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The World Bank

Report No: ICR00003153

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(GEF-TF054687)

ON A

GRANT

IN THE AMOUNT OF US$18 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

HEAT REFORM AND BUILDING ENERGY EFFICIENCY PROJECT

April 24, 2014

China and Mongolia Sustainable Development Unit (EASCS)
Sustainable Development Department
East Asia and Pacific Region (EAP)

CURRENCY EQUIVALENTS

(Exchange Rate Effective 07/01/2013)

Currency Unit = Renminbi (RMB)
RMB 1.00 = US$ 6.15
US$ 1.00 = RMB 0.16

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

AAA	Analytical and Advisory Activities
BEE	Building Energy Efficiency
BLS	Building Level Substation
CBB	Consumption-based Billing
CPS	Country Partnership Strategy
DH	District Heating
ECA	Europe and Central Asia
FFEM	Fonds Français pour l'Environnement Mondial
FSR	Feasibility Study Report
GEF	Global Environment Facility
GJ	Gigajoules
GOC	Government of China
HMO	Heat Management Office
HRBEE	Heat Reform and Building Energy Efficiency
ICR	Implementation Completion and Results Report
IP	Implementation Progress
ISR	Implementation Status and Results Report
IT	Information Technology
kg ce	kilogram of coal equivalent
LPMO	Local Project Management Office
M&E	Monitoring and Evaluation
MOC	Ministry of Construction (renamed MOHURD)
MOF	Ministry of Finance
MOHURD	Ministry of Housing and Urban-Rural Development
MOU	Memorandum of Understanding
MS	Moderately Satisfactory
MTR	Mid-Term Review
MU	Moderately Unsatisfactory
NDRC	National Development and Reform Commission
NPMO	National Project Management Office
PAD	Project Appraisal Document

PDO	Project Development Objectives
PMO	Project Management Office
RMB	Renminbi
S	Satisfactory
TA	Technical Assistance
TCE	Ton Coal Equivalent
TF	Trust Fund
TRV	Thermostatic Radiator Valve
TTL	Task Team Leader
UNFCCC	United Nations Framework Convention on Climate Change
WBG	World Bank Group

Vice President:	Axel van Trotsenburg
Country Director:	Klaus Rohland
Sector Manager:	Charles Feinstein
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ICR Team Leader:	Emmanuel Py

PEOPLE'S REPUBLIC OF CHINA
HEAT REFORM AND BUILDING ENERGY EFFICIENCY PROJECT

CONTENTS

A. Basic Information			
Country:	China	Project Name:	Heat Reform and Building Energy Efficiency Project
Project ID:	P072721	L/C/TF Number(s):	TF-54687
ICR Date:	04/24/2014	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	PEOPLE'S REPUBLIC OF CHINA
Original Total Commitment:	USD 18.00M	Disbursed Amount:	USD 17.41M
Revised Amount:	USD 17.41M		
Environmental Category: B		**Global Focal Area: C**	
Implementing Agencies: -Ministry of Housing and Urban-Rural Development (overall project coordination and implementation of the national level component) -Tianjin Municipality (Tianjin component) -Municipalities of Tangshan, Chengde, Datong, Wuzhong, Dalian, and Urumqi (other cities component).			
Cofinanciers and Other External Partners: None			

B. Key Dates				
Process	**Date**	**Process**	**Original Date**	**Revised / Actual Date(s)**
Concept Review:	02/06/2003	Effectiveness:	None	09/23/2005
Appraisal:	01/19/2005	Restructuring(s):	None	12/22/2011 12/21/2012
Approval:	03/17/2005	Mid-term Review:	None	09/15/2008
		Closing:	12/31/2011	10/31/2013

C. Ratings Summary	
C.1 Performance Rating by ICR	
Outcomes:	Moderately Satisfactory
Risk to Global Environment Outcome:	Moderate
Bank Performance:	Moderately Satisfactory
Borrower Performance:	Moderately Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance			
Bank	**Ratings**	**Borrower**	**Ratings**
Quality at Entry:	Satisfactory	Government:	Moderately Satisfactory
Quality of Supervision:	Moderately Satisfactory	Implementing Agency/Agencies:	Moderately Satisfactory
Overall Bank Performance:	**Moderately Satisfactory**	**Overall Borrower Performance:**	**Moderately Satisfactory**

C.3 Quality at Entry and Implementation Performance Indicators			
Implementation Performance	**Indicators**	**QAG Assessments (if any)**	**Rating**
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA):	None
Problem Project at any time (Yes/No):	Yes	Quality of Supervision (QSA):	None
GEO rating before Closing/Inactive status:	Moderately Satisfactory		

D. Sector and Theme Codes		
	Original	**Actual**
Sector Code (as % of total Bank financing)		
Central government administration	11	11
Energy efficiency in Heat and Power	32	32
Housing construction	40	40
Sub-national government administration	17	17

Theme Code (as % of total Bank financing)		
Climate change	67	67
Municipal governance and institution building	33	33

E. Bank Staff		
Positions	At ICR	At Approval
Vice President:	Axel van Trotsenburg	Jemal-ud-din Kassum
Country Director:	Klaus Rohland	David R. Dollar
Sector Manager:	Charles M. Feinstein	Junhui Wu
Project Team Leader:	Emmanuel Py	Robert P. Taylor
ICR Team Leader:	Emmanuel Py	
ICR Primary Author:	Emmanuel Py	

F. Results Framework Analysis

Global Environment Objectives (GEO - from Project Appraisal Document, page 4) and Key Indicators(as approved)
The objective of the project is to achieve substantial, sustained and growing increases in energy efficiency in urban residential buildings and central heating systems in China's cold climate regions.

Revised Global Environment Objectives (as approved by original approving authority) and Key Indicators and reasons/justifications
Not applicable.

(a) GEO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values[1]	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Cumulative coal savings capacity achieved: 660,000 TCE/year			
Value quantitative or Qualitative)	0	660,000 TCE/year	660,000 TCE/year	2.6 million TCE/year[2]
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Achieved			
Indicator 2 :	Percent of cumulative new residential stock billed on heat consumption basis: 50%			
Value quantitative or Qualitative)	0%	50%	50%	40%
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Not achieved			
Indicator 3 :	Percent of current-year new housing completion compliant with BEE standard: 80%			
Value quantitative or Qualitative)	40%	80%	80%	98.7%
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Achieved			

[1] Extension of the grant closing date to October 31, 2013 (from originally December 31, 2011). The target values at closing remained unchanged.
[2] Estimated coal savings comparing the actual coal consumption for heating of the 7 project cities during the 2012-2013 Heating Season with an estimated/projected business-as-usual scenario for these cities in the PAD for the same Heating Season (see PAD's baseline scenario for these cities, page 26).

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	**Component 1 (Tianjin):** Percent of cumulative new housing stock billed on heat consumption basis			
Value (quantitative or Qualitative)	0%	60%	60%	31%
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Not achieved			
Indicator 2 :	**Component 1 (Tianjin):** Percent of current-year new housing completion compliant with BEE standard			
Value (quantitative or Qualitative)	50%	89%	89%	100%
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Achieved			
Indicator 3 :	**Component 2 (national level):** Number of cities which will have implemented consumption-based billing[3]			
Value (quantitative or Qualitative)	0	30	30	33
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Achieved			
Indicator 4 :	**Component 2 (national level):** Number of cities which will have integrated building energy code compliance into regular construction supervision			
Value (quantitative or Qualitative)	0	30	30	132
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Achieved			

[3] To be understood as "Number of cities which will have implemented consumption-based billing with at least 10,000 m2 of pilot areas". This is substantially less than the number of cities that have issued a municipal two-part tariff policy for CBB.

Indicator 5 :	**Component 2 (national level):** Number of specialists/officials trained through national seminars or workshops			
Value (quantitative or Qualitative)	NA	200	200	2160
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Achieved. More than 2000 specialists/officials were trained in China through the HRBEE Project during the 8 years of implementation.			
Indicator 6 :	**Component 3 (other cities):** Percent of cumulative new housing stock billed on heat consumption basis			
Value (quantitative or Qualitative)	0	50%	50%	51%
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Achieved			
Indicator 7 :	**Component 3 (other cities):** Percent of current-year new housing completion compliant with BEE standard			
Value (quantitative or Qualitative)	35%	75%	75%	95.1%
Date achieved	12/31/2004	12/31/2011	10/31/2013	10/31/2013
Comments (incl. % achievement)	Achieved			

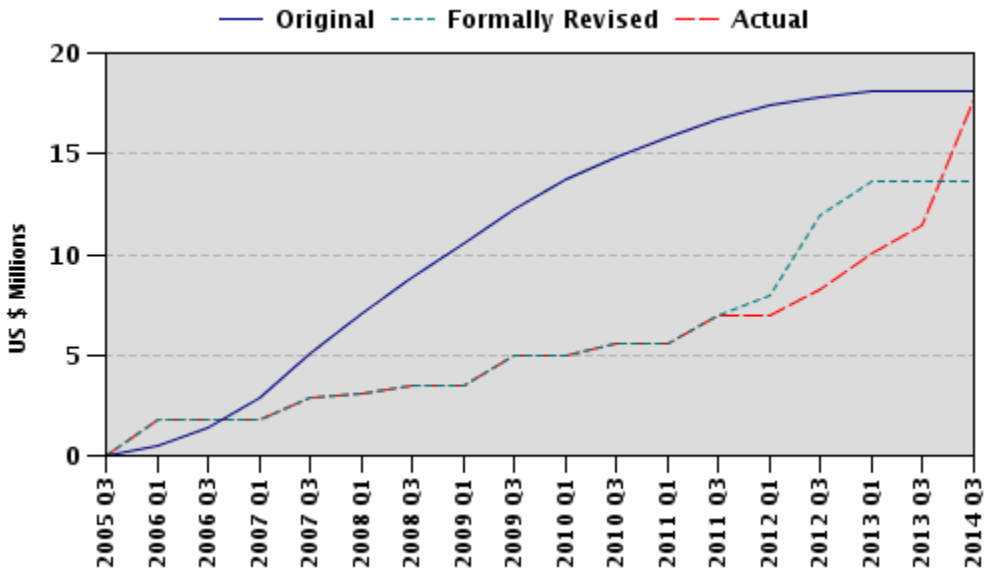
G. Ratings of Project Performance in ISRs

No.	Date ISR Archived	GEO	IP	Actual Disbursements (USD millions)
1	06/20/2005	Satisfactory	Satisfactory	0.00
2	12/19/2005	Satisfactory	Satisfactory	1.80
3	12/19/2006	Satisfactory	Satisfactory	1.80
4	01/09/2008	Satisfactory	Satisfactory	3.05
5	05/14/2009	Moderately Satisfactory	Moderately Satisfactory	4.95
6	06/28/2010	Moderately Satisfactory	Moderately Unsatisfactory	5.54
7	02/12/2011	Moderately Satisfactory	Moderately Unsatisfactory	5.54
8	04/11/2012	Satisfactory	Satisfactory	8.27
9	12/31/2012	Satisfactory	Satisfactory	10.01
10	06/22/2013	Moderately Satisfactory	Moderately Satisfactory	11.41
11	10/24/2013	Moderately Satisfactory	Moderately Satisfactory	12.43

H. Restructuring (if any)

Restructuring Date(s)	Board Approved GEO Change	ISR Ratings at Restructuring		Amount Disbursed at Restructuring in USD millions	Reason for Restructuring & Key Changes Made
		GEO	IP		
12/22/2011		MS	MU	6.92	To extend the grant closing date to December 31, 2012, reallocate grant proceeds across categories, increase the percentage of expenditures for certain categories from 91% to 100%, and amend one procurement provision.
12/21/2012		S	S	10.01	To extend the grant closing date to October 31, 2013.

I. Disbursement Profile (Calendar Year)



1. Project Context, Development Objectives and Design

1.1 Context at Appraisal

1. The year preceding the start of project preparation (2002), China consumed about 1.5 billion TCE of primary commercial energy, second to the U.S. in the world. Even with large improvement of the economy's energy efficiency, China's energy demand was then expected to double in the next twenty years. Much of this future growth in energy demand would be met by coal, which accounted for two thirds of primary commercial energy consumption in China. This prospect had very significant global as well as local environmental ramifications, since coal is not only the most carbon intensive but also the most polluting fossil fuel. Improving end-use energy efficiency was among the most economic short to medium-term options to mitigate the global and local environmental impacts of burning coal.

