more suitable for energy efficiency investment

Chinese bank lending is mainly based on collateral assets. The Chinese banking practice of making credit decisions based on collateral assets of the company or project sponsor is one of the biggest constraints to finance for many companies, especially SMEs.[5] A World Bank report revealed that in China, about 69 percent of small companies that had been rejected for a loan stated it was because they lacked acceptable collateral, and nearly a quarter of SMEs did not apply for a loan because of the strict requirements on collateral (World Bank 2008b).

The program's unique contribution is in the promotion of lending that relies more on project cash flow and project assets than on corporate assets. As one of its core interventions, the program helped participating banks assess credit risks and underwrite loans for energy efficiency projects more on the basis of cash flow (energy cost savings) and project assets (equipment) than the conventional lending, based on the assets or creditworthiness of the project sponsors.[6] The program's guarantee and technical assistance in such areas as engineering due diligence, risk assessment, loan structuring, and market research were to promote lending practices such as—

- Charging risk-weighted interest rates to cover additional risks
- Providing additional bank loss reserves
- Establishing debt service reserves for individual loans
- Establishing more decentralized loan approval authority to enable branch offices to make expedient credit decisions or apply innovative practices tailored to local conditions
- Conducting engineering due diligence and technology assessment
- Introducing mortgages on project equipment as security for loans[7]
- Offering three- to five-year loan tenures to match project cash flows and amortize loan repayment in order to reduce repayment risk as well as loan interest cost.[8]

Participant banks adopted new lending practices with lower collateral requirement. The two participating banks, for example, stated that they had not had this project finance-based lending practice before and had adopted it with help from CHUEE. Before CHUEE, a department in BOB made loans to ESCOs based on World Bank–supported guarantees, but those loans were not project finance based, though some of them were based on pledges of account receivables. Only 4 of the 50 loans made by IB and one of the 9 loans by BOB under the first guarantee facility involved partial use of fixed assets collateral; the loans were supplemented by additional personal guarantees and corporate guarantees. As many as 32 of the 50 IB loans and 4 of the BOB loans were based on mortgages on equipment being used in the project being financed.

The value of the mortgaged equipment is often significantly lower than that of traditional corporate fixed assets collateral. For example, the value of mortgaged equipment under loans by BOB has been as low as 56 percent and no more than 100 percent of the loan amount. This is because BOB considers the coverage under the guarantee (40 percent) as alternative collateral and requires that its clients cover the balance.

Project finance energy efficiency lending is scarce among banks that are not in the program. Except for some loans made to EMCs based on World Bank–supported guarantees and pledges of stable account receivables,[9] all but one bank said explicitly that it had no project finance-based energy efficiency loans, though it provided financing to energy efficiency indirectly through a corporate financing approach. In particular, banks found project finance-based lending difficult to handle because of the technical complexities. One bank had some standalone energy efficiency

TABLE 3.11 Institutional Set-Up of Energy Efficiency Lending

	Dedicated unit	No dedicated unit but dedicated professionals	Special procedures or guidelines for processing energy efficiency loans
IB	Yes	NA	No
IB comparables[a]	1/6	1/6	1/6
BOB	No	Yes	Yes
BOB comparables	No	No	No
Policy and state banks	2/7[b]	2/7[c]	2/7[b]
Other commercial banks	0/10	4/10[d]	2/10[d]

Source: IEG/CBRC survey on energy efficiency finance in China.

Note: Denominator indicates total number of banks. NA = not applicable.

a. The corresponding banks had direct cooperation with a bilateral and an international agency on energy efficiency financing.

b. Same two policy banks.

c. One of the two banks is a policy bank that said in the survey it didn't provide stand-alone energy efficiency loans.

d. One bank with both dedicated professionals and special procedures for energy efficiency lending said in the survey it did not lend to projects, but to companies.

TABLE 3.12 Factors Influencing Decisions on Energy Efficiency Investment (part II)

Why have you decided to invest in an energy efficiency project? (Check all applicable answers)

	Cement companies that received loans guaranteed by the program (%)	Cement companies that did not receive loans guaranteed by the program but actually implemented energy efficiency projects (%)
Assurance (guarantee) that the energy efficiency will be realized	47	27
Availability of credit[a]	53	17
Availability of government subsidies	60	43
Age of the equipment that had to be replaced	13	7

Source: IEG surveys of Chinese cement companies.

a. Statistically significant difference between the two groups.

loans, but it indicated that the results were less than successful and did not see significant potential for increasing its energy efficiency lending.

This move away from corporate fixed asset collateral requirements improved access to financing by companies with a weak capacity to provide collateral. For example, two client cement companies visited by IEG, one in Jiangsu and another in Fujian, said that they would have to postpone their investments in waste heat recovery (a very effective energy efficiency investment) without the program loans because they used up their collateral capacity and thus could not get loans from other sources. Another client cement company in Tianjin said that without the IB loan, it would have to resort to short-term loans. However, short-term loans are generally not a good choice for energy efficiency projects, which typically have a payback period of more than three years.

An SME located in Shenzhen City of Guangdong Province, which borrowed 10 million yuan from IB under the program in 2007, said that it had wanted to carry out the same energy efficiency project about five years before but couldn't get a loan because it had a limited capacity to provide collateral. The loan allowed the SME to achieve a cost savings of 5 million yuan a year from reduced consumption of oil, electricity, and water. In total, IB provided CHUEE loans to four other similar SMEs in the city during a period of just several months (Shenzhen Commerce Daily 2007).

Regression analysis also indicated that availability of credit was a significant factor for cement companies that received loans guaranteed by CHUEE. More than half of cement companies that received loans guaranteed by CHUEE indicated that the availability of credit was important. This was the case for only 17 percent of the companies not assisted by the program. At 5 percent statistical significance, availability of credit was a significant factor for program recipient cement companies in making a decision to invest (table 3.12).[10] In contrast, there is no statistically significant difference between beneficiaries and nonbeneficiaries in terms of size, age, and financial indicators, such as debt to assets ratios.

The loans guaranteed by CHUEE have longer maturities. About 66 percent of the loans guaranteed by CHUEE mature in three or more years, with a maximum of five years and a minimum of one. Overall average maturity is 3.7 years. This is in line with the energy efficiency projects' payoff periods, which range from two to four years. Larger loans tend to have longer maturity, partly reflecting the investment payoff periods (table 3.13). All loans are amortizing loans and not bullet repayments at the end, which is more common with Chinese commercial banks.

Access to technical assistance, including from the program, is linked to loans with longer maturity. Half of the energy management companies received loans (from any banks) with a tenure of less than a year. For those with access to loans, technical assistance (irrespective of sources) lengthened the term of the loan beyond that. In particular, technical assistance from CHUEE or EMCA is associated with longer loan tenure. Eighty percent of the energy management companies that did not receive technical assistance received short-term loans (less than a year), compared with 53 percent of technical assistance recipients (longer-term loans with maturity of a year or more). About 80 percent of the program's technical assistance recipients and 72 percent of EMCA technical assistance recipients had longer-term loans.

Role of guarantees

The guarantee was actually an appropriate instrument in the context of the Chinese banking industry. The Chinese banking sector has abundant liquidity, and sources of funding are hardly any incentive for new types of lending activities such as energy efficiency. In contrast, guarantees by third parties are widely used among banks and are usu-

ally considered one of the risk mitigants in the credit review process. In fact, guarantees were counted as a substitute for the borrower's collateral requirements.

Guarantees helped promote the energy efficiency line of business within the banks. Both IB and BOB had strong top management commitment toward sustainable green businesses. However, such commitment does not always guarantee operational performance. As each loan officer and operating branch faces volume and profit targets, there is a strong disincentive to trying new, untested operations. In fact, interviews with banks revealed that bank staff also encounter internal resistance to new business. The guarantee enabled banks to build up the portfolio very quickly, which made the energy efficiency lending team more visible. Their large volume and no-default performance helped the business be recognized as an important part of normal banking operations. Nevertheless, both banks indicated that there was a strong need to promote the business within the bank, with more training to loan officers and credit/decision makers.

CHUEE's demonstration effects on other banks

The program experience is fairly well known among China's financial institutions. A total of 70 percent of surveyed banks said they were aware of IFC's support to IB and BOB. And 100 percent of IB and BOB's comparison banks knew the program. This was because IFC held several promotions of the program, including a national workshop organized by the CBRC to promote IB's experience and the innovative lending methods under the program, with all major banks participating.

Another major indicator of the demonstration effects is that three additional banks expressed interest in joining the program, and the fact of Shanghai Pudong Development Bank's continued commitment to the second guarantee facility even after suspension of the legal agreement for the program. However, demonstration is not a major factor for other banks to engage in the energy efficiency business; the survey answers did not put a heavy weight on observation of other banks engaging in the energy efficiency business.[11] Government policy and recognition of business opportunities are more important.[12]

Many banks were interested in energy efficiency lending, but commitments vary among them. There were significant differences among the levels of interest of different types of banks and among their attitudes toward different program instruments, such as loan guarantees and technical assistance. The survey shows that all IB comparison banks knew the program well and were clearly interested in doing energy efficiency lending using this type of framework (appendix D).

TABLE 3.13 Average Maturity of the Loan with CHUEE Guarantee, by Loan Size

Loan size	Average maturity of the loan (years)
Small	2.37
Medium	2.76
Large	4.03
Very large	4.06

Source: IEG, based on CHUEE data.

Note: Loan size categories were based on the appraisal report (World Bank 2006b; actual figures are from CHUEE project files). Small: 0.5–2 million yuan (average :1.43 million yuan = $0.2 million); medium: 2.1–9.0 million yuan (average: 5.35 million yuan = $0.8 million); large: 9.1–19 million yuan (average: 14.5 million yuan = $2.1 million); very large: 19.1 million–40 million yuan (average: 27.49 million yuan = $4 million).

In contrast, BOB-comparable banks knew the program as well but not in depth, and their interests in the program's energy efficiency lending methods were not as strong. All banks except one were interested in the program's guarantee or considered it important. All IB comparator banks unequivocally expressed willingness to accept the program's fee-based technical assistance, whereas BOB comparators were lukewarm. Two IB comparator banks also had a soon-to-be implemented plan on establishing a dedicated energy efficiency lending unit, and a third one had an International Bank for Reconstruction and Development project under implementation.

The World Bank is about to implement the new program (ECP III), which features a partial loss guarantee to energy efficiency lending by commercial banks. The Asian Development Bank is also preparing similar guarantee programs (see appendix H for major energy efficiency and emission reduction programs).

Access to financing for EMCs

CHUEE improved access to financing among the EMCs. The evaluation created matched samples between program network participants and nonparticipants based on a propensity scoring method in order to minimize the selection bias (see appendix E for detail). Based on this data, more than half (52 percent) of the EMC network members applied for a loan, compared with only one-third of nonmembers. Moreover, members were more successful in getting loans; 91 percent of applicants obtained a loan, compared with just half of nonmembers. Overall, nearly half of

TABLE 3.14 Access to Financing among EMCs

	Program's network members (%) (n = 21)	Not member of the program (%) (n = 29)	Overall (%) (n = 50)
Applied to loan	52	31	40
Of which, obtained a loan	91	56	75
Overall access to finance	48	17	30

Source: IEG/EMCA survey data.

Note: Matched sample based on propensity scoring method. EMC = energy management company.

members received a loan, compared with just 17 percent of nonmembers (table 3.14).

Being a network member will increase the chance of receiving loans. A test of probability of access to finance was conducted, with EMC characteristics as independent variables (asset size, number of employees, years of establishment); other variables included receiving technical assistance from any source, experience in arranging or marketing loans, and being part of an IFC network.[13] The results showed that the whole model is statistically significant (likelihood ratio Chi square 25.17 [p = 0.0]), as shown in table 3.15.

Two variables are significant in explaining the probability of receiving finance at 5 percent: belonging to the network and receiving technical assistance. The results show that network membership and receiving technical assistance both influence EMCs' access to financing. Arranging or marketing loans to clients is not related to the EMCs' access to financing. A probit analysis also indicates a relationship between the asset size of the companies and their possibility of getting a loan, as the larger the asset size of the company, the more likely it was to get a loan. The chance of getting a loan was enhanced by 31 percent with network membership and by 27 percent with receipt of technical assistance. It is also important to indicate that members that were successful in getting bank loans have a relatively smaller asset size than nonmember companies (average assets 130 million yuan for treatment, 160 million yuan for comparison).

The members on average grew faster than nonmembers. Based on the matched samples by propensity scores, the average asset (measured by average assets) treatment group grew by 20 percent and 25 percent in 2007 and 2008, respectively. This can be compared with the comparison group, which grew 16 percent and 7 percent in the same periods (table 3.16). Those EMCs that obtained financing had a higher growth rate than average. The CHUEE network members had a much higher growth rate than average, far higher than the comparison group.

Quantifying Overall Impacts and the Program's Efficiency

The overall impact of the program consists of the GHG reduction and the net private benefits generated by projects that would not have happened without the program, plus nonquantifiable benefits related to demonstration and spillover effects. The latter appear to be emerging—according to survey results the program is well known in China, and there is interest among banks to learn from its approaches to the end users—but are hard to estimate. The quantifiable impacts are conservatively estimated at $384 million for 10 years since program's inception, based on the 9 percent of the projects' gross dollar value of annual emission reductions (by emission trade market price) and energy savings (by international coal price). It is likely that they are underestimated—more than 68 percent of borrowers indicated that without the program they would still have implemented their energy efficiency projects but on a smaller scale or over a longer time frame (table 3.7). The critical factors that affect the magnitude of the benefits are the program's additionality at the bank level, banks' additionality for end users, the size of average CO_2 emission reduction per project, and the prices of CO_2 and coal (for the energy saving calculations).

