Public Disclosure Authorized

Public Disclosure Authorized

Document of
The World Bank

Report No.: 54832

PROJECT PERFORMANCE ASSESSMENT REPORT

PEOPLE'S REPUBLIC OF CHINA

ENERGY CONSERVATION PROJECT
IBRD-4304 CHA; TF-028323 CHA; EECT-20949

June 1, 2010

Sector Evaluations (IEGSE)
Independent Evaluation Group (World Bank)

Currency Equivalents (annual averages)

Currency Unit = Chinese Yuan Renminbi (CNY)

1998	US$1.00	CNY 8.28
1999	US$1.00	CNY 8.28
2000	US$1.00	CNY 8.28
2001	US$1.00	CNY 8.28
2002	US$1.00	CNY 8.28
2003	US$1.00	CNY 8.28
2004	US$1.00	CNY 8.28
2005	US$1.00	CNY 8.19
2006	US$1.00	CNY 7.99

Abbreviations and Acronyms

Btu	British Thermal Unit
EC	European Commission
EMCA	Energy Management Company Association
EMC	Energy Management Company
EPC	Energy Performance Contract
ERR	Economic Rate of Return
GDP	Gross domestic product
GEF	Global Environment Facility
GEO	Global environment objective
ICR	Implementation Completion Report
IBRD	International Bank for Reconstruction and Development
IEG	Independent Evaluation Group
IEGWB	Independent Evaluation Group (World Bank)
M&E	Monitoring and evaluation
NDRC	National Development and Reform Commission
PDO	Project Development Objective
PMO	Project Management Office
PPAR	Project Performance Assessment Report
TCE	Tons of Standard Coal Equivalent

Fiscal Year

Government: January 1 - December 31

Director-General, Evaluation	:	Mr. Vinod Thomas
Director, Independent Evaluation Group (World Bank)	:	Ms. Cheryl Gray
Manager, IEGSE	:	Ms. Monika Huppi
Task Manager	:	Ms. Fan Zhang

IEGWB Mission: Enhancing development effectiveness through excellence and independence in evaluation.

About this Report

The Independent Evaluation Group assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the Bank's self-evaluation process and to verify that the Bank's work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, IEGWB annually assesses about 25 percent of the Bank's lending operations through field work. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which Executive Directors or Bank management have requested assessments; and those that are likely to generate important lessons.

To prepare a Project Performance Assessment Report (PPAR), IEGWB staff examine project files and other documents, interview operational staff, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, and interview Bank staff and other donor agency staff both at headquarters and in local offices as appropriate.

Each PPAR is subject to internal IEGWB peer review, Panel review, and management approval. Once cleared internally, the PPAR is commented on by the responsible Bank department. IEGWB incorporates the comments as relevant. The completed PPAR is then sent to the borrower for review; the borrowers' comments are attached to the document that is sent to the Bank's Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

About the IEGWB Rating System

IEGWB's use of multiple evaluation methods offers both rigor and a necessary level of flexibility to adapt to lending instrument, project design, or sectoral approach. IEGWB evaluators all apply the same basic method to arrive at their project ratings. Following is the definition and rating scale used for each evaluation criterion (additional information is available on the IEGWB website: http://worldbank.org/ieg).

Outcome: The extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently. The rating has three dimensions: relevance, efficacy, and efficiency. *Relevance* includes relevance of objectives and relevance of design. Relevance of objectives is the extent to which the project's objectives are consistent with the country's current development priorities and with current Bank country and sectoral assistance strategies and corporate goals (expressed in Poverty Reduction Strategy Papers, Country Assistance Strategies, Sector Strategy Papers, Operational Policies). Relevance of design is the extent to which the project's design is consistent with the stated objectives. *Efficacy* is the extent to which the project's objectives were achieved, or are expected to be achieved, taking into account their relative importance. *Efficiency* is the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared to alternatives. The efficiency dimension generally is not applied to adjustment operations. *Possible ratings for Outcome:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Risk to Development Outcome: The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). *Possible ratings for Risk to Development Outcome:* High Significant, Moderate, Negligible to Low, Not Evaluable.

Bank Performance: The extent to which services provided by the Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan/credit closing, toward the achievement of development outcomes. The rating has two dimensions: quality at entry and quality of supervision. *Possible ratings for Bank Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Borrower Performance: The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. *Possible ratings for Borrower Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Contents

This report was prepared by Fan Zhang, who assessed the project in April 2009. Marie Charles provided administrative support.

Tables

Figures

Principal Ratings

	*ICR**	*ICR Review**	*PPAR*
Outcome	Satisfactory	Satisfactory	Satisfactory
Risk to Development Outcome	Negligible to Low	Negligible to Low	Negligible to Low
Bank Performance	Satisfactory	Satisfactory	Satisfactory
Borrower Performance	Satisfactory	Satisfactory	Satisfactory

* The Implementation Completion Report (ICR) is a self-evaluation by the responsible Bank department. The ICR Review is an intermediate IEGWB product that seeks to independently verify the findings of the ICR.

Key Staff Responsible

Project	*Task Manager/Leader*	*Division Chief/ Sector Director*	*Country Director*
Appraisal	Robert P. Taylor	Yoshihiko Sumi	Yukon Huang
Completion	Robert P. Taylor	Junhui Wu	David R. Dollar

Preface

This Project Performance Assessment Report (PPAR) assesses the China Energy Conservation Project. This project had a total actual cost of US$194.8 million equivalent, which was financed through International Bank for Reconstruction and Development (IBRD) Loan No. 43040 in the amount of US$60.51 million, a counterpart contribution of US$107.8 million equivalent, a European Commission (EC) Grant EECT-209849 of US$4.5 million equivalent, and a Global Environment Facility (GEF) Grant TF-028328 of SDR 16.3 million (approximately US$22.0 million). The loan was approved on March 26, 1998, became effective on December 16, 1998, and was closed on June 30, 2006. The loan was 100 percent disbursed. The GEF Grant was closed one year after the originally scheduled closing date on June 30, 2007.

The Energy Conservation Project was selected for a PPAR because it is one of the earliest energy conservation projects financed by IBRD and GEF in China and the assessment will help to inform IEG's ongoing climate change evaluation.

This PPAR was based on a review of project documents, including the Implementation Completion Report (Report No. ICR0000701), Project Appraisal Document (Report No. 17030-CHA), loan documents, mid-term review reports and other project files, as well as discussions held with Bank staff involved in the project. An Independent Evaluation Group (IEG) mission visited China in April 2009 to discuss the project's development effectiveness of with the government, the project implementing agencies at the national and provincial levels, financial institutions, private investors and the business association for energy conservation, research institutes, and other stakeholders. Their cooperation and assistance are gratefully acknowledged.

Following standard IEG procedures, copies of the draft PPAR were sent to the government for their review, but no comments were received.

Summary

The China Energy Conservation Project was approved in March 1998. The project was identified during the time when China was moving toward an increasingly market-oriented economy. The heavily regulated energy conservation system that had been built up during the 1980s had gradually lost its effectiveness as private sector ownership diversified, and the government was faced with constrained fiscal revenues. With this background, both the Chinese government and the World Bank recognized the need to develop market-based instruments to encourage private participation in energy conservation investment.

Energy performance contracting (EPC) was introduced with the Bank's assistance as a commercially based financing mechanism to promote greater energy efficiency. Under an EPC, Energy Management Companies (EMCs) provide customers with a comprehensive set of energy efficiency measures and often guarantee that the savings produced by a project will be sufficient to finance its full costs. Though they generally assume the project's performance risk, the EMCs receive a share of the cash savings generated by the reduction in energy consumption over the contract period. After contract expiration, the clients retain all future energy savings benefits.

The EPC mechanism can help overcome several key market barriers to energy conservation, including lack of awareness of energy efficiency, lack of access to appropriate technology and financing, high transaction costs, and perceived high technical risks. The government of China showed strong interest and endorsed the EPC concept. As a result, the Energy Conservation Project was designed and implemented to foster the development of an EPC market in China.

Both the project development objective and the global environment objective of the Energy Conservation Project were to improve the efficiency of energy use in the People's Republic of China and facilitate reductions in carbon dioxide emissions and other pollutants through energy efficiency investments within the territory of the Borrower. The project had three components: (1) to develop three pilot EMCs to introduce, demonstrate, and disseminate the EPC concept; (2) to develop a national energy conservation information center to disseminate energy conservation project results to enterprise managers; and (3) a project management and monitoring component.

Project objectives and design were substantially relevant. The design of the project was simple and focused on introducing the EPC model as a way to overcome some key market failures and barriers to energy conservation. These initial barriers – such as lack of regulatory oversight and market incentives for the private sector – became less important during implementation due to more stringent Government regulations for energy conservation, increasing energy costs, and adjusted incentives of state-owned enterprises. These later improvements in market and regulatory conditions mitigated the initial risks associated with the over-enthusiastic investment plans and stretch targets of the three EMC demonstration companies. The project also had a well-planned sequence of financing to cover risks of venturing into a new market. The overall relevance was rated **substantial**.

The **efficacy** of the project is rated **substantial.** The project implemented the three EMC pilots and introduced and demonstrated the EPC concept. The rapid growth of the three

pilot EMCs confirmed the financial viability of the EPC mechanism in China and generated significant interest among Chinese investors in developing various types of EMC businesses. The mechanism is now being disseminated and replicated by more than 400 companies across the country. The project achieved its original targets established during project appraisal for energy savings and emissions reduction mainly through its demonstration effect and the resultant investments realized outside the project. The project successfully established an information center which helped disseminate information about relevant new technologies, surpassing targets for indirectly induced energy savings (through information campaigns leading to investment decisions for new technologies).

The project yielded very high financial and economic return, thus **efficiency** is rated **high**. Based on substantial relevance and efficacy, and high efficiency, the project's **outcome** is rated **satisfactory**. The **Risk to Development Outcome** is rated **negligible to low**. The EPC mechanism has been recognized as an important instrument to achieve the Chinese government's energy conservation goals. A series of Bank supported follow-up projects has also been developed to scale up EMC business in order to improve energy efficiency. At the industry level, a wider range of EPC models are being developed, including more sustainable contractual arrangements that share the financing responsibility between EMCs and their clients.