2. Few end-use sectors then represented a more compelling and urgent case of the abundant opportunities for and the critical role of energy efficiency than the urban space heating sector in the "cold and severe cold regions" of Northern China, covering roughly half of China's population. Centralized heating, predominantly coal-fired systems, had expanded rapidly, and then served about two thirds of urban households. The central heating sector had no mechanisms for consumers to respond to energy service costs, and heating systems were based on Soviet fixed-flow technologies that did not allow consumers to control their heating. Heat metering was basically inexistent, and billing was based on a flat per square meter tariff. Moreover, many employers paid the heat bills of their employees, representing one of the last vestiges of the old-style welfare system.

3. China's urban residential building stock was then expected to more than double in the next twenty years. China had issued its first mandatory national building energy efficiency (BEE) standard for new residential buildings in the cold and severe cold regions in 1995. This design standard (referred to as the "50% BEE standard") required new buildings to achieve a combined 50% improvement in energy efficiency over buildings constructed on standard designs of the early 1980s. However, it had been difficult to implement the regulation.

4. As a result, the heating energy use per unit floor area of Chinese residential buildings was at least double that in similar climates in Western Europe and North America, and the potential for energy savings was huge. For this reason, in July 2003, eight central government ministries and commissions jointly issued the Heat Reform Guidelines calling for each of the 16 Northern provinces/autonomous regions to implement the Heat Reform in several pilot municipalities. The principles of these Guidelines were the commercialization of urban heating, the promotion of technical innovation in the heating sector, and the improvement of building energy efficiency.

5. The Project was to contribute to the deployment of the reform in the city of Tianjin and in 4-6 other Northern cities through the "two-handed" approach and to support the Ministry of Housing and Urban-Rural Development (MOHURD) for the relevant national-level policy development work. The "two-handed" approach referred to:

- On one hand, the creation of a market mechanism through the heat reform and heat system modernization so consumers pay for actual heat consumption (by passing responsibility of payment to households from employers, establishing metering consumption and introducing consumption-based billing), and to enable consumers to control how much heat they consume (by using manual or thermostatic valves to control indoor temperature and by adopting demand-driven variable-flow heating systems).
- On the other hand, major improvements in the thermal integrity of urban residential buildings to reduce building heat losses substantially, requiring widespread adoption of more energy-

efficient designs, new or improved materials and components, as well as adjustments in construction practices.

6. The Project was a central part of the Bank-led international assistance program to MOHURD for its heat reform and building energy efficiency (HRBEE) efforts. This program had been underway for several years with some studies already completed before the start of preparation.

1.2 Global Environment Objectives (GEO) and Key Indicators

7. The project development objective (PDO and GEO) was to achieve substantial, sustained and growing increases in energy efficiency in urban residential buildings and central heating systems in China's cold climate regions.

8. This was to be done through: (i) the improvement of the energy efficiency of residential buildings; (ii) the implementation of reform on heat pricing and billing; and (iii) the modernization of heat supply systems for residential buildings.

9. The key performance indicators for the project were at project completion:

- Annual coal savings capacity achieved by the implementation of the heat reform and building energy efficiency programs in the project cities;
- Percentage of cumulative new residential floor area (built since 2004) in the project cities subject to heat metering and consumption-based billing; and
- Percentage of current-year new residential housing completion compliant with the ongoing BEE standard.

1.3 Revised GEO (as approved by original approving authority) and Key Indicators, and reasons/justification

10. The PDO and the key indicators were not revised during implementation. The grant closing date was extended to October 31, 2013 (from originally December 31, 2011), and the target values at closing remained unchanged.

1.4 Main Beneficiaries

11. The main beneficiaries of the project identified in the PAD were:

- The local and global environment through substantial improvement in energy efficiency.
- The Ministry of Housing and Urban-Rural Development (MOHURD) for the relevant national policy development work for the Heat Reform.
- The city of Tianjin and 4-6 other Northern cities to be identified during implementation for the project's support to the deployment of the Heat Reform.
- The heating and housing development companies in those cities that would receive up to one third of the incremental cost of the energy efficiency measures implemented.
- The people who would live in the residential communities supported by the project in those cities for a more efficient and comfortable approach to indoor heating and for the anticipated reduced cost of their heat bills.
- Other Northern Chinese cities that would learn about the experiences of Tianjin and the other 4-6 Northern cities and would be invited to participate to the project supported workshops and study tours.

1.5 Original Components (as approved)

12. The project had three components.

13. ***Tianjin Municipality Component:*** demonstration of the two-handed approach in Tianjin Municipality. This component sought to provide the project's first operational demonstration that the greatest energy efficiency gains and cost savings in residential space heating could be achieved through an integrated effort (the "two-handed" approach) that simultaneously addressed the thermal integrity of buildings, the operational efficiency of heat supply systems, the provision of means for heat control by consumers, and the implementation of heat metering, cost-based heat pricing and consumption-based heat billing.

14. ***National Policy Support and Project Management Component:*** support for the Ministry of Housing and Urban-Rural Development (MOHURD)[4] for national policy development and project implementation. This component provided the vehicle to support the critical role of the central government to provide policy direction to localities, to bring the best national and international expertise to bear on issues surrounding the implementation of the reform and the development of new technical approaches, to coordinate and guide the implementation of local project activities, to undertake central project management and monitoring functions, and to disseminate successful ideas and results outside participating cities.

15. ***Other Northern Cities Component:*** replication of the two-handed approach in 4-6 other Northern cities. This component was to promote simultaneous development of both heating sector reforms and building energy efficiency improvements in 4-6 additional Northern Chinese municipalities, achieving broader impact. With emerging results from the Tianjin Component, and national-level support, comprehensive development of HRBEE measures would be rolled out in these additional cities.

1.6 Revised Components

16. The project components were not revised. A significant change was the cancellation of the Xindu Garden subproject (total incremental cost of US$ 8.7 million, and proposed GEF cofinancing of US$ 2.6 million) from the Project. The proposed GEF cofinancing was instead spent on similar subprojects in Tianjin (Huaxiajindian, Diliutianyuan, and Taida & Jinhong). There were two reasons for this cancellation: (a) the real estate market was changing rapidly in Tianjin, and the developer wanted to move fast to sell the apartments as soon as possible, without the administrative constraints of the GEF cofinancing; (b) the agreements (in building energy efficiency, inspections, and heat supply systems) reached with the developer were not implemented.

1.7 Other significant changes

17. Two level-two restructurings were approved by the Country Director:

- In December 2011: to extend the grant closing date to December 31, 2012, reallocate grant proceeds across categories, increase the percentage of expenditures for certain categories from 91% to 100%, and amend one procurement provision. The disbursement rate of the grant was then 43% and the original grant closing date (December 31, 2011) was extended one more year to advance project activities, with the possibility of extending again up to one more year if specific time-bound conditions on the implementation progress in year 2012 could be met.
- In December 2012: to extend the grant closing date to October 31, 2013. During the first extension period (year 2012), the project had met the time-bound conditions set for a second

[4] Originally the Ministry of Construction (MOC), but renamed Ministry of Housing and Urban-Rural Development (MOHURD) during implementation.

extension of the grant closing date. The disbursement rate of the grant was then 55%. The extension was necessary to execute at least 35% of the grant amount during the last ten months.

18. In July 2013, a four-month grace period was granted by the Country Director to process final disbursements until February 28, 2014. The final disbursement rate of the grant was 96.7%.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

19. Quality at entry was satisfactory. This was the first Bank's project focusing exclusively on the residential heating sector in China. It was an important next step in the Bank's support to the Government of China (GOC) for its heat reform and building energy efficiency efforts. The HRBEE's design was informed by two AAA studies, which had already been completed prior to project preparation. Lessons learned were taken into account during project preparation from previous Bank-financed projects in the residential heating sector in Europe and Central Asia (ECA) and from energy conservation projects in China. The project also complemented other donor efforts which focused on building retrofits.

20. The project design was well thought out. The project properly set as a priority and focused sharply on new construction, as a rapidly urbanizing Northern China continued its torrid pace of residential building construction. The design allowed the project to develop a model integrated city HRBEE program in Tianjin, which was at the forefront of heat reform and building energy efficiency in China, and follow up with adaptations by other Northern cities so as to establish the applicability of the two-handed approach in the cold climate regions of China. The introduction of new technologies and policy innovations through pilots is a successful model used in many projects in China. The HRBEE's flexible "learning by doing" approach with simultaneous knowledge sharing and parallel replication activities in multiple cities was facilitated by a national coordination and policy support component.

21. The central government was committed but cautious, allowing heating reforms in particular to be implemented gradually according to local conditions. The MOHURD's challenge was to identify cities in addition to Tianjin that would volunteer to pilot the heat reform, the benefits of which had not yet been tested in China. Two risks were identified at appraisal: (a) that the heat reform might be reversed or its scope might be significantly reduced (assessed as "moderate"); and (b) that the demonstration projects might be slow to develop due to lower capacity of the implementing agencies (assessed as "substantial"). Mitigation measures included: strengthening channels of support between levels of government; and working with cities that had integrated the HRBEE agenda in their strategic development plans. Given the substantial risks in slow uptake identified at entry, the project could have had a more modest disbursement schedule.

2.2 Implementation

22. **Project implementation was characterized by a slow progress and therefore initially low disbursement levels.** In December 2010, after five-and-a-half years in implementation, the disbursement rate was only 30%. This was mainly caused by a long time to build up a pipeline of subprojects and technical assistance (TA) activities in other project cities. The first implementation agreements with other project cities were signed after two-and-a-half years in implementation. This slow progress for selecting other project cities was due to the following reasons mentioned below.

23. ***A mandatory city commitment to the heat reform.*** To be eligible for the grant, cities had to commit to the heat reform and prepare an action plan for the implementation of the HRBEE program. This was a high standard to access GEF funds for many cities. According to MOHURD, project cities were among the first to pilot the consumption-based billing reform at the national level. Tianjin was the very first and the Tianjin results only came during the 2006-2007 heating season. Cities needed some form of evidence to follow the reform and seek project support, which explains the time taken to sign the municipal sub-grant agreements.

24. ***A slow uptake of the heat reform.*** The implementation of the heat reform was a local level agenda that depended on the mayor's commitment. MOHURD had few levers or incentives to offer mayors, who perceived implementation of heat reform not among their top priorities to improve energy efficiency in their cities. They were not familiar with the two-part heat tariff promoted by MOHURD, which raised perceived concerns over affordability (from increased heating bills due to inefficient housing) or loss of revenues for heating companies (from decreased energy use for heating by households). International experience suggests that the district heating sector is one of the toughest municipal services to be reformed because it is considered a vital service in cold climate regions, and in China this is no exception. External factors also impeded the progress of the heat reform, such as: the negative impact of the global financial crisis in 2008 (causing a difficult financial environment for heating companies), high coal prices in 2008 with local pressures to keep heat prices low, and MOC/MOHURD's restructuring in 2007-2008. At the time of the Mid-Term Review in September 2008, the work on the building energy efficiency part of the project had been much faster than the progress on the heat reform, and the Bank and NPMO assessed that the slow implementation of consumption-based billing (CBB) was the main obstacle to the full achievement of the PDO. Consequently, they decided to focus new HRBEE activities as much as possible on the implementation of CBB, in particular the national TA and the training / dissemination program.

25. ***Uneven interest of real estate companies.*** The hot real estate market reduced interest from developers to take time to optimize building energy efficiency designs. The incremental cost coverage by the grant (up to one third of the incremental cost of the energy efficiency measures) was a helpful incentive. It was small relative to the size of the investment and not a major factor in decision to participate – the most important incentive was association with a national pilot project, which could be used as a marketing tool. But timing mattered. The project engaged developers usually when site plans were already approved and construction designs underway. While suggestions on improved building energy efficiency codes had been accepted by developers, it took time to gain that understanding. Some developers did not want to wait. Three subprojects in Tianjin were dropped from the GEF Project, two after appraisal and one during preparation. As noted earlier, even with slow uptake, advanced building energy efficiency codes and their enforcement achieved earlier successes, partly due to Tianjin's successes and because new standards were applied to new construction. The project focused more attention on heat reform after the Mid-Term Review.