The costs expended to derive the benefits consist of (i) project investments costs; (ii) the costs of running the program, including the costs of the technical assistance that was provided, minus payments made to IFC in the form of guarantee and other fees; and (iii) the subsidy embedded in the first loss cover by GEF, which underpinned the guarantee facility. Of these costs, only the valuation of the first loss cover presents methodological difficulties. Given the lack of actuarial data, and in the absence of a market in similar guarantee or insurance products, these estimates are based on the expected default rate at the inception of the program. This represents an estimate of the willingness to pay for the protection given by GEF. The base case default rate was expected to be 4 percent and the GEF grants were used to cover these potential losses. This GEF first loss cover catalyzed the IFC guarantees and supported the energy efficiency lending by partner banks. The program would collect about $1.3 million in guarantee fees under the existing agreements. The costs of running the program so far were $4.6 million, including $3 million in technical assistance.

TABLE 3.15 Probit Analysis on Access to Finance among EMCs

	Coefficient	Z score
Year company established	0.0463877	0.65 (0.513)
Company's assets (in yuan)	0.0002626	1.57 (0.11)
Number of employees	–0.0045136	0.55 (0.585)
Receiving technical assistance[a]	1.001503	2.01 (0.045)
Participating CHUEE network[b]	0.9355355	1.94 (0.053)
Arranging or marketing loans to clients	–0.1424357	–0.27 (0.790)

Probabilities in gaining access to financing

	Yes (If yes in parameters, probability of gaining access to financing) (%)	No (If no in parameters, probability of gaining access to financing) (%)	Differences (%)
Receiving technical assistance	36	9	27
Participating CHUEE network	40	9	31

Source: IEG/EMCA survey data.

Note: Samples based on propensity score matching (n = 50). EMC = energy management company.

a. Statistical significance = 5%.
b. Statistical significance = 10%.

The real rate of return of the program so far is estimated at 38 percent. This is based on an assumption that 9 percent of projects gain additional impact from the program. The cost benefit analysis takes 9 percent of total benefits in energy savings and emission reductions, corresponding project costs as well as entire program cost, including costs of technical assistance. This is a high rate given the seemingly modest rate of additionality at the level of the end users.

The result is indicative of the win-win nature of energy efficiency investments, which can generate both significant social and private benefits. Even small additionality can be sufficient to justify the subsidies involved. The upper-bound rate of return of the program gained by taking 76 percent of the program's outcomes (that is, excluding the clear cases of projects that would take place without the program) is 45 percent.

Social benefits exceed benefits to private organizations by a wide margin: the private benefits in the form of energy savings from this program are 20 percent, based on total project costs and energy savings measured by the international price of coal (but not reflecting emission reductions). However, this private benefit is extremely sensitive to the energy price. This private return can be compared to other energy savings estimates. An average internal rate of return of energy efficiency project is an estimated 17 percent (Farrell and Remes 2009). This evaluation's estimates do not take into consideration the actual cash-flow benefits, and they omit various operating costs and maintenance capital expenditures. Actual private financial return would be lower than the 20 percent private return from energy savings.

TABLE 3.16 Average Asset Growth Rate (%)

		2006–07	2007–08
Matching samples, with program and without program	Program's network EMCs (n = 21)	20	25
	Nonnetwork companies (n = 29)	16	7
All samples, separated by access to bank financing	EMCs with loans (n = 36)	17	18
	Companies without loans (n = 62)	12	10
	All (n = 98)	14	13

Source: IEG/EMCA survey data.

Note: EMC = energy management company.

The return is especially sensitive to assumptions about the prices of coal and carbon emissions. The quoted price of carbon in the emission trading market is also volatile. For example, the price of emission traded in the European futures market fluctuated between 26.29 and 8.2 euro per CO_2 ton in just 7 months (proxies were used in the calculation, as the domestic emission market is not yet fully

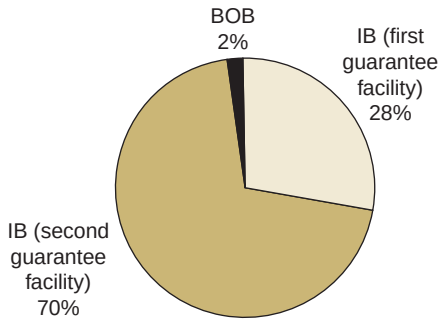
developed in China). Moreover, the model assumed GEF grants supported guarantees as expensed—the no-defaults under the guarantee program would reduce the ex post cost of running the program and thus reduce costs and improve rates of return.

Issues and Challenges

The program is narrowly based on one dominant bank. Ninety-eight percent of the loans covered by the program's guarantee were from IB (figure 3.5). The size of the loan as well was influenced by the fact that IB's client base is larger industrial companies. In stark contrast with IB, BOB was slow in growing its energy efficiency loan portfolio under the program. As of August 2009, BOB had provided nine loans to six companies, with a total loan amount of 117 million yuan, financing about 3 billion yuan projects (against the target of 200 million by November 2009).

BOB's low utilization of the program was due to a limited client base and few branches outside Beijing, where most of its potential energy efficiency loan clients were located. BOB targeted industrial companies as end users, especially in the high-pollution, high energy consumption industries such as cement, steel, coking, and chemical. This turned out to be difficult. Most of the potential client companies had relocated out of Beijing and its neighboring areas over the years before the Beijing Olympics. As a result, BOB used EMCs/ESCOs as borrowers, which BOB saw as potentially a good channel to reach industrial end users. Recently, BOB announced its alliance with Carrier Asia (a subsidiary of the world's largest provider of heating, air conditioning, and refrigeration solutions) to promote energy efficiency equipment marketing and finance (IFC 2009).

FIGURE 3.5 Distribution of Projects Supported by Guarantees, by Project Amount



Source: IEG, based on CHUEE data.

Note: BOB = Bank of Beijing; IB = Industrial Bank.

Sustainability of the banks' energy efficiency operations

There are some areas of concern regarding the sustainability of energy efficiency lending activities after completion of the program. First, the capacity to appraise technical aspects of energy efficiency has not yet been fully developed in partner banks. The partner banks expressed that they still need the program's support to continue and expand their operations, particularly in the technical review of project proposals, which is undertaken by consultants. This was the most valued part of the technical assistance from the program, but it was unintentional and against the spirit of the capacity building efforts of the program.

IFC was supposed to conduct technical reviews of the first five projects and intended to hand over the responsibility to the client bank. But this did not take place, as IB requested continuous reviews by the program team, and the legal agreement was not clear about the arrangement. Subsequently, the program performed technical reviews of all projects in the program until August 2009, when the bank strengthened its internal technical capacity by establishing a Sustainable Finance Center specialized in managing energy efficiency business and started reviewing some of the projects independently.

Moreover, the guarantee facility temporally relieves collateral requirements, as banks only requested collateral for 60 percent of the loan, with the remaining 40 percent to be covered by the RSF. There is no assurance that the practice of having collateral requirements of less than 100 percent of loan amounts would continue after the expiration of the guarantee.

The second guarantee facility (CHUEE II), which reduced the first loss coverage by the program from 75 percent of the first 10 percent losses to 50 percent of first 5 percent of losses, actually increased IFC's guarantee of the overall portfolio to 50 percent (compared with 40 percent in the first guarantee facility). There is no plausible design for how the banks will take project finance types of loan products, with increased reliance on cash flow from project assets, rather than relying primarily on collateral assets. Experience from earlier IFC energy efficiency programs in Eastern Europe suggests that banks tend to revert to old practices after withdrawing the guarantees.

SME outreach

The program loans were larger than originally planned. The original program appraisal emphasized that the program's end users would be primarily SMEs (this was because the original utility-based model was based on Xinao's clients, which were mostly SMEs).[14] However, the actual portfolio is dominated by large loans. The guaranteed loan portfolio had

many fewer loans (although it achieved the total investment target), with small loans representing less than 10 percent of those. Furthermore, there were multiple loans (each used the maximum allowed loan and guarantee coverage) to some large companies. The second guarantee facility portfolio is even more weighted toward large loans so far; nearly three-quarters of the loans are very large (19.1 million yuan or more), and the average loan size is about $9 million, which is much higher than the appraisal target of average loan size of 10–15 million yuan ($1.3–2 million) (figure 3.6).

The survey of the EMCs highlighted the ongoing challenges for the SMEs, including many energy management companies, face in obtaining loans.

Missed energy efficiency potentials

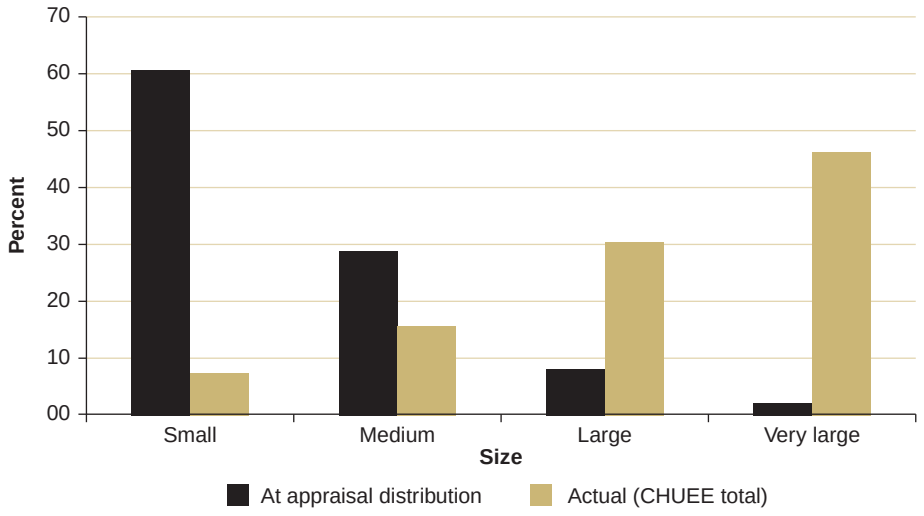
CHUEE investments are similar to what other Chinese banks are doing in energy efficiency lending. Figure 3.7 indicates the sector focus of energy efficiency lending among Chinese banks. The most commonly cited clients by banks are industrial enterprises—21 banks had made energy efficiency loans to these enterprises. Second in the ranking are utilities—13 banks had made loans to this sector. EMCs and public organizations rank third and fourth, respectively. Last are housing entities; only one bank had made energy efficiency loans to the housing sector.

However, the most important areas for emission reductions are not well addressed by any of these players. The China National Development Reform Commission showed that the most significant emission reduction should come from industrial boiler retrofitting, followed by energy savings in building (table 3.17). Both banks in general and the CHUEE banks so far have not lent significantly in those areas identified as high potential. Moreover, these are the areas where there are a lot of small and dispersed users and access to finance and technical services is more challenging than for the large enterprise energy users.

Summary of CHUEE's Impact

CHUEE is a small actor, or even a niche player, in the context of China's energy efficiency and emission reduction fields. The program's rapid growth in lending and achievement of the emission reduction target are relatively minor when compared with the overall market development. The very strong government orientation toward energy efficiency and emission reduction has been the key driver of the market development. Many client companies that participated in the program would have been invested in energy efficiency, even without the program. However, even with the modest additionality, the program's return in energy savings and emission reduction was estimated at about 43 percent. Also, the program provided many unique contributions to the energy efficiency market. Building banks' institutional capacities, promoting new lending practices, and improving access to financing for some underserved groups are the additional contributions of the program.

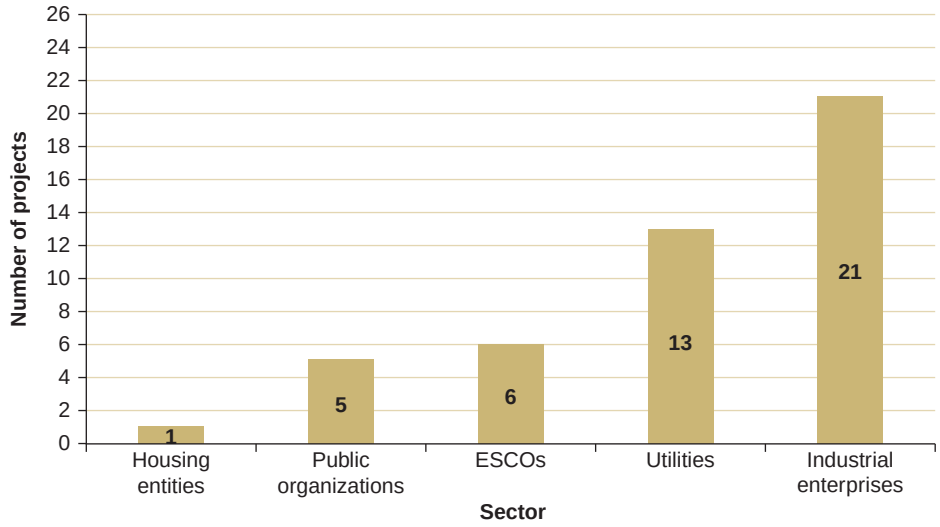
FIGURE 3.6 Distribution of RSF-Supported Loans by Number of Projects (percent of total)



Source: IEG, based on CHUEE data.

Note: Loan size categories were based on the appraisal report (World Bank 2006b; actual figures are from CHUEE project files). Small: 0.5–2 million yuan (average: 1.43 million yuan = $0.2 million); medium: 2.1–9.0 million yuan, (average: 5.35 million yuan = $0.8 million); large: 9.1–19 million yuan (average: 14.5 million yuan = $2.1 million); very large: 19.1 million–40 million yuan (average: 27.49 million yuan = $4 million).