The **Bank's Performance** is rated **satisfactory.** The Bank adopted a clear EPC instrument focus and a learning-by-doing approach to the creation of a new business line. The Bank successfully mobilized co-financing and collaboration among donors, which is particularly important in covering risks of venturing into a new market. During implementation, the task team delivered timely and intensive supervision, and showed flexibility as needed. One shortcoming of Bank supervision, however, is that it failed to formalize the downscaling of the ambitious targets this operation had originally promised.

Borrower performance is rated **satisfactory.** Strong government support and the dedicated efforts of the implementing agency were critical to addressing the tax and legal challenges encountered in adapting the EPC concept to the Chinese market. The pilot EMCs were proactive and creative in developing contracts that suit the Chinese market. They developed a unique mix of technical, financial risk assessment and management, and marketing skills to ensure the companies' long-term success.

The main lessons emerging from this assessment are as follows:

- EPCs require quick implementation and closure, so it is important for the Bank's procurement procedures to be flexible to provide the quick response necessary to get the private sector involved in the EMC business.
- For an energy efficiency project to succeed, it is important to engage government officials across ministries in practical and operationally focused dialogues to address specific implementation challenges, such as regulatory instruments, financial incentives, and provision of information.
- Although EPCs are meant to be a market solution for energy efficiency, in a transitional economy like China, strong government support is crucial for the market to deliver successful results. In the case of the Energy Conservation

project, the Government's policies, regulations and instructions on reducing energy intensity were important drivers for the expansion of the EMB business.

- Strong country ownership requires adapting the project to the country-specific context. Bank-generated ideas work best when they are appropriately adapted to country circumstances.. In the case of the Energy Conservation Project, the Government had adjusted tax treatment and legal interpretation of EMCs, thereby creating an enabling environment for the dissemination of the EPC concept in China.

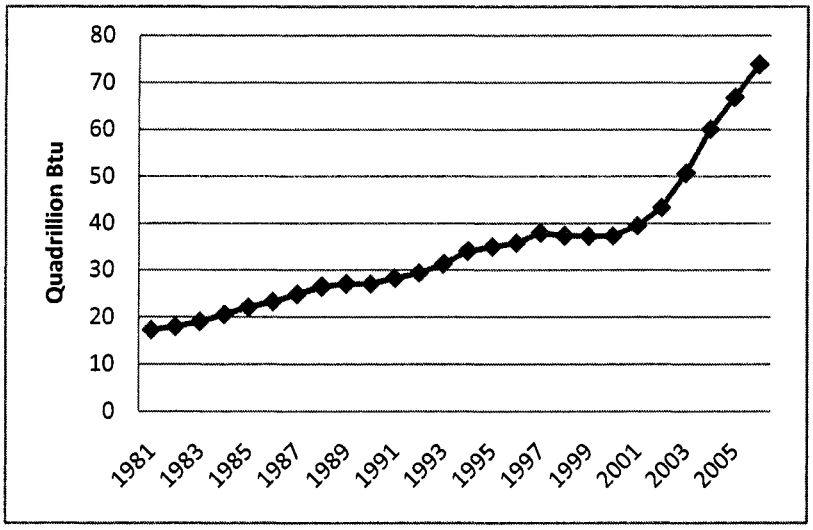
Vinod Thomas
Director-General
Evaluation

1. Introduction

Country and Sector Background

1.1 Since initiating economic reform in 1979, China has become one of the world's fastest-growing economies. From 1979 to 2000, China's real Gross Domestic Product (GDP) grew at an average rate of 9.6 percent per annum.[1] This economic growth has been accompanied by soaring energy consumption and production. Primary energy demand grew by 4 to 5 percent per year during the same period. China is now the world's second largest energy consumer, accounting for one-tenth of the global total. Figure 1 illustrates the steep upward trend in energy consumption in China.

Figure 1. Total Primary Energy Consumption in China



Source: United States Energy Information Administration.

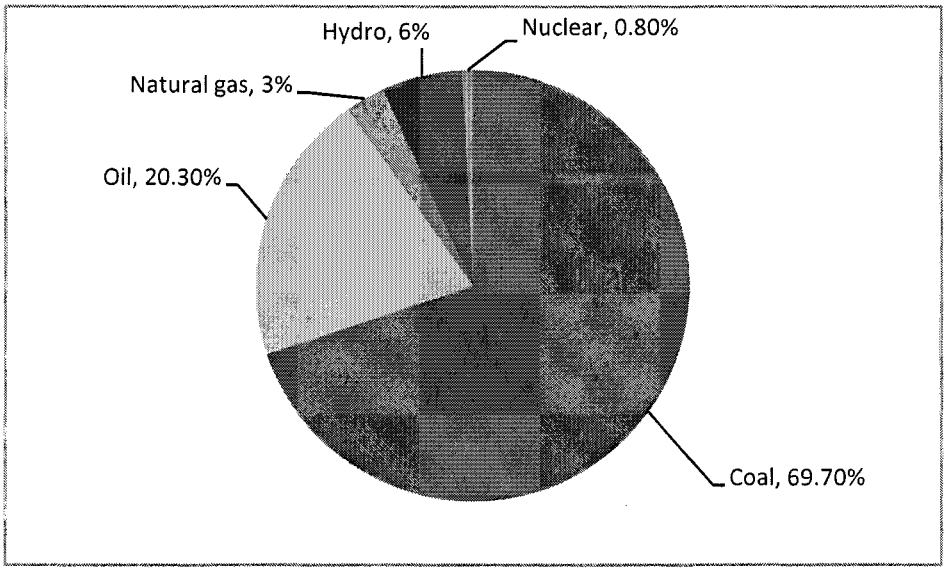
1.2 Although energy use grew only half as fast as the economy, the disparity in energy efficiency between China and developed countries was significant at the time of project preparation. The average thermal efficiency of China's power plants was 25-29 percent, compared to 35-38 percent in Organization for Economic Co-operation and Development countries. In other segments, the difference was even higher, for example, 52 percent compared to 72 percent for industrial boilers, 28 percent versus 52 percent in iron and steel heat generation, and 15 percent compared to 55 percent for commercial and household energy use (Blackman and Wu 1999).

1.3 Since the early 1990s, China's energy deficit has sharply increased because of its rapid economic expansion and its economy's high energy intensity. The power supply has fallen short of demand by about 20 percent annually; frequent power outages have caused widespread disruption to industrial production as well as huge economic losses.

1. World Bank 2000.

1.4 Low efficiency also magnifies local and global environmental concerns. China's energy mix has been dominated by coal, which accounts for more than two-thirds of the country's primary energy demand. With 1.28 billion tons of raw coal produced in 1995, China ranked as the world's largest producer and consumer of coal. Inefficient coal-based power generation has released substantial pollutants, including carbon dioxide (CO_2), sulfur dioxide (SO_2), total suspended particulates, and so forth, causing severe health effects and global warming effects. Figure 2 shows China's primary energy consumption by fuel type.

Figure 2. China's Primary Energy Consumption by Fuel Type (2006)



Source: Chinese Electric Power Research Institute.

Government Strategy

1.5 Starting from the early 1980s, the Chinese government issued a series of administrative measures to promote greater end-use energy efficiency. Efficiency programs, particularly for the industrial sector, were based on consumption control through quotas and prohibitions against new facilities with outdated energy-consuming equipment.

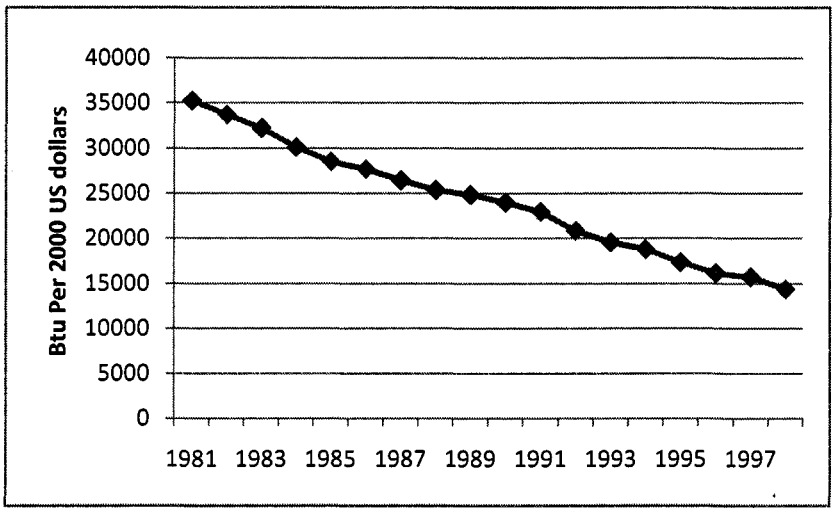
1.6 One important component of the early energy conservation system built up in the 1980s was a government-sponsored network of more than 200 energy conservation technology service centers. They had more than 3,000 staff members throughout the ministry systems and in all major cities across the country. These centers received government directives and grants to conduct energy audits, pursue efficiency projects, provide technical assistance to energy end-users, and disseminate energy saving technology and information.

1.7 These command and control-based efficiency programs had worked effectively in a centrally planned economy. The energy intensity—that is, energy consumption per unit of GDP—of the Chinese economy dropped from 35,241 British thermal unit (Btu) per US dollar

to 12,238, a two-thirds reduction from 1981 to 2000. Figure 3 illustrates this decreasing trend.

1.8 However, the effectiveness of the energy conservation system was severely weakened throughout the 1990s by the deepening of economic reform, the shrinking government control over the economic system, and increasingly restricted central budget. In particular, the energy service centers had gradually lost government funding for mandated efficiency projects; their capacity to execute serious energy conservation initiatives was largely threatened. The government recognized the urgency of developing market-oriented policy measures to mobilize private sector resources for energy conservation.

Figure 3. Energy Intensity in China (1981-98)



Source: United States Energy Information Administration.

