

## China: Heat Reform and Building Energy Efficiency Project

### PROJECT BRIEF

April 04, 2004

#### 1. IDENTIFIERS

Country:	China
Focal Area:	Climate Change
Operational Program:	OP 5
Project Title:	Heat Reform and Building Energy Efficiency Project
Total Project Cost:	US\$ 1,097.0 million
GEF Grant Estimate:	US\$ 18.0 million
Requesting Agency:	World Bank
Executing Agency:	Ministry of Construction (MOC)
Project Duration:	7 years
Eligibility:	Country ratified UN Climate Change Convention: January 5, 1993 GEF Operational Focal Point endorsement: October 28, 2002.

#### 2. SUMMARY

The objective of the proposed project is to achieve sustained and growing increases in energy efficiency in residential buildings in China's cold and severe cold regions and in the heating systems which supply them. To achieve this will require step-by-step resolution at local levels of systemic problems in the development of more energy-efficient buildings, and the "commodification" of heat through reform of heat pricing and billing, introduction of heat metering and consumer controls, and heat system modernization. GEF financing would provide the core support for a program of World Bank-led international assistance to the Chinese, as they seek to accomplish market transformation in building energy efficiency and implement a major multiyear program of reforms and technical modernization in urban heating systems, from heat production boilers through transmission and distribution network to consumer radiators.

The proposed project is a national-level project, including three components: (a) a large demonstration project in Tianjin Municipality, integrating development of modern, variable flow heat supply systems, construction of highly energy efficient residential buildings, and implementation of comprehensive heat billing and pricing reforms; (b) national-level coordination and policy support; and (c) phased-in heating system and building energy efficiency investments and reform activities in other northern Chinese cities, to be identified and developed as project preparation and implementation for the first two components proceed. The proposed GEF grant of US\$18 million would partially defray certain incremental costs associated with achieving reductions of greenhouse gas (GHG) emissions, which cannot be achieved through other means or with other financing. Investments partially supported by GEF would have clear potential for further cost-effective application in China (e.g., without further subsidy), once current institutional, policy and market development barriers have been overcome.

The proposed project will be complemented by and will be integrated with a closely-related new French GEF project with the city of Harbin. The French GEF project will help improve energy efficiency at the building level in that city, and this project will create the supportive policy framework and an efficient heat supply system.

By adopting integrated programs to reform heat billing and pricing, improve the efficiency of heating systems and building energy efficiency, the 5-7 Chinese cities participating in the project are expected to reduce energy use for residential space heating by some 267,000 GWh between

2004 and 2024, and still improve heating service. Adding in major additional savings through replication in other cities as the national heat reform promoted by the country's leadership deepens, total energy savings associated with this Chinese program are estimated at about 3,629,000 GWh between 2004 and 2024.

### **3. COST AND FINANCING (MILLION US\$)**

#### **Estimated Total Project Cost (in US\$ millions)**

	<b><u>Total</u></b>
<b>Total</b>	<b>1,097</b>
A. Tianjin Municipality Demonstration Component	435
B. National Level Coordination and Policy Support Component	2
C. Demonstration Projects and Heat Policy Reforms in Other Northern Cities Component	660

#### **Indicative Financing Plan (in US\$ millions)**

	<b><u>Total</u></b>
<b>Total</b>	<b>1,097</b>
Global Environment Facility	18
Government	6
Corporate Sources	1,073

#### **Indicative Financing Plan by Component (in US\$ millions)**

	<b><u>Total</u></b>	<b><u>Corporate</u></b>	<b><u>Government</u></b>	<b><u>GEF</u></b>
<b>Total</b>	<b>1,097</b>	<b>1,073</b>	<b>6</b>	<b>18</b>
Component A. Tianjin Municipality Demonstration Component	435	428	1	6
Component B. National Level Coordination and Policy Support Component	2	-	0	2
Component C. Demonstration Projects and Heat Policy Reforms in Other Northern Cities Component	660	645	5	10

### **4. ASSOCIATED FINANCING (US\$)**

#### **Associated Financing (in US dollars)**

	<b><u>Total</u></b>
<i>IBRD Lending: Possible, if requested by Provincial governments</i>	
<i>Technical Assistance and Analytical and Advisory Support</i>	
<b>Total (as of March 31, 2004)</b>	<b>5,450,000</b>
Asia Alternative Energy Program (ASTAE)	200,000
Energy Sector Management Assistance Programme (ESMAP)	500,000
French GEF	3,300,000
Finnish Government (Bank CTF)	200,000
Danish Government (Bank CTF)	150,000
World Bank (BB)	100,000
-Additional Planned	1,000,000

### **5. OPERATIONAL FOCAL POINT ENDORSEMENT**

**Name:** Yang Jinlin    **Title:** Operational Focal Point  
**Organization:** Ministry of Finance    **Date of Endorsement:** October 28, 2002.