FIGURE 3.7 A Ranking of Sectors by Number of Energy Efficiency Projects (n = 26)



Source: IEG/CBRC survey.

Note: Some banks are operating in multiple sectors. ESCO = energy service company.

TABLE 3.17 China's Energy Efficiency/Renewable Energy Potential

Industries	Estimated total investment ($ millions)	Annual emission reduction (millions of tons of CO_2)	10-year emission reduction (millions of tons of CO_2)
Coal-fired industrial boiler (kiln) retrofitting	18,182	168	1,680
District heating and cogeneration	9,091	84	840
Waste heat and pressure recovery	2,597	24	240
Energy saving buildings	12,987	120	1,200
Petroleum saving and substitution	19,481	103	1,030
Motor and drive upgrading	6,494	18	180
Green-lighting	9,416	26	260
Energy saving in public facilities	2,597	24	240
Energy efficiency total	80,845	567	5,670
Renewable energy investment	90,000	410	4,100
Total	170,845	977	9,770

Source: China National Development Reform Commission data.

Chapter 4

Photo by Curt Carnemark, courtesy of the World Bank Photo Library

Lessons and Recommendations

The program operates in a dynamic market, which government actions have significantly pushed toward energy efficiency objectives. CHUEE benefitted from the very strong government orientation toward energy efficiency and emission reductions, which generated strong demand for energy efficiency project finance. Also, previous interventions by other parties, especially by the World Bank on EMCs, helped create an "energy efficiency finance-ready" situation.

CHUEE is a small actor or even a niche player in the context of China's energy efficiency and emission reduction fields. Despite that, and although it has a relatively short track record, it has left a mark in the energy efficiency market in China. Its main contribution has been the access to finance for energy efficiency projects by Chinese companies, which face relative constraints in conventional bank lending because of the high collateral asset requirement. The program also facilitated access to finance for key market players—EMCs—through its technical assistance for capacity building and relationship brokerage.

The main outstanding issue is the sustainability of the program benefits, such as the promotion of project finance-type of lending, in the absence of IFC or third-party guarantees. Furthermore, moving down market to SMEs or other marketing partners (such as utilities) is needed, as there are still significant constraints in access to finance among these parties. This may involve working with different partners and trying new models as the market evolves.

Lessons from CHUEE

Careful selection of private sector partners is needed to meet strategic program objectives. The program experienced different outcomes between the two banks—IB and BOB—in terms of portfolio growth and ability to use the guarantee. Earlier IFC energy efficiency programs in other countries also experienced varied usage of financial facilities. Obviously, a guarantee by itself is not an adequate incentive to increase energy efficiency lending, and the program needs to find the right balance between banks' strategic objectives and the program's objectives. IB, for example, combined the marketing of energy efficiency loans with a strategy of retaining customers. Thus, it made energy efficiency loans largely to existing clients, whereas BOB targeted new types of clients and faced difficulty in growing its energy efficiency loan portfolio.

Flexibility is needed in the program design to respond to unexpected challenges and opportunities. The program experienced a complete modification of its business model and responded with additional resources when confronted with larger-than-expected market demand for investment. This indicates that programs require some flexibility to respond to new developments in the market or to changes in regulatory regimes.

Government policies and market readiness are important factors in determining program design. In China, the timing for the program was right, as the government was putting significant emphasis on promoting energy efficiency activities. It had already put various policy measures in place for energy efficiency. Also, the World Bank initiatives for the energy management companies paved the way for further assistance by IFC and others. CHUEE built on these market conditions.

The combination of private and public benefits in energy efficiency projects suggests the need for a more discriminate and dynamic approach to subsidies in the sector. As the sector matures and certain types of energy efficiency projects become well established, subsidies need to shift to less mature areas with high growth potential and significant social benefits. Indiscriminate use of subsidies impedes the commercialization of energy efficiency finance.

In emerging markets, caution is needed in applying a utility-based energy efficiency finance model. Utilities may not have incentives for reducing energy consumption or expanding their market through energy switching when there are enough potential customers. It is important to assess incentives, policy environments, and the degree of

match between a utility's clients and partner banks' market strategies.

An exit plan is critical. Many of the efforts to promote financing of energy efficiency focus more on generating investments than on the sustainability of maintaining energy efficiency investments after the completion of the program. Moreover, there is little practical information on how to terminate a program or how to shift its focus when commercial energy efficiency operations are emerging and start to compete with the program. One of the factors behind the quick build-up of IB's energy efficiency loan portfolio was the technical reviews by the program, instead of doing it by itself or by developing key service relations with local firms. However, the overreliance on the program undermines its sustainability by reducing incentives to build internal capacity for such reviews.

Recommendations

Based on the findings, IEG recommends that IFC do the following:

1. **Increase additionality at the level of banks and end users.** CHUEE has supported substantial emission reductions mainly through projects carried out by larger companies, but not all can be counted as impact. The program needs to orient activity to the areas with potential for the largest additionality. Program activities should be more strategically focused on areas where IFC could have a unique role, such as working with SMEs, residential housing, or commercial buildings. This requires that IFC consider and design new approaches and work with different types of partners, not just extend the existing types of program activities.
2. **Enhance the CO_2 emission reduction impact of projects financed through the program by moving into areas that are identified as having high potential, but that are not currently addressed by market participants.** Despite the explosive growth of energy efficiency finance in China, market participants do not adequately address the most important areas for emission reductions. The China National Development Reform Commission showed that the most significant emission reduction should come from industrial boiler retrofitting, followed by energy savings in building. Banks so far have not provided financing in the areas identified as high potential. Moreover, in these areas there are a lot of small and dispersed users, and access to finance and technical services is more challenging than for the large enterprise energy users. Thus, additionality is also high in these areas of high energy saving potential.
3. **Reorient subsidies to areas with market failure and increase IFC's involvement in first loss guarantee.** CHUEE has reduced the first loss cover under the GEF grants, but IFC continues to rely on GEF to provide first loss guarantees. Furthermore, there is no assurance that the banks will continue to lend without substantial collateral in the absence of CHUEE guarantees. Efforts are also being made to charge for technical assistance. These measures need to be pursued with existing and new partners, as they can both provide a market test of additionality and enhance sustainability. The program should prepare an exit plan to ensure the sustainability of its energy efficiency lending activities. It should design a workable plan to hand off technical appraisal functions to client banks and encourage risk taking. These efforts need to be supplemented by policy work of the World Bank Group to promote market-based practices in energy efficiency finance and more discriminate use of subsidies at the sectoral level.

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APPENDIX A

Chinese Government Policy to Support Energy Efficiency

The Chinese government's efforts to curb the country's expanding energy appetite have been evolving over the years. Early policies on energy conservation can be traced back to the mid-1980s. In 1985, the government issued several preferential fiscal, tax, and financial policies for enterprise activities on energy conservation. These favorable policies, however, were subsequently abolished in 1994 as the country embarked on a massive transition to a market economy. In 1998, the country did pass the Energy Conservation Law, but there were no substantial incentives or enforcement measures for energy conservation in the law.[1]

Since 2006, the government has been increasingly conscious of energy efficiency and pollution reduction. China's 11th Five-Year Plan for Social Economic Development (2006–10) represented a turning point in terms of government support for energy conservation: it stipulates that the country's energy consumption per unit of gross domestic product nationwide be reduced by 20 percent during the planned five-year period, or about 4.4 percent annually. This is the first time that quantitative targets for energy efficiency have ever been included in a five-year plan. Subsequently, various measures were introduced to achieve this goal. These include various directives and regulations toward the most polluting industries, as well as various subsidies to provide incentives to conserve energy.

To implement the plan, the government issued a number of important supplementary polices in 2006 and 2007: [2]

- In March 2006, the State Council issued a "Notice on Accelerating the Push for Structural Adjustment in Industries with Surplus Capacities." This encourages large companies to acquire smaller ones that have excess capacities to consolidate polluting industries and keep small producers from using backward technologies. [3]
- In May 2007, the State Council issued the "Comprehensive Work Program for Energy Conservation." This forced each level of the government and state-owned enterprises to set up energy conservation targets. It also introduced detailed measures on curbing the expansion of "high energy consumption, high pollution" sectors and closing down companies or production facilities using obsolete technologies.

To implement the policy, various government agencies introduced additional measures:

- In August 2007, the Ministry of Finance, together with the National Development and Reform Commission, introduced a subsidy for projects that conserve at least 10,000 standard grade coal equivalents of energy. Similar incentives were introduced by provincial and municipal governments. At the end of 2007, the ministry also established the Clean Development Mechanism Fund in local currency. It intends to raise awareness about energy saving and to finance relevant investments (World Bank 2008a).[4]
- In November 2007, the China Banking Regulatory Commission issued a policy that requires banks and other financial institutions to establish a link between their new credits and borrowers' performance against the energy conservation targets agreed with the government. Because of this policy, bank lending to the "high pollution, high energy consumption" sectors was practically banned, except for financing investments that promote energy efficiency and pollution reduction.

As a result of these initiatives, by the end of 2007 China had established various institutions within the government that share energy conservation responsibilities. The major outstanding policy issues were inadequate tax and energy price regimes that rewards efficient use of energy (World Bank 2008c). Nevertheless, the International Finance Corporation (IFC) program was started within the context of strong government policy and support toward energy efficiency and emission reductions.

Many of these policies and regulations were later integrated into China's new Energy Conservation Law, enacted on April 1, 2008. The law authorizes the development and issuance of energy efficiency standards and requires that all new capital investment projects be subject to an assessment of whether they can reach energy efficiency standards issued by the government—the government will not approve projects that cannot reach the standards. The law also supports use of tax and pricing policies to promote energy conservation and supports the establishment of energy audit

and statistics functions in key government entities and energy consumption companies.

During 2008 and 2009, the government issued a number of policies aiming at strengthening implementation of the existing policies, such as better measurement and monitoring of emission reduction; fiscal policies to support specific sectors or technologies, such as solar energy use in building; new sources of fiscal funds for attracting investment in building energy conservation; replacement of old equipment; utilization of recycled products, use of renewable energy in public transportation systems, and promotion of energy conservation concepts nationwide.

APPENDIX B

CHUEE Funding Sources

Funding source	CHUEE (original) ($ millions)	CHUEE I (revised) ($ millions)	CHUEE II/CEE ($ millions)	Total ($ millions)
Total	60.6	51.0	180.5	231.5
IFC (guarantee facility, own account)	41.1	40.0	167.0	207.0
GEF (first loss guarantee)	16.5	8.0	8.5	16.5
Finland (technical assistance)	3.0	3.0	1.0	4.0
Norway (technical assistance)	—	—	3.0	3.0
IFC technical assistance	—	—	1.0	1.0

Sources: IEG, based on CHUEE approval documents; CHUEE II/CEE approval documents.

Note: CEE = China Energy Efficiency Finance Program; CHUEE = China Utility-Based Energy Efficiency Finance Program; GEF = Global Environment Facility; IFC = International Finance Corporation.

APPENDIX C

Summary of Surveys Conducted for the Evaluation

Type of survey	Survey targets (samples)	Survey administrator and response rate	Population
Financial institutions	37 financial institutions: • Four big state-owned banks and three policy banks • 17 joint-stock commercial banks • Other major banks in eight major cities • Five leasing companies	China Banking Regulatory Commission (Statistics Dept.) **Response rate of 91 percent: 29 of 32 banks**	Sample covers 80+ percent of banking assets
EMCs	100 EMCs in China (41 IFC CHUEE network members and 59 randomly selected from remaining 179)	China Energy Management Company Association **Response rate of 86 percent: 86 of 100 EMCs**	220 EMCs—members of the China EMC Association
CHUEE client companies: companies that received loans from CHUEE partner banks with program guarantees	20 IB client companies, located in five cities (Wuhan, Tianjin, Jinan, Nanjing, and Shenzhen) All five BOB client companies	IB and BOB **Response rate of 76 percent: 19 of 25 companies**	62 companies (excluding cement companies)
Cement companies (CHUEE beneficiaries and non-beneficiaries)	CHUEE beneficiaries: All cement companies that received CHUEE loans from IB or BOB	China Cement Association **Response rate of 94 percent: 15 of 16 companies**	16 cement companies
	Non-CHUEE beneficiaries: Randomly selected sample of 40 cement companies in Henan, Zhejiang, and Shandong Provinces that have at least one NSP cement production line with production capacity of 2,500 tons/day, and not receiving financial assistance from CHUEE. The criteria of NSP production line with capacity of 2,500t/day matches CHUEE client profiles.	China Cement Association **Response rate of 95 percent: 38 of 40 companies**	98 eligible cement companies The three provinces cover 29 percent of national cement outputs: Henan 6 percent, Zhejiang 9 percent, Shandong 14 percent. There are no CHUEE cement projects in Henan Province.

Source: IEG.

Note: BOB = Bank of Beijing; CHUEE = China Utility-Based Energy Efficiency Finance Program; EMC = energy management company; IB = Industrial Bank; IFC = International Finance Corporation; NSP = new suspension precalcination.

APPENDIX D

Bank Survey

The Survey

From May to August 2009, the Independent Evaluation Group–IFC and the Statistics Department of China Banking Regulatory Commission carried out a joint survey of energy efficiency activities in China's financial institutions. The main objective of the survey was to assess the impact of IFC's China Utility-Based Energy Efficiency Finance (CHUEE) Program on energy efficiency lending portfolios and capacity among financial institutions in China.