26. ***Management capacity issues at NPMO until July 2010.*** The project was designed very NPMO dependent, since NPMO was responsible for the national component and for identifying and supporting the other cities component. In the beginning of the project, NPMO was supported with national technical experts on an as needed basis. However, the depth of engagement required on building energy efficiency and consumption-based billing overwhelmed NPMO's capacity. Given the small amounts of grants (except in Tianjin), local project management units were staffed with temporary staff and needed greater support from NPMO than originally envisioned. The Bank team identified this issue consistently but it took time for MOHURD to absorb the point that there was a need for NPMO (and its director) to have a deep understanding of the heat reform, gathering and disseminating early lessons learned, an ability to effectively engage and dialogue with potential pilot

cities/developers, and put in place and manage effective systems and procedures to appraise potential new subprojects and TA activities. The Project Leading Group appointed a senior NPMO's technical advisor with substantial experience in the heating sector as the third project director in July 2010. With this and other changes, the grant's disbursement rate started to improve after his appointment and greater support and attention from the Leading Group. In addition, as results from studies and demonstrations became known, MOHURD used HRBEE materials for important working level conferences attended by local government leadership, a key channel for disseminating results.

2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

27. **M&E design.** The M&E program was designed on a set of ten indicators including three outcome indicators and seven results indicators covering the three components. NMPO was responsible for developing and implementing, with the support of project cities, the M&E system for the entire project, including collecting project performance information and reporting on the impact and results of the project.

28. **M&E implementation.** Implementation of the M&E system focused on regular reporting on the outcome and results indicators, as well as feedback on issues and their resolution. In addition, after the completion of each subproject, an M&E report on its performance had to be prepared by external consultants for NPMO's review. Data was reported annually by NPMO in the project monitoring report. Some variability was noted due to difficulties with obtaining consistent data from cities. During the ICR Mission in October 2013, the final data was gathered from the project cities and was double-checked. The quality and reliability of the data used in the ICR is consistent with agreed methodologies.

29. **M&E utilization.** Strengthening of the existing M&E systems and capacity in project cities and sustainability of the M&E arrangements beyond the operation's implementation period were key reasons for supporting the deployment of municipal pilot heat consumption monitoring platforms in five project cities (Tianjin, Chengde, Tangshan, Wuzhong, and Datong) to gather operation data from heat sources, primary networks, substations, and sometimes as well from apartment-level heat meters. Selected data is accessible online and real-time by city heat management offices and could later be accessible by MOHURD.

2.4 Safeguard and Fiduciary Compliance

30. The project was a Category B. It actually financed TA activities and subprojects consisting of: incremental building energy efficiency improvements (such as energy efficient doors, windows, and insulation material), internal heating systems (mostly apartment-level heat meters and TRV), small building level substations, and heat consumption monitoring platforms (which are metering and IT systems).

31. **Environmental and Social Safeguards.** The environmental impacts of the project were overwhelmingly positive in terms of reduced emissions as shown in Annex 3. Due-diligence reporting was required on environmental and social impacts from project heating and housing development company beneficiaries as part of subproject proposals according to two separate environmental and social impact frameworks developed by the Bank. They were appraised by NPMO, and reviewed by the Bank, and provided evidence that all national and local laws and regulations had been followed. No environmental and social safeguards issues were detected by the Bank during the eight years of supervision, and no land acquisition and resettlement was required for the implementation of the project's energy-efficiency investments.

32. **Procurement.** Procurement was compliant with Bank rules. There were no procurement issues. For the Lugang BEE subproject in Tangshan, the HRBEE national experts (advising NPMO) discovered that some of the windows installed by the real-estate developer did not meet the energy efficiency requirements of the FSR and the corresponding buildings (part of Lugang Phases II and III) were dropped from the subproject scope.

33. **Financial Management.** Project financial management met acceptable standards. Project funds were used for their intended purposes. Annual audit reports were submitted to the Bank on time, and no significant issues were identified. Financial management supervision and selected post-reviews of project accounts, documents, and internal control procedures confirmed that management of project funds was sound.

2.5 Post-completion Operation/Next Phase

34. **Physical assets.** The project basically financed three types of investment subprojects: (a) building energy efficiency improvements and internal heating systems; (b) building level substations (BLS); and (c) heat consumption monitoring platforms. Building energy efficiency improvements and internal heating systems are owned by tenants, but city DH companies are responsible for maintaining apartment-level heat meters. The BLS and the platforms are owned by city DH companies and they are in charge of maintaining them (see table in Annex 2).

35. **Means of sustaining reforms and institutional capacity.** Ten years after the issuance of the Heat Reform Guidelines, the Heat Reform still has a modest but accelerating penetration rate in Northern China. The project promoted key aspects of the Government's plan including: (1) making households responsible for the heating bill; (2) introducing consumption based billing; (3) promoting energy efficient buildings and technologies. On the first, MOHURD reports that households are now largely responsible for the heating bill, which was an early reform started but not completed prior to the project. On the second, consumption based billing for district heating has moved from the 2003 guideline to a clear measure to promote energy savings and energy efficiency improvement in the 12th Five-Year Plan for Energy Development (2011-2015) and it is an explicit measure to promote clean energy in the State Council's 2013 Air Pollution Prevention and Control Action Plan[5], as urban air quality is now a top government priority. By 2013, MOHURD estimated that the consumption-based billing area was 805 million m^2 (about the equivalent of Sweden's entire building stock or the residential building stock in the Netherlands[6]) compared to a total heated building stock of about 8 billion m^2 in Northern China (and compared to 1 million m^2 at the start of the project). On the third, the 65% BEE standard, which was the advanced building energy efficiency standard promoted through the HRBEE has become mandatory for new construction in China's cold climate regions in August 2010. The Government is continually studying and improving standards with new emphasis on green buildings.

36. **Next phase / follow-up operation.** The HRBEE directly helped to identify two follow on operations and one regulatory technical assistance AAA: (1) Urumqi District Heating Project (IBRD $100 million, approved in May 2011) supporting district heating modernization, including accounting and billing preparations for consumption based billing of the city's largest district heating company. Urumqi was one of the HRBEE cities (HRBEE supported an analysis of billing and accounting systems of the largest district heating company in Urumqi whose recommendations were incorporated into downstream institutional strengthening under the loan); (2) the Urban Scale Building Energy Efficiency and Renewable Energy Project (GEF $12 million, approved in April

[5] State Council of the PRC, September 10, 2013, Guofa [2013] 37.
[6] Buildings Performance Institute Europe, *Europe's Buildings under the Microscope*, 2011.

2013) with MOHURD supporting changes to statutory urban planning requirements, distributed generation policy studies, and green building pilots to promote building energy efficiency and renewable energy applications nationally; and (3) Enhancing the Institutional Model for District Heating Regulation AAA (completed in 2012 with MOHURD which used HRBEE for supporting studies), recommending additional regulatory measures that would help advance sector reforms.

37. The project's outcomes were also taken into account in the preparation of the *Urban China: Toward Efficient, Inclusive, and Sustainable Urbanization (Conference Edition, March 2014)* which defines *inter alia* an agenda for greener urbanization. In addition, the project informed the development of a business line on low carbon cities.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation
Rating: **Satisfactory**

38. The project's objectives and design remain fully consistent with the country's priorities in terms of energy conservation, climate change mitigation, and pollution reduction in urban areas. China is still highly dependent on fossil fuels, with coal accounting for 69 percent of primary energy consumption, and for most of China's heating systems. The 12th Five-Year Plan (2011-2015) aims to reduce carbon intensity by 17 percent, and to contribute to the overarching goal of reducing the economy's carbon intensity by 40-45 percent during 2005 to 2020. As noted earlier, the 12th Five Year Plan for Energy Development and the Air Pollution Prevention and Control Action Plan (State Council, 2013) clearly identify the heat reform as a measure to promote energy efficiency and reduce air pollution. While the project did have a slow uptake, in the end, the project's design and implementation is relevant and contributed to reinforcing building energy efficiency and heating sector reforms as important measures to achieve the Government's above mentioned objectives.

39. The project's objectives and design remain consistent with the Country Partnership Strategy (CPS, FY2013-2016) with China. The CPS has supporting greener growth as one of its three strategic themes and shifting to a sustainable energy path as one of the supporting pillars. It is also aligned with the WBG engagement in the energy sector[7], designed to help client countries secure the affordable, reliable, and sustainable energy supply needed to end extreme poverty and promote shared prosperity. The project's objectives and design remain consistent with the Climate Change focal area of the GEF Trust Fund, which is to help developing countries and economies in transition contribute to the overall objective of UNFCCC.

3.2 Achievement of Project Development Objectives
Rating: **Moderately Satisfactory**

40. The project's achievement of its PDO/GEO is rated Moderately Satisfactory based on the following assessment. The cumulative coal savings capacity of 2.6 million tce/year achieved by HRBEE project cities greatly exceeded the target value of 660,000 tce/year (Indicator 1) mainly due to the better than expected outcome for building design compliance with the 65 percent standard, achieving a 98.7% compliance rate compared to the 80% target value (Indicator 3), and the participation of seven cities in the project compared with six cities originally planned at the start of the project. However, critically, the cumulative new residential stock with consumption based billing missed the target value of 50% (Indicator 2), achieving 40% by the end of the project.

[7] See *WBG Energy Sector Directions Paper*, July 2013.

41. The project had a significant contribution to the preparation of the national 65% residential BEE standard that was made mandatory by MOHURD[8] for new construction in China's cold climate regions in August 2010, during the project implementation period. Compared to the national 50% BEE standard, the national 65% BEE standard reduced design building heating energy consumption by 30%. This raised the floor for minimum building energy efficiency code requirements that municipalities could exceed but not reduce for new construction. Therefore, local pilots were an important entry point for building the case for national application. Tianjin adopted the 65% standard in 2004 through its dialogue with the Bank during preparation and made it mandatory in 2005. The first Tianjin 65% BEE standard was issued in 2004 (DB29-1-2004) and was implemented in 2005[9]. Tianjin was the first Chinese city to include heat metering in the 65% BEE standard. Beijing also issued its 65% BEE standard in 2004 (DBJ01-602-2004) which was implemented in 2005, but contrary to Tianjin, it did not include heat metering as a mandatory requirement. The national 65% residential BEE standard made mandatory by MOHURD for new construction in China's cold climate regions in August 2010 includes heat metering as a mandatory requirement.

42. The HRBEE helped to promote early adoption and collected important early implementation experience. The Huaxiajindian and Diliutianyuan subprojects in Tianjin supported by the project were the first residential building communities in China to implement the 65% BEE standard. Code compliance at the design stage, used for the purpose of HRBEE performance indicators, was an essential first step. Building a system to enforce strengthened standards was also needed. The HRBEE helped to pilot through Tianjin the integration of systematic building energy efficiency code inspection procedures with the existing construction quality inspection system and strengthening the supervision capacity for building energy efficiency code compliance. Tianjin accumulated a unique body of knowledge and practical technical experience on the effective implementation of the 65% BEE standard, which through the project's design fed directly into MOHURD's policies and was disseminated to other cities by the project's sponsored workshops and studies (2160 people were trained in BEE and CBB by the end of the project).

43. The HRBEE also provided tailored support to project cities, depending on their need and stage of BEE code development. In Chengde, the project supported enforcement improvements after adoption of the 65% standard. In Tangshan and Urumqi the project supported demonstration of the standard which led to its adoption as a mandatory standard (in 2008 and 2009 respectively).