## **6. IMPLEMENTING AGENCY CONTACT**

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**Project Concept Document**  
East Asia and Pacific Region  
EASEG

**Date:** April 04, 2004

**Team Leader:** Robert P. Taylor

**Sector Manager/Director:** Junhui Wu  
**Country Manager/Director:** Yukon Huang  
**Project ID:** P072721  
**Lending Instrument:**

**Sector(s):** District heating and energy efficiency services (100%)  
**Theme(s):** Climate change (P), Pollution management and environmental health (P)

**Project Financing Data**

Loan       Credit       Grant       Guarantee       Other:

**For Loans/Credits/Others:**

**Total Project Cost (US\$m):** \$1,097 million      **Cofinancing:** No

**Total Bank Financing (US\$m):** \$18 million

**Proposed Terms (GEF): Grant**

**Commitment fee:** Not Applicable

<b>Financing Plan (US\$m):</b>	<b>Source</b>	<b>Local</b>	<b>Foreign</b>	<b>Total</b>
CORPORATE SOURCES				1,073
BORROWER				6
GEF				18
<b>Total:</b>				1,097

**Borrower/Recipient:** Government of China

**Responsible agency:** Ministry of Construction

Address:

Contact Person:

Tel: Fax: Email:

Other Agency(ies): Tianjin Municipality Project Management Office

Address:

Contact Person:

Tel: Fax: Email:

**Project implementation period:** 2004 - 2011

## **A: Project Development Objective and Key Indicators**

### **A.1. Project Development Objective**

The objective of the proposed project is to achieve sustained and growing increases in energy efficiency in residential buildings in China's cold and severe cold regions and in the heating systems which supply them. The project will achieve this by leveraging corporate resources and working in close collaboration with the Chinese Government to reduce energy waste in buildings and heating systems through a combination of (i) improvements in the buildings themselves, through improved design and use of improved insulation and other energy efficiency measures, (ii) reform of the pricing and billing systems, through implementation of heat metering, cost-based pricing and consumption-based billing, and (iii) improvements in the heat supply systems to enable consumer control, demand-based dispatch and more commercial operation.

The focus of the project is to implement comprehensive programs in a series of northern Chinese cities which combine heat supply modernization, key and difficult heat billing and pricing reforms, and development of more energy-efficient buildings. The potential for dramatic reductions in coal use for heating through these measures is very large, not to mention cost savings and improvements in consumer comfort. However, the savings potential cannot be achieved unless a series of changes in heat supply technical approaches, heat payment policies, and housing construction practices are implemented simultaneously at local levels. This presents enormous political, institutional and technical challenges.

China's Central Government launched a major heat reform program, focusing on pilot northern cities, in July 2003. The Government also has stepped up efforts in transforming the market for more energy-efficient residential buildings, which have only seen limited market penetration so far. Combined with a series of World Bank technical assistance and policy advisory activities, the proposed GEF project would assist the Government to achieve results on the ground in developing and implementing the comprehensive local programs. With demonstrated results at the local level, and the strong policy support to back up nationwide dissemination, the principal barriers to achieving the cost and energy savings in China's heat supply and use can be overcome.

### **A.2. Key Performance Indicators (See Annex 1 – Project Design Summary)**

Key performance indicators will include total annual energy savings achieved through the project from adoption of energy-efficient improvements in buildings and heating system modernization and reform. In addition, a number of other quantitative and qualitative indicators will be monitored and reported in all regular project reports, such as penetration of heat metering and consumption-based billing (percent of heated floor area), an indicative measure of heat reform progress. The key performance indicators will be finalized during project appraisal and formally agreed at project negotiations.

### **A.3. Global objectives and key performance indicators (see Annex 1 – Project Design Summary):**

The achievement of sustained and growing increases in energy efficiency in residential buildings in China's cold and severe cold regions and in the heating systems which supply them would result in significant long-term savings of energy (mainly coal) and prevention of associated carbon dioxide emissions.

Key performance indicators: Same as above.

#### **A.4. Context Within FCCC National Communications**

The proposed project has been endorsed by the GEF focal point on October 28, 2002. China ratified the UN Framework Convention on Climate Change (UNFCCC) on January 5, 1993.

#### **A.5. Project Processing**

The proposed project is scheduled for appraisal in late Summer2004 and World Bank Board approval in November 2004.

### **B: Strategic Context**

#### **B.1. Sector-related Country Assistance Strategy (CAS) goal supported by the project - (see Annex 1 – Project Design Summary)**

**Document number:** No. 25141      **Date of latest CAS discussion:** January 22, 2003

The project supports the CAS objective of *facilitating an environmentally sustainable development process*, through investment lending in natural resource management, watershed rehabilitation and wastewater treatment, energy, global environment projects supported by the Global Environment Facility and Montreal Protocol, and policy work. The project proposes to use GEF support to co-finance investments in energy efficiency improvements of residential buildings and heat supply systems and support the implementation of heat reforms that will reduce coal consumption, which is the primary fuel used for heating residential buildings in Northern China.

The project also supports a second CAS objective of *improving the business environment and helping accelerate the transition to a market economy*, mostly through knowledge transfer activities. The project is expected to improve knowledge of ways to introduce market economy principles to centralized heating, which is one of the last vestiges of the welfare state in China.

#### **B.2. GEF Operational Strategy/program objective addressed by the project:**

The proposed project is fully consistent with GEF Operational Program 5 (Removal of Barriers to Energy Efficiency and Energy Conservation) and GEF Business Plan Strategic Priorities (S1) Transformation of markets for high volume, commercial, low GHG products or processes and (S3) Energy sector policy frameworks supportive of renewable energy and energy efficiency. Section 5.7 of OP5 includes support for activities that lead to sustainable “win-win” results that demonstrate local, national and global benefits through the removal of barriers. In addition, the proposed project will combine market transformation activities with heat reform, heat modernization and building energy efficiency improvements, representing the holistic approach to sustainable and significant market expansion on a national scale that is the defining element of S1. The proposed project also fits within S3 by helping to consolidate key energy efficiency policies and facilitate regulatory frameworks supportive of demand-driven heat supply, demand-side measures, and creation of market mechanisms that allow consumers to pay for actual heat consumption in the Government’s energy policy framework.