The survey targeted 37 financial institutions, including 32 major banks, which account for more than 80 percent of the total assets of China's banking industry, as well as five energy efficiency equipment leasing companies. The following were among the targeted financial institutions:

- The four largest state-owned banks and three policy banks
- 17 major joint-stock commercial banks, including Industrial Bank (IB) and Bank of Beijing (BOB) (the treatment banks)
- Eight other major banks in large cities
- Five energy efficiency equipment leasing companies.

The selection of financial institutions allows for comparison between CHUEE treatment banks and similar banks, as well as comparison with the industry average of the financial sector.

Survey Responses

Twenty-nine of the 37 surveyed financial institutions answered the questionnaire. The respondents are the three policy banks, the big four state banks, and all the major joint-stock banks, including IB and BOB—the treatment banks. Three banks and five energy efficiency equipment leasing companies didn't answer the survey.

All policy and state-owned banks are located in the nation's capital, Beijing, and 32 percent of joint stock, city commercial and other banks are in Beijing, 21 percent each in the second largest city Shanghai and Guangdong province, and 5 percent each (one bank) in Fujian, Shandong, Tianjin, Zhejiang, and Sichuan Provinces.

The specific composition of the 29 responding banks is given in table D.1.

Among the banks, the survey response rate was 91 percent (29 of 32 banks surveyed). By the end of 2007, the total assets of these 91 responding banks were 41.1 trillion yuan, about 78 percent of the total assets of China's banking sector.

Summary of Findings

Number of banks giving energy efficiency loans

Most responding banks (22 of 29) said that they had provided energy efficiency loans to companies. Taking into account the six banks that did not complete the survey, as they do not engage in energy efficiency loans, 76 percent (22 of 29) of sample banks are in the business of energy efficiency loans. Among the seven banks that answered that they do not provide energy efficiency loans, two were rural development or rural commercial banks whose clients are unlikely to be large energy end users, and five are small joint-stock banks that said they either had no capacity to appraise energy efficiency loans or did not provide project-based energy efficiency loans.

TABLE D.1 Composition of Banks Responding to the Survey

Bank type	Number
Policy[a]	3
State-owned	4
Joint-stock[b]	15
City commercial	4
Rural commercial	3
Total	29

Source: IEG/CBRC survey on energy efficiency finance in China.

a. Policy banks include State Development Bank, which has recently converted to a commercial bank.
b. BOB is included here as a joint-stock bank—the bank has converted from a city commercial bank to a joint-stock bank over the past several years.

TABLE D.2 Period when Banks Started Energy Efficiency Lending

Period	Number of banks
Less than 1 year ago	1
1–3 years ago	8
3–5 years ago	1
5–10 years ago	8
10+ years ago	3
No answer	1
Total	22

Source: IEG/CBRC survey on energy efficiency finance in China.

Most banks started energy efficiency lending during two time periods in the past 10 years—5–10 years ago and 1–3 years ago (table D.2). About 45 percent of banks (10 of 22) started energy efficiency lending during the last five years. This is consistent with the government's dramatically strengthened emphasis on energy conservation in the past three years or so.

Table D.3 shows that all banks that started energy efficiency lending 1–3 years ago are commercial banks, and most of them are joint-stock banks (six of eight). In contrast, all the large, state-owned banks entered into energy efficiency lending more than five years ago.

Type of projects supported by energy efficiency finance

The largest share of energy efficiency loans went to restructuring projects that often have a strong focus on capacity expansion, such as thermal power "large replacing small" projects, general purpose technical renovation, and clean energy and waste treatment projects (included in the "other" category). In contrast, the share of energy efficiency loans made to standard energy efficiency projects such as waste heat recovery and cogeneration was much smaller. Particularly, the share of energy efficiency loans to the housing sector was among the lowest (figure D.1).

Reasons for energy efficiency lending business

The top two drivers for banks to engage in energy efficiency lending were government policies and market opportunities. Ninety-five percent of banks that had started energy efficiency lending (21 of 22) cited that enhanced government policies were an important reason for them to decide to make energy efficiency loans (table D.4), and 91 percent of the banks (20 of 22) said market opportunities for energy efficiency lending were an important reason. Financial incentives provided by the government were third in the ranking, cited as an important factor by about 59 percent of the banks, but the percentage is dramatically lower than for the top two drivers. Support from international organizations was rated as important by 32 percent of the banks and ranks as the fourth most important factor.

Services by energy service companies (ESCOs) and peer demonstration effects rank the lowest: they were least commonly cited as an important factor by the banks. The same is generally true for each of the three types of banks, except that joint-stock banks cited support from international organizations and services by ESCOs much more as an important factor than other banks.

Growth potential for energy efficiency lending business

Most banks saw significant future growth potential for energy efficiency finance (table D.5). Nearly 80 percent (20 of 26) of banks answered that they see significant potential for increasing their financing for energy efficiency projects. However, only six percent (one bank) among joint-stock and city commercial and other banks answered that there

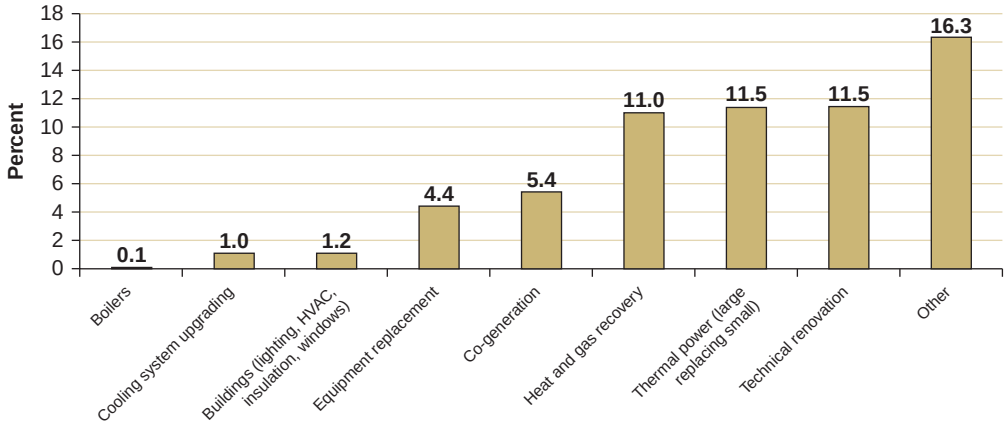
TABLE D.3 Period when Banks Started Energy Efficiency Lending, by Type of Bank

Period	Number of banks			
	State owned	Joint stock	Other commercial banks	Total
1–3 years ago	0	6	2	8
3–5 years ago	0	1	0	1
5–10 years	2	5	1	8
10+ years ago	2	1	0	3

Source: IEG/CBRC survey on energy efficiency finance in China.

Note: State-owned banks here includes State Development Bank. One state-owned bank did not answer the question.

FIGURE D.1 Average Shares of Loans Made to Various Types of Energy Efficiency Projects



Source: IEG/CBRC survey on energy efficiency finance in China.

Note: Examples of relatively large energy efficiency projects included in the "other" category are clean energy and waste treatment.

are no constraints to reaching this potential. Among those that answered that there are some constraints, half considered competition too strong, followed by high risks (44 percent) and high transaction cost (38 percent).

In contrast, state-owned banks and policy banks were relatively more optimistic, as half of those who answered positively on growth potential saw no major constraints. The biggest constraints for them were that potential customers do not see the need to implement such projects. This suggests that the private sector banks are more conscious about competition and risks than their state-owned counterparts and are relatively less concerned about customers' demand for energy efficiency projects.

Internal capacity building for energy efficiency activities

In contrast to the tremendously increased energy efficiency lending volume, only about 18 percent of banks that had started energy efficiency lending (4 of 22) had established a dedicated unit to deal with energy efficiency loans, and only 32 percent of the banks (7 of 22) had dedicated professionals working exclusively on energy efficiency lending (excluding those having a dedicated energy efficiency lending unit) (table D.6). This means that 50 percent of banks that had started energy efficiency lending had no staff working full time on energy efficiency lending. On the other hand, only 23 percent of the banks (5 of 22) had

TABLE D.4 Main Reasons for Engaging in Energy Efficiency Financing—Share of Banks that Rated Various Reasons as "Important"

Type of bank	Energy efficiency became an important national policy priority (%)	Management saw a market opportunity (%)	Government started providing incentives for energy efficiency (%)	Received support from an international organization (%)	ESCOs began bringing bankable projects (%)	Saw other banks engaging in the business of energy efficiency (%)
Policy or state-owned	83 (5/6)	83 (5/6)	50 (3/6)	17 (1/6)	0 (0/6)	17 (1/6)
Joint stock	100 (13/13)	92 (12/13)	69 (9/13)	46 (6/13)	31 (4/13)	15 (2/13)
City or rural commercial	100 (3/3)	100 (3/3)	33 (1/3)	0 (0/3)	0 (0/3)	0 (0/3)
Total	95 (21/22)	91 (20/22)	59 (13/22)	32 (7/22)	18 (4/22)	14 (3/22)

Source: IEG/CBRC survey on energy efficiency finance in China.

Note: Numbers in parentheses indicate how many banks answered this way out of total banks answering. ESCO = energy service company.

TABLE D.5 Growth Potential for Energy Efficiency Lending

Do you see significant potential for increasing your finance for energy efficiency projects?	Joint stock, city or rural commercial banks	State-owned or policy banks
	Yes = 16 (84%)/No = 3 (16%)/No answer = 0	**Yes = 4 (100%)**/No= 0/No answer = 3
If yes: what are the constraints?	Out of 16	Out of 4
No major constraints	1 (6%)	2 (50%)
Competition is too high	8 (50%)	1 (25%)
Risks are too high	7 (44%)	1 (25%)
Transaction costs are too high	6 (38%)	0 (0%)
Potential customers do not see the need to implement such projects	4 (25%)	2 (50%)
Others	5 (31%)	0 (0%)

Source: IEG/CBRC survey on energy efficiency finance in China.

developed special guidelines/manuals for processing of energy efficiency loans (table D.6).

Assistance received for energy efficiency lending for banks providing energy efficiency loans

About 45 percent of banks (10 of 22) received various types of support from different sources (table D.7). The most commonly received support is technical assistance—nine of the ten banks received technical assistance. Other types of support were evenly spread among grants, guarantees, and subsidized credit. The top two sources of support were international development agencies and international financial institutions. Each of these two channels provided support to nine banks. Domestic providers comprised three groups: government, Chinese financial organizations, and other Chinese institutions. But overall their activities seemed fairly sporadic.

Types of technical assistance received for all banks

Among all banks giving energy efficiency loans, the majority (15 of 26) received various types of technical assistance, including training on energy efficiency technologies, structuring and marketing energy efficiency loans, credit underwriting and risk assessment, portfolio management and reporting practices, and marketing research and identification of target sectors. Fourteen of them have received more than one of the above types of training. There are no significant differences among the numbers of banks that have received different types of training (figure D.2).

This technical assistance was generally valued by recipient banks. Only two banks answered that the technical assistance was not an important factor for their energy efficiency finance business. One bank answered that the technical assistance was important at the beginning, and 13 answered that technical assistance was important to entering the market and continuing. That said, however, they also believe that technical assistance is not essential for sustaining and expanding their energy efficiency financing. Seventy-one percent of banks that answered the question said they can sustain and expand energy efficiency financing without the technical assistance.

TABLE D.6 Institutional Setup for Energy Efficiency Lending

Bank type	Dedicated unit (%)	No dedicated unit but dedicated professionals (%)	Special procedures or guidelines for processing energy efficiency loans (%)
Policy and state owned	33 (2/6)	33 (2/6)	33 (2/6)
Joint stock	15 (2/13)	31 (4/13)	23 (3/13)
City or rural commercial	0 (0/3)	33 (1/3)	0 (0/3)
Total	18 (4/22)	32 (7/22)	23 (5/22)

Source: IEG/CBRC survey on energy efficiency finance in China.

Note: Numbers in parentheses indicate how many banks answered this way out of total banks answering. ESCO = energy service company.

TABLE D.7 Types of Support Banks Received in Provision of Energy Efficiency Financing

Support	Government	International development agencies	International financial institutions	Chinese financial organizations	Other Chinese institutions	Total
Grants		1	2			3
Guarantees		2			1	3
Technical assistance	1	4	6	1	2	9
Subsidized (low interest rate) credit lines		2	1			2
Total	1	9	9	1	3	10

Source: IEG/CBRC survey on energy efficiency finance in China.

Note: Rows and the last column here do not necessarily add up because some banks received support from more than one agency.

IFC and CHUEE

Seventy percent of all 23 responding banks (excluding the three CHUEE banks) said they were aware of CHUEE support to IB, BOB and SPDB on energy efficiency lending (table D.8). Comparatively speaking, joint-stock banks have the highest awareness, followed closely by policy and state-owned banks, with city and rural commercial banks coming as a distant third. This is consistent with the fact that CHUEE banks are all joint-stock banks, though BOB is a city commercial bank turned joint-stock bank.

Issues in interpreting the data

A caveat to keep in mind is that not all the loans reported by respondent banks as energy efficiency loans are in fact standard energy efficiency loans as typically defined in the literature (Taylor and others 2008, pp. 39–40), that is, a loan made to a standard energy efficiency project whose primary objective is to achieve energy efficiency savings, as opposed to say a multipurpose restructuring project with energy efficiency as only one of its multiple objectives. The investment cost of a standard energy efficiency project is relatively small, usually no more than 39 million yuan at the 2007 price (Taylor and others 2008), whereas that of a restructuring project is much higher. Hence, the average size of a standard energy efficiency loan should be much smaller than 39 million yuan. The comments made by banks in the survey answers suggest that they had included loans to restructuring projects as part of their reported energy efficiency loans, such as thermal power "large replacing small" projects, clean energy projects, general purpose technical renovation and structure adjustment projects, and so forth. These projects have certain energy efficiency effects but are largely for the purpose of capacity expansion, and their sizes are much larger than standard energy efficiency projects.