44. As compared with the target value of 30 cities (Indicator 4), the 132 medium-size cities in China's cold climate regions integrated building energy code compliance into regular construction supervision by the end of the project. In July 2008, the State Council issued the "Civil Building Energy Efficiency Management Regulations" to regulate this process and it is supervised annually by MOHURD in the 132 cities through a random check. The process is documented and has two elements: (1) energy inspection is part of the routine building construction supervision conducted by construction supervision companies (third party hired by the developer), meaning that there is a compliance check list/form which the supervision companies have to fill out; and (2) the municipal government oversight agency (construction quality supervision office) signs off on the checklist as part of the final building completion review. The client noted that the project had a direct influence on the issuance of these regulations[10].

[8] Design standard for energy efficiency of residential buildings in severe cold and cold zone, MOHURD, August 1, 2010, JGJ26-2010.

[9] This 65% standard was updated in 2007 (DB29-1-2007) with support from the GEF project and the updated standard became mandatory in 2007.

[10] Before 2008, NPMO organized two national-level heat metering reform seminars (in 2007 and 2008) and five national-level training programs. In addition, Huaxiajindian and Diliutianyuan were completed in 2008. They were

45. However, despite an eight year implementation period, the project fell qualitatively short of its targets for promoting billing based on heat consumption across the country. Nationally, while consumption based billing objectives are now firmly in official plans and heat pricing reform is accelerating, they had a slow uptake during most of the project implementation period. MOHURD reports that while 116 out of 132 northern Chinese cities have adopted the two-part heat tariff, only 33 cities have at least 10,000 m2 of CBB pilot areas (See Indicator 3). The eight pilot subprojects[11] demonstrated that CBB, when combined with demand driven heating supply systems required by the project, could be implemented in the Chinese context and that it could save energy. Eight pilot sub-projects required variable flow heating supply that enabled systems to respond far more efficiently to building energy needs than traditional (used widely at the start of the project) constant flow systems. This demand driven operating mode was especially important with the introduction of end-use controls (e.g. thermostats) required under building energy efficiency codes and anticipated changes in consumer behavior from consumption based billing. Without consumption based billing, the incentive for end user energy efficiency was weak and the modern heating supply systems are likely to not have reached their full potential.

46. In total, the demonstration subprojects represented 4.13 million m^2 of floor area billed according to heat consumption. While the replication of this experience had a slow uptake, the 50% target of cumulative new housing stock with CBB in other cities (Indicator 6) was met (51%). However, Tianjin, despite being a pioneer in CBB, did not achieve its target of 60% (actual, 31%), which corresponds to 46 million m^2 (the HRBEE subprojects in Tianjin represented 5.5% of this share). Tianjin's relative underachievement of the target (since it is the first city in China in terms of actual CBB area) can be explained by the following factors: (a) its large size and fast growth rate[12] made the achievement of the target more challenging than for the six other project cities; (b) Tianjin is a provincial level city (like Beijing and Shanghai) and MOHURD has no direct authority over it since they rank at the same level in the national/ party hierarchical system; and (c) being a very large and provincial level city makes effective coordination between departments more difficult for the deployment of a challenging reform, like the heat reform.

47. The slow progress of the heat reform at the national level was caused by several factors, the main two being:

- The successful deployment of the reform in several cities in the same province does not necessarily translate in its overall implementation at the provincial level. The role of provincial-level functions in district heating sector reform and development would gain to be enhanced, as recommended by the HRBEE Heat Regulation Report.
- The reform is facing resistance from district heating companies at the municipal level which are rarely keen to promote consumption-based billing since it means reduced revenues for them.

48. Nevertheless, the project has helped strengthen regulatory and institutional capacity at the national and local levels. The National Component supported the promulgation of several key studies (see Annex 2). Under the Other Cities Component, five cities carried out heat price studies to establish the local two-part heat tariff for CBB. Wuzhong and Datong which joined the project at a later stage did it on their own based on the national guidelines that emanated originally from the

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the first residential building communities implementing the 65% BEE standard (with household heat metering) in China. Most activities supported by the HRBEE were pioneer in China in terms of BEE and CBB work and strengthened the case for clause 18 (Chapter 2) of the "Civil Building Energy Efficiency Management Regulations" which states that "newly constructed residential buildings should install heat meters" (NPMO statement, April 2014).

[11] Six with the 65% BEE standard, one with the 75% BEE standard, and one with the 50% BEE standard.

[12] Tianjin's residential floor area has increased by 150% in 8 years compared to 62% for the six other project cities.

project. The Tianjin Component supported improving consumer heat price contracts and improvements in consumer services, consumer awareness and education on heat metering and consumption based billing. According to MOHURD, support from HRBEE to these pilot cities have helped sustain the momentum of the heat reform in China and some of the stronger cities (Chengde, Tangshan, and Tianjin) are often invited to national and provincial-level workshops to share their experience with other cities.

49. The project also introduced innovative heat consumption monitoring platforms. The platforms aim to remove barriers to CBB by providing data on energy consumption needed to calculate two part heat tariffs and benchmark overall heating system performance, i.e. understand actual energy savings generated from heat price reforms. It can also help monitor energy savings to ensure bills are calculated properly in case of disputes when CBB is implemented. The platforms might be used at some stage for carbon trading in the heating sector, which was piloted under the project in Tianjin (Taida & Jinhong CBB subprojects).

50. The project also piloted the BLS technology, which enhances energy efficiency and reduces maintenance needs compared to a traditional group substation. Two BLS subprojects were implemented in Urumqi (9 BLS in 4 buildings covering 72,000 m^2) and in Chengde (18 BLS in 10 buildings covering 180,000 m^2).

3.3 Efficiency

Rating: **Moderately Satisfactory**

51. Efficiency can be viewed in two ways: cost effectiveness of the project ("value for money") and efficiency of project implementation. Efficiency of project implementation was moderately satisfactory overall during the 8 years as described in Part 2.2 and in Part 5. Furthermore, 3.3% of the grant amount was not used, which indicates that counterparts (mostly project cities) did not fully use all the available financial resources to maximize the achievement of the PDO.

52. The cost effectiveness of the project ("value for money") was satisfactory. A similar incremental cost analysis as conducted at appraisal and documented in the PAD was carried out at the ICR stage (see Annex 3). Since the project supported a comprehensive national policy reform and regulatory agenda that required many years to implement and would not fully materialize until many years after the project implementation is completed, its impact in the PAD (and therefore in the ICR stage analysis) was not limited to the activities and investments which the project directly supported. Like in the PAD, the analysis did not attempt to separate out the impact of the GEF alternative from the overall government efforts it supported because there would have been no rationale for implementing the GEF alternative without the government's supportive reform and policy efforts. The incremental cost analysis in the PAD (and in the ICR stage analysis) attempted to assess the long-term aggregate impact of implementing the HRBEE agenda in the project cities and at the national level. It is estimated that by 2024 this national effort (compared to the PAD's estimated business-as-usual scenario for Northern Chinese cities, see page 26) would result in potential cumulative coal savings of about 590 million TCE (2004-2024), avoiding emissions of about 440 million tons of carbon. Under this broad definition of project impact boundary, the undiscounted cost of carbon emission reduction to the GEF is about $0.04/ton carbon (60% less than estimated at appraisal). For the project cities, 2.6 million TCE annual coal-saving capacity[13] has been achieved by closing (compared to the PAD estimated target of 660,000 TCE) potentially generating over 51

[13] Estimated coal savings comparing the actual coal consumption for heating of the 7 project cities during the 2012-2013 Heating Season with an estimated/projected business-as-usual scenario for these cities in the PAD for the same Heating Season (see PAD's baseline scenario for these cities, page 26).

million TCE coal-savings and reducing CO2 emissions by about 38 million tons of carbon over a 20-year period (2004-2024). For the project cities only, the undiscounted cost of carbon emission reduction to the GEF is about $0.47/ton-carbon (74% less than estimated at appraisal).

3.4 Justification of Overall Outcome Rating

Rating: **Moderately Satisfactory**

53. Based on the above ratings, the project outcome rating is moderately satisfactory. The target (Indicator 2) of 50% actual cumulative new residential stock billed on heat consumption basis was not met, despite a 22 month extension. Project efficiency was moderately satisfactory. Despite an extended 8 year implementation period and underachievement in a key indicator, counterparts did not fully utilize grant resources (3.3% was not used).

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

54. **Social Development.** The project has had a positive impact on heating consumers because it improved the quality of heating services and promoted awareness in using energy wisely for heating. Building energy efficiency codes improved tightened building envelopes and mandated end-use controls while the demand driven heating supply mode improved responsiveness and efficiency. Results from the subprojects showed that CBB had a direct impact on heat consumers' consumption patterns. In Tianjin, municipal pilot CBB areas reported energy savings of about 11%. For heat consumers, this represents financial savings of about 5% compared to their previous annual heating bills under a fixed tariff. This is not negligible, especially for poorer households. A World Bank study[14] in Liaoning Province showed that on average heating bills represented between 7 and 10% of income and up to 21% for the poorest quintile. Therefore, the changes in pricing and billing brought by the heat reform can have a positive impact on the welfare of heat consumers.

55. **Poverty Impacts.** This project did not have a direct poverty reduction objective. However, efforts to raise the floor for minimum residential building energy efficiency standards reduce the energy consumption needs for heating in buildings and can reduce heating bills (depending on the desired level of comfort). Mandatory end-user controls and metered billing empowered consumers to determine the desired level of energy consumption for heating, which factors in affordability concerns. Without metered heating, everyone pays a flat rate per square meter no matter the amount of energy consumed or level of comfort desired.

56. **Gender Aspects.** The project did not have any specific gender development outcome. The benefits of the heat reform are equally positive for men and women.

(b) Institutional Change/Strengthening

57. Although the pace of replication in CBB was slow, the project built institutional knowledge and catalyzed changes in residential building energy efficiency and central heating systems that supply the buildings as follows:

<u>Building Energy Efficiency</u>

- As discussed in Part 3.2 a), the elements of the building energy code compliance process piloted with the support of the project are now integrated into regular construction supervision. This

[14] *China, Social Analysis of Heating Reforms in Liaoning Province,* World Bank / ASTAE, November 2009, Gailius Draugelis and Xun Wu.

process is supervised annually by MOHURD in the 132 cities through a random check, and the implementation rate is very high. This implies that the role and capacity of the local agencies responsible for this work has been enhanced since 2005, either directly through the project city pilots (Tianjin, Chengde, Tangshan, and Urumqi) or indirectly through MOHURD's own regulations and supervision system.

- The project accelerated adoption and/or implementation of the 65% residential building energy efficiency standard in the project cities (for new construction) and its analytical studies informed MOHURD in its continuous efforts to improve the standards. Through the experience of the pilot cities that was monitored by MOHURD, the project had a significant contribution to the preparation of the national 65% residential BEE standard that was made mandatory by MOHURD for new construction in China's cold climate regions in August 2010, during the project implementation period.

Central Heating Systems

- The project accelerated adoption of consumption based billing in the seven project cities. In Tianjin, HRBEE subprojects represented 5.5% of total floor area billed according to consumption, and in the six other project cities 2.5%. This provided important experience and lessons learned for various institutions – municipal heating offices, municipal pricing bureaus, district heating companies, developers and consumers.
- In addition, the project supported national guidelines for the adoption of a two part heat tariff, which had a slow uptake but are used for ongoing heat price reform efforts (see Annex 2).
- The project has empowered government institutions in five of the seven project cities to supervise the actual progress of DH companies for implementing the heat reform by getting objective data on energy savings and CBB / variable-flow penetration rates directly from the platforms.
- The project also supported MOHURD's collaboration with the Bank's AAA to lay out a comprehensive agenda for further enhancements of the institutional model for heat regulation in China.
- The project has sponsored four international study tours and 22 domestic training programs and workshops that have sensitized and trained a large pool (Indicator 5: 2160 persons) of municipal technicians and leaders in city construction commissions about the HRBEE agenda, national guidelines, international approaches, and the results of the HRBEE project in China.

(c) Other Unintended Outcomes and Impacts (positive or negative)
Not applicable.

3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops
Not applicable.