#### **B.3. Main sector issues and Government strategy:**

## **China's Challenge to Reform and Modernize Urban Residential Heat Supply and Use**

**Energy Use for Urban Heating.** China currently consumes about 180 million tons of raw coal each year for space heating of urban residential and commercial buildings. Energy use per unit floor area is at least double that of buildings in similar cold climates in Western Europe or North America, with still far less comfort. Urban space heating accounts for about 10 percent of China's total commercial energy use. In cold and severe cold regions, defined as regions which have at least 90 days of average outdoor temperature at or below 5°C, urban space heating accounts for 20-25% of total commercial energy consumption. Due to its major cost advantage, and shortages of alternatives, coal is expected to remain the dominant fuel for heating systems for the foreseeable future. Natural gas use is becoming more common in some areas, such as Beijing, but is unlikely to gain a large market share over broad northern areas, due to its relatively high cost. During winter, emissions from coal-fired central heating facilities are the primary cause of the severe air pollution prevalent in northern Chinese cities, and are a major public health concern of the Government. The situation is likely to be exacerbated if the overall efficiency of space heating is not greatly improved.

**Current Heat Supply Systems.** China's cold and severe cold regions cover about two thirds of national territory and account for nearly one half of the total residential floor area of the country. In the mid twentieth century, most homes were heated with small coal stoves. Gradually, these have been replaced with centralized, hot-water radiator heating systems in areas of relatively high population density, so that currently about two-thirds of urban residential buildings in cold and severe cold regions are heated by centralized systems. In most cases, centralized heating began with small, "block" systems, using relatively small, heat-only boilers for one or several buildings. Gradually, and increasingly during the late 1980s and 1990s, larger district heating systems have been developed to cover parts of most northern cities. Today, most medium and large northern cities have one or several major district heating systems within the city center, and a fairly large number of smaller, "block" systems. Use of small coal stoves is limited mostly to homes in older and smaller buildings, as well as in small cities and towns. Government policy continues to strongly promote increasing development of larger district heating systems, to capture the economies of scale and reduce air pollution.

China's centralized, hot-water heating systems are based on standard Soviet-era technology except that only heat, and not domestic hot water, is provided. These systems rely on flow of water at constant speed through the piping networks, with changes in water temperature made at the heat source or substation to accommodate major changes in outdoor temperatures. The systems allow little flexibility, and the use of the traditional vertical single-pipe systems (radiators are sequentially connected from top floor to bottom floor) within buildings is not readily compatible with consumer control and metering. The advantage of these systems is that they are relatively simple and inexpensive to construct. However, they carry major efficiency penalties, and consumers have no means to control their heat supply. Heating levels are often too high (so that people open their windows, resulting in additional heat waste), or uncomfortably too low.

**Current Heat Billing and Pricing Systems.** As in other countries using Soviet-era centralized heating technology, consumers are billed each season according to a flat rate per square meter of floor area. There is no measurement of heat consumption in apartments or even at the building or substation level. In order to change the existing payment system to a consumption-based system, which provides incentives to consumers to use heat efficiently, consumers must have the ability to control their heat consumption. This requires major technical adjustments. Essentially, the fixed flow systems must be changed to variable flow systems, so that consumers can adjust their

heat consumption by adjusting the flow of hot water. This requires very different internal piping configurations, use of measurement technology, and adoption of totally new heat pricing policy.

Currently, most urban dwellers with central heat supply also are not responsible for paying their own heat bills—this is still typically the responsibility of employers or local governments. Stemming from coal subsidy programs in northern China which began in the 1950s, heat supply in major northern urban centers has been considered a public welfare entitlement. Indeed, heat supply is the last unreformed element of the public welfare system from the previous planned economy. Although reform of urban housing to individual ownership has proceeded strongly since 1996, employers continue to pay for employee heating. To both free employers from the social burden of heat supply, and to provide incentives to consumers to use heat efficiently, major reforms are required to transfer employer heating payment responsibilities and funds to employees..

The need for heat system reform is well understood. Yet, the technical, organizational, and financial challenges of this reform are particularly great, and socially sensitive: it is not by accident that this reform has been put off to the end.

**Building Energy Efficiency Levels.** Northern China's existing urban apartment housing stock, largely constructed since 1950, is known for its low upfront cost design and construction, and disregard for energy efficiency, similar to buildings of Eastern Europe constructed in the Soviet era. Very different from Eastern Europe, though, is the rate of new housing construction: more than one half of China's urban residential building stock in 2015 is expected to be constructed after the year 2000. Demand for heating and cooling services in new buildings will be greater than ever.

Attention to energy efficiency in new housing construction is of critical importance because the rate of construction is so high, and because the new buildings will lock in energy use parameters for fifty years or more. The technologies exist to reduce building heat losses in China by at least one half at reasonable cost. However, there are strong incentives among the various building design, materials supply, and construction players in the housing development industry to maintain existing, easily understood designs and practices, avoid change, and minimize upfront costs. Even in economies subject to market forces for many years, consumers may pay some attention to future heating costs when purchasing a home, but housing developers know that home purchase costs, location, convenience, lay out, appearance and other factors tend to far outweigh heating cost concerns among purchasers. Countries which have made major improvements in reducing energy losses in new buildings have all achieved this through regulation, forcing transformations in the market by successfully implementing building energy efficiency codes.

China's Ministry of Construction (MOC) issued energy efficiency regulations for centrally-heated new residential buildings in cold and severe cold regions in 1986. Major revisions were then issued in 1995. However, these regulations have been difficult to implement. The housing industry has continued to resist real changes. MOC officials estimate that by 2000 only 6% of new urban residential buildings in northern China conformed with the applicable 1995 energy efficiency standards. Since 2000, there has been some improvement in implementation. However, achievement of better results will require sustained development of stronger implementation and enforcement mechanisms at local levels, and targeted assistance to the housing development industry to develop low-cost, yet efficient building designs, materials and construction options.