Table D.9 provides three examples of such projects reported by banks. The size of the loan for each of the projects is well above the amount typical for a standard energy efficiency loan. The first and second projects have a heavy focus on output capacity expansion. They do contribute to emission reduction in certain locations or plants, but emission might have increased in the other locations or plants. Therefore, the new plant necessarily contributes to emission reduction at the aggregate level. No information is available about the purpose and contents of the third project. But it can be told from the large size of the loan that the project is far from being a standard one.

TABLE D.8 Recognition of CHUEE among Banks

Type of bank	Banks that know CHUEE (%)
Policy and state-owned	71 (5/7)
Joint stock	75 (9/12)
City and rural commercial	50 (2/4)
Total	70 (16/23)

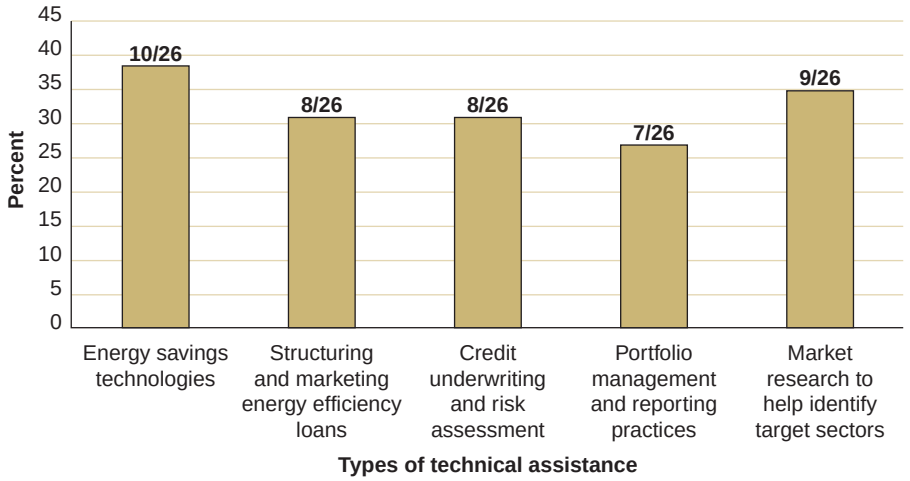
Source: IEG/CBRC survey on energy efficiency finance in China.

Note: Numbers in parentheses indicate how many banks answered this way out of total banks answering.

Selection of Comparable Banks

From the 27 nontreatment banks that answered the survey, 6 comparison banks for IB and 3 for BOB have been identified (tables D.10 and D.11). They are selected based on similarity of a number of baseline bank characteristics such as ownership/governance structure and geographical distribution/coverage of operations that are largely determined by bank type (state-owned, joint-stock, city commercial, and other factors), size as measured by total assets and total outstanding loans, and portfolio/client base. The

FIGURE D.2 Number of Banks and Types of Technical Assistances Received



Source: IEG/CBRC survey on energy efficiency finance in China.

Note: Numbers above bars represent how many banks received that type of assistance out of total number of banks.

rationale for considering these factors is that they are very likely correlated with the outcomes of CHUEE support to banks. The process of identifying the comparison banks was straightforward because the dropped banks were either significantly too small or too much larger than or not the same type as IB or BOB.

The participating banks were selected based on a combination of IFC's screening and self-selection of potential participant banks themselves. There was no pipeline of candidate participating banks, so the pipeline method is not used in the identification of the comparison groups. The propensity score matching method is not used because there was only one treatment bank—that is, either IB or BOB—and there were no more than 10 loosely comparable banks to either IB or BOB, based on some of the most obviously relevant variables, such as bank size and ownership/governance structure.

Almost all these comparison banks have had some experience in making loans to/via energy management companies (EMCs) guaranteed by China Investment and Guarantee Agency with support from the World Bank. In addition, two of the comparison banks have had direct cooperation with aid agencies in energy efficiency financing, mainly in the form of on-lending loans from aid agencies to end loan recipients for energy efficiency investments. One received assistance from a bilateral aid agency in 2005, shortly before CHUEE, and the other from both a bilateral agency and an international organization at the end of the

TABLE D.9 Examples of Energy Efficiency Loans Provided by Responding Banks

Project type and loan amount	Description of projects
Capacity expansion / environmental relocation (300 million yuan)	A loan to a steel company for its environmental relocation project. The loan is also sub-categorized by the bank as an equipment replacement loan. However, the construction contents of the project were mainly expansion of production capacity of pig iron by 320 thousand tons/year, steel billet by 1,990 thousand tons/year, and steel by 1,080 thousand tons/year.
Capacity expansion / "large replaces small" (220 million yuan)	A loan to a power plant phase III expansion via building a 1 x 600 megawatt ultra super-critical coal burning power generation unit, also called a "large replaces small" project.
Unknown-purpose electric power project (117 million yuan)	The balance amount of a loan to an electric power project.

Source: IEG/CBRC survey on energy efficiency finance in China.

review period (table D.10). These interventions are substantially different from CHUEE in that they are not based on a third-party guarantee for loans to energy efficiency projects and on project finance based lending as CHUEE is. However, they do provide support for certain training activities that are similar in some aspects to those supported by CHUEE. This can cause potential bias in estimating the impact of CHUEE's support to IB, as IB didn't receive assistance from any such interventions. The possible bias is worth keeping in mind. However, it ought not to be large, and the direction of the bias is known to be downward.

TABLE D.10 Industrial Bank and Comparable Banks

Bank (bank name or survey number)	Total assets in 2006 (billion yuan)	Outstanding loans by end of 2006 (billion yuan)	Portfolio/client base around 2006
Industrial Bank	617.5	324.4	Corporate banking and large enterprises, with corporate loans amounting to 77.9 percent of total loans by the end of 2006. Had limited experience in SME lending and energy efficiency equipment financing, but was committed to developing this business.
Bank 6	700.5	472.1	Traditionally focused on large enterprises. Loans to the top 10 clients amounted to 43.7 percent of total loans by end of 2006. Started to serve SMEs in 2006. Had a lot of focus on trade finance.
Bank 11[a]	944.6	565.7	Focused on large enterprises and projects. As of 2007, loans to enterprises in manufacturing, transport and telecommunications, storage, and wholesale and retail accounted for 63.6 percent of gross loans. In recent years it strengthened lending to SMEs. The bank put a lot of emphasis on retail banking as well.
Bank 22	706.9	463.2	Focused on large enterprises, but increasingly on SMEs as well. As of 2007, corporate loans accounted for 80.9 percent of gross loans. Portfolio composition: manufacturing 31.2 percent; transport, storage and telecommunication 13.5 percent; power, gas, and water 9.5 percent; and wholesale and retail 9.1 percent.
Bank 24[b]	445.1	259.8	Focused on corporate banking and medium-sized enterprises, with increased emphasis on financing of large enterprises. Corporate loans to top five industries amounted to 64.8 percent of total loans by the end of 2006.
Bank 25	596.1	352.3[c]	Focused on large and medium-sized enterprises. Meanwhile, started providing loans to small enterprises. Known for financing businesses through innovation and marketing.
Bank 26	689.3	460.9	Core business was corporate banking with retail banking only accounting for around 14 percent of its business activity; as of mid-2007, manufacturing 26 percent, wholesale and retail and restaurants 11 percent, real estate 10 percent, and social services 8.5 percent. The bank had a lot of focus on large enterprises but an increasing focus on SMEs as clients.

Sources: IEG survey of China financial institutions, IFC database, and banks' annual reports.

Note: SME = small and medium-size enterprise.
a. Received assistance from a bilateral aid agency in 2005.
b. Received assistance from both a bilateral agency and an international organization in late 2008.
c. By September 2006, based on the bank's Web site.

TABLE D.11 Bank of Beijing and Comparable Banks

Bank (bank name or survey number)	Total assets in 2006 (billion yuan)	Outstanding loans by end of 2006 (billion yuan)	Bank type and geographic coverage	Portfolio/client base around 2006
Bank of Beijing	272.8	129.6	City commercial bank turned joint-stock bank. Traditionally limited to Beijing Municipality. Now expanded to some major economic centers in various areas of the country. Main business is corporate banking, supplemented by retail banking, consumer banking.	Traditionally large, state-owned enterprises and large public projects owned by Beijing Municipality. Started to diversify in recent years.
Bank 18	262.9	124.7	City commercial bank turned joint-stock bank. Focus on local enterprises and projects in the municipality of its headquarters, but started to diversify into other parts of the country in 2006, especially some major economic centers.	Large municipal projects as well as SMEs.
Bank 20	260.8	182.2	Established branches in major economic centers around the country, especially in the coastal areas.	Large enterprises in manufacturing, social services, commerce, real estate, and so forth. In recent years, SMEs have become a target group.
Bank 21	374.3	217.0	A joint-stock bank with branches in many major economic centers around the country.	Large enterprises in a variety of sectors. Launched a SME initiative around 2006.

Sources: IEG survey of China financial institutions, IFC database, and banks' annual reports and Web sites.

Note: SME = small and medium-size enterprise.

APPENDIX E

Energy Management Company Survey

The Survey

There were 135 ESCOs/energy management companies (EMCs) on the list of the CHUEE network. The treatment sample was restricted to 41 China-based ESCOs/EMCs that were mainly in the business of energy efficiency services provision and that were members of the China Energy Management Company Association (EMCA), because of the key role these ESCOs were expected to play in helping reduce market barriers to energy efficiency investment in China related to the lack of channels for access to reliable energy efficiency services. The excluded ESCOs were either foreign based or those based in Hong Kong SAR, China, and had relatively strong financial and technical capacities, or they were equipment suppliers. The untreated comparison sample consists of 59 ESCOs/EMCs randomly selected from the remaining 179 EMC members of EMCA that were mainly energy efficiency services providers. The total size of the sample was 100, of which 86 ESCOs/EMCs answered the survey. The survey was carried out through EMCA (86 percent response rate).

The CHUEE treatment on ESCOs/EMCs focused on providing a network of information and knowledge sharing to enhance possible partnerships and carry out certain training for network ESCOs/EMCs. The treatment is relatively simple and homogeneous and thus allows for appropriate use of dummy and mean comparison approaches.

Survey Responses

Access to technical assistance

CHUEE network members are associated with receiving effective technical assistance from various sources including CHUEE (table E.1). More than half of the network members (61 percent) received technical assistance from any sources (such as CHUEE and EMCA), compared with nonmembers (only a quarter received technical assistance).

Access to finance

Based on the survey, a larger number of CHUEE's EMC network members applied for a loan than nonmember EMCs. More than half (62 percent) of CHUEE network members applied for a loan, compared with only a quarter of nonmembers (table E.2). Moreover, CHUEE members were more successful in getting loans: 78 percent of applicants obtained a loan, compared with just half of non-CHUEE members. Overall, nearly half of CHUEE members received a loan, compared with just 13 percent of nonmembers.

Terms and conditions of the loan

When EMCs have some access to loans, the size of the loans is relatively small: 60 percent of EMCs are getting loans for less than 5 million yuan ($0.73 million), with bulk of the loans between 1 and 5 million yuan (table E.3).

Half the EMCs are getting loans with a maturity of less than a year. For those with access to a loan, technical assistance (irrespective of sources) lengthens the term of the loan. Technical assistance from CHUEE and EMCA in particular lengthens loan maturity: 80 percent of the EMCs without technical assistance received only short-term loans (less than a year), and 53 percent of technical assistance recipients had long-term loans (maturity of a year or more). About 80 percent of CHUEE technical assistance recipients and 72 percent of EMCA technical assistance recipients had long-term loans.

TABLE E.1 EMCs Receiving Technical Assistance

Have you received technical assistance?

	CHUEE network (%)	Non-CHUEE network (%)
Technical assistance received (from any source)	61	24
Technical assistance not received	39	76

Source: IEG/EMCA survey data.

Note: EMC = energy management company.

TABLE E.2 Access to Finance among EMCs

	CHUEE network member EMCs (%)	Non-CHUEE network member EMCs (%)	Overall (%)
Applied to loan	62	25	41
Of which, obtained a loan	78	50	63
Overall access to finance	49	13	28

Source: IEG/EMCA survey data.

Note: EMC = energy management company.

TABLE E.3 Size of Loans Obtained by EMCs

Amount	EMCs obtained loans (%)
Less than 1 million yuan	17
1–5 million yuan	43
5–10 million yuan	9
10–20 million yuan	13
20–40 million yuan	13
More than 40 million yuan	4

Source: IEG/EMCA survey data.

TABLE E.4 Types of Loan Collaterals and Use of Guarantees for Loans to EMCs

	Percent of EMCs provided loans
Liens on personal or corporate assets (including parent company guarantees, mortgage in equipment, and so forth)	67
Receivables from the energy efficiency project	29
Loan guarantee from China National Investment and Guarantee Co .	24
Other guarantee agency	33
Others	18

Source: IEG/EMCA survey data.

Loan collaterals and guarantees

Majority of loans are liens on personal or corporate assets, while about a quarter to one-third include receivables from energy efficiency projects (table E.4). Guarantees from China National Investment and Guarantee Co. and other agencies/companies are popular as well.