World Bank Group Assistance

1.9 Since the mid 1990s, the World Bank has served as a core partner of the Chinese government in designing and implementing energy conservation programs. An energy conservation study in 1993 (World Bank 1993) and a major Global Environment Facility (GEF)-financed China greenhouse gas emission control study in 1994 (NEPA and others 1994) led to the initial dialogue between the Bank and China on developing national energy efficiency strategies.

1.10 With China seeking the Bank's financial and technical support, two options were considered. One was the development of a line-of-credit operation to support energy conservation investments, and the other was the introduction of energy performance contracting (EPC) as a market-based approach to promote energy efficiency. The government strongly preferred the EPC concept, particularly because it represented a business model on which energy conservation service centers could continue to operate on commercial terms. Consequently, the Energy Conservation Project was designed. The Bank was on the forefront in helping China develop the EPC mechanism.

1.11 The Energy Conservation Project was conceived from the beginning as a two-phase operation. The first phase aimed at demonstrating the viability of the EPC business by forming three pilot energy management companies (EMCs)[2] and promoting the dissemination of information on energy conservation. The second phase (Second Energy Conservation Project, approved in 2002) supported the scaling up of EPC business both through a loan guarantee program and the development of an EMC association (EMCA). This PPAR only assesses the first phase because the second phase was ongoing at the time of the assessment.

1.12 In addition to the Energy Conservation and the Second Energy Conservation Projects, five other major stand-alone energy efficiency projects in China have been approved by the Board since December 1996. These projects (with their approval year in the parentheses) focused on:

a. Disseminating more energy-efficient and cleaner industrial boiler technologies (Efficient Industrial Boiler Project, 1996)
b. Moving to central district heating and implementing more stringent building standards (Second Beijing Environment Project, 2000)
c. Developing market-based demand-side management, including heat metering and heat tariff system reform, and more stringent building standards (Heat Reform and Building Energy Efficiency Project, 2005)
d. Strengthening commercial financing for EMCs and efficiency investment (China Energy Efficiency Financing Project, 2008)
e. Improving thermal power efficiency, including mitigating the financial barriers of closing inefficient small coal-fired units, demonstrating the viability of investments in efficiency improvements in existing mid-sized thermal units, and supporting efficient generation dispatch (Thermal Power Efficiency, 2009).

1.13 Total Bank lending to the above projects amounts to US$650.1 million. The Bank has also leveraged US$132.6 million in cofinancing grants from GEF. These activities are summarized in Annex B.

1.14 In addition, an International Finance Corporation/ GEF-supported China Utility-based Energy Efficiency (CHUEE) Program was approved in April 2006 in the amount of US$146.9 million. The project goals were to provide marketing, development, and financing services to commercial, industrial, and municipal sector energy users to install more energy efficient equipment. In contrast to the Energy Conservation Program which used ESCOs as a vehicle to address the information and credit constraints to energy efficiency investments, CHUEE worked directly with domestic banks by providing loan guarantees. CHUEE also provided technical assistance to a range of market players in energy efficiency, including banks, market partners, and end-users.

2. Energy management companies (EMCs), as they are referred to in China – are also called energy service companies (ESCOs) in other countries.

1.15 The World Bank was also engaged in China's energy policy reform through sector work and technical assistance. Among the policy and reform goals of the Bank's assistance to China have been to promote energy pricing reform and decentralized power generation, both of which would have important implications for energy efficiency development. (ESMAP 1994, 2005; World Bank 1993, 1995).

Assistance of Other Donors

1.16 Many other donor agencies, including the United Nations Development Program (UNDP) and the Asian Development Bank (ADB), continue to be involved in improving China's energy efficiency. Annex C provides a list of the agencies, brief descriptions of the projects, and the amount of the grant and loan provided by each for energy efficiency development.

2. Project Objectives, Components, and Financing Mechanisms

Objective

2.1 According to the Loan and Grant Agreements, both the Project Development Objective (PDO) and the Global Environment Objective (GEO) of the Energy Conservation Project were to assist the Borrower to improve the efficiency of energy use in the People's Republic of China and facilitate reductions in CO_2 emissions and other pollutants through energy efficiency investments within the territory of the Borrower.

2.2 The Project Appraisal Document stated the PDO and GEO as to achieve large, sustained, and growing increases in energy efficiency and associated reduction in the growth of CO_2 emissions and other pollutants. The PDO and GEO stated in the Loan and Grant Agreements were used as the basis for this assessment.

2.3 The objectives would be achieved by: (a) introducing, demonstrating and disseminating new project financing concepts and market-oriented institutions to promote and implement energy efficiency measures in China; and (b) developing a more efficient national energy conservation information dissemination program.

Components

2.4 The project had three principal components:

2.5 **An EMC demonstration** (US$136.8 million appraisal estimate; US$180.8 million actual) was designed to develop three demonstration EMCs in Beijing Municipality and Liaoning and Shandong Provinces. All three EMCs initially adopted a full-service shared savings model, in which the EMC provides full project service, including design, development, finance, implementation, and supervision of energy efficiency investments in customer facilities. The customers, also called host enterprises, bear no financial obligation other than to pay a percentage of the actual savings to the EMC according to provisions in

the contract during the contract period. After contract expiration, the host enterprise retains all assets and future energy savings benefits. The implementation of the component was in four stages:

- 1997: Training and technical assistance on the EPC concept, establishment of the EMCs, and initial project preparation (the European Commission [EC] financed about US$1.5 million).
- 1997-98: Intensive training and technical assistance on EMC operations and implementation of the first pilot projects by the EMCs (the EC financed about US$3 million)
- 1999-2000: Implementation of a wide variety of demonstration projects (GEF/counterpart fund-financed).
- 2000-06: EMC growth, through replication of successful demonstration projects (International Bank for Reconstruction and Development [IBRD]/counterpart fund-financed)

2.6 **Information dissemination** (US $10 million appraisal estimate; US $10 million actual) supported the development of a new system to provide information on energy conservation projects to Chinese enterprise managers. The information being disseminated focused on the financial results actually achieved, problems and solutions during implementation, any impacts on main enterprise production or other key risks, and contact information on enterprises with relevant experience.

2.7 **Program Management and Monitoring** (US$4 million appraisal estimate; US$4 million actual). A Project Management Office (PMO) was created with two units: the Energy Management Company Development Unit for promoting and assisting the creation of new EMCs by domestic or international investors; and the Project Management Unit to provide training, technical assistance, and operational support for the above two project components.

Project Implementation

2.8 The PMO was established to oversee project preparation and implementation. It was chaired and partially staffed by the Department of Resource Savings and Comprehensive Utilization of the State Economic and Trade Commission. The Commission was abolished in 2003, and relevant departments were merged into National Development and Reform Commission (NDRC). This organizational restructuring partially contributed to a two-year delay in the implementation of the information dissemination component. The GEF grant was extended for one year to allow this component to be fully implemented.

2.9 Two midterm reviews were undertaken. During the first review (2000), investment plans of the three EMCs from 2001-05 were downscaled by about two-thirds to develop more realistic goals compared to the overly optimistic investment plans initially prepared by the EMCs and accepted by the Bank. The schedule for year-by-year energy savings and carbon emission reduction were also revised to reflect the one-year delay in starting project implementation, which had been caused by the delays in arranging counter-guarantees and establishing disbursement systems.

2.10 During the second mid-term review (2002), the business plans of the three EMCs for the remainder of the project implementation period (2003-06) were revised downward again. The outcome targets on energy savings (13 million tce) and CO_2 emissions reduction (33.73 million tons), which were determined based on the original investment business plans, were significantly downscaled to 5.22 million tce and 13.82 million tons, respectively. It was determined, however, that all the GEF and IBRD funds would still be fully utilized. The Region did not seek Board approval for the revised outcome targets as required by BP 13.05 (see paragraph 5.1).

2.11 The one-year delay in project implementation partially contributed to the failure in meeting original outcome targets. But more importantly, both the Bank team and the Chinese counterpart did not fully acknowledge the existing market and institutional barriers that would constrain the growth of the EPC business, and set unrealistic targets at appraisal. This will be discussed in detail in the Relevance section.

Costs and Financing

2.12 The project's total costs were estimated during appraisal at US$150.8 million. Actual project costs amounted to US$194.8 million and were financed as shown in Table 1. The project was co-financed by EC and GEF following the chronology below:

2.13 In 1997, an EC grant of US$4.5 million was made effective to support the initial formation of EMCs and an information dissemination center. An average of US$1.1 million was provided to each EMC to support some 8-12 EPC pilot projects.

2.14 From 1999 to 2000, a GEF grant partially financed demonstration projects, especially projects in new subsectors or with new variations in contractual design. The GEF's participation provided a critical source of risk coverage to the EMC shareholders to start untried businesses.

2.15 Starting in 2000, the IBRD loans were onlent to the EMCs on commercial terms, to finance replication of successful demonstration projects on a large scale and to support EMC growth as commercial businesses.

2.16 The amount of EMC funds invested in energy conservation was considerably expanded, contributing to the overall increase of the project cost. As EMCs gradually intensified capital strength, they became more self-sustaining in developing energy saving businesses. After 2002, EMC own-financing accounted for more than 60 percent of all energy conservation investment.

Table 1. Project Components, Costs, and Sources of Financing

COMPONENT	AGENCY	APPROVED (INCLUDING CONTINGENCY) (US$MILLION)	ACTUAL (US$ MILLION)
EMC	IBRD	63.0	60.5
Demonstration	EMC own funds	54.3	100.8
	GEF	15.0	15.0
	EC	4.5	4.5
	Total	***136.8***	***180.8***
Information	GEF	5.0	5.0
Dissemination	Government	5.0	5.0
	Total	***10.0***	***10.0***
Program	GEF	2.0	2.0
Management and	Government	2.0	2.0
Monitoring	***Total***	***4.0***	***4.0***
	IBRD	63.0	60.5
Totals	GEF	22.0	22.0
	EC	4.5	4.5
	Government	7.0	7.0
	EMC own funds	54.3	100.8
	Total	**150.8**	**194.8**

3. Monitoring and Evaluation

3.1 ***Design.*** The project's key performance indicators were: (i) energy savings achieved per year from project investments; and (b) associated reductions in the growth of CO_2 emissions. Although they focused on the most important aspects, these indicators did not cover the project's development objectives fully, because the objectives also included the reductions in other pollutants.