**Recent Efforts to Improve Systems and Practices.** The above problems are well known by authorities and experts in China, and a certain amount of progress has been made in addressing them during the last ten years. Many large urban district heating companies have adopted aspects of western European technology in some new projects, including use of variable flow technology in a few cases for parts of systems. Pilot projects have experimented with a range of metering technologies which could be applied if and when consumer-control and consumption-based billing were adopted. In Tianjin and some medium-sized cities, local governments have undertaken the first reforms to transfer heat payment responsibilities to households. Most major northern cities now also have a growing number of large new housing complexes which incorporate serious energy efficiency improvements, and the market of energy efficient building materials is growing.

Nevertheless, big results have still proved elusive, and serious energy waste remains the norm. The continued lack of change in both urban central heating systems as well as urban apartment buildings could lock consumers into high heating bills for many years, and/or commensurately expensive government programs to help subsidize them. To break the inertia, widespread transfer of heat payment responsibility to households and implementation of heat metering and heat pricing and billing reform are required. Without these reforms, the heating industry has no incentive to modernize, and consumers have no incentives to control heat and reduce wasteful consumption. Secondly, with the support of the reforms, modernization of heat supply systems and serious building energy efficiency measures must be implemented together, in integrated packages. The piecemeal approach of modernizing parts of heat systems in isolation, and developing energy efficient buildings in different isolated areas, has not worked well. A most vivid example is the case of several new energy efficient housing complexes developed in the northeast, where the heat supply systems remained unchanged, and the real result of the efforts to reduce building heat losses was apartment overheating. The constraints of two separate industries needing to work together must be overcome to integrate both heat supply and use improvements. This is the only way to realize serious gains in energy efficiency.

### **Government Strategy**

The need to implement heat system reforms has been discussed in China for years. In the last few years, however, the country's leaders have made it clear that the reforms must proceed, and discussion has moved on to the specifics of how to implement a series of interrelated policy changes. At the same time, the central government has moved strongly to encourage broad implementation of building energy efficiency regulations, and local governments are beginning to put certain enforcement mechanisms in place. As a result, with the focus now on how to implement these efforts efficiently, rather than whether or not they should be implemented, the next few years represent the critical opportunity for overcoming the complex and interwoven barriers obstructing the heating and building energy efficiency agenda.

**The Government's New Heat Reform Program.** In July 2003, eight central government ministries and commissions jointly issued a Government Circular calling for each of the 16 northern provinces/autonomous regions to implement heat system reforms in several pilot municipalities, according to guidelines specified in the document ("Heat Reform Guidelines"). The principles of these Guidelines are the commercialization of urban heating, promotion of technical innovation of heating systems, application of energy-saving building construction, and improvement of living standards. The reforms are to be implemented in the pilot municipalities during 2004-2006, and, if successful, will be expected to be implemented more broadly

thereafter. During the Fall of 2003 each of the provinces was in the process of selecting the pilot municipalities which will then prepare and implement the local heat reform programs.

The goals of the heat reform program to be piloted are to

- Reform the system of employers paying for heating, discontinue welfare heating, and monetize and commercialize heating. Households will become responsible for paying their heat bills, and former in-kind wages will be transformed into a transparent payment for heat added to the wage. Transparent subsidies will be provided to low-income households. Heat prices will be set locally to recover costs.
- Introduce heat metering and consumption-based billing, promote the application of new wall construction materials and energy-saving construction technologies and technological reform of heating facilities, enhance the efficiency of heat utilization, and improve the air quality of urban areas.
- Continue to develop and perfect the economic, safe, clean and highly efficient urban heating systems based on centralized heating, together with various other methods; and
- Accelerate the reform of heating enterprises, introduce competition mechanisms, and foster and standardize the urban heating market.

MOC, the National Development and Reform Commission, the Ministry of Finance, the Ministry of Personnel, the Ministry of Civil Affairs, the Ministry of Labor and Social Security, the State Taxation Administration, and the State Environmental Protection Administration have set up an inter-ministry coordinating and leading team to provide leadership for the implementation of the pilot reforms. These agencies have created a system of inter-ministry joint conferences to coordinate the reform work and to research policies related to support for the work. The office of the team is located in the MOC and members of this team are involved in the preparation of the proposed GEF project.

**Strengthening Implementation of Building Energy Efficiency Standards.** Updating previous regulations, the Central Government issued the “Energy Efficiency Design Standard for Residential Buildings (for Heated Building Construction)” in 1995, which lays out standards to achieve a 50% improvement in energy efficiency compared with 1981 standard designs. This was more recently followed with an MOC Ministerial Order entitled “Residential Building Energy Conservation Management Regulations” which became effective in October 2000. The Management Regulations specify requirements for designers, developers, construction units and agencies responsible for review, approval and inspection to implement the 1995 Standards. They also stipulate that new residential central heating systems should adopt indoor temperature control, apartment-level heat metering and amenable piping system, and implement consumption-based billing (although the latter can only be implemented in due course, following enactment of other, accompanying reforms). Since 2000, many local governments have stepped up their efforts to implement the standards, and to begin to include enforcement of building energy efficiency standards as part of the regular building construction permitting and inspection systems. While much work remains to be done at local levels, results have noticeably improved during 2001-2003.