Corporate business performance

CHUEE members on average grow faster than nonmembers as measured by growth in average assets (table E.5). Those who obtained loans had a higher growth rate than average; however, the CHUEE network group had a much higher growth rate than the average, and far higher than the comparison group.

Confirming ongoing challenges to access to financing

The survey highlighted ongoing challenges for EMCs to obtain loans. Twenty-eight percent of the answers indicated that banks are requesting fixed asset collateral, rather than cash flow, and that was considered a constraint. Furthermore, 22 percent of EMCs answered that the banks are not aware of energy efficiency projects. Banks' lending attitudes are still a concern for some, as 16 percent responded that banks cannot lend for long-term or small projects. Access to guarantees was a concern for 12 percent of EMCs. The survey also revealed that 29 percent of loans include receivables from the energy efficiency project as collateral; thus, there is more room for a project finance type of loan to EMCs.

TABLE E.5 Average Asset Growth Rate

	2006–07 (%)	2007–08 (%)
CHUEE network EMCs	19	21
Non-CHUEE network EMCs	11	7
EMCs with loans	17	18
EMCs without loans	12	10
All	14	13

Source: IEG/EMCA survey data.

Note: EMC = energy management company.

Propensity Score Matching Methods to Minimize Selection Bias

Although the program did not intentionally screen the applicants for membership into the network, the beneficiaries were not a random sample of the population. Therefore, the comparison group is also not a random sample of the population. The comparison group needs to be matched with the treatment group on relevant characteristics.

The propensity score matching method is one way to achieve this matching. Propensity score matching identifies a group of individuals, households, or firms with the same observable characteristics as those participating in the project. It does this by estimating a statistical model of the probability of participating (propensity to participate) using a regression model with participation as the zero-one dependent variable and a set of observable characteristics that must be unaffected by the intervention as the explanatory variables. The coefficients are used to calculate a propensity score, and participants are matched with nonparticipants based on having similar scores.

In this case, the statistical model of participating was based on the following:

- Dependent variable: network participation
- Independent variables: asset size before program, year of establishment of the company, number of employees, and applications for loans.

Based on the matching exercise, 50 companies (21 network, 29 nonnetwork) were matched, and the same analysis was conducted with a reduced amount of data (see tables 3.14–3.16 in the text). The analysis confirms the conclusion about the association between network participation and access to financing and asset growth.

APPENDIX F

Cement Company Survey

The Survey

The survey of energy end users mainly consists of a sample of untreated cement companies in Henan, Shandong, and Zhejiang Provinces and treated ones in a number of provinces. The cement industry was selected because it is one of the key sectors that CHUEE has been providing support to and it is reasonably easy to identify untreated comparison companies in the industry. The three provinces were selected because they were among the largest cement producing provinces in China and had comparatively the least exposure to CHUEE intervention and thus were unlikely to have significant contamination effects. For example, there were no CHUEE-supported cement companies in Henan Province, and there were only one and three in Shandong and Zhejiang Provinces, respectively (table F.1). The three provinces were also selected because they are located in the same region as CHUEE clients: the coastal and central part of China.

The sample of untreated cement companies consists of 13 companies in each of Henan and Shandong Provinces and 14 in Zhejiang Province. For each of the three provinces, the sample companies were randomly selected for inclusion in the survey from a population of untreated companies that in turn were identified from China Cement Association's list of cement companies that had at least one new suspension precalcination (NSP) cement production line of 2,500 tons per day at the time of the survey (table F.2). The rationale for using this NSP production line–based criterion in the sample selection was to ensure basic comparability: CHUEE loans to cement industry focused exclusively on waste heat recovery from NSP cement production lines with a cement production capacity of 2,500 tons per day.

The distribution of the untreated sample companies among the three provinces was determined partially based on consideration of matching with the geographic distribution of the treatment companies, which are located in either coastal or central regions. The two regions tend to have significantly different characteristics that very likely affect the outcome of CHUEE energy efficiency lending in the cement industry, such as energy price, government incentives, ease of access to the electricity grid, environmental performance measurement and monitoring by the government, effectiveness of business contract enforcement, and so forth. Hence, the percentage of untreated sample companies in the central region should be more or less the same as that of treated sample companies.

The survey was carried out from May to August 2009, mainly through the China Cement Association. The survey questionnaire is the same for all sample companies, treated or untreated. Thirty-eight of 40 untreated cement companies answered the survey (95 percent response rate). Sixteen treated cement companies were surveyed, and 15 of them answered the questionnaire (95 percent response rate). Table F.2 shows that the regional distribution of treated cement companies that answered the survey indeed matches well with that of untreated sample companies.

Other company characteristics that likely correlate with the outcome of CHUEE energy efficiency lending include the age of the company; the NSP production line; company

TABLE F.1 Descriptive Statistics of the Sample for Survey of Untreated Cement Companies

Province	Number of sample companies	Number of cement companies meeting the criteria	Number of CHUEE clients in the province	Province's national production share in 2005 (%)	Province's national output ranking
Henan	13	32	0	6	6
Shandong	13	32	1	14	1
Zhejiang	14	34	3	9	2

Sources: IEG, China Cement Association.

TABLE F.2 Regional Distribution of Treated vs. Untreated Cement Companies that Answered the Survey

Region	CHUEE cement companies			Non-CHUEE cement companies		
	Province	Number of responses	Regional distribution	Province	Number of responses	Regional distribution
Central provinces	Chongqing	1		Henan	12	
	Hebei	1				
	Hubei	2				
	Hunan	1				
	Subtotal	5	**33%**		12	**32%**
Coastal provinces	Jiangsu	3		Shandong	13	
	Shandong	1		Zhejiang	13	
	Tianjin	1				
	Zhejiang	2				
	Fujian	3				
	Subtotal	10	**67%**		26	**68%**
Total		15	100%		38	100%

Sources: IEG, China Cement Association.

size, as measured by sales, output, and NSP production capacity; whether the company is a member of a "group company" (conglomerates); and level of indebtedness as reflected by the ratio of outstanding loans to total assets. In general, large companies or those that are a member of a group company that have been in the market for a relatively long period tend to be more creditworthy and have more access to finance, have a stronger technical and management capacity, enjoy more support from government policies, and are subject to more pressures from the government on energy efficiency investment. Thus they are more likely to carry out energy efficiency investment and achieve good results.

In contrast, in general a company with less indebtedness tends to be more creditworthy and have better access to bank loans. The treated and the untreated sample companies match reasonably well on these characteristics (table F.3). Admittedly, there are certain differences between the two groups: treated companies are larger in general and relatively more established in the market, but a higher percentage of untreated companies are a member of a group company. This will result in possible estimation bias, but the bias is not expected to be very large.

Any possible contamination effect on the untreated sample from the treated companies should not be large. Besides

TABLE F.3 Characteristics of the Cement Companies Covered by the Survey

	% of companies that are a member of a group company or a holding company	Average year when an NSP production line was first built	Average total NSP production capacity as of end of 2006 (tons per day)	Average total sales in 2006 (million yuan)	Average total output in 2006 (million tons)	Average ratio of total outstanding loans to total assets in 2006 (%)
Non-CHUEE	97	2005	2,958	387	168	33
CHUEE	87	2001	6,113	495	231	31

Sources: IEG, China Cement Association.

Note: NSP = new suspension precalcination.

the fact that the untreated cement companies in the sample provinces had relatively less exposure to CHUEE financing, as discussed above, the CHUEE energy efficiency project finance–based lending model was unique in China and there were no comparable alternatives in the market. In addition, waste heat recovery projects were listed as one of the 10 key recommended energy efficiency projects by the government in 2006 and hence were well known among cement companies, especially among large ones.

More importantly, many companies in China completed investment in waste heat recovery and achieved success from 2005 to 2006, shortly before CHUEE's intervention. Table F.4 shows that 25 waste heat recovery projects were put into operation in 2005 and 2006 (6 in 2005 and 19 in 2006). These projects were implemented by major cement companies in about 12 provinces in the coastal and central part of China, and most of them were based on an NSP production line of 2,500 tons per day or more as CHUEE cement projects. The electricity generation output of most of these projects was above expectation, though it is based on domestic technology and equipment (IFC 2007).

TABLE F.4 Waste Heat Recovery Projects in the Cement Industry in China (February 2007)

	Name of enterprise	Scale of production (tons/day)[a]	Designed installed capacity (kW)	Average electricity generation (kW)[b]	Designing unit	Year operation started
1	Conch Group Ninguo Cement Plant	4,000	6,480	7,000	TCDRI	1998
2	Shanghai Wanan Enterprise Corp.	1,200	2,500	2,000	TCDRI	2003
3	Guangxi Liuzhou Cement Plant	4,000	6,000	5,900	TCDRI	2005
4	Zhejiang Shenhe Cement Co., Ltd.	2,500	3,000	2,900	TCDRI	2005
5	Zhejiang Qinglongshan Cement Co., Ltd.	1,200 + 2,500	2 × 3,000	4,900	TCDRI	2005
6	Zhejiang Changxing Xiaopu Zhongsheng Cement Co., Ltd.	2,500	3,000	3,300	TCDRI	2005
7	Zhejiang Changxing Meishan Zhongsheng Building Material Co., Ltd.	5,000	6,000	6,800	TCDRI	2005
8	Zhejiang Leomax Cement Co., Ltd.	2,500 + 5,000	3,000 + 6,000	9,600	TCDRI	2005
9	Zhejiang Zhongxinyuan Cement Co., Ltd.	2,500	3,000	3,200	TCDRI	2005
10	Zhejiang Haolong Building Material Co., Ltd.	1,200	1,500	1,700	TCDRI	2006
11	Hainan Sanya Huashengtianya Cement Co., Ltd.	5,000	6,000	7,200	TCDRI	2006
12	Shandong Zibo Donghua Cement Co., Ltd.	5,000	6,000	6,600	TCDRI	2006
13	Jiangxi Taihe Yuhua Cement Co., Ltd.	1,200	2,500	2,000	TCDRI	2006

(continued on next page)

TABLE F.4 Waste Heat Recovery Projects in the Cement Industry in China (February 2007) *(continued)*

	Name of enterprise	Scale of production (tons/day)[a]	Designed installed capacity (kW)	Average electricity generation (kW)[b]	Designing unit	Year operation started
14	Sichuan Shuangma Yibin Electric Power & Energy Co., Ltd.	2,500	3,000	3,200	TCDRI	2006
15	Beijing Cement Plant Co., Ltd.	2,000 + 3,000	7,500	7,000	TCDRI	2006
16	Gansu Qilianshan Cement Co., Ltd.	2 × 2,200	6,000	6,200	TCDRI	2006
17	Zhejiang Red Lion Cement Co., Ltd.	2 × 2,500 + 5,000	2 × 7,500	18,000–20,000	TCDRI	2006
18	Hebei Luquan Quzhai Cement Co., Ltd.	2 × 2,500	2 × 4,500	7,800	TCDRI	2006
19	Zhejiang Zhengda Cement Co., Ltd.	1,200	2,500	2,000	TCDRI	2006
20	Jiangxi Gaoan Red Lion Cement Co., Ltd.	5,000	9,000	9,600–10,000	TCDRI	2007
21	Weifang Sunnsy Cement Co., Ltd.	2,500	4,500		Dalian Yishida Energy Engineering Co., Ltd.	2006
22	Changle Sunnsy Cement Co., Ltd.	2,500	3,300		Dalian Yishida	2007
23	Zhejiang Dushan Group	2,500	4,500		Dalian Yishida	2006
24	Zhejiang Xingbaolong Co., Ltd.	1,600	3,000		Dalian Yishida	2006
25	Changzhou Pangu Cement Co., Ltd.	2,000	3,000		Shanghai Kaineng	2006
26	Taishan Cement Group Co., Ltd.	2,500 + 5,000	13,200		Huaxiao Energy	2006
27	Liaoyuan Jingang Cement Group	2 × 5,000	2 × 7,500		CITIC Heavy Machinery Inc.	2006
28	Guangdong Tapai Cement Co., Ltd.	5,000	7,500		CITIC Heavy Machinery Inc.	2007
29	Conch Group Ninguo Cement Plant	5,000	9,100		Conch Group	2006
30	Jiande Conch Cement Co., Ltd.	5,000	9,100		Conch Group	2006
31	Anhui Chizhou Conch Cement Co., Ltd.	2 × 5,000	17,000		Conch Group	2006
32	Anhui Tongling Conch Cement Co., Ltd.	4,000 + 5,000	16,300		Conch Group	2007
33	Anhui Congyang Conch	2 × 2,500 + 5,000	18,300		Conch Group	2007
34	Jiangxi Cement Plant	2,000	3,000		NCDRI & Shanghai Kaineng	2001
Total		150,500	239,780			

Source: IFC 2007.

Note: kW = kilowatt.
a. Two entries indicates two production lines with different capacities.
b. Blank cells indicate no data available.

Survey Responses

Incidence of waste heat recovery projects

The survey indicated that there is considerable uptake on energy efficiency investments within the industry. All companies surveyed responded that they have either invested or are planning to invest in a waste heat recovery system on at least one of the company's production lines. In total there are 42 (some companies have more than one waste

TABLE F.5 Source of Technical Expertise in Implementing Energy Efficiency Projects

	CHUEE cement companies	Non-CHUEE cement companies that actually implemented energy efficiency projects
Internal technical staff	87%	83%
Equipment suppliers	53%	53%
Relationship companies (clients, suppliers)	33%	13%
EMCs	40%	23%
Technical consultants specialized in industry	73%	50%
Utility companies (gas, electricity, and so forth)	20%	0%
Banks	40%	17%
Government agencies	73%	73%
Industry association	40%	47%
Average types of technical expertise involved in energy efficiency projects	4.6	3.6
Percent of companies with 0–3 types of technical assistance involved	47	44
Percent of companies with 7–9 types of technical assistance involved	20	4

Sources: IEG surveys of Chinese cement companies.

heat project) projects among companies not participating in the program.