3.2 As a demonstration investment, the project monitoring and evaluation (M&E) should have also included provisions for measuring sector-level demonstration effect. This measurement could have been used to quantify benefits resulting from the dissemination of the EPC model so as to better assess to what extent the project contributed to achieving its energy efficiency and emissions reduction objective (see further discussion on this point in paragraph 5.5.)

3.3 It is commendable that the project M&E was designed to support the preparation of the proposed Phase II EMC expansion. The Program Management and Monitoring Component included evaluation of the implementation results, assessment of the lessons learned, and identification of issues requiring further solution. Phase II efforts would build on the evaluation and assessment of the implementation experience of the Phase I project.

3.4 ***Implementation.*** During project implementation, the PMO commissioned third-party post evaluation of 67 subprojects carried out by the EMCs and organized onsite inspections of 50 projects by expert teams. The PMO also requested that each EMC provide financial reports and M&E data on each demonstration subproject biannually.

3.5 Based on the M&E reports, the PMO developed a valuable database on energy efficiency investment. By the project's closing date, the PMO had prepared a large volume (900 pages) of case studies of energy conservation projects by Chinese EMCs, which was published by the China Economic Publishing House in 2006. It contains performance data on 357 EPC subprojects which were peer-reviewed and confirmed by outside experts.

3.6 For the information dissemination component, the M&E involved third-party assessments of the energy saving and emissions reduction achieved. The assessments were based on three national surveys, and followed the methodology used in United Kingdom's information dissemination programs.

3.7 The PPAR identifies two shortcomings that undermine the reliability of the M&E Data. First, some subprojects reported deemed/stipulated energy savings that did not involve actual measurements. Because no coherent monitoring and verification protocol had been adopted in China, the methodology these subprojects used to estimate energy savings was not standard or consistently matched to the risk of each particular energy efficiency technology. As a result, the reported data might not provide rigorous evidence of outcomes.

3.8 Second, in the case of carbon savings monitoring, a carbon coefficient of power consumption (0.2268 tons of carbon [t-c] / Megawatt hour [MWh]) was determined based on the statistics of the national power structure in 1999, and was used to convert the amount of energy savings to the associated emissions reduction.[3] Considering the considerable variation that exists between enterprises and the likely changes in generation mix, fuel efficiency, and transmission and distribution efficiency over time, a simple coefficient without time and regional differentiation was hardly likely to produce accurate results. More efforts could have been devoted to develop a better set of coefficients that would have provided more convincing evidence.

3.9 ***Utilization.*** The EMCs have regularly monitored and reported investment outcomes, which served as useful inputs for adjusting business plans. The EPC performance data collected and disseminated by the PMO and the information dissemination center were used to attract greater government support and private investments. Based on three surveys conducted with various stakeholders, the difficulty of obtaining commercial loans and the lack of EMC business skills were recognized as two barriers, and corresponding solutions were built into the Phase II project. The surveys also provided important market feedback as to which information dissemination methods provided the best results. After the first survey, in particular, the information dissemination center adjusted its allocation of time and resources among different dissemination methods.

3.10 Finally, being the first EMC project in China, the project produced valuable lessons for financing energy efficiency investment in other developing countries. These lessons were well documented and exploited in related studies and projects.[4]

---

3. PMO 2002.

4. The lessons were summarized in Taylor and others (2008). The relevant project is the The Three-Country Energy Efficiency Project, which aimed to substantially increase investments in energy efficiency by the

3.11 The **overall quality of project M&E** is rated **substantial** based on modest for design and substantial for implementation and utilization.

4. Relevance of Objectives and Design

4.1 **The stated PDO was substantially relevant** to both government and Bank strategies at the time. The 1997 Bank Country Assistance Strategy for China emphasized increasing energy efficiency as a key means of increasing energy supply and safeguarding the environment.

4.2 The GEO was also consistent with Operational Program #6 of the GEF operational strategy for climate change. One of the long-term mitigation measures of that program is to remove the barriers to energy conservation and energy efficiency.

4.3 The project objectives remain substantially relevant at the time of the evaluation. The Government's 11th Five-Year Plan calls for China's energy intensity per unit of GDP to be reduced by 20 percent from 2005 to 2010. An amended Energy Conservation Law enacted on April 1, 2008, puts conservation at the top of China's energy development strategy.

4.4 The project also supports the current Bank Country Partnership Strategy (2006-10). The third pillar of that strategy is to manage resource scarcity and environmental challenges. In addition, the GEO is fully consistent with GEF-4's Focal Area Strategies and Strategic Programming (October 2007), wherein GEF aims to promote energy-efficient technologies and practices in the industrial, manufacturing, appliance, and building sectors.

4.5 The design of an EMC demonstration component was simple and well focused on introducing EPC model as a way to overcome some key market barriers/failures to energy conservation, including lack of awareness of energy efficiency, lack of access to appropriate technology and financing, high transaction costs, and perceived high technical risk. Specifically, all three EMCs supported by the project initially adopted a full-service shared savings model, in which customers bear no financial obligation other than to pay a percentage of the actual savings to the EMC over a specified period. The EMCs arrange for project financing, and customize a turnkey service required to implement an energy efficiency project at the customer facility. Such a contracting arrangement not only reduces clients' costs of adapting existing process of production and/or of learning about a new technology, but minimizes the perceived uncertainty of future benefits.

4.6 The project had a well-planned sequence of financing: an EC seed grant, followed by GEF "start-up" funding and IBRD "expansion" financing, which was directed toward projects that had established an initial track record of operational success. The coordinated sequencing of donor funding was successful and important for the government and the Bank to reduce the risks of venturing into a new market.

---

domestic financial sectors in Brazil, China, and India. The project was a partnership among the World Bank, the United Nations Environment Program, and institutions in Brazil, China, and India.

4.7 Although the introduction of the EPC mechanism provided an innovative instrument to promote energy efficiency investments, at the time of project preparation, several institutional and market barriers existed that tended to undermine the effectiveness of performance contracting. These barriers included the lack of regulatory oversight, lack of market incentive for the private sector, and principal-agent problem in the public sector. These risks appeared to be significant at project appraisal but were less of an issue in later stages due to more stringent Government regulation on energy conservation, increasingly higher energy costs, as well as adjusted incentives of the state-owned enterprises. While these risks were not fully acknowledged when the three demonstration companies enthusiastically adopted stretch targets in their investment plans and associated energy savings, the targets were eventually achieved with improved regulatory and market conditions. The **overall relevance of project design** is rated **substantial.**

4.8 Information dissemination is critically important for generating sufficient awareness among investors and energy end-users regarding the existence and profitability of energy saving opportunities. However, the information dissemination component was designed to target only the enterprise managers. In retrospect, the lack of information and educational programs for financiers was a missed opportunity to increase awareness of the EMC industry and efficiency investment within the domestic banking sector. While a decade has passed since the launch of the project, the banks' unfamiliarity with industrial energy conservation practices still imposes a challenging obstacle for the financing of energy conservation investment.[5] It is commendable that the follow-up Bank projects, the China Energy Efficiency Financing, were designed to address the issues.

4.9 The **overall rating for project relevance** is **substantial** based on substantial ratings for the objectives and the design.

5. Efficacy

5.1 Both the stated PDO and GEO were to improve the efficiency of energy use in the People's Republic of China and facilitate reductions in CO_2 emissions and other pollutants through energy efficiency investments within the territory of the Borrower. The project did successfully introduce and demonstrate the EPC concept. Investments of the three pilot EMCs saved 5.92 million tce in energy, and reduced CO_2 by 18.55 million tons by the end of 2006. Energy savings and emissions reduction from other EPC projects outside the project were higher: in 2006 year alone, these projects resulted in project life-cycle energy savings of 18.7 million tce, and CO_2 emissions reductions of 49 million tons. Although direct energy savings and emissions reduction from the three EMCs fell short of meeting the targets set at appraisal, results achieved outside the project due to EMC demonstration exceeded expectations.[6] The Information Dissemination Component is estimated to indirectly have

[5]China Energy Efficiency Financing Project Appraisal Document, Report No. 38641-CN .

[6] The targets were revised downward during the second midterm review but not submitted to the Board for approval, per Bank guidelines (BP13.05, July 2001). Thus, the project will need to be assessed against the original project targets.

helped save 27.2 million tce and reduced CO_2 emissions by 70.8 million tons, both outcomes exceeding the targets. The **overall efficacy** is rated **substantial.**

5.2 The achievements of the project are assessed by outcomes and outputs in detail below.

Energy efficiency and reduction in CO_2 emissions.

5.3 For *EMC demonstration*, by the end of 2006, the energy efficiency investments financed under the project realized 5.92 million tons of standard coal equivalent (tce) energy savings and associated reductions of 18.55 million tons of CO_2.[7]

5.4 In addition, the project also had a considerable demonstration effect (see paragraphs 5.9-5.13), and the energy savings and emissions reduction achieved through the scale-up of the Chinese EMC industry is much higher than those directly resulting from the investment of the three pilot EMCs. Based on a comprehensive survey undertaken by EMCA and the PMO, investments from EPC projects totaled about $280 million in 2006 alone, of which the three demonstration EMCs accounted only about 11%. These investments resulted in project life-cycle energy savings of 21.1 million tce, and CO_2 emissions reductions of 55.05 million tons. The overall achievement of the EMC demonstration may well exceed the original energy savings target of 13.0 million tce and associated reductions in the carbon emissions of 18.55 million tons.[8]

5.5 *The information dissemination center* developed 100 Energy Conservation Case Studies and 20 Energy Conservation Technical Guidelines, and delivered more than 200,000 energy conservation materials by the end of 2006. The center also developed a Web site, an inquiry service, a system of dissemination meetings, a network of energy efficiency experts, and an expanding relationship with media organizations.