**Adoption of a Comprehensive Approach.** The two major agendas of implementing heat reforms and building energy efficiency standards at local levels mutually reinforce each other, and are best adopted in concert. This is increasingly recognized among government leaders and experts. Some of the most compelling examples include (a) the importance of reducing consumer heat costs through building energy efficiency measures as a means to defray impacts of billing and pricing reforms, (b) needs to provide heat more efficiently to consumers who are required to

pay for heating for the first time, (c) needs for consumer heat control to make building energy efficiency measures effective, and (d) needs to integrate heat system technology modernization both inside and outside of buildings.

#### **B.4. Sector issues to be addressed by the project and strategic choices**

There are two themes which underlie all aspects of the Bank's assistance program on heat reform and building energy efficiency in China, and the proposed GEF project which is the core element in that program: (1) all efforts are designed to assist the Chinese Government in its own efforts to implement its multi-year, large-scale programs for heat system reforms and modernization and for realization of building energy efficiency standards at local levels; and (2) all efforts are designed to encourage the integrated implementation of the two key Government initiatives in local projects, creating additional benefits from the synergies of the two.

#### **Assisting Ongoing Government Initiatives**

The timing, content, focus and location of project activities will be designed to provide maximum impact for the Government's ongoing heat reform and building energy efficiency agendas. Project work will be developed and implemented in direct collaboration with the Government units responsible for implementing the broader programs. The barriers to be overcome for successful implementation of the interrelated heat reforms and building energy efficiency market transformation are an enormous challenge, and such a challenge cannot be attempted by any project alone. Success will require many years of collaboration of many groups in a concerted program led by the Government.

The Bank's program and the proposed GEF project are a vehicle to bring lessons learned, international experience and new ideas to bear to the Government's ongoing reform work. They also can assist at times as a mechanism for convening relevant parties and concentrating attention on key issues. In particular, the proposed GEF project can provide a means to try out pilot demonstration efforts on development and reform packages which are particularly challenging, breaking ground which has not yet been broken, but which, if successful, can have a major practical demonstration impact for the broad national initiatives.

#### **Integrated Implementation—the “Two-handed Approach”**

As described before, one of the main reasons for limited success in energy efficiency gains in residential heating in China to date has been a general lack of integration of the heat supply modernization and reform efforts with building energy efficiency efforts. This project will concentrate its support on implementation of a comprehensive “two-hand” approach, including simultaneous efforts on both heat reform and system modernization, and on building energy efficiency, in distinct projects in a series of municipalities. This approach was developed in the initial study work completed by the Bank in 2000 to review building energy efficiency issues in China, and it has been a theme in the Bank's assistance program since.<sup>1</sup>

**Heat Reform.** On the “left hand”, heat system reform policies and programs must be implemented to make heat a commodity—creating a market mechanism to enable consumers to be able to control how much they consume, and pay according to actual consumption. This

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<sup>1</sup> China: Opportunities to Improve Energy Efficiency in Buildings, August 2000. Funded by ASTAE and the World Bank. World Bank Discussion Paper.

market mechanism will give consumers the incentives to realize the benefits which can be obtained from more efficient use. Commodification of heating also is key to developing truly commercial operation of the heating utilities. There are four, interrelated necessary reforms:

- (a) Change in the responsibility for payment of heat bills, so that individuals pay for their heat use, rather than their employers or the state. This is perhaps the most difficult reform in most northern cities. Whereas some high-income families now purchase new homes with heating systems which require personal payment, assumption of these costs by middle and low-income households is a major issue. Heat bills at current prices are equivalent to 15-30% of average household income in the three northeastern provinces. In principle, funds currently used for payment of employee heat bills can be distributed to employees for them to then pay their heat bills. However, there are complex issues concerning (i) formula to ensure equity in such distributions of supplemental wages, (ii) how to proceed in the cases where enterprises are currently unable to pay heat bills due to financial distress (common for many industrial enterprises in northeastern China), and (iii) how to proceed concerning the unemployed, fixed-income pensioners, and various other lowest income groups.
- (b) Adoption of technical measures to allow consumers to control their heat consumption. For new systems, this requires a variable-flow, two-pipe design, and use of manual valves or thermostatic radiator valves (TRVs) in radiator systems. Horizontal pipe configurations for each apartment work best. Existing constant-flow, vertical, single-pipe systems can be retrofitted to allow consumer control by adding control valves, radiator by-pass pipes, and making adjustments at the building/substation level to accommodate the flow variations.
- (c) Adoption of some means to determine actual heat consumption and allow billing accordingly. The minimum requirement is for centralized heat use at the building or apartment complex level to be metered and billed. Heat costs can then be allocated to individual apartments based on floor area (as, for example, in Finland), or through the use of heat allocation meters, water flow meters or heat meters (as in most continental western European countries). New buildings should be constructed with horizontal/dual pipe systems, which entail virtually no extra cost, compared with the vertical single pipe systems, but allow apartment-level supply and cut-off flexibility, and apartment-level metering at any desired time in the future.
- (d) Reform of heat tariffs, so that heat is priced according to cost recovery principles, billed according to actual heat demand and use, as opposed to heated area, and are fair to consumers. This is necessary to provide incentives for consumers to use heat efficiently. A two-part tariff is required, including: (i) a capacity charge, based on heated square meters or contracted maximum demand (e.g. GJ/hour), designed to defray at least a large portion of the costs of fixed assets of heat supply companies, and (ii) an energy charge, based on heat consumed.

**Building Energy Efficiency.** The “right hand” of the two-handed approach is to cause major improvements in the energy efficiency of urban residential buildings. New more energy-efficient buildings can save 50% or more of heat energy through better building design and application of good insulation and improved windows with relatively small increases in construction costs (e.g., 3-10%, depending upon the circumstances). Investment in such energy efficiency improvements is cost effective over the lifecycle of the buildings.