Role of marketing actors more critical for CHUEE cement companies

The role of internal staff and equipment suppliers was nearly the same for CHUEE clients and nonclients; the most important differences are a strong reliance on marketing partners among CHUEE clients, such as EMCs and technical consultants (83 percent and 100 percent for CHUEE, 23 percent and 50 percent for non-CHUEE, respectively). Banks are more relevant as source of technical expertise for CHUEE (50 percent) than non-CHUEE companies (17 percent; see table F.5). The non-CHUEE groups got more assistance from government agencies and industrial associations.[1] The role of banks and marketing channels reflects inputs from CHUEE interventions.

Significant differences between CHUEE and non-CHUEE companies exist in the role of EMCs, which is higher for CHUEE companies. Equipment suppliers are important players for both groups. Government support in providing technical advice and awards (financial stimulus) is widespread in the sector.

The survey results confirm the importance of internal technical capacities in executing energy efficiency projects, and technical help from banks (for CHUEE beneficiaries), EMCs, suppliers, and the government played supplementary roles (table F.6).

TABLE F.6 Type of Support Received in Energy Efficiency Projects

Support	CHUEE companies	Non-CHUEE companies
Grants	13% government grant	3% government grant
Energy saving performance guarantees	20% Suppliers 7% international donors	20% suppliers 3% EMCs
Technical assistance	33% EMCs 13% suppliers	23% suppliers 7% suppliers and EMCs
Government awards for energy conservation	87% received government awards	70% received government awards
Government subsidized (state bond fund subsidized) line of credit	27% received subsidized credit	13% received subsidized credit

Sources: IEG surveys of Chinese cement companies.

Note: EMC = energy management company.

APPENDIX G

CHUEE Cost Benefit Analysis

The calculation covers energy efficiency projects supported by the program's guarantee and financed by the partner banks (IB and BOB). The portfolio includes projects under the guarantee facility, and program expenditures and fee incomes until the end of fiscal 2009.

Benefits

1. Greenhouse gas (GHG) emission reductions, measured by an engineering calculation of estimated annual GHG reductions in CO_2 tons. They are monetized by the price quoted in the carbon trade market.
2. Energy savings, measured by an engineering calculation of estimated annual energy savings by ton of coal equivalent. They are monetized by using the international price of coal.

Costs

1. Project costs of each energy efficiency projects
2. Program costs, consisting of
   a. Costs of technical assistance
   b. Costs of program's operations
   c. Costs of guarantees covered by the GEF grants (covering the first loss portion of the risk-sharing facility). IFC's expenditures come from the expense records of supervision reports, verified with the program's original budgets and records for the trust funds (technical assistance).

Assumptions

1. Projects are implemented by 2008. Project benefits last until 2016. Exchange rates and carbon and coal prices will be stable until 2016.
2. Costs of guarantees are expected losses (4 percent of the portfolio) estimated at the time of appraisal.

Scenarios

1. Base case: Based on the program's end user surveys (general client and cement), interviews, and reviews of project documentation, it is estimated that 9 percent of end users would not have implemented the energy efficiency projects if there were no loans supported by the program. This 9 percent figure was used to benchmark incremental benefits from the program (9 percent of total project costs and project benefits are used).
2. High case: Program's additionality may be higher because of its assistance to capacity building in banks and because of the introduction of loans with lower collateral requirements. High case assumes partial additionality in 76 percent of projects as a direct contribution from the program.

Results

In the base case, the rate of return was 38 percent, which is higher than the private return (cost of project versus energy savings) of the same projects (20 percent). The gap between the two is a proxy of the program's social contributions through the emission reductions, leveraged by the program inputs including the subsidy components. The upper limit of the program's return takes into account benefits from 76 percent of projects, as 24 percent of projects were said to be implemented in full even without the program. The upper limit rate of return is as high as 45 percent.

Realistically, the program's return would be somewhere between 38 and 45 percent but closer to the 38 percent, as benefits in the 76 percent case are only partial—bigger scope or faster implementation. The calculations also suggest that the social rate of return is not very sensitive to the degree of additionality once a certain threshold is reached, covering the fixed costs of running the program and the subsidies involved.

TABLE G.1 Cost Benefit Analysis Worksheet

Year		2006	2007	2008	2009	
RMB/$		7.80	7.32	6.85	6.83	
Benefits						
Emission reductions	CO_2 ton	—	—	1,050,827.53	6,698,565.72	
Carbon price	$/$CO_2$ ton			19.24	19.24	
Emission in $				20,217,921.60	128,880,404.45	
Energy savings	Ton of coal equiv.	—	—	345,837.02	1,801,787.27	
Price of coal	$/ton		65.73	127.10	70.82	
Energy savings ($)				36,628,855.40	191,216,537.13	
Total benefits	4,267,197,356.85			64,175,248.10	256,484,617.16	
9% benefits scenario	384,047,762.12			5,775,772.33	23,083,615.54	
76% benefits scenario	3,243,069,991.21			48,773,188.55	194,928,309.04	
New guarantees issued	RMB		435,300,000	206,664,166	1,494,308,817	
	$		59,467,213	30,191,107	218,738,025	
Costs						
Project costs	$		78,689,536.99	781,975,329.16	76,238,780.95	
9% benefits scenario			7,082,058.33	70,377,779.62	6,861,490.29	
76% benefits scenario			59,804,048.11	594,301,250.16	57,941,473.52	
Program costs		457,500.00	4,751,422.47	3,580,378.23	11,122,254.94	
Operations costs	$	457,500.00	1,372,733.94	1,372,733.94	1,372,733.94	
Technical assistance	Trust funds (est.)		1,000,000.00	1,000,000.00	1,000,000.00	
Guarantee (est. losses)	4% of portfolio		2,378,688.52	1,207,644.28	8,749,521.00	
Total costs		457,500.00	83,440,959.45	785,555,707.38	87,361,035.89	
9% benefits scenario		457,500.00	11,833,480.80	73,958,157.85	17,983,745.22	
76% benefits scenario		457,500.00	64,555,470.58	597,881,628.38	69,063,728.46	
GDP deflator		100.0	102.7	105.0	106.6	
Net benefits (real)						
Total net benefits		(457,500.00)	(80,279,083.47)	(686,349,747.57)	159,533,586.60	
9% benefits scenario		(457,500.00)	(10,549,390.92)	(65,927,826.36)	7,609,059.28	
9% case rates of return	38%					
76% benefits scenario		(457,500.00)	(61,888,834.89)	(522,215,843.68)	118,967,408.29	
76% case rates of return	45%					
Private net benefits		—	(76,626,035.77)	(703,154,094.89)	48,167,993.49	
Private rates of return	20%					

Source: IEG database.

Note: CO_2 = carbon dioxide; GDP = gross domestic product; RMB = Chinese yuan; USD = United States' dollar.

	2010	2011	2012	2013	2014	2015	2016
	6.83	6.83	6.83	6.83	6.83	6.83	6.83
	14,155,449.42	14,155,449.42	14,155,449.42	14,155,449.42	14,155,449.42	14,155,449.42	14,155,449.42
	19.24	19.24	19.24	19.24	19.24	19.24	19.24
	272,350,846.84	272,350,846.84	272,350,846.84	272,350,846.84	272,350,846.84	272,350,846.84	272,350,846.84
	3,316,114.07	3,316,114.07	3,316,114.07	3,316,114.07	3,316,114.07	3,316,114.07	3,316,114.07
	87.89	87.89	87.89	87.89	87.89	87.89	87.89
	351,926,034.31	351,926,034.31	351,926,034.31	351,926,034.31	351,926,034.31	351,926,034.31	351,926,034.31
	563,791,070.23	563,791,070.23	563,791,070.23	563,791,070.23	563,791,070.23	563,791,070.23	563,791,070.23
	50,741,196.32	50,741,196.32	50,741,196.32	50,741,196.32	50,741,196.32	50,741,196.32	50,741,196.32
	428,481,213.37	428,481,213.37	428,481,213.37	428,481,213.37	428,481,213.37	428,481,213.37	428,481,213.37
	108.8	110.9	113.2	115.4	117.7	120.1	122.5
	518,329,150.15	508,165,833.48	498,201,797.53	488,433,134.83	478,856,014.54	469,466,680.92	460,261,451.89
	46,649,623.51	45,734,925.01	44,838,161.78	43,958,982.13	43,097,041.31	42,252,001.28	41,423,530.67
	393,930,154.11	386,206,033.44	378,633,366.12	371,209,182.47	363,930,571.05	356,794,677.50	349,798,703.43
	267,939,616.79	262,685,898.82	257,535,194.92	252,485,485.21	247,534,789.42	242,681,166.10	237,922,711.87

APPENDIX H

Major Climate Change Projects in China

Project name	Agency	GEF grant ($ millions)	Cofinancing total ($ millions)	Approval date	Description	Executing agency
Energy Conservation and Pollution Control in Township and Village Enterprise Industries	UNDP	1.00	0.00	Dec. 5, 1997	The primary objective of the project is to raise the energy efficiency of the rural industrial sector in China by selecting several key TVEs to carry out demonstration projects involving improved technologies. Four subsectors targeted: brick making, coking, metal casting, and cement.	Ministry of Agriculture
Efficient Industrial Boilers	IBRD	32.81	68.57	Dec. 23, 1996	This project will reduce GHG emissions by adapting high-efficiency foreign technologies to local conditions for small and medium-sized, coal-fired industrial boilers. To assist the dissemination and effective use of efficient technologies, the project will also strengthen China's industrial-boiler engineering, operations, production management, and marketing capabilities and improve boiler technology exchange domestically. As long-term measures for barrier removal, the project will support related technical and policy studies, public awareness/information dissemination, and strengthened environmental standards for the industrial boiler sector.	Ministry of Machinery Industry
Energy Conservation	IBRD	22.70	180.00	Mar. 26, 1998	The project will support the establishment, pilot testing, and commercial demonstration of market-oriented EMCs that will promote investments in energy-efficient technology through energy performance contracting. The project will start in three provinces, and after a pilot phase will be expanded to other parts of the country; it may involve more varied applications such as leasing or Chinese-foreign joint ventures. The project will also develop a national energy conservation information dissemination center to gather information and lessons learned on energy efficiency measures and to disseminate information on the technical and financial results of these measures, targeting enterprise managers.	State Economic and Trade Commission
Energy Conservation and GHG Emission Reduction in Chinese Township and Village Enterprises, Phase II	UNDP	8.00	10.55	Dec. 26, 2000	This project will focus on TVEs, which constitute a significant share of Chinese economic production. It seeks to reduce GHG emissions in China from the TVE sector by increasing the utilization of energy efficient technologies and products in the brick, cement, metal casting, and coking sectors. The project removes key market, regulatory, technological, management, and commercial barriers to the production, marketing, and utilization of energy efficient technologies and products in these industries.	UNIDO

Second Beijing Environment Project	IBRD	25.00	437.00	June 20, 2000	The project's objectives are to (i) improve the quality of life for the citizens of Beijing by alleviating the city's acute air and water pollution problems and (ii) significantly reduce China's GHG emissions. It has three components: energy conversion and efficiency; wastewater treatment; and environment capacity building. GEF assistance is requested to remove the barriers to successful implementation of the project's two major energy components. One of these components will convert at least 2,500 small (below 20 tons/hour) space-heating boilers from coal to natural gas (small boilers being the largest cause of ambient air pollution) and, by reducing the cost of gas boilers and creating conversion capacity, will indirectly facilitate at least another 2,500 boiler conversions. The second component will improve the energy efficiency of the city's extensive district heating systems.	Beijing Municipal and District Government, Beijing Comprehensive Investment Co.
Barrier Removal for Efficient Lighting Products and Systems	UNDP	8.14	18.07	July 6, 2001	The project aims at addressing identified market barriers to widespread use of energy efficient lighting in China by broadening the China Green Lights start-up efforts. The overall objective of this project is to save energy and protect the environment by reducing lighting energy use in China in 2010 by 10 percent, relative to a constant efficiency scenario. The specific objectives include upgrading of Chinese lighting products; increased consumer awareness of, and comfort with, efficient lighting products; and establishing a vibrant, self-sustaining market in efficient lighting products and services.	State Economic and Trade Commission
Demonstration of Fuel Cell Bus Commercialization in China (Phase II-Part I)	UNDP	5.82	10.12	Nov. 28, 2002	This project will help catalyze the cost-reduction of FCBs for public transit applications in Chinese cities by supporting significant parallel demonstrations of FCBs and their fueling infrastructures in Beijing and Shanghai. In collaboration with the Chinese government, the municipal governments of Beijing and Shanghai, and the private sector, the GEF and UNDP will assist the public transit companies of Beijing and Shanghai to obtain six FCBs each and operate these over a combined total of 1.6 million kilometers. The knowledge and experience gained through this project will enable the technology suppliers to identify cost-reduction opportunities and the host public transit operators to gain valuable experience needed to adopt larger fleets of FCBs in the future. Additionally, some activities will help build capacity relating to FCBs. Finally, a series of activities will also focus on defining a detailed strategy for large-scale FCB implementation in China, which is planned as a follow-on to this initial project.	State Economic and Trade Commission
Energy Conservation Project, Phase II	IBRD	26.00	255.20	Oct. 24, 2002	Phase II of the project is designed to replicate the experience of phase I, especially to support the development of new EMCs in China by strengthening an EMC service group, which is expected to develop into a self-sustaining EMC association and by establishing a guarantee fund to provide partial risk guarantees to local financial institutions that lend to the EMCs.	State Economic and Trade Commission
End Use Energy Efficiency Project	UNDP	17.38	63.00	Mar. 29, 2005	The Chinese government is embarking on a long-term program to support energy efficiency in the industrial and building sectors. This project supports the first phase (three years) of that program. The project's purpose is to remove barriers to the widespread application and practice of energy conservation and energy efficiency in the major energy consuming sectors (buildings and industrial) in China. The project fosters a strategic approach to developing, implementing, and enforcing a comprehensive and effective energy conservation policy and regulatory system consistent with the objectives of the Energy Conservation Law of 1998. The project will play a catalytic role in promoting energy efficiency improvement and market development in China. The Chinese government attaches great importance to the project and intends for it to be the overarching framework for international cooperation on end-use energy efficiency.	State Development and Planning Commission