5.6 To estimate the energy and CO_2 savings impact of the information dissemination center, three surveys were conducted by a third-party agency. The agency randomly selected 10,000 enterprises for telephone interviews. Of the interviewed enterprises 18.7 percent indicated having conducted energy conservation investment, among which 6.2 percent attributed investment decisions to the center's information dissemination efforts. The enterprises also provided detailed information on the amount of energy saving, total investment, and payback period for the investment. Based on the survey results, total energy and CO_2 emission saved were then estimated according to the energy conservation measures adoption rate, the average energy saved from a conservation investment, and the total number of enterprises in major energy consuming industries. The PMO reported that as of the end of June 2007, the estimated cumulative energy savings associated with the information dissemination center was 27.2 million tce, as compared to the target of 24.3 million tce set at appraisal. The associated CO_2 emission reduction was 70.8 million tons versus the target of

7. These figures exclude benefits that arose after project closing.

63 million tons. Considering the large sample size and the fact that the samples were selected randomly, the results appear credible.

Introducing, demonstrating, and disseminating new project financing concepts and market-oriented institutions

5.7 *Development and growth of three demonstration EMCs.* During the course of the project, the three pilot EMCs experienced strong and continued development. Their growth was measured by the amount of investment conducted and the returns on investments. According to the PMO, by the end of 2006, the three EMCs had carried out 475 performance contracts with a total investment of more than RMB 1.5 billion. The average financial return from these projects across the three EMCs exceeded 20 percent and the rate of project failures overall was only one percent. The three EMCs have made net profits of RMB 0.48 billion (net profits of clients were 8 -10 times that of EMCs) and broadened their equity base about nine-fold (from RMB 86 million in 1997 to an estimated RMB 757 million in 2006). Table 3 summarizes the financial positions of the three EMCs.

Table 2. Summary of Financial Positions of Three Pilot EMCs (1999, 2002, 2006) (US$ million)

	YEAR	*ASSET*	*REVENUE*	*PROFIT*
Beijing EMC	1999	4.82	1.33	0.15
	2002	13.69	3.56	0.10
	2006	25.76	4.40	1.79
Liaoning EMC	1999	5.86	1.16	-0.14
	2002	17.39	2.75	0.04
	2006	35.11	13.56	1.35
Shandong EMC	1999	8.55	0.87	-0.23
	2002	18.32	4.30	0.29
	2006	31.04	10.01	1.13
Total	1999	19.23	3.36	-0.21
	2002	49.39	10.61	0.43
	2006	91.91	27.98	4.26

Source: PMO Data.

5.8 *Project Demonstration Effects and Proliferation of EPCs in China.* The project had a considerable demonstration effect, as the rapid development of the three pilot EMCs verified the financial viability of EPC projects in China and generated significant interest among Chinese investors. The mechanism is now being disseminated and replicated by many other companies across the country.

5.9 During the implementation period of the project, the EMC industry had experienced triple-digit growth. As of the end of 2003 (before the launch of the Phase II project), the

EMCA reported that there were 59 operating EMCs. The total investment value reached US$85 million.[9]

5.10 In 2007, a core of about 40 to 50 well-established EMCs who had fully mastered the concept of EPC were operating in China, while the total number of companies reporting experience with at least one EPC exceeded 400 (EMCA 2008). See Figures 4 and 5 for the year-by-year growth of EMC business.

5.11 IEG Communication with the PMO, EMCA, and Beijing and Shandong EMCs confirmed that the original EMCs played an important role in demonstrating and adapting the EPC concept to the Chinese market. The operation of the three EMCs generated considerable experience and expertise and numerous examples of how to market EMC services, evaluate a profitable energy saving project, measure and verify energy savings, and solve specific tax and/or legal issues. The pilot EMCs contributed to numerous technical training workshops and dissemination courses, and received onsite visits from domestic investors, and investors from India, Mongolia, and Brazil.

5.12 From 2001 to 2005, the United Kingdom's Department for International Development supported, through the Bank's Asia Sustainable and Alternative Energy Program, a comprehensive program of training and technical assistance for new EMCs. The training program, which was built on the expertise of the three EMCs, had trained more than 1,000 people, many of whom started their own companies after completing training.

Figure 4. Growth of Chinese EMCs

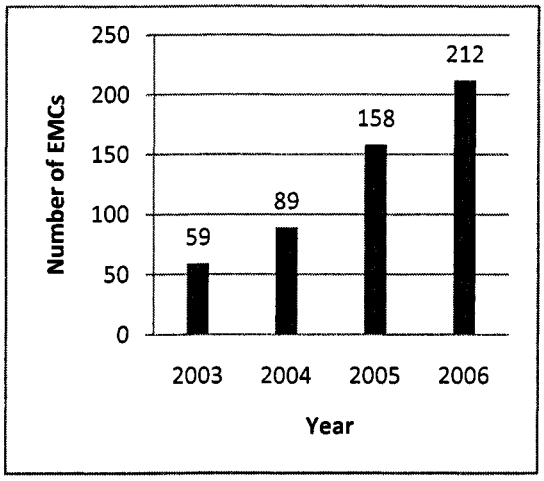
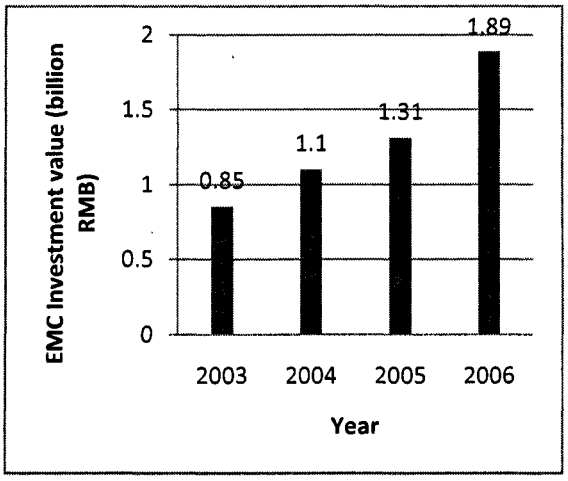


Figure 5. Total Investment of Chinese EMCs (billion RMB)



Source: China Energy Management Company Association.

5.13 The project also served as a "broker" to engage the State Economic and Trade Commission/NDRC to work with other relevant government entities in addressing tax and legal interpretation issues raised. Because an EPC combines several economic activities,

9. EMCA, Secretary General Zhao Ming, "EMCA and ESCO Industry Development in China." March 7-8 2007.

including services, sales of equipment, and a special performance guarantee, local tax authorities were unclear about which type of taxes should be assessed against the EMCs. In addition, some regulatory authorities interpreted the EPCs to be financial leases, which legally can only be undertaken by institutions licensed to operate as financial institutions. Through proactive efforts from all parties, these issues were satisfactorily resolved. The central government confirmed the legality of the business, and the three EMCs each chose a corporate accounting stance that was accepted by the local auditing and taxation entities. The IEG mission was informed that the PMO and EMCA have recently submitted a comprehensive proposal to NDRC to reform the tax code for the EPC business, which would benefit all other EMCs in the industry.

5.14 *Limitations.* Despite the rapid growth of EPC business, IEG identified two major market and institutional barriers that have constrained the scale-up of the EMC industry in China: financing constraints for EMCs and the high risk of counterpart breach of contract. This is discussed in detail in a later section.

5.15 Regarding the project demonstration effect, the IEG mission found that although Shanghai is an active zone for EMC development, where about 140 EMC companies have been established since 2001, the project had limited impact in Shanghai.

6. Efficiency

6.1 The economic return of the subprojects that the EMC conducted compares well with other similar energy efficiency investments. In the United States, the highest return on energy conservation project saved approximately 14,100 Btu annually per dollar of capital investment (DOE 2005), or 0.51 tce per thousand dollars of investment. That is 65 times lower than the average return under this project (Table 4). This suggests that with lower capital cost and higher potential for improving efficiency, China enjoys a much lower marginal cost of energy conservation.

6.2 IEG analysis also shows that the three EMCs have made investments in product lines that over time yielded larger energy and emission savings per unit of capital investment. From 1997 to 2006, the annual energy savings per dollar invested increased from 17.95 tce to 44.39 tce, whereas the abatement cost per ton of CO_2 emissions was reduced from US$11.22/ton to US$ - 6.00/ton.[10] This may result from the EMCs being more selective in energy saving technologies and practices, and because more subprojects targeting coal or oil consumption reduction were undertaken.

[10] As explained in note 2 of Table 4, a negative marginal cost for CO_2 abatement means that the economic value of energy savings exceeds the value of investments needed for CO_2 emissions reduction.

Table 3. Energy Saving Unit Cost and Cost of per ton of CO_2 Reduction

YEAR	ENERGY SAVING PER UNIT INVESTMENT (TCE/YEAR/US$ 000)[A]	INVESTMENT PER TON OF CO_2 REDUCTION (US$/TON CO_2)[B]
1997-2001	17.95	11.22
2002	26.92	4.17
2003	35.78	1.11
2004	38.29	-7.81
2005	35.67	-4.08
2006	44.39	-6.00

Source: Project Documents, GEM Commodity Market Databank
a. Investments are based on the year the energy performance contract is signed. These figures do not include the full savings resulting from the project; they account for accumulated savings from the date the contract was signed until June 30, 2008.
b. Energy savings could be viewed as a coproduct of reducing CO_2 emissions. To estimate the marginal abatement cost of CO_2 emissions reduction, the economic value of energy saving is deducted from the total investment cost. The PPAR uses the global economic monitor suggested coal prices to calculate the economic benefits associated with the energy savings, which is then deducted from the total investment cost. The negative costs of CO_2 emissions reduction underline the fact that energy efficiency investment could be a win-win solution for global climate change mitigation.