4. Assessment of Risk to Development Outcome
Rating: Moderate

58. The risk at closing that development outcomes will not be maintained is moderate. The achievements on the BEE side, especially the very high penetration of the advanced 65% BEE standard for new construction in Northern China, are irreversible. The national building and construction materials industries have now raised their standards in the past four years since the adoption of the mandatory 65% BEE standard for new construction. The tendency is now to move to

the 75% BEE standard for new construction, which has become mandatory in Tianjin in October 2013. MOHURD is also promoting green buildings. These trends will ensure that the estimated cumulative coal savings capacity that could be achieved in the project cities between 2004 and 2024 (see Annex 3) will be maintained or even exceeded.

59. The heat reform, however, is still at a crucial stage. Based on discussions carried out during the ICR mission, the CBB penetration rates in new construction will keep increasing in the 7 project cities. However at closing only one-quarter of Northern Chinese cities were actually implementing CBB (with at least 10,000 m2 of pilot areas) and the CBB area was only 805 million m2 (10% of the total estimated heated building stock[15]) in Northern China compared to a total heated building stock of about 8 billion m2. There is strong political willingness at the national level to push for the deployment of the reform since it is now mandatory by MOHURD for new residential construction, and it can alleviate the serious air pollution issues that Chinese cities face during the winter. This should mitigate the risk of backsliding on this reform; however, the two barriers mentioned in paragraph 47 will still need to be addressed for a full deployment of the reform.

5. Assessment of Bank and Borrower Performance

5.1 Bank Performance

(a) Bank Performance in Ensuring Quality at Entry
Rating: **Satisfactory**

60. As summarized in Sections 1.1 and 2.1, the Bank's support for the project was based on solid rationale, and the quality at entry it helped attain is considered satisfactory.

61. This was the first Bank project focusing exclusively on the residential heating sector in China, but lessons learned were taken into account during project preparation from previous Bank-financed projects in the residential heating sector in Europe and Central Asia (ECA) and from energy conservation projects in China. Technical expertise through AAA and during preparation was used to assist in review of design options.

62. The design was appropriate but its NPMO dependence (for components 2 and 3) was an inherent risk that might have been addressed earlier on during implementation when it became apparent that MOHURD lacked leverage over the cities and NPMO's capacity was weak during the first years of implementation.

(b) Quality of Supervision
Rating: **Moderately Satisfactory**

63. Until the Mid-Term Review (MTR) in September 2008, the Bank conducted on average three supervision missions per year, which is more than the usual two weeks. This reflected an enhanced supervision strategy required during the slow start of the project. Supervision teams were appropriately staffed to address and report on implementation issues as they emerged. Given the persistently low disbursement of the project (about 22%), the PDO and IP ratings were downgraded from S to MS after the MTR. The MTR also appropriately shifted focus on the more difficult part of the project's policy support agenda, CBB, noting that the slow implementation of CBB was seen as the main obstacle to the full achievement of the PDO. Dissemination and training were given a priority. The team also signed an MOU with the Fonds Français pour l'Environnement Mondial

[15] For residential buildings only (on which the project focused), the CBB area was only 616 million m^2 for a total heated residential building stock of about 6 billion m2 (10% as well).

(FFEM) which had been doing building energy efficiency work in China. The team utilized a FFEM supported expert who had led the Shanghai work to try to sustain enhanced technical supervision of the HRBEE. Task management was transferred to the Beijing Office to enhance communications. (There were four task team leaders under this project but transitions appeared to be smooth.)

64. Nevertheless, in June 2010, the IP rating was further downgraded to MU because disbursement remained low (30%), project management issues were addressed incompletely, and the build-up of a pipeline of subprojects and TA activities in other project cities was very slow to materialize. At the Bank's urging, MOHURD appointed a more senior NPMO Executive Director (the third of the project) in early July 2010. The Bank also enhanced the supervision team (with an additional Beijing based Senior Energy Specialist) and further intensified supervision – the Bank conducted at least monthly visits to the NPMO. Overall, the Bank was responsive to client demands and made considerable efforts to help solve implementation issues. However, it could have been faster in recognizing the project's slow performance through its performance ratings and in establishing the increased frequency of meetings earlier during supervision. It is difficult to predict with certainty that such efforts would have addressed project implementation issues sooner. The project started to take off again under the new NPMO management. During the last months of implementation, NPMO and the Bank launched a broad and systematic nation-wide effort to disseminate the results of the project, which has been effective in establishing conditions for sustained project outcomes.

65. Supervision reports were generally realistic, candid, internally consistent, and focused on the PDO. Management letters highlighted key issues to be brought to the attention of the implementing agencies, and of the municipal and national levels. Ratings given by staff were generally appropriate, but perhaps too slow in reflecting slow progress. As a result, though efforts were indeed very strong, the Bank's overall supervision performance is marginally satisfactory.

(c) Justification of Rating for Overall Bank Performance
Rating: **Moderately Satisfactory**

66. Overall Bank performance is rated moderately satisfactory, based on the ratings for quality at entry and for supervision.

5.2 Borrower Performance

(a) Government Performance
Rating: **Moderately Satisfactory**

67. The national government performance is moderately satisfactory. The national government (mainly MOHURD but also NDRC and MOF) was very supportive of the HRBEE project and of the heat reform. However, project efficiency may have been better with an enhanced National Project Management Office, capable of engaging more deeply the local project cities and supporting them, and establishing standardized management procedures. The Government recognized very late in the process the need for a strong NPMO as a critical element to project success. MOHURD became more proactive in the later stages of the project, and the results show significant improvement. In addition, the NPMO was located under the Department of Building Energy Efficiency, Science and Technology. Heating reform was also under the responsibility of another department. It is possible that the residential building energy efficiency elements of this project were more successful due to this direct link to the line department responsible for building energy efficiency. Coordination across departments was at times difficult, needing greater MOHURD support, and possibly a contributing factor to more moderate success in the heating sector objectives.

(b) Implementing Agency or Agencies Performance
Rating: **Moderately Satisfactory**

68. Overall, the performance of implementing agencies (NPMO and project cities) was moderately satisfactory. Once a new executive director was selected in July 2010, NPMO's performance improved to satisfactory for the last three years of implementation. However, for the reasons discussed in Part 2.2, NPMO's performance was sub-optimal during the first five years of implementation. As noted earlier, proactive support from MOHURD was missed in the first part of the project to address shortcomings early in implementation.

(c) Justification of Rating for Overall Borrower Performance
Rating: **Moderately Satisfactory**

69. Overall borrower performance is rated moderately satisfactory based on the ratings of the performance of the government and the implementing agencies.

6. Lessons Learned

70. **Strong project management units are needed especially for projects with transformative objectives depending mainly on outcomes from technical assistance.** Compared with loan projects, PMOs for technical assistance projects tend to be under-resourced or under-skilled, placed inside an existing project management unit established for lending, or set up with part time staff. Yet TA requires deep engagement with counterparts to clearly identify problems, transform them into well designed activities, establish the institutional arrangements to ensure inputs are transformed into outcomes, and efficiently monitor progress. TA projects tend to have many small contracts, requiring strong contract management. Clear project management procedures with annual planning, monthly supervision, periodic training (if multiple city level PMOs are involved) to become familiar with Bank requirements, and quality control are key elements. Additionally, institutional arrangements matter – PMOs managing multi-sector projects, like buildings and heating, will need to have very strong coordination mechanisms. If left on their own, PMOs may have difficulty engaging across departments and agencies.

71. **Concentration of resources can help to enhance engagement needed to catalyze change, reduce transaction costs, and increase local government support.** Technical assistance projects tend to be grant financed, smaller and realize outcomes more slowly than loan projects. As a result they receive less attention than projects needing loan repayment and generating substantial physical investment. In principle, concentrating resources as much as possible in fewer geographic locations can help both the Bank team and the main counterpart provide better service and engagement under their respective budget constraints. Bringing loan and grant resources together to support a common objective in one location can provide high value added (as in Urumqi).

72. **Engaging real estate developers to promote more advanced building energy efficiency concepts requires more incentives than partial grant support.** Developers follow the local standards and would entertain innovations if they perceive it provides them a competitive advantage. The incremental cost coverage from the HRBEE grant was not the main incentive for participation – designation as a national demonstration project was seen to strengthen the development's marketing. Labelling programs, for instance, can have a strong impact should the market demand greener homes. Technical assistance, if provided efficiently, for adjusting building designs can also bring value added. Regulatory changes are also critical factors in moving markets toward greener buildings. Projects targeting real estate developers must be very efficient to keep pace with the market.

73. **District heating sector reform in transition economies requires a long term engagement that could be accelerated with strengthened institutions and regulations.** Heating used to be provided as a free housing service by the welfare state. Transitioning to selling heat as a commodity requires a long term effort. Pilots and local policy engagements can be effective if the lessons learned are absorbed by the institutions responsible for the reform. In China, there are multiple institutions including local pricing bureaus, heating management offices, mayor's office, heating enterprises, consumers and MOHURD at the central government level that have jurisdiction over parts of the reform. With about 132 cities across 15 provinces and a few tens of thousands of heating enterprises in Northern China, reaching out to all stakeholders is a very difficult assignment for a budget-strapped central authority like MOHURD. The HRBEE provided resources for piloting, policy support and strengthened dissemination. Sustaining this effort may require enhancing provincial-level institutions that could facilitate knowledge exchange, monitor and even benchmark district heating enterprises, and provide support to local authorities within the province.

7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

(a) Borrower/implementing agencies

74. The final draft ICR was shared with the borrower (NPMO and MOHURD) in February 2014. The borrower's comments are attached to Annex 7. NPMO expressed two main points:

- The percent of cumulative new residential stock billed on heat consumption basis since 2004 in the 7 project cities is 66% (and not 40%);
- Project efficiency and implementing agency performance has been satisfactory during implementation.

75. Regarding point 1, 66% may indeed be the percentage of the total residential area built in the 7 project cities since 2004 with installed heat meters. Some of them may be working, some not. Of those working, some may have been used for actual CBB during the 2012-2013 Heating Season (40%, Indicator 2), some may have been used for the one-year testing period preceding actual CBB during the following Heating Season, some may be working but may not be used in the short-term for CBB as stressed by the borrower's comments.

76. The 7 project cities (LPMOs) reported their figures to the World Bank Task Team, through NPMO in July 2014. These figures were analyzed and double-checked again by the Task Team with the project cities during the ICR Mission in October 2013. They were reported in the World Bank ICR Mission Aide-Memoire (attached to Annex 10). This data is robust and the Task Team has additional written evidence[16] of Tianjin's actual CBB area in 2012-2013 (46 million m^2), which, unfortunately, drags the overall project's CBB indicator down (to 40%, Indicator 2).

77. Regarding point 2, the project closed after a 22 month extension and with grant savings. The project progress was rated Moderately Unsatisfactory for two consecutive years and the last two ISR ratings were Moderately Satisfactory. Efficiency of project implementation was Moderately Satisfactory overall during the 8 years of implementation as described in Part 2.2 and in Part 5 in part because of weak capacity of the NPMO during the first five years of implementation.

(b) Cofinanciers. None.

(c) Other partners and stakeholders *(e.g. NGOs/private sector/civil society)*
None.

[16] In the final report "*Summary and Conclusion of Tianjin Heat Metering Reform Experience"*, October 2013.