Widespread adoption of more energy-efficient designs, materials/components and construction methods, a phenomenon often called building energy efficiency market transformation, requires some basic changes in customary practices by a large number of different actors, and hence, a major organizational effort. At least three key measures are required:

- (a) Strong efforts to implement the national building energy efficiency standards at local levels. The new Management Regulations effective in October 2000 have begun to achieve some results. However, mechanisms must be developed at local levels to ensure that implementation of the energy efficiency standards becomes an integral and regular part of the general building code inspection and enforcement system. Most localities are just beginning to develop ways to integrate energy efficiency standard enforcement into existing inspection systems, and, based on international experience, developer acceptance, procedural changes, inspector training, and improvement in technical knowledge of the topic all take concentrated effort and time.
- (b) Model designs and specifications, and detailed regulations, must be developed and issued for those key aspects of building and heat system design and construction where changes are critical, and professionals working on building design and construction management must be trained in the new methods.
- (c) Information dissemination and other programs to help spur the rapid, market-based development of new, more energy efficient building designs, materials and products, and technical approaches (such as testing and certification or organization of large-scale procurement packages) need to be implemented. New approaches need to be tested in practice. The actual performance of many of the new materials is not well known, and costs vary sharply. Housing development companies are justified in their skepticism until the real costs and benefits of major changes are better known under Chinese conditions.

### **Barriers to Improving Energy Efficiency in Residential Heating in China**

As described above, the economic benefits of heat system reform and modernization, and improving energy efficiency in buildings, are clear and large. Technical options also exist, and are fairly well known. Yet progress has been minimal to date. This is because of the complexity of implementation of the many interrelated aspects, the fact that these reforms will affect the daily lives of hundreds of millions of people, uncertainties in combined effects, and the many risks inherent in the required changes to current practices.

**Organizational and institutional barriers.** On the heating side, the primary initial constraint has been the risks of negative social impacts from reform of heat payment responsibilities. Once progress on this front is achieved, as in a few cities so far, the next organizational and institutional barriers involve the development and implementation of new pricing systems, metering systems, and billing practices. Technical changes to demand-driven systems also will require wholesale changes in the operation and management of heating systems. On the building efficiency side, the challenges are to incorporate energy efficiency standard enforcement into the building design and construction regulation system at local levels, to develop a credible market of energy efficient building materials and components, and to ameliorate the concerns of the housing development industry.

With the two-handed approach, an additional major barrier is the difficulties involved in integrating efforts of both the heat supply industry and the housing development industry, and the government units responsible for their respective regulation, to work closely together to optimize approaches and synchronize efforts.

**Lack of experience, knowledge and prior track-records.** Even though other countries have experience in undertaking heat system reforms and implementing building energy efficiency standards, there are many areas where there is little experience conforming to Chinese conditions, which entails a series of major difficulties involved in change.

On the heating side, there are a host of challenges resulting from little or no prior experience, including, to name a few:

- Virtually no experience in China with billing of heat according to actual use. While various measurement technologies have been piloted, almost none have been used for actual billing, due to the lack of price reform. What are the actual patterns of heat use in most Chinese apartments? What measurement methods will be preferred by customers? What is the appropriate balance in trade-offs between cost, reliability and accuracy?
- Virtually no experience in China with operation of heating networks where supply is determined by consumers and not the supplier (as in an electric power system). What will demand be? What will load curves look like? How will heating companies adjust to a dynamic operating environment?
- Unclear impacts of pricing reform. What will be the financial implications for heating companies and customers of the combined effect of movement to demand-based systems and billing based in part on variable heat use?

On the building energy efficiency side, true enforcement of energy efficiency standards is a new concept, to which building designers, building materials/components manufacturers, and housing development companies have yet to adjust. Choices in design and building materials are just beginning to develop. A credible system to assure the quality and performance of energy-efficient building materials and components has yet to be established. The building design community, which is accustomed to applying standard drawings, needs to be trained and retooled to become a driving force in building energy efficiency innovation. Market barriers resulting from little or no prior experience include issues such as:

- Unclear performance of new building materials. Experience in application, as well as standardized and objective testing and certification are lacking. Future costs and prices also are highly uncertain, as the market is still immature.
- Unclear consumer interest. How big of a potential selling point will energy efficiency actually be?

Finally, some major uncertainties in building energy efficiency gains need to be addressed to fully capture the energy savings potential resulted from the two-handed, integrated approach:

- To what extent do different building energy efficiency measures actually result in energy savings in practice? (Heretofore, without heat supply measurement and consumer control, only heat losses could be calculated.)
- How much will energy use actually be reduced when demand-based modern heat supply networks are combined with consumer control, billing based on heat use measurement, and highly energy efficient buildings? How much will consumer heat bills actually decline? Will there be a rebound effect with consumers opting for more comfort and thus increased consumption?

- How much will heat supply demand actually decline? How should this be reflected in future heat supply system design? How will this affect heating industry economics?