6.3 The Implementation Completion Report (ICR) reported the economic rates of return (ERR) of the EMC's subprojects ranging from 36 to 168 percent, with the average ERR at 78 percent. The financial rate of return of the EMCs based on the net annual cash flow from operations net of all equity infusions is 17.6 percent per year in real terms. [11]

6.4 The ICR reported that ERR was estimated based on a sample of 357 best performing projects, which were not exclusively the result of support by the three EMCs.[12] Furthermore, the ICR economic analysis was based solely on energy savings. Because the project is considered as emissions abatement initiative, environmental benefits should have been factored into the economic analysis. The PPAR reassessed the ERR based on 339 projects carried out by the three EMCs whose data are available to IEG. These projects accounted for all subproject financed by GEF grant and IBRD loan during the course of the project. IEG re-estimated the ERR based on reported subproject investment, the amount of energy savings, and CO_2 emissions reduction. The rate of US$6 per ton was used to estimate the economic value of CO_2 abatement. Assuming energy efficient equipment on average lasts for at least 9

11. The huge difference between ERR and financial rate of return does not suggest price distortion because both analyses rely on actual market prices; the value of the external benefits, such as environmental benefits, was not included in the ERR analysis. The difference is partly due to the fact that the financial rate of return only estimates the value recouped by the EMCs, while ERR also includes the benefits to host enterprises.

[12] The 357 projects were selected from 1,000 projects based on the following criteria: (a) the projects were carried out based on the EPC mechanism; (b) the projects' energy saving/economic benefits were confirmed by both EMCs and end-users; (c) the projects applied technologies that were proven and reliable; and (d) the projects have large potential to be replicated (PMO 2006).

years, the corresponding ERRs with and without CO_2 benefits are 50 percent and 58 percent, respectively (see Table 5).

Table 4 Project ERR

	PAD	*ICR*	*PPAR*
ERR without CO_2 abatement benefits (%)	47	78	50
ERR including CO_2 abatement benefits (%)	NA	NA	58

6.5 There are a couple of caveats with the IEG calculation of ERRs that may have underestimated the ERRs of the EMC subprojects. These caveats are:

- The ERR was calculated without adjustment of the output effect. Many of the energy efficiency technology options involve output effects such that – in spite of increased energy efficiency per unit of output – the total output and the accompanied emissions of the enterprise increase because of income and price effects. The ERR of output-value-increasing project will be underestimated without output adjustments.

- The ERR estimation only included initial capital investments, without taking into account project operating and maintenance costs. Because retrofitted facilities usually cost less to operate and maintain, the ERR was likely to have been distorted downward.

6.6 Annex D estimates the ERR of a green lighting subproject, addressing the two biases mentioned above.

6.7 These analyses point to the high efficiency of the EMCs subprojects. The **efficiency** is therefore rated **high.** However, it is important to note that the reported ERR results only apply to the individual subprojects. The EMCs' administrative expenses, which were not separately reported, were excluded from the calculation. The overall project ERR factoring into the overhead costs would still be over 50 percent with CO_2 abatement benefits.

7. Outcome

7.1 The **project outcome rating** is **satisfactory**, based on project sub-ratings of substantial for relevance and efficacy, and high for efficiency. Overall, the project demonstrated the financial viability of what was initially a completely unknown concept. Judging by the number of new entrants in the market and the program's impact on changes in the tax code and other regulations that improved the business environment, its impact may have gone far beyond the foreseen parameters in its design.

8. Risk to Development Outcome

8.1 The **risk to the project's development outcome** is rated **negligible to low.** With the rapid development of EMC business, the EPC mechanism has been recognized as an important instrument to help achieve China's energy conservation goals. In March 2007, the State Council called for accelerated development of the EMC industry. In Shanghai, the municipal government mandates energy audits for all enterprises, subsidizes EMCs to undertake diagnoses to identify energy saving opportunities, and rewards EMCs RMB 300/tce of energy savings for the first year of the EPC project.[13]

8.2 A series of Bank follow-up projects has also been developed to scale up EMC business in order to improve energy efficiency, including the Energy Efficiency Financing and the Provincial Energy Efficiency Scale-Up Projects. Annex B provides brief descriptions of these projects.

8.3 At the industry level, a wider range of EMC business models is being developed, including shared savings contracts, guaranteed savings contracts, outsourcing of energy system management (such as commercial buildings, hospitals, hotels, and market), and combinations of all three. Guaranteed savings and outsourcing are more sustainable for the growth of EMC industry because clients shoulder the financing responsibility.

9. Bank Performance

9.1 **Quality at entry is rated satisfactory.** The Bank introduced an innovative approach to stimulate greater private sector participation. It adopted a learning-by-doing approach of staging the creation of a new business line through pilots, demonstration, operation, dissemination, and a follow-on project. Despite the underestimation of some of the existing market and institutional barriers at project appraisal, the Bank team did attempt to manage the risks by successfully mobilizing co-financing and collaboration among donors, which was particularly important in addressing barriers to venturing into a new market.

9.2 During project implementation, the Bank maintained a sustained dialogue with government and business stakeholders. Communicating with all levels is crucial for understanding concerns of the EMCs and for obtaining government support. For example, the Bank emphasized, in a timely manner, the urgency on the issue of tax treatment and legal interpretation of an EPC, which contributed to quick resolutions to the issue. In addition, to ensure efficient implementation, the Bank showed flexibility in adjusting project implementation. For example, although prior approval for all EMC subprojects was initially required, the Bank team waived prior review requirements for some project lines once the EMCs had gained adequate technical expertise and experience.

9.3 The Chinese authorities and industry practitioners highly appreciated the leadership role played by the Bank. The borrower expressed its satisfaction with the way the Bank

13. Communication with Shanghai Energy Conservation Supervision Center, April 22, 2009.

carried out its responsibilities on many occasions during the IEG mission. **The quality of supervision is rated satisfactory**.

9.4 While there was a procedural shortcoming related to the noncompliance with the requirement to formally seek Board approval for revising key associated outcome targets, **the overall Bank performance is rated satisfactory.**

10. Borrower Performance

10.1 **The performance of both the borrower and the implementing agency is rated satisfactory.** The government's commitment to the project's PDO and GEO was a key factor in the positive outcomes throughout the design and implementation stages. The municipal and provincial governments concerned (Beijing, Liaoning, Shandong) were also proactively involved in establishing the EMCs. For example, both the central and provincial governments collaborated to resolve initial difficulties in arranging counter-guarantees for the Bank loan and setting up disbursement systems. Another example is the study on the tax treatment of the EMCs, which was mobilized by the concerned government agencies and instrumental in reaching agreements with provincial tax bureaus. The government was also responsive in issuing new policies, regulations, and instructions to support energy conservation.

10.2 The adaptation of the EPC concept to the Chinese market, and the development of these new types of commercial companies have not been easy. This process would not have been possible without the intensive efforts and resilient support from the PMO that helped address many hurdles and challenges encountered. The three EMCs were proactive and creative in creating contracts that suit the Chinese market and had developed a unique mix of technical, financial risk assessment and management, and business marketing skills to ensure the companies' long-term success.

11. Lessons and Outlook

11.1 Although the growth of the EMC business has been impressive, the scale of the industry remains small compared to the needs and potential of energy conservation in China. In 2007, the China EMC-deployed energy efficiency investment amounted to US$889 million, whereas the projected energy efficiency investment in China could reach as high as US$11 billion per year according to EMCA estimates. By comparison, although the energy intensity of the United States is smaller than that of China,[14] the annual investment of the US Energy Service Companies market is approximately $2.5 billion (NAESC 2007).

11.2 The IEG mission identified two major market and institutional barriers that constrained a wider-scale implementation of the EMC business:

- **Limited financing constitutes a major constraint to more aggressive and sustained growth of EPC business**. There are various reasons for the shortfall in financing. Lack of experience in dealing with investors on the part of EMCs is one

14. According to the US Energy Information Administration, China's energy intensity is about 13,780 Btu per U.S. dollars in 2006, compared to 8,840 in the United States.

reason, but more issues seem to be related to the general impediments for small- and medium-size enterprises to access finance in China. Most of the Chinese EMCs are small start-ups, with registered capital ranging between US$35,000 and $600,000. Because of the EMCs' small size, Chinese domestic banks have generally been unwilling to lend. This phenomenon, although common to all small- and medium-size enterprises in China, has especially restricted the EMCs' potential growth. This is because executing EMC business usually requires a substantial working capital to support the up-front tax obligation, project financing, and project construction and commissioning before finally generating revenues through client payments. The follow-up phase II project has created a guarantee fund for EMCs, aiming to engage the Chinese financing community as the key financier for EMCs. The IFC CHUEE Program provided bank guarantees to energy efficiency loans, as well as technical assistance to stimulate energy efficiency lending in China. However, the IEG mission discovered that financing difficulty still remains as the biggest obstacle. The IEG evaluation on the CHUEE program (IEG, 2010) also recognizes that one of the main challenges that smaller companies continue to face is access to finance for energy efficiency investments.

- **Lack of contract enforceability remains a fundamental challenge to EPC market development.** In a business environment where trust and long-term relationship are more emphasized than the enforceability of the contact, EMCs usually incur huge administrative costs to secure creditworthy customers. The high risk of counterpart breach of contract, both in terms of collection of repayment and verification of energy savings, increases the investment hurdle rate. Anecdotal evidence suggests that companies are far more cautious about the counterpart risk that is inherent in performance contracting and willing to forgo business opportunities if the perceived contractual risks are too high. In fact, the IEG mission discovered that both Beijing and Shandong EMCs have turned away from the original "full-service" shared-savings model in order to minimize client credit risk. The Beijing EMC now focuses on developing outsourcing of energy system management EPC, whereas the Shangdong EMC was reorganized into a financial leasing company.

11.3 To address the challenges for the future development of the EPC business in China, the PPAR identified several strategies for all parties involved.

Future Outlook

Borrower Strategies

11.4 To meet the large market potential for energy efficiency in China, it is important for the EMC industry and the government to work collaboratively to remove several market and policy barriers. The EMCs need to enhance technical skills to provide more comprehensive

service packages and to secure project financing. The government must establish financial and contract enforcement policies to address financing and client creditworthiness issues.[15]

BANK STRATEGIES

11.5 The Bank has been persistent in promoting the EPC mechanism in China, including provisions for only supporting EPC-type subprojects. Although such a narrow focus has been paramount for the success of the project, the choice of business models would be best determined by market conditions, by financing practices and systems, and by the institutional environment. To meet the ends of improving energy efficiency investment, a variety of approaches could tried, such as direct energy efficiency lending to small-and-medium-size enterprises, energy utility demand-side management, technical assistance to domestic banks, and so on. It is commendable that the follow-up Bank projects, such as China Energy Efficiency Financing, are moving in this direction.