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in USD Million equivalent)

Table A1

Components	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
A. Tianjin Municipality Demonstration Component	**21.20**	**21.20**	**100%**
A1. Energy Efficient Investment in Buildings and Heat Supply	20.00	20.00	100%
A2. Technical and Institutional Capacity Building	1.20	1.20	100%
B. National Policy Support & **Project Management Component**	**2.30**	**3.25**	**141%**
B1. Technical Assistance to Ministry of Construction	1.35	1.20	89%
B2. Project Management, Monitoring and Dissemination	0.95	2.05	216%
C. Other Northern Cities Component	**29.10**	**25.60**	**88%**
C1. Energy Efficiency Investment in Buildings and Heat Supply	26.70	24.00	90%
C2. Technical and Institutional Capacity Building	2.40	1.60	67%
Unallocated	**-**	**0.00**	**n/a**
Total Financing Required	**52.60**	**50.05**	**95%**

(b) GEF Grant Contribution (in USD Millions) by Component (Table A2)

Components	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
A. Tianjin Municipality Demonstration Component	6.00	5.95	99%
B. National Policy Support & Project Management Component	2.25	3.09	137%
C. Other Northern Cities Component	9.45	8.37	89%
Unallocated	0.30	0.00	0%
Total GEF Grant Contribution	**18.00**	**17.41**	**97%**

(c) GEF Grant Contribution (in USD Millions) by Category (Table A3)

Category	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
(1) Sub-grants	12.70	12.17	96%
(2) Goods (under Part B.6 of the Project)	0.05	0.05	100%
(3) Consultants' Services	4.37	4.16	95%
(4) Incremental Operating Costs (under Part B.6 of the Project)	0.15	0.25	167%
(5) Training	0.44	0.78	177%
(6) Unallocated	0.30	0.00	0%
Total GEF Grant Contribution	**18.00**	**17.41**	**97%**

(b) Financing

Table A4

Source of Funds	Type of Financing	Appraisal Estimate (USD millions)	Actual/Latest Estimate (USD millions)	Percentage of Appraisal
Borrower	Budget	34.60	32.64	94%
Global Environment Facility (GEF)	Grant	18.00	17.41	97%
Total		**52.60**	**50.05**	**95%**

Annex 2. Outputs by Component

Components	PAD	At Project Completion
A: Tianjin Municipality Component	1. Energy efficiency investment in new residential buildings and heat supply systems a. Improvement of building thermal integrity b. Improvement of building internal heating system c. Improvement of heating system and network	Completed: -Huaxiajindian BEE -Diliutianyuan BEE -Taida & Jinhong CBB -Municipal Pilot Heat Consumption Monitoring Platform The Xindu Garden Demonstration Subproject presented in the PAD was implemented with counterpart funds only (see Section 1.6).
	2. Technical and Institutional Capacity Building	Completed:
	2.1 Technical studies and analytical work essential to the implementation of heat metering, cost-based pricing, consumption-based billing, as well as more stringent BEE standard;	5 studies produced (see list below).
	2.2 Development of BEE compliance enforcement capacity through introduction of systematic inspection procedures compatible with the existing construction quality inspection system, and by strengthening the supervision capacity of the local BEE authority;	BEE Standard Compliance TA.
	2.3 Public education in the local area on the benefits of energy efficiency and in particular for new residents in the demonstration projects on the use and benefits of consumption-based billing and heat metering and consumer control equipment; and professional training for designers, construction supervisors, and building inspectors on energy efficiency compliance requirements and procedures; and	Dissemination TA for Heat Metering Users, training programs, and study tours.
	2.4 Monitoring and evaluation of technical outcomes, as well as the economic and social impacts of the demonstration projects.	Two monitoring and evaluation contracts for the Tianjin Component and two studies related to heat consumption monitoring (Municipal Pilot Heat Consumption Monitoring

Components	PAD	At Project Completion
		Platform FSR, and Carbon Trading Methods for the Heating Sector).
B. National Level Policy Support and Project Management	1. Policy Advice, Technical and Institutional Support	Completed: -17 studies produced (see list below). -4 contracts for the National Experts, providing quality control for the national and municipal studies. -Training and dissemination activities: 4 international study tours (to Denmark, Finland, Poland, Germany, and Russia), and 22 domestic training programs and workshops.
	2. Project Management, Monitoring and Evaluation	Completed: -8 annual project management contracts (National PMO). -Incremental costs for the National PMO.
C. Other Northern Cities Component	1. Energy efficiency investment in new residential buildings and heat supply systems • Building Energy Efficiency • Internal Heating Network • Network and Substations • Heat Supply	Completed: -Building Energy Efficiency and Internal Heating Network: Dalian, Yihexiangxie BEE; Urumqi, Boruixincun BEE; Tangshan, Lugang BEE; Wuzhong, Jinxing CBB. -Network and Substations: Building Level Substations: Urumqi, BLS; Chengde, BLS. -Heat Supply: no direct investment in energy efficiency improvement at the heat source level, but installation of network-wide heat monitoring platforms, covering heat sources and substations: Tangshan, Chengde, Datong, and Wuzhong.
	2 Technical Assistance 2.1 Project Development Support 2.2 Development and Piloting Heat Reform Support	Completed: 7 studies produced (see list below). 13 studies produced (see list below) and associated training and study tours.

5 Tianjin Studies (Tianjin Component I. 2.1):

1. Specifications on Application of Thermal Flow Meters
2. Heat Standard Contract
3. Variable-flow Heating System
4. Determination Method of Heat Energy Consumption Based Billing (CBB) Baseline
5. Summary and Conclusion of Tianjin Heat Metering Reform Experience

18 National Level Studies:

1. Temporary Management Regulations of Urban Heat Price
2. Guidelines for Urban Heat Fee Subsidies
3. Guidelines for Promoting the Implementation of Heat Metering
4. Heat Regulation Research
5. Evaluation and Assessment of China's Heat Metering Reform
6. Datong, Heat Consumption Monitoring Platform FSR
7. Wuzhong, Heat Consumption Monitoring Platform FSR
8. Summary and Conclusion of Yuzhong Heat Metering Reform Experience
9. Technical and Economic Analysis of Ground Source Heat Pump
10. Research on BEE Renovation of Existing Buildings; Research on Technology Selection and Cost Analysis of Existing BEE Renovation
11. Policy Research on Existing BEE Renovation
12. Study of heating network reconstruction implementation and planning
13. Research for HRBEE program summary and design of second phase HRBEE Project
14. Conclusion and Dissemination of the HRBEE Project
15. Training and material compiling of 100 questions on the work guideline of heat metering
16. FSR of Lanzhou Heat Supply Renovation
17. Documentary of HRBEE project achievements

Other Northern Cities Component:

Project Development Support:

1. Chengde, Heat Consumption Monitoring Platform FSR
2. Chengde, Study on the potential for integrating renewable energy into the Chengde district heating system
3. Tangshan, Heat Consumption Monitoring Platform FSR
4. Tangshan, Lugang M&E
5. Urumqi, Boruixincun M&E
6. Urumqi, Heat Consumption Monitoring Platform FSR
7. Wuzhong, FSR of Wuzhong Heat Supply Renovation

Development and Piloting Heat Reform Support:

1. Chengde, BEE Standard Compliance
2. Chengde, Research for Optimized Energy Saving Operation Management of Heating Company
3. Chengde, Summary and Conclusion of Chengde Heat Metering Reform Experience
4. Dalian, Heat Metering and Billing Management Methods
5. Dalian, Heat Price Research
6. Datong, Heat Reform Planning Research

7. Tangshan, Heat Price Research
8. Tangshan, Summary and Conclusion of Tangshan Heat Metering Reform Experience
9. Urumqi, Heat Price Research
10. Urumqi, Improvement of Urumqi DH Company's Accounting and Billing Information System for Consumption Based Billing
11. Urumqi, Study on CBB, Heat Standard Contract, and Training
12. Wuzhong, HRBEE Planning Research
13. Yinchuan, Heat Price Research

The project has helped develop the national and local body of methodologies and guidelines needed for implementing the heat reform[17].

At the national level, four key studies were produced for the implementation of the heat reform:

1. Guidelines for Urban Heat Fee Subsidies
2. Temporary Management Regulations of Urban Heat Price
3. Guidelines for Promoting the Implementation of Heat Metering
4. Enhancing the Institutional Model for District Heating Regulation

The work done under the first study (Guidelines for Urban Heat Fee Subsidies) was used by MOHURD for the publication of the "opinion on city heat fee subsidy work" (in June 2007) which was implemented in December 2007. This document stated that heat was changed from a benefit of the government-supported welfare system to a commercial commodity (referred to as the *"an bu bian ming bu reform"* in Chinese).

The second study (Temporary Management Regulations of Urban Heat Price) resulted in the publication by MOHURD and NDRC of the "Interim Guidelines for Heat Tariff" in June 2007 and implemented in October 2007. The guidelines specified that heat tariff had to consist of two parts: (i) a capacity charge, based on heated square meters (GJ/hour), and (ii) an energy charge, based on heat consumed. The study also specified the general methodology for assessing the unit costs needed for the two parts.

The third study (Guidelines for Promoting the Implementation of Heat Metering) finished in 2007 made recommendations to improve the implementation of heat metering. Based on this study, MOHURD issued two documents in 2008 and 2009: (i) heat metering and billing management methods (Construction City (2008) No.106), and (ii) heat metering technical norms (JGJ173-2009). This study influenced the preparation of the "Residential Building Energy Efficiency Ordinance" issued by the State Council in July 2008, mandating the installation of apartment level heat meters for new buildings.

The fourth study made specific recommendations for enhancing the institutional model for district heating regulation. The final report is available in English and in Chinese on the internet[18]. One key recommendation is to enhance provincial-level functions in district heating sector reform and development.

[17] The client has provided documented evidence of the project's impact on the development of the national and local body of methodologies and guidelines needed for implementing the heat reform, which is in the project files.

[18] http://documents.worldbank.org/curated/en/2012/12/18481031/enhancing-institutional-model-district-heating-regulation-outside-perspectives-suggestions

Arrangements for the Operation and Maintenance of Physical Assets

The physical investments financed by the project are being operated and maintained. The arrangements for their operation are the following:

Physical Investment	Subproject and City	Owner of the Asset	Maintenance
Building Energy Efficiency Improvements and Internal Heating & Metering Systems	Huaxiajindian, Diliutianyuan (Tianjin); Yihexiangxie (Dalian); Boruixincun (Urumqi); Lugang (Tangshan)	-BEE investments / TRV / heat meters owned by tenants	-DH companies are responsible for maintaining heat meters
Internal Heating & Metering Systems	Taida & Jinhong (Tianjin); Jinxing (Wuzhong)	-TRV / heat meters owned by tenants	-DH companies are responsible for maintaining heat meters
Building Level Substations (BLS)	Urumqi, Chengde	-BLS owned by city DH companies -BEE investments / TRV / heat meters owned by tenants	-DH companies are responsible for maintaining the BLS and heat meters
Heat Consumption Monitoring Platforms	Tianjin, Tangshan, Chengde, Datong, Wuzhong	-Heat meters (at heat source and substation level), software & hardware of the control center: owned by city DH companies	-DH companies are responsible for maintaining heat meters, the software & hardware of the control center

Annex 3. Economic and Financial Analysis
(reviewed by Dr. Arto Nuorkivi, PhD, District Heating Expert)

An incremental cost analysis is carried out with the same approach and baseline scenario of the PAD to derive the following two numbers:

- estimated annual coal-savings achieved by the project cities (the PAD estimated 660,000 TCE by the end of the project for Tianjin and 5 other project cities[19]);
- estimated annual coal-savings of the national HRBEE effort in China (the PAD estimated about 240 million TCE between 2004 and 2024).

Since the project supported a comprehensive national policy reform and regulatory agenda that required many years to implement and would not fully materialize until many years after the project implementation is completed, its impact in the PAD (and therefore in this ICR stage analysis) was not limited to the activities and investments which the project directly supported. Like in the PAD, the analysis did not attempt to separate out the impact of the GEF alternative from the overall government efforts it supported because there would have been no rationale for implementing the GEF alternative without the government's supportive reform and policy efforts. The incremental cost analysis in the PAD (and in this ICR stage analysis) attempted to assess the long-term aggregate impact of implementing the HRBEE agenda in the project cities and at the national level.