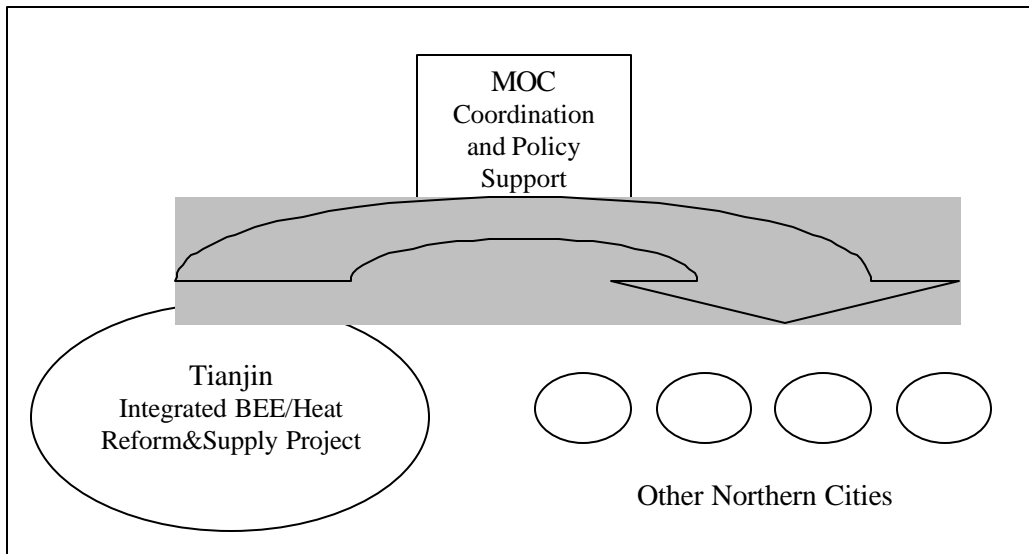
Many of these barriers, and especially the organizational and institutional ones, can only be overcome by the Government, working together with industry and housing developers, and over a number of years. However, the proposed GEF project can provide the core mechanism for providing consistent support over the required multi-year period, in terms of advice, but especially in terms of incremental financial support and convening assistance to try out the integrated projects demonstrating the feasibility and benefits of the two-handed approach. Development of packages which combine heat reform, the consumer-control approach to heat supply and true building energy efficiency measures represents a great organizational challenge. Because such packages have not been implemented in China before, their development involves risks associated with major changes, especially if constructed at the scale required to be meaningful. However, these risks need to be taken, if the questions listed in the section above are to be answered, the needed experience is to be gained, and the required track records in practice are to be developed.

## **C: Project Description Summary**

### **C.1. Project description and components (see Annex 2 for a detailed description):**

The proposed GEF project is the central part of an on-going program of World Bank-led international assistance to the Chinese Government, as it implements major policy reforms in the welfare-based urban space heating sector and scales up the construction of more energy-efficient residential buildings. In addition to GEF support, the international assistance program includes World Bank technical assistance and analytical and advisory support to the Government for its heat reform and building energy efficiency efforts,<sup>2</sup> as well as the development of possible IBRD loans to support municipal heat system modernization, rationalization and reform.

The proposed GEF project is designed around three principles: (i) to lend practical assistance and reinforce the Government's heat reform initiatives and the building energy efficiency market transformation in China; (ii) to maintain flexibility to adjust to evolving circumstances and learn from experience; and (iii) to focus on municipalities with the greatest commitment to achieving results and potential demonstrative effect. The proposed project comprises three mutually reinforcing components: (a) a large, integrated building energy efficiency and heat reform and supply demonstration project in Tianjin Municipality; (b) national-level coordination and policy support; and (c) phased-in building energy efficiency and heat reform demonstrations in additional northern Chinese cities, to be identified and developed as project preparation and implementation for the first two components proceed.



<sup>2</sup> Two such activities already completed include: China Opportunities to Improve Energy Efficiency in Buildings (August 2000), and Heat Metering and Billing: Technical Options, Policies and Regulations (August 2002). Two on-going activities include: Development of Pro-poor National Heat Pricing and Billing Policy, and Economic Analysis of Energy Efficiency Measures for New Residential Buildings in Northern China. Additional World Bank policy support activities are planned as the program progresses.



**Table 1. Estimated Total Project Cost and Financing**  
(in US\$ millions)

	<u>Total</u>	<u>Corporate</u>	<u>Government</u>	<u>GEF</u>
<b>Total</b>	<b>1,097</b>	<b>1,073</b>	<b>6</b>	<b>18</b>
Component A. Tianjin Demonstration Project	435	428	1	6
Component B. National Level Coordination and Policy Support	2	-	0	2
Component C. Other Northern Cities	660	645	5	10

The proposed GEF financial support of US\$18 million is very small in comparison with the size of the overall undertaking, which will involve about US\$1.1 billion in domestic corporate resources, including co-financing and leveraged resources. At least \$75 million of this corporate co-financing for some of the initial demonstration sites in Tianjin will be confirmed by CEO endorsement.

The proposed project will be complemented by and will be integrated with a closely-related new French GEF project with the city of Harbin. The French GEF project will help improve energy efficiency at the building level in that city, and this project will create the supportive policy framework and an efficient heat supply system.

#### **(A) Tianjin Municipality Demonstration Project Component**

The Tianjin component seeks to demonstrate that the greatest energy efficiency gains and cost savings in residential space heating can be achieved through an integrated effort that simultaneously addresses 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 and cost-based heat pricing and consumption-based heat billing. China has in the past decade or so pursued thermal improvements for new residential buildings and modernization of district heating systems in separate efforts which have focused mainly on demonstrating technical feasibilities of different measures. The national heat reform agenda is only in its pilot stage, and there are no models or examples of proper approaches to heat metering, cost-based heat pricing and consumption-based billing. Sustainable and meaningful energy savings can be achieved only when all the aforementioned elements are put together in practice. The Tianjin demonstration will be the first time in China that such an attempt is made and is designed to serve as a national model for such an integrated approach.