EMC INDUSTRY STRATEGIES

11.6 *New Sectors and Product Lines.* The EPC market is dominated by industrial customers and focused quite narrowly on energy saving concepts. The industrial sector represents 97 percent of the total investment for Shandong EMC and 82.5 percent for the Liaoning EMC. The Beijing EMC is an exception, for which the building sector constitutes 75 percent of investment. At the industry level, 63.1 percent of the EMC revenues in 2008 were attributable to the industrial sector market segment, and 33.4 percent and 3.5 percent were attributable to building and transportation sectors, respectively. Although industry is the largest energy consumer in China, other sectors, especially heating and cooling in the housing sector, have enormous potential for energy savings (McKinsey Global Institute 2008).[16] The EMCs may wish to consider identifying a broader range of energy efficiency investments across the sectors to capture the rich energy-saving opportunities in the economy.

11.7 *Single versus Bundled Projects.* The EMCs usually focus on certain product lines instead of conducting comprehensive energy audits to identify all the feasible improvements that will save energy at the facility. As a result, the scope of energy savings was narrower. The literature suggests that bundled/comprehensive projects that optimize energy through a series of improvements tend to achieve an overall greater gain in dollar and /or energy

---

15. In its effort to spur the development of the local EMC industry, the Shanghai municipal government has taken some cutting-edge initiatives. An interministerial committee, Shanghai EMC Director Committee, chaired by the vice mayor, was established. The committee sponsors a third-party evaluation on both the technical risk and the creditworthiness of the client for each EPC project. The municipal- or district-level government also works directly with guarantee agencies and local banks to ensure viable financing to EPC projects (conversation with Shanghai Economic and Trade Commission, Shanghai Energy Conservation Supervision Center, the EMC Committee of Shanghai Energy Conservation Association and the office of Shanghai EMC Supervision Committee, April 22, 2009).

16. Heating and cooling of commercial and residential buildings constitutes 20 percent of the total energy consumption. According to Chou Baoxing, Vice Minister of Construction, using highly efficient energy technology to transform existing buildings may save about RMB 600 billion (US$80.5billion) each year.

savings. (DOE 2005). Of the 357 PMO documented projects, only 3 are this kind. Furthermore, large enterprises usually prefer a systematic approach to maintain the reliability of manufacturing process rather than changing one production process based on one single technology.[17] The single-project approach risks losing an important segment of the clients.

Lessons

11.8 The main lessons emerging from this assessment are as follows:

- EPCs require quick implementation and closure, so it is important for the Bank's procurement procedures to be flexible to provide the quick response necessary to get the private sector involved in the EMC business.
- For an energy efficiency project to succeed, it is important to engage government officials across ministries in practical and operationally focused dialogues to address specific implementation challenges, such as regulatory instruments, financial incentives, and provision of information.
- Although EPCs are meant to be a market solution for energy efficiency, in a transitional economy like China, strong government support is crucial for the market to deliver successful results. In the case of the Energy Conservation Project, the Government's policies, regulations and instructions on reducing energy intensity had been important drivers of the expansion of the EMC business.
- Strong country ownership requires adapting the project to the country-specific context. Bank-generated ideas work best when they are appropriately adapted to country circumstances. In the case of the Energy Conservation Project, the Government had adjusted tax treatment and legal interpretation of EMCs, thereby creating an enabling environment for the dissemination of the EPC concept in China.

17. Conversation with Shanghai Economic and Trade Commission, Shanghai Energy Conservation Supervision Center, the EMC Committee of Shanghai Energy Conservation Association and the office of Shanghai EMC Supervision Committee. April 22, 2009.

References

Blackman, A., and Wu, X. 1999. "Foreign Direct Investment in China's Power Sector: Trends, Benefits and Barriers." *Energy Policy* 27(12): 695-711.

Department of Energy (DOE). 2005. "FEMP Analyzes Federal Energy Savings from Utility Service Programs." Washington D.C.

Energy Sector Management Assistance Program (ESMAP). 1994. "China Energy Efficiency and Pollution Control in Township and Village Enterprises (TVE) Industry." Report No. ESM 168. Washington, D.C.

ESMAP. 2005. "Demand-side Management in China's Restructured Power Industry: How Regulation and Policy can Deliver Demand-side Management Benefits to a Growing Economy and a Changing Power System." Report No. ESM314. Washington, D.C.

Energy Conservation Project Management Office. 2002. "Midterm Report of Energy Savings and CO_2 Emissions Reductions." Beijing, China.

Energy Conservation Project Management Office. 2006. *Energy Conservation Project Case Studies of Chinese ESCO.* Beijing: China Economic Publishing House.

Independent Evaluation Group (IEG). 2001. The Bank's Assistance to China's Energy Sector An OED Country Sector Evaluation. Sector and Thematic Evaluations Group Operations Evaluation Department. Report No. 21891. World Bank. Washington, DC.

IEG. 2010. Accessing the Impact of IFC's China Utility-Based Energy Efficiency Finance Program. World Bank. Washington, DC.

McKinsey Global Institute. 2007. "Curbing Global Energy Demand Growth: The Energy Productivity Opportunity." McKinsey&Company. San Francisco, CA

McKinsey Global Institute. 2008. "Fueling Sustainable Development: The Energy Productivity Solution." McKinsey&Company. San Francisco, CA

National Environment Protection Agency of China (NEPA), State Planning Commission of China, United Nations Development Program, and World Bank. 1994. "China: Issues and Options in Greenhouse Gas Emissions Control." Report NO 15199. World Bank. Washington, D.C.

National Association of Energy Service Companies (NAESC). 2007. "Introduction to Energy Performance Contracting." Washington. D.C.

Potter, A., Shen. L. and Taylor, R.P. 2006. "Developing Financial Intermediation Mechanisms for Energy Efficiency Projects in Brazil, India and China: China Country Report." World Bank, Beijing, China.

Taylor, R. P., Govindarajalu. C., Levin. J., Meyer. A.S., and Ward, W.A. 2008. *Financing Energy Efficiency: Lessons from Brazil, China, India and Beyond.* World Bank. Washington. D. C.

Taylor R.P. 1993. "China - Energy Conservation Study." Report No: 10813-CHA. World Bank. Washington, D.C.

Ward, W.A., J. Li, J.B. London, G.J. Wells, Y.D. Dai, and J. Liu.. 1994. "Energy Efficiency in China: Case Studies and Economic Analysis." Report Number 23802. World Bank. Washington, D.C.

World Bank. 2000. *World Development Indicators 2000.* World Bank, Washington, D.C.

Annex A. Basic Data Sheet

CHINA ENERGY CONSERVATION PROJECT (P003606, P037859)

Key Project Data *(amounts in US$ million)* *

	Appraisal estimate	*Actual or current estimate*	*Actual as % of appraisal estimate*
Total project costs	150.8	194.8	129.2
Loan amount	63.0	60.5	96.0
Cofinancing	22.0	22.0	100
Cancellation	--	2.49*	--

* Cancelled amounts are in terms of loan amount at appraisal.

Cumulative Estimated and Actual Disbursements *(amounts in US$ million)*

	FY00	*FY01*	*FY02*	*FY03*	*FY04*	*FY05*	*FY06*	*FY07*
Annual	2.62	4.68	6.85	9.46	7.72	12.01	12.01	5.15
Cumulative	2.62	7.31	14.15	23.61	31.33	43.35	55.36	60.51

Project Dates

	Original	*Actual*
Begin Appraisal	--	10/22/1997
Board approval	--	03/26/1998
Signing	--	06/26/1998
Effectiveness Loan, 43040	12/16/1998	12/16/1998
Effectiveness Grant, TF-28323	--	12/22/1998
Closing for Loan, 43040	06/30/2006	06/30/2006
Closing for Grant, TF-28323	06/30/2006	06/30/2007

Staff Inputs (staff weeks)

Stage of Project Cycle	*Staff Time and Cost (Bank Budget Only)*	
	No. Staff Weeks	*US$ ('000)*
Lending		
FY98		186.10
Total:		**186.10**
Supervision/ICR		
FY98		0.03
FY99		56.36

Stage of Project Cycle	*Staff Time and Cost (Bank Budget Only)*	
	No. Staff Weeks	*US$ ('000)*
FY00	31.90	110.73
FY01	31.83	122.03
FY02	23.08	80.64
FY03	24.88	103.16
FY04	25.44	92.62
FY05	22.74	88.86
FY06	10.19	50.63
FY07	12.84	57.68
FY08	0.25	1.47
Total:	**183.15**	**794.86**

Mission Data

Ratings of Project Performance in ISRs

No.	*Date ISR Archived*	*Performance rating: Development Objective*	*Performance rating: Global Environment Objective*	*Performance rating: Implementation Progress*
1	06/24/1998	Satisfactory	Satisfactory	Satisfactory
2	06/29/1998	Satisfactory	Satisfactory	Satisfactory
3	02/10/1999	Satisfactory	Satisfactory	Satisfactory
4	06/15/1999	Satisfactory	Satisfactory	Satisfactory
5	12/21/1999	Satisfactory	Satisfactory	Satisfactory
6	06/27/2000	Satisfactory	Satisfactory	Satisfactory
7	12/22/2000	Satisfactory	Satisfactory	Satisfactory
8	06/14/2001	Satisfactory	Satisfactory	Satisfactory
9	12/21/2001	Satisfactory	Satisfactory	Satisfactory
10	06/27/2002	Satisfactory	Satisfactory	Satisfactory
11	12/27/2002	Satisfactory	Satisfactory	Satisfactory
12	06/27/2003	Satisfactory	Satisfactory	Satisfactory
13	12/24/2003	Satisfactory	Satisfactory	Satisfactory
14	06/29/2004	Satisfactory	Satisfactory	Satisfactory
15	12/28/2004	Satisfactory	Satisfactory	Satisfactory
16	06/20/2005	Satisfactory	Satisfactory	Satisfactory
17	03/02/2006	Satisfactory	Satisfactory	Satisfactory

Other Project Data

Borrower/Executing Agency:

FOLLOW-ON OPERATIONS

Operation	*Loan no.*	*Amount (US$ million)*	*Board date*
Second Energy Conservation Project	TF-51678	26	10/24/2002

Annex B. Major World Bank Group Energy Efficiency Projects in China (1998-2009)

Project Name	GEF Grant	Co-financing Total	Approval Date	Description
Efficient Industrial Boilers	32.81	68.57	23-Dec-96	This project will reduce greenhouse gas 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.
Energy Conservation	22.00	194.80	26-Mar-98	The project will support the establishment, pilot testing and commercial demonstration of market-oriented Energy Management Companies (EMCs) that will promote investments in energy-efficient technology through energy performance contracting. The project will also develop a national energy conservation information dissemination center to gather information and lessons learned on energy efficiency measures and disseminate information on the technical and financial results of these measures, targeting enterprise managers.