1. Estimated annual coal-savings achieved by the project cities

During the ICR mission, the actual heated residential building stock as of April 2013 (end of the last heating season before the project closing) was gathered from the 7 project cities that had carried out both investment subprojects and technical assistance activities through the HRBEE. It is shown below by building energy efficiency performance standard (from 30% BEE to 65% BEE):

	Tianjin	Chengde	Tangshan	Dalian	Urumqi	Wuzhong	Datong
Total	**248.2**	**8.3**	**70.7**	**96.8**	**112.1**	**12.0**	**32.2**
65% BEE	138.4	1.4	16.1	24.2	23.8	0.7	4.2
50% BEE	23.5	1.6	25.4	23.0	36.9	5.9	13.4
30% BEE	86.3	5.3	29.2	49.7	51.4	5.4	14.5

Table 3.1: Actual heated residential building stock as of April 2013 (in million m2)

The actual coal consumption indexes (in kg coal equivalent per m2) were also gathered from the project cities for the October 2012 – April 2013 Heating Season, and are presented below by building energy efficiency performance standard (from 30% BEE to 65% BEE) along with the city average:

	Tianjin	Chengde	Tangshan	Dalian	Urumqi	Wuzhong	Datong
Average	**18.6**	**10.8**	**11.6**	**21.0**	**25.3**	**31.0**	**16.4**
65% BEE	13.4	6.3	7.4	13.0	15.8	18.7	10.1
50% BEE	19.2	9.0	10.6	18.6	22.6	26.7	14.4
30% BEE	26.8	12.6	14.8	26.0	31.6	37.4	20.1

Table 3.2: Actual coal consumption indexes for the October 2012 – April 2013 Heating Season (in kg coal equivalent per m2)

[19] One of the 5 other project cities in the PAD was expected to be Harbin (thus the reference to the French GEF project in the PAD's analysis) but Harbin finally did not express an interest to receive support from the HRBEE.

From these two tables, the total coal consumption of the 7 project cities during the October 2012 – April 2013 Heating Season was about 11.3 million TCE as shown below:

	Total Coal Consumption (TCE)
Tianjin	4,623,221
Chengde	89,640
Tangshan	820,302
Dalian	2,033,010
Urumqi	2,835,624
Wuzhong	372,000
Datong	528,173
Total	**11,301,969**

To derive the estimated annual coal-savings achieved by the project cities by the end of the project, one has to compare this figure with the **PAD's baseline scenario,** which is:

(a) The share of buildings with relatively *good* energy efficiency performance (which is referring to the 50% BEE standard in the PAD) in the annual new construction will increase by about 2 percentage points per year, rising from 30% in 2004 to reach 70% in 2024;
(b) The share of buildings with heat metering, consumer controls and consumption-based billing in centrally-heated residential buildings constructed after 2004 will reach 50% by 2024, an average annual growth rate of about 2.5 percentage points; and
(c) Only those buildings that have installed consumer heat metering, consumer controls and consumption-based billing will install modern, variable flow control technology to operate their systems, which will enable consumers to adjust their heat demand.

During the ICR mission, the actual heated residential building stock was gathered from the 7 project cities for each year since 2004. Based on this, the PAD's baseline scenario for the heated residential building stock in April 2013 (e.g. the business as usual scenario based on the actual total annual building stock construction in the project cities during the 9 years) was derived as follows based on point (a) above:

	Tianjin	**Chengde**	**Tangshan**	**Dalian**	**Urumqi**	**Wuzhong**	**Datong**
Total	**248.2**	**8.3**	**70.7**	**96.8**	**112.1**	**12.0**	**32.2**
65% BEE	0.8	0.0	0.0	0.0	0.0	0.0	0.0
50% BEE	62.9	1.4	15.0	31.3	24.5	3.8	4.5
30% BEE	184.5	6.9	55.7	65.5	87.6	8.2	27.7

Table 3.3: Business as usual scenario for the heated residential building stock in April 2013 (in million m2)

To compare with the actual 11.3 million TCE emitted by the 7 project cities, one has to estimate what the coal consumption indexes of the 7 project cities would have been for the October 2012 – April 2013 Heating Season under the PAD's baseline scenario.

During the ICR mission, the coal consumption indexes (in kg coal equivalent per m2) were gathered from the project cities for the 2004 Heating Season by building energy efficiency performance standard (from 30% BEE to 65% BEE):

	Tianjin	Chengde	Tangshan	Dalian	Urumqi	Wuzhong	Datong
65% BEE	13.7	7.4	9.8	13.7	16.6	20.9	19.8
50% BEE	19.6	10.6	14.0	19.6	23.7	29.8	28.3
30% BEE	27.4	14.8	19.6	27.4	33.2	41.7	39.5

Table 3.4: Actual coal consumption indexes for the 2004 Heating Season (in kg coal equivalent per m2)

Then one needs to know what the coal consumption indexes would have been in April 2013 under the business as usual scenario (PAD's baseline scenario).

Based on points (b) and (c) above, 20% of the buildings constructed after 2004 would have implemented consumption-based billing by April 2013 and would therefore have variable-flow systems with total efficiency of 67.5% (from page 60 of the PAD). 80% of the buildings constructed after 2004 would use traditional heating systems with constant-flow technology and total efficiency of 52% (from page 60 of the PAD). The average efficiency of the added heating systems since 2004 would therefore be 55%.

This compares to an average efficiency of about 46% for heat supply systems in Northern China in 2004. Indeed, over the 4 billion m2 of heated area in Northern China in 2004, 2 billion m2 were using traditional heating systems with constant-flow technology and total efficiency of 52%, and 2 billion m2 were scattered coal-fired heating systems with efficiencies of about 40%.

Since the building stock has almost doubled in China and in the 7 project cities since 2004, the total efficiency of the heating systems in the 7 project cities was expected to be about half of 46% and 55%, which is 51%, a 10% gain in efficiency overall from 2004 levels. Therefore, under the PAD's baseline scenario, the coal consumption indexes of the 7 project cities in April 2013 would have expected to be 10% lower than their 2004 values, as shown below:

	Tianjin	Chengde	Tangshan	Dalian	Urumqi	Wuzhong	Datong
65% BEE	12.5	6.7	8.9	12.5	15.1	19.0	18.0
50% BEE	17.8	9.6	12.8	17.8	21.6	27.1	25.7
30% BEE	25.0	13.5	17.8	24.9	30.2	37.9	36.0

Table 3.5: Estimated/projected business as usual scenario for the coal consumption indexes for the October 2012 – April 2013 Heating Season (in kg coal equivalent per m2)

Based on Table 3.3 and Table 3.5 (estimated/projected business as usual scenario), the total coal consumption of the 7 project cities during the October 2012 – April 2013 Heating Season was expected to be about 13.9 million TCE as shown below:

	Total Coal Consumption (TCE)
Tianjin	5,735,205
Chengde	106,327
Tangshan	1,185,030
Dalian	2,189,096
Urumqi	3,177,526
Wuzhong	414,148
Datong	1,112,183
Total	**13,919,516**

The implementation of the HRBEE agenda in the 7 project cities is therefore estimated to have saved some **2.6 million TCE** during the October 2012 – April 2013 Heating Season. This compares very favorably to the PAD's target of 660,000 TCE. This will potentially generate over 51 million TCE coal savings and reduce CO2 emissions by about 38 million tons of carbon over a 20-year period (2004-2024).

These high coal savings compared to PAD estimates are explained by the much higher than expected penetration rate of the 65% BEE standard in the 7 project cities. For example, in 2012, 98.7% of the new residential building stock in the 7 project cities was constructed according to the 65% BEE standard, when the PAD was projecting only 16%. By April 2013, 36% of the total residential building stock in the 7 project cities (some 580 million m2) had been constructed according to the 65% BEE standard. The PAD estimates were also based on a projected 6 billion m2 of net growth in the heated urban residential building stock between 2004 and 2024, when by current trends, at least 7.5 billion m2 (or an additional 25%) is expected.

Note:

In their comments on the ICR (Annex 7), NPMO pointed out that since the heat consumption monitoring platforms were not operational during the 2012-2013 Heating Season, it was not possible to derive the actual average coal consumption indexes of the project cities. Actually, all the cities interviewed during the ICR Mission had this information which they gathered from the heat sources. Tianjin for example shared that its average coal consumption index for the October 2012 – April 2013 Heating Season was 18.6 kg coal equivalent per m2.

2. Annual coal-savings of the national HRBEE effort in China

In 2004, Northern China consumed about 180 million TCE for space heating of urban buildings (residential, commercial, and public buildings) for a total heated building stock of about 4 billion m2. In 2004, the average coal consumption index in Northern China was therefore 45.1 kg coal equivalent per m2.

Based on the PAD's baseline scenario mentioned earlier (e.g. 10% in efficiency gains for heating systems from 2004 levels and a high penetration of *good* building energy efficiency standards – actually translating into an average 4% efficiency gain for the entire building stock compared to 2004

levels), the average coal consumption index in Northern China was therefore expected to reach 38.9 kg coal equivalent per m2 in 2012-13.

Northern China actually consumed about 272 million TCE in 2012-13 for space heating of urban buildings (residential, commercial, and public buildings) for a total heated building stock of about 8 billion m2. The actual average coal consumption index in Northern China was therefore 34 kg coal equivalent per m2 in 2012-13.

4.9 kg of coal equivalent has therefore been saved per m2 in Northern China in 2012-13 compared to the PAD's estimated baseline scenario. This translates into 29.4 million TCE for the entire heated residential building stock of 6 billion m2 in 2012-13[20]. Over a 20-year period (2004-2024), about 590 million TCE would be saved, 2.5 times more than the PAD's estimate of 240 million TCE. This represents **a potential reduction in CO2 emissions due to coal savings of about 440 million tons of carbon[21] over a 20-year period (2004-2024) compared to the PAD's estimated business-as-usual scenario for Northern Chinese cities (see page 26).**

3. Coal-savings achieved by the investment subprojects

The total coal-savings achieved by the investment subprojects are shown in the table below. They reach **345,169 TCE over 20 years,** and represent **0.68% of the 51 million TCE coal savings** generated by the implementation of the HRBEE agenda in the 7 project cities. This reduces CO2 emissions by 257,500 tons of carbon over a 20-year period (2004-2024). **The project financed consumption-based billing area reached 4.13 million m2.**

	GEF (000 USD)	kg ce/m2 saved	Area (000 m2)	TCE saved in 20 years
1. Tianjin				
Huaxiajindian BEE	707	3.6	480	34,080
Diliutianyuan BEE	918	3.6	160	11,360
Taida & Jinhong CBB	2,061	5.5	1,880	205,717
2. Dalian				
Yihexiangxie BEE	159	0.9	95	6,276
3. Urumqi				
Boruixincun BEE	1,862	5.1	320	32,640
BLS subproject	347	1.2	72	1,706
4. Tangshan				
Lugang BEE	583	3.9	533	41,379
5. Chengde				
BLS subproject	603	0.9	161	2,903
6. Wuzhong				

[20] This is comparing actual coal consumption of Northern Chinese cities for heating during the 2012-2013 Heating Season with an estimated business-as-usual scenario for Northern Chinese cities in the PAD for the same Heating Season (see PAD's baseline scenario for these cities, page 26).

[21] Carbon content in tons C per ton coal equivalent = 0.746 ± 2%, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee, http://cdiac.ornl.gov/pns/convert.html

	GEF (000 USD)	kg ce/m2 saved	Area (000 m2)	TCE saved in 20 years
Platform + Metering Deployment	322	1.1	430	9,107
TOTAL	**7,561**		**4,132**	**345,169**

Table 3.6: Total coal savings achieved by the investment subprojects (in TCE)

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Robert P. Taylor	Lead Energy Specialist	EASEG	TTL
Feng Liu	Consultant, Energy Specialist	EASEG	Consultant
Anke Meyer	Consultant, Energy Economist	EASEG	Consultant
Osmo Tammela	Senior Technical Specialist	EASUR	Technical Specialist
Gailius J. Draugelis	Urban Infrastructure Specialist	ECSIE	Operations
Shenhua Wang	Senior Operations Officer	EASUR	Operations
Haixia Li	Financial Management Specialist	EAPCO	Financial Management
Xiaowei Guo	Procurement Specialist	EAPCO	Procurement
Teri G. Velilla	Program Assistant	EASEG	Assistant
Yuling Zhou	Senior Procurement Specialist	EASEG	Procurement
Youxuan Zhu	Consultant, Resettlement Expert	EASEG	Social
Marc Bellanger	Consultant, Energy Efficiency Engineer	EASEG	Building Energy Efficiency
Soren Christensen	Consultant, District Heating Engineer	EASEG	District Heating
Douglas Clark	Consultant. Environmental Assessment Specialist	EASEG	Environment
Supervision/ICR			
Robert P. Taylor	Lead Energy Specialist	EASEG	TTL
Gailius J. Draugelis	Lead Energy Specialist	EASCS	TTL
Frederic Asseline	Sr Energy Specialist	EASCS	TTL
Emmanuel Py	Infrastructure Specialist	EASWE	TTL
Feng Liu	Sr Energy Specialist	SEGES	Technical Specialist
Ximing Peng	Sr Energy Specialist	EASCS	Operations
Yanqin Song	Energy Specialist	EASCS	Operations
Marc Bellanger	Consultant, Energy Efficiency Engineer	EASCS	Building Energy Efficiency
Arto Emerik Nuorkivi	Consultant, District Heating Engineer	EASCS	District Heating
Jun Zeng	Social Development Specialist	EASCS	Social
Xin Ren	Environmental Specialist	EASCS	Environment
Haixia Li	Financial Management Specialist	EASFM	Financial Management
Xiaowei Guo	Procurement Specialist	EASR2	Procurement

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD Thousands (including travel and consultant costs)
Lending		
FY01	16	65.59
FY02	15	60.68
FY03	28	110.42
FY04	42	166.99
FY05	27	106.72
Total:	**128**	**510.40**
Supervision/ICR		
FY06	17	86.23
FY07	15	75.35
FY08	9	45.00
FY09	11	55.40
FY10	6	30.15
FY11	3	14.90
FY12	7	36.40
FY13	7	34.97
FY14	7	40.00
Total:	**82**	**418.40**

Annex 5. Beneficiary Survey Results
Not Applicable.