(continued on next page)

Project name	Agency	GEF grant ($ millions)	Cofinancing total ($ millions)	Approval date	Description	Executing agency
Heat Reform and Building Energy Efficiency Project	IBRD	18.35	81.00	Mar. 17, 2005	The project aims to improve the energy efficiency of new building construction in China through a combination of building equipment market transformation and heat supply policy approaches. It promotes demand in the housing sector for more efficient building materials and for more effective heat metering and control equipment. It also promotes new policies and institutions for metering, controlling, and managing centralized heat supply systems. The project is part of a broader program for heat reform and building energy efficiency by the World Bank and China. The concept fits within a "efficient product market transformation" strategic priority.	Ministry of Construction/CEEB
China Utility-Based Energy Efficiency Finance Program (CHUEE)	IBRD/IFC	16.50	130.40	Apr. 24, 2006	This project will organize and provide marketing, development, and financing services to commercial, industrial, and municipal sector energy users to implement energy efficiency equipment installations ("subprojects"), including those using high efficiency natural gas equipment.	IFC PMO
Energy Efficiency Financing	IBRD	13.50	583.15	May 27, 2008	The development objective of the proposed project is to improve the energy efficiency of medium and large industrial enterprises and to reduce their impact of climate change.	National Development and Reform Commission
Thermal Power Efficiency	IBRD	20.05	143.80	Nov. 16, 2007	The objective of the proposed project is to reduce GHG emissions by removing regulatory, institutional, and technical barriers to phasing out small inefficient coal-fired units, improving the efficiency of larger units, and introducing new generation dispatch models and trading mechanisms to improve the overall efficiency of the power system.	N/A
Promoting Clean Electric Buses for the Beijing Olympics	UNDP	1.00	12.30	May 2, 2008	This project supports the Chinese efforts in greening the 2008 Olympic Games in Beijing through the demonstration of electric buses solely powered by Li-ion batteries.	Beijing Municipal Environmental Protection Bureau
Phasing-out Incandescent Lamps & Energy Saving Lamps Promotion	UNDP	14.25	70.00	July 28, 2008	Enhanced promotion and implementation of the utilization of ESLs in China through the transformation of the local lighting products market and the phasing out of incandescent lamp production and sale.	National Development and Reform Commission
Promoting Energy Efficient Room Air Conditioners Project	UNDP	6.36	19.03	Nov. 13, 2008	Reduction of China's future GHG emissions through transformation of the Chinese RAC market to production and sale of more energy-efficient RACs.	Ministry of Environmental Protection
Provincial Energy Efficiency Scale-Up Program	IBRD	13.64	313.70	Under preparation	The overall development objective of this project is to achieve significant reductions in GHG emissions by establishing s uitable provincial-level policies and institutional and financial mechanisms to scale up the adoption of energy efficiency practices, technologies, and programs.	Shanxi Provincial Government, Jiangxi Provincial Government, Shandong Provincial Government

Energy Efficiency Power Plan Program	ADB		100 (ADB)	Under preparation	This program will establish a special financing fund implemented by a provincial government fund manager. It targets large/medium industrial and large commercial and institutional end users and ESCOs for retrofitting of plants and building.	Guangdong Provincial Government
Energy Efficiency Multi-Project Financing Program	ADB			Program concept approved in 2008; some projects are under discussion	Partial credit guarantees with partner banks. Will use technical partners to provide technical services for banks and will mobilize equipment vendor cofinancing. The project focuses on a variety of subsectors, including district heating, district cooling, and cogeneration projects.	The Chinese Government/Joint Venture Entities
Government of China Energy Efficiency Incentives and Special Funds	Government of China				In 2007 NDRC and the Ministry of Finance created energy efficiency fiscal incentive programs, including incentive payment of 200–250 yuan per annual TCE energy savings (15–20 percent project capital cost). Similar incentive funds set up or being formed at provincial and city levels, for example, Jiangsu, Guangdong, Hebei, subsidizing 10–30 percent of project costs. Currently the main focus is large projects. A new national government clean energy fund is being set up with proceeds from clean development mechanism projects.	Government of China
CDM Energy Efficiency Projects	CDM				Since 2006, CDM has financed energy efficiency projects in China. One criterion for a clean development mechanism project is additionality, implying that the program does not include commercially viable projects.	CDM PMO

Sources: GEF Web site: http://projectdatabase.thegef.org; ADB Web site: http://www.adb.org/Documents/Periodicals/Clean-Energy/ENERGY EFFICIENCY I-Update-Issue6.pdf; China Daily Web site: http://www.chinadaily.com.cn/bizchina/2008-06/20/content_6781657.htm; World Bank Web site: http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:20981087~pagePK:34370~piPK:34424~theSitePK:4607,00.html; MacLean 2008.

Note: ADB = Asian Development Bank; CDM = clean development mechanism; CEEB = Center of Energy Efficiency in Buildings; EMC = energy management company; ESCO = energy service company; ESL = energy sector loan; FCB = fuel cell bus; GEF = Global Environment Facility; GHG = greenhouse gas; IBRD = International Bank for Reconstruction and Development; IFC = International Finance Corporation; N/A = not applicable; NDRC = National Development and Reform Commission; PMO =Project Management Office; RAC = room air conditioner; TCE = ton of coal equivalent; TVE = township and village enterprise; UNDP = United Nations Development Programme; UNIDO = United Nations Industrial Development Organization.

Endnotes

Executive Summary

1. In 2008, total annual CO_2 emissions from the consumption of energy was 14.4 million metric tons in Lebanon, 13.5 million in Bolivia, 13.3 million in Sri Lanka, and 13.1 million in Jamaica.

Chapter 2

1. A quadrillion is one thousand million million or 10^{15} (1,000,000,000,000,000).
2. The appraisal assumed the following scenarios: the volume of projects financed ($150 million is the target case and $75 million the reduced volume case) and the level of loan defaults that directly affects expenditures of GEF RSF reserves (4 percent is the estimated case and 10 percent, reflecting complete expenditure of GEF RSF reserve funds, is the worst case). The "high defaults and low volume" case is a combination of 10 percent default rate and volume of $75 million. The base case is $150 million worth of projects financed with default rates at 4 percent.
3. The three pilot EMCs have been successful in terms of the delivery of energy savings and emission reductions; they have also shown that the ESCO model and the EPC mechanisms can be successfully and profitably implemented in China. By the end of 2006, the three ESCOs implemented 1,426 projects with total investments of 4.26 billion yuan (about $550 million). These projects saved 2.8 million tons of coal equivalent energy and reduced CO_2 by 1.81 million tons of carbon equivalent (IEG, forthcoming).
4. SAFE has been formulating an overall policy on risk-sharing and partial guarantee facilities. The IFC requests for SAFE approval became subject to the new regulations, and that caused the substantial delays in obtaining the approval.
5. Although the program is no longer based on utility-based financing, IFC continues to refer to it as Utility-Based Energy Efficiency (CHUEE).
6. The legal agreement allows IB to continue its lending, in anticipation of the program's effectiveness.
7. CHUEE conducted six studies covering the market potential for certain sectors and regions to guide the CHUEE team and clients (including network participants) and to inform their business plan in certain targeted energy efficiency markets.
8. The Castle Peak Power Plant in Tuen Mun, China, emits 35,800,000 tons of CO_2 per year. This is the China's largest emitter of CO_2, and the world's third largest (Science Daily 2007).

Chapter 3

1. Beijing Energy Efficiency Center data.
2. This to a significant extent reflected the national standards and practices these banks followed. For example, large thermal power plants built to replace small ones are counted as energy conservation projects, according to the government regulation.
3. "Over the next three years, IB will provide loans of 10 billion yuan to support the undertaking of energy conservation and emission reduction in China, and projects financed by this program are expected to save 60 million tons of coal equivalent and reduce 200 million tons of CO_2 emission. Capitalizing the know-how and experience obtained in CHUEE, the IB innovated upon financial instruments to successfully offer loans for carbon emission reduction, and developed two product series for buyer and seller in the carbon trading. The Company also established cooperative ties with the major carbon finance institutions such as the IFC, the Arreon Carbon UK Ltd, the Climate Change Capital and the KFW Carbon Fund" (IB 2008).
4. In December 2006, IB became a signatory on the Carbon Disclosure Project (a voluntary mechanism for institutions to disclose information about their carbon emissions). The following year, IB signed up for the United Nations Environment Programme Finance Initiative. IB became the first Chinese bank to adopt the Equator Principles in October 2008. In July 2008, the Chinese nongovernmental organization sector presented the first-ever Green Banking Innovation Award to IB. A Friend of the Earth report describes IB as "fast becoming a model of sustainable investing in the country. IB's relationship with the IFC probably has much to do with its environmental progress" (Matisoff and Chan 2009). IB was a runner up in the *Financial Times*/IFC Sustainable Banking Awards in 2007 and 2008.
5. SMEs in China were defined as businesses with fewer than 2,000 employees, less than $50 million in assets, and less than $37 million in sales (these amounts vary depending on sector).

6. The project finance-based lending discussed here is different from traditional project finance, especially in that it is not based on a nonrecourse loan structure, as traditional project finance models are. When making credit risk decisions and underwriting loans, project finance-based lending may to a certain extent still consider the general assets or creditworthiness of the project sponsors, though it puts more emphasis on project cash flow and project assets.
7. This practice by itself is probably not entirely new in China. IB said in the survey that it followed this practice before CHUEE, though BOB said that this is an innovation brought by CHUEE.
8. Based on field interviews with end users and banks, such mid- to long-term loans with amortization repayments alone are actually not entirely lacking in China's financial market. However, especially for smaller companies or companies with perceived high credit risk, such loans are in short supply. The amortization schedule tends to be by year rather than by quarter, as is the case under CHUEE. Also see appendix D for further statistics from the survey.
9. These loans are in general not project finance based, because (i) the guarantees were typically based on counter guarantees in the form of fixed asset collateral from loan recipients, and these collateral requirements are typically as strict as those of commercial banks; (ii) account receivables are mostly associated with already implemented projects, not with the project being financed; or (iii) in certain cases, such as for some clean development mechanism projects, the loan was for refinancing. This was often the case in which the account receivables of the project had become stable after it had been in operation for some time (IFC 2008).
10. Regression of factors influencing cement companies' decision to invest in waste water heat recovery projects among CHUEE cement companies tested "investment implementation" as the dependent variable, with independent variables from survey answers ("competitive pressure," "availability of credit," "availability of government subsidies," and "GHG reduction as policy"). Only "availability of credit" was a significant factor, with statistical significance at 5 percent.
11. The relevant survey statement was: "We saw other banks engaging in the business of energy efficiency." The ratings were as follows: important: 6 percent; fair: 28 percent; not important: 22 percent; NA: 44 percent.
12. Relevant questions were as follows: (i) "Management saw a market opportunity." Important: 94 percent; fair: 6 percent. "Energy efficiency became an important national policy priority." Important: 100 percent. "The government started providing incentives for energy efficiency." Important: 56 percent; fair: 11 percent; not important: 6 percent; NA: 28 percent.
13. There is near-zero correlation between receiving technical assistance from any source and program membership.
14. The original expected project sizes under CHUEE range from 500,000 to 1 million Chinese yuan at the small end to 16–40 million yuan at the large end. Expected average size is about 2–4 million yuan, and targets directly supporting more than 1 billion yuan in loans and 350–400 transactions over the six-year life of the program, with 61 percent of the volume to be small projects with average loan size of 1.5 million yuan. This indicates that the intended projects are small and support SMEs purchasing relatively small-scale energy efficiency equipment. This target was maintained in CHUEE II, as it set its target for 160–250 transactions with average loan size $1.3–2.0 million.

Appendix A

1. www.zhjieneng.net. "合同能源管理资料整理与分析."
2. In December 2005, the State Council issued a provisional regulation on promoting structural adjustment, calling for, among other things, developing large corporations and a "recycle economy" (featuring resource reutilization, energy conservation, and so forth) and reducing the share of "high energy consumption, high pollution" sectors. The regulation set up some good goals but lacked specific implementation measures.
3. Subsequently, the government issued a number of policies to implement the notice. In April and June 2006, for example, the National Development and Reform Commission, jointly with seven other ministries and bureaus, issued implementation policies for the cement and steel industries, entitled "Notice on Several Opinions Regarding Accelerating Structure Adjustment in the Cement Industry" and "Notice on Controlling Total Quantities, Eliminating Backward Capacities, and Accelerating Structural Adjustment in the Iron and Steel Industry," respectively.
4. www.cdmfund.org.

Appendix F

1. This survey was conducted by the EMCA; therefore, there may be some elements of bias in this answer.

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