Project Name	GEF Grant	Co-financing Total	Approval Date	Description
Second Beijing Environment Project	25.00	437.00	20-Jun-00	The project's objectives are to: (a) improve the quality of life for the citizens of Beijing by alleviating the city's acute air and water pollution problems; and (b) 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 least 2,500 small (below 20 t/hr), 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.
Second Energy Conservation Project	26.00	255.20	24-Oct-02	The project is designed to replicate the experience of Energy Conservation Project (phase I), especially to support the development of new EMCs in China by strengthening a 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 which lend to the EMCs.
Heat Reform and Building Energy Efficiency Project	18.35	81.00	17-Mar-05	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. Promotes demand in the housing sector for more efficient building materials and for more effective heat metering and control equipment. Also promotes new policies and institutions for metering, controlling, and managing centralized heat supply systems. Project is part of a broader program for heat reform and building energy efficiency by the World Bank and China. Concept fits within "efficient product market transformation" strategic priority.

Project Name	GEF Grant	Co-financing Total	Approval Date	Description
IFC China Utility-Based Energy Efficiency Finance Program (CHUEE) I	16.50	130.40	24-Apr-06	This project will organize and provide marketing, development and financing services to commercial, industrial, and municipal sector energy users to implement energy efficiency (EE) equipment installations ("sub-projects"), including those using high efficiency natural gas equipment.
Energy Efficiency Financing	13.50	583.15	27-May-08	The development objective of the proposed project is to improve the energy efficiency of medium and large-sized industrial enterprises, and to reduce their impact on climate change.
Thermal Power Efficiency	19.70	108.96	5-May-09	The objective of the 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.
Provincial Energy Efficiency Scale-Up Program	13.64	313.70	Under preparation	The overall development objective of this project is to achieve significant reductions in greenhouse gas (GHG) emissions by establishing suitable provincial level policies, institutional and financial mechanisms to scale up the adoption of energy efficiency practices, technologies and programs.

Annex C. Energy Efficiency Projects Sponsored by Other Donor Agencies

Project Name	Agency	GEF Grant	Co-financing Total	Approval date	Description
Energy Conservation and Pollution Control in Township and Village Enterprise Industries	UNDP	1.00	0.00	05-Dec-97	The primary objective of the project is to raise the energy efficiency of the rural industrial sector in China by selecting several key Township and Village Enterprises (TVE) to carry out demonstration projects involving improved technologies. Four subsectors targeted: brickmaking, coking, metal casting and cement.
Energy Conservation and GHG Emission Reduction in Chinese Township and Village Enterprises (TVE), Phase II	UNDP	8.00	10.55	26-Dec-00	This project will focus on Township-Village Enterprises (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.

Annex C. Energy Efficiency Projects Sponsored by Other Donor Agencies

Project Name	Agency	GEF Grant	Co-financing Total	Approval date	Description
Energy Conservation and Pollution Control in Township and Village Enterprise Industries	UNDP	1.00	0.00	05-Dec-97	The primary objective of the project is to raise the energy efficiency of the rural industrial sector in China by selecting several key Township and Village Enterprises (TVE) to carry out demonstration projects involving improved technologies. Four subsectors targeted: brickmaking, coking, metal casting and cement.
Energy Conservation and GHG Emission Reduction in Chinese Township and Village Enterprises (TVE), Phase II	UNDP	8.00	10.55	26-Dec-00	This project will focus on Township-Village Enterprises (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.

Project Name	Agency	GEF Grant	Co-financing Total	Approval date	Description
Barrier Removal for Efficient Lighting Products and Systems	UNDP	8.14	18.07	06-Jul-01	The project aims at addressing identified market barriers to wide spread 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% 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 the establishment of a vibrant, self-sustaining market in efficient lighting products and services.
Demonstration of Fuel Cell Bus Commercialization in China (Phase II-Part I)	UNDP	5.82	10.12	28-Nov-02	This project will help catalyze the cost-reduction of fuel-cell buses (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 national 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 6 FCBs each and to

Project Name	Agency	GEF Grant	Co-financing Total	Approval date	Description
					operate these over a combined total of 1.6 million km. 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.
End Use Energy Efficiency Project	UNDP	17.38	63.00	29-Mar-05	The Chinese government is embarking upon a long-term program to support energy efficiency in the industrial and building sectors. This project supports the first phase (3 years) of that program. The project's purpose is the removal of 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

Project Name	Agency	GEF Grant	Co-financing Total	Approval date	Description
					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.
Promoting Clean Electric Buses for the Beijing Olympics (CEBBO)	UNDP	1.00	12.30	02-May-08	Supporting the Chinese efforts in greening the 2008 Olympic Games in Beijing through the demonstration of electric buses solely powered by Li-ion batteries.
Phasing-out Incandescent Lamps & Energy Saving Lamps Promotion (PILESLAMP)	UNDP	14.25	70.00	28-Jul-08	Enhanced promotion and implementation of the utilization of energy saving lamps (ESLs) in China through the transformation of the local lighting products market and the phasing-out of incandescent lamp production and sale.
Promoting Energy Efficient Room Air Conditioners (PEERAC) Project	UNDP	6.36	19.03	13-Nov-08	Reduction of China's future GHG emissions through transformation of the Chinese room air conditioner (RAC) market to production and sale of more energy-efficient RACs.

Project Name	Agency	GEF Grant	Co-financing Total	Approval date	Description
Energy Efficiency Power Plan (EEP) Program	ADB		100 (ADB)	Under preparation	Establishing a special financing fund implemented by provincial government fund manager. Targeting large/medium industrial and large commercial and institutional end users and ESCOs for retrofitting of plants and building.
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 co-financing. Focusing on a variety of subsectors, including, among others, district heating, district cooling, and cogeneration projects.
Government of China (GOC) Energy Efficiency Incentives and Special Funds	GOC				In 2007 NDRC and MOF created energy efficiency fiscal incentive programs, including incentive payment of RMB 200-250 per annual tce energy savings (15-20 percent project capital cost). Similar incentive funds set up or being formed at provincial and city levels, e.g., Jiangsu, Guangdong, Hebei, subsidizing 10-30 percent of project costs. Currently the main focus is large projects. A new national government clean energy fund being set up with proceeds from CDM projects.
CDM Energy Efficiency Projects	CDM				Since 2006, CDM has financed energy efficiency projects in China. One

Project Name	Agency	GEF Grant	Co-financing Total	Approval date	Description
					criterion for CDM project is additionality, implying that they do not include commercially viable projects.

Annex D. Estimation of a Subproject Economic Rate of Return

(Green Lighting Project in Dafa Zhengda Chicken Company)

As discussed in the main report, the ERR estimation is biased downward with output effect and without counting operation and maintenance costs. In this Annex, the ERR of a green lighting project documented as one of the 357 EMC projects selected by the PMO (PMO 2006, P.487) was estimated, taking into account the two issues mentioned above.

In this case, the Beijing EMC used 3,095 9-w CFL bulbs to replace 1,600 40-w incandescent bulbs for Dafa Zhengda Chicken Farm, where the lighting system was used 14 hours a day for 270 days. The initial investment on the CFL bulbs was RMB 949,000. The electricity shadow price was RMB 0.71 /kWh.

We assume that an incandescent bulb produces 22 lumens/watt and lasts for 1,890 hours and a CFL bulb produces 100 lumens/watt and lasts for 11,340 hours. The new lighting system can be used for 3 years and produces a lighting level that equals to 3,165 40-w incandescent bulbs. To adjust for the scale effect, we assume that total lighting output with the project will be used in substitution for production that would have occurred in the sector without the project and that such production would have occurred with the old lighting efficiency. Suppose the purchase price for a 40-w incandescent bulb is RMB 2.

Finally, using the carbon reduction coefficient used by the PMO, assume that for every MWh of energy used, an average of 0.2268 ton of carbon is emitted into the air.

The annual energy consumption of the Chicken Farm's lighting system with and without the project is shown in Table A1. The annual cash flow of the project is shown in Table A2. The subproject ERR without and with CO_2 abatement benefits is 302 percent and 303 percent, respectively.

Table A1. Annual Energy Consumption and Carbon Emission

Total number of Bulbs	Watt/bulb	Annual Usage (h)	Annual Energy Consumption (104 kWh/a)	Annual Carbon Emission (t)
3095	9	3780	10.53	23.88
3165	40	3780	47.85	108.53

Table A2. Project Cash Flow (Amounts in US$ 000)

Year	0	1	2	3
Purchase cost of CFL	-11.46			
Energy Savings		32.00	32.00	32.00
Avoided Replacement Cost of Incandescent bulbs		1.53	0.76	0.76
Other Maintenance Cost (replacing transformer)		-0.57	-0.57	-0.57
Carbon reduction benefits		0.10	0.10	0.10
Annual cash flow without carbon benefits	-10.70	32.96	32.20	32.20
Annual cash flow with carbon benefits	-10.70	33.07	32.29	32.29

Note: Assume the first year cash flow is negative. Otherwise, an IRR does not exist.