Annex 6. Stakeholder Workshop Report and Results
Not Applicable.

Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR

Comments on HRBEE ICR from World Bank

NPMO

1、Pviii “Ratings of Overall Borrower Performance” should be Satisfactory.

2、Pix, “PDO Indicator”

1）The actual coal savings should be 3.65 million TCE/ year. As well as the “percent of current-year new housing completion compliant with BEE standard’, which should be 100% since 2004. That is also related with the values of “the area of new BEE buildings” and “heating efficiency indicators”. These values are confirmed through repeated discussions and checking by experts from HRBEE project summary group, heating offices and BEE offices of each demo-cities, that is more accurate compare with the data in the ICR which reported by LPMO.

2）The “percent of new residential stock implementing CBB” should be 66%. This figure is also confirmed through repeated discussions and checking by experts from HRBEE project summary group, heating offices and BEE offices of each demo-cities, that is more accurate compare with the data in the ICR which reported by LPMO.

The heat metering and charging practice for new buildings in the demonstration cities are: reading of the heat meter was only recorded in the first year after completion of new buildings rather than metering and charging. Heat metering and charging starts from the second year, which was a cautious practice. Firstly, in order to observe whether the heat meter worked normally, secondly, Chinese residents had decoration habit, and generally did not live in new buildings in the first year. In case occupancy rate was not high, heat metering and charging effect was poor. Such practices were different from European practices. When reporting the number of heat metering and charging area to NPMO and the Ministry of Housing and Urban-Rural Development, the demonstration cities did not differentiate meter reading area from charge area, so in our opinion, the reading area was also the charging area. So the heat metering and charging area was 70 million m2 in Tianjin. Heat metering and charging area of other 6 demonstration cities was also summarized in the same way.

Therefore, in the World Bank ICR, the CBB area that reported from LPMO excluding the meter reading area is not correct since the meter reading area in demo-cities of HRBEE project will become the CBB area in the next heating season.

Admittedly, there is a different scenario in non-demonstration cities in China. The new buildings in these cities that installed meters or meter readers would not implement CBB in the next heating season since the developers of these new buildings only care about getting the certificate of BEE acceptance.

3）The “percent of current-year new housing completion compliant with BEE standard” has reached 100% in 2008, since these demo-cities are selected by MOHURD that have good performance in BEE, coupled with the impact of HRBEE project.

3、P8 The rating of “Achievement of PDO” should be Satisfactory. Because the indicators about coal-saving quantity, proportion of CBB implementation and BEE compliance are not correct. We believe in the 11 outcome indicators are all reached. Therefore, the rating should be “Satisfactory”.

4、P10 The rating of “Efficiency” should be Satisfactory. Because the ratings “cost effectiveness” and “efficiency of project implementation” are satisfactory. We think the rating of “efficiency of project implementation” in World Bank ICR that is “moderately satisfactory” is not correct.

5、P11 The rating of “overall outcome” should be Satisfactory since the ratings “project relevance, achievement of PDO and efficiency” should be all Satisfactory. We think it is not correct to grade the “overall outcome” as “Moderately Satisfactory” in World Bank ICR.

6、P15 The rating for “overall borrower performance” should be Satisfactory, since the rating for “Government performance is Satisfactory. Although, the performance of agencies had some issues before 2010, they performed well during 2011 to 2013. Therefore, the rating for “overall borrower performance” should be Satisfactory.

7、P24-28 The values about coal-savings, proportion of CBB implementation and BEE standard compliance are not correct, since the raw data reported from LPMO are inaccurate.

Annex: The calculation and interpretation of PDO index by the experts of HRBEE project summary task group

1. The achievement of PDO index in the summary report by NPMO

Achievement indexes			Target value							
		Base year	The first year	The second year	The third year	The fourth year	The fifth year	The sixth year	The seventh year	The eighth year
		2004	2005	2006	2007	2008	2009	2010	2011	2012
At the end of 2011: amount of coal saving was 660 kt of standard coal/year	Plan	0	0.55	2.1	6	14.6	26.3	41.9	66	66
	Actual		5	23	68.62	111.85	161.51	225.87	296.19	356.32
Accumulated emission reduction of carbon dioxide (10^4 tons of carbon/year)	Plan	0	0.42	1.59	4.54	11.04	19.89	34.68	49.90	49.90
	Actual		12.5	57.5	171.55	279.625	403.775	564.675	740.475	890.8
Proportion% of accumulated metered charging area of new residences in new residential area	Plan	0	1%	3%	8%	18%	28%	38%	50%	50%
	Actual		67	20	15	25	32	37	55	66
Proportion of new buildings in compliance with building energy efficiency standard: 80%	Plan	40%	43%	47%	52%	58%	64%	72%	80%	80%
	Actual		66%	75%	99%	100%	100%	100%	100%	100%
Achievement indexes of each part										
Tianjin Part:										
Proportion% of accumulated metered charging area of new residences in new residential area	Plan	0	2%	5%	15%	25%	35%	45%	60%	60%
	Actual		67	20	18	32	39	42	65	66

Proportion of new buildings compliant with building energy efficiency standard	Plan	50%	53%	57%	62%	68%	75%	82%	89%	89%
	Actual		66%	100%	100%	100%	100%	100%	100%	100%
Central Part:										
Number of cities to carry out heat consumption based charging	Plan	0	1	2	5	10	15	25	30	30
	Actual		1	2	6	7	9	15	31	33
Number of cities that will execute combined building energy efficiency standard and regular building supervision[22]	Plan	0	1	2	5	10	15	25	30	30
	Actual		1	2	6	7	9	15	132	132
Number of experts/officials who receive training at national-level symposiums or work meetings	Plan	No	100	200	300	300	200	200	200	200
	Actual		50	10	10	720	620	120	270	360
The Part of other cities:										
Proportion% of accumulated metered charging area of new residences in new residential area	Plan	0	0	2%	5%	15%	25%	35%	50%	50%
	Actual				9	17	23	31	44	66
Proportion of new buildings compliant with building energy efficiency standard	Plan	35%	37%	40%	45%	50%	55%	65%	75%	75%
	Actual				96%	100%	100%	100%	100%	100%

[22] With the increasing compliance of new buildings with building energy efficiency standard year after year, construction drawing archiving system and special inspection system of building energy efficiency have been basically established all over China.

Note:

1) In this table, we calculate the carbon dioxide emission reduction (which, = amount of coal savings X 2.5). However, in the World Bank ICR, it is calculated carbon emissions.

2) In the World Bank ICR, the figures about "amount of coal savings, emission reduction and CBB proportion" are calculated based on the statistics tables in Annex 3 P24. The building area in World Bank ICR refers to the current building stock, while the data in summary report by NPMO focuses the project implementation period (from 2004 to 2013) and are collected after the end of each heating season and also included in the annual energy report, that means to grasp the BEE situation during the eight-year implementation period of HRBEE project. Therefore, in the newly constructed buildings, the proportion of BEE standard compliance is 100% and the proportion for CBB area is also meet and exceed the planning value. In addition, the coal consumption index in World Bank ICR refers to the actual value. In fact, due to the lack of real-time monitoring platform for heating energy consumption (some demo-cities established the platform just before the HRBEE project finished), there is no actual energy consumption value. However, the coal consumption indexes in the summary report by NPMO are calculated based on energy efficiency standard for each demo-city, which has a theoretical basis.

Annex 8. Comments of Cofinanciers and Other Partners/Stakeholders
Not Applicable.

Annex 9. List of Supporting Documents

1. The World Bank/ GEF, China Heat Reform and Building Energy Efficiency Project: Project Appraisal Document, Report No. 30747-CHA, February 17, 2005.

2. The World Bank/ GEF, China Heat Reform and Building Energy Efficiency Project: Grant Agreement, GEF TF054687-CHA, May 24, 2005.

3. The World Bank, China Heat Reform and Building Energy Efficiency Project: Aide-Memoires, Management Letters, Implementation Status and Results Reports, Official Letters to and from the Government of China, and all other Official Project Documents, 2002-2013.

4. From the National Project Management Office (NPMO): "Implementation Completion Report of the Heat Reform and Building Energy Efficiency Project", received in January 2014.

5. Studies of the China Heat Reform and Building Energy Efficiency Project, listed in Annex 2, 2005-2013.

6. Audit Reports, China Heat Reform and Building Energy Efficiency Project, 2005-2013.

Annex 10. Outcome Indicators

From the October 2013 ICR Mission's Aide-Memoire transmitted to the client:

1. In July, the TTL circulated a table to gather standard information from the 7 project cities with subprojects (Tianjin, Tangshan, Chengde, Dalian, Urumqi, Wuzhong, and Datong) to evaluate the project impacts (both direct and indirect). During the mission, the TTL double checked this information with each of the 5 cities visited (further to this, Urumqi was contacted by email). From the information gathered on the heated residential building stock in each city (classified between the 30%, 50%, and 65% BEE standards) for each year between 2004 and 2012 (project implementation period), it can be seen that the penetration of the 50% (good BEE) and 65% (advanced BEE) standards has exceeded the expectations of the PAD for these cities. This combined with heating system efficiencies (at the heat source and network levels) realized in these 7 cities between 2004 and 2012, would have enabled these 7 cities to save more than 2.5 million TCE per year.

2. Data on actual consumption-based billing in these 7 cities as of April 2013 (end of the heating season) was also gathered and double checked with each of the 5 cities visited:

	Heated Residential Area (million m2) in April 2013	**Heated Residential Area (million m2) in Dec. 2004**	**Actual CBB Area (million m2) as of April 2013**	**Actual CBB Area as a % of new Heated Residential Area built since 2004**
Tianjin	***248.2***	***98.0***	***46.0***	***31%***
Other Cities (OC)				
Chengde	8.3	5.4	3.0	100%
Tangshan	70.7	38.1	23.0	70%
Dalian	96.8	71.0	5.5	21%
Wuzhong	12.0	2.5	0.7	8%
Datong	32.2	20.5	1.0	9%
Urumqi	112.1	67.2	31.6	70%
Sub-Total OC	***332.1***	***204.7***	***64.8***	***51%***
Total	**580.3**	**302.7**	**110.9**	***40%***

3. It appears that the 50% PAD target (originally set for Dec. 2011) for the Actual CBB Area as a Percentage of the new Heated Residential Area built since 2004 has not been met since, as of April 2013, the actual value for the project cities was 40%. The Tianjin PAD target of 60% was also not met as of April 2013.

4. However, this average 40% CBB penetration rate for the 7 cities is twice higher than the average in Northern Chinese Cities, estimated to be about 20%. The actual heated building stock in Northern Chinese Cities was about 8 billion m2 as of Dec. 2012 (it was about 4 billion m2 as of Dec. 2004), and the total CBB area was estimated to 805 million m2 by MOHURD.

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