Tianjin is a provincial rank municipality, with an urban population of 6 million, and lies 150 km southeast of Beijing. It is the only large northern city which has completed the transfer of heat bill payment responsibility from work units to individual households – a critical step in reforming the welfare-based heating system. The municipal government firmly supports national heat reforms and is preparing, with assistance provided through the World Bank’s ESMAP program, to roll out heat metering and cost-based pricing and consumption-based billing in the next few years. The city is advanced in construction of more energy-efficient residential buildings, compared to most other northern Chinese cities. It also is embarking on a ten-year heat supply system modernization program. These conditions make Tianjin a highly suitable site for China’s first large scale, integrated building energy efficiency and heat reform and supply demonstration project.

The component comprises three subcomponents:

**Energy Efficient Buildings and Heat Supply Investment** The project will support construction of about 923,000 square meters of gross floor area in two new residential subdivisions developed by two local real estate companies: Tianjin Jintou Jinsha Real Estate Development Co, Ltd. at Xindu (740,000 m<sup>2</sup>) and Demaofeng Real Estate Development Co. at Beixinzhuang (183,000 m<sup>2</sup>). These buildings will incorporate best-practice energy efficiency design and construction techniques and will require 65% less energy for heating, compared with buildings constructed based on the general national design standards in the early 1980s. In other words, energy efficiency levels will exceed prevailing standards, which require a reduction of 50%. A heat-only supply system will be constructed to serve the larger site at Xindu and will use state-of-the-art coal-fired boiler technology and environmental controls as well as demand-driven system control technologies. In the buildings to be constructed in Phase 1 of the Xindu development, floor heating will be adopted, instead of wall-mounted radiators, which may be used in latter phases. A combined heating and cooling system will be constructed to serve the second development, at Beixingzhuang. It will use water-source geothermal heat pumps with 100 percent ground water re-injection and demand-driven system control technologies. Apartment heating and cooling will utilize a fan-coil system. In both developments, apartment-level heat metering and indoor temperature control will be introduced, and consumption-based billing will be implemented.

Key areas of the building and heat supply energy efficiency improvements in both developments that are planned for project support include: (a) installation of a variable flow heat supply system and associated operation management systems (for *Xindu* only); (b) installation of improved pre-insulated pipes for the primary and secondary network; (c) installation of smaller, state-of-the-art substations with automatic temperature control equipment (for *Xindu* only); (d) installation of apartment level meters and temperature control equipment; (e) improvements in exterior wall construction, including use of higher quality and / or thicker exterior wall insulation; (f) improvements in roof construction, including higher quality water proofing material as well as better quality and / or thicker roof insulation; (g) installation of push-open PVC windows with high thermal resistance and low infiltration; (h) installation of insulated doors to the building and apartments.

With associated program financing, the Bank has been providing technical assistance for the feasibility study and the design of the two heat supply systems and the architectural and energy efficiency designs of the two housing developments. This has provided local counterparts with direct access to international best practices and will help reduce project costs. For example, improvement of building architectural design in both developments will lead to reduced construction costs as well as life-cycle heating energy costs because of reduced building shape coefficient, which reduces area of exterior wall per unit floor area.

GEF support of about \$ 5.1 million is proposed for this major subcomponent, accounting for about 1% of the total \$433 million investment of the two housing and heat supply projects. GEF support enables both international and national technical and organizational support, through MOC and the Bank, and assists the relevant corporate housing development companies to overcome the many risks involved in so many simultaneous changes, to allow this complex development of China's first large integrated demonstration project using the "two hand" approach to proceed. GEF support covers about one-quarter of the estimated incremental costs of the major energy efficiency innovations, while Chinese counterpart funds will finance the remaining three quarters.

**Building Energy Efficiency Market Transformation.** In addition to the demonstration subcomponent, the project will assist the Tianjin Municipal Government to broaden the impact of its building energy efficiency program through activities targeted to address the greatest current weaknesses, including: (a) installation of equipment, related training and technical assistance to strengthen the local calibration and certification program for heat meters; (b) strengthening local testing and certification program for energy-efficient building materials and components; (c) introduction of innovative programs in building energy efficiency regulatory compliance enforcement, and (d) external communications to build awareness in the local area on the benefits of energy efficiency and in particular from results of the demonstration project. \$ 600,000 of GEF support is proposed.

**Technical Assistance to the Tianjin Municipality.** Heat policy reform is a central element in Tianjin's application of the integrated approach. Having implemented the key reform in heat bill payment responsibilities during 2001-2, completion of the reform is now considered essential by the Municipal Government. The Bank and MOC have provided concrete assistance through past and ongoing policy study work to Tianjin, using the city as a primary case study for both metering and price reform support efforts. To sustain the strong support, the proposed GEF project will include: (a) studies, policy advice and training in the preparation of very specific implementation regulations related to the introduction of cost-based pricing methodology and consumption-based billing; (b) monitoring and evaluation of the technical outcomes, (c) economic and social impacts of the two demonstration projects, including small studies which address knowledge gaps in the use of new technologies introduced in the demonstration projects such as small substations; and (d) education for new residents in the two demonstration projects on the use and benefits of consumption-based billing and heat metering, and consumer control equipment. \$300,000 of GEF support is proposed.

## **(B) National Level Policy Support and Project Management**

As the focal point of the national heat reform and building energy efficiency programs, MOC's work on program development and implementation is critical for China to succeed in these overall efforts. The proposed project includes \$2.0 million in GEF support for partial funding of technical assistance efforts in policy and program development and implementation, to be complemented by other World Bank and donor financing, and for essential project management, evaluation and dissemination activities.

**National Technical Assistance.** MOC requires technical assistance financing in a wide range of specific areas to develop and implement national heat reform and building energy efficiency policies, and to assist localities in the detailed implementation of the reforms. Assistance is required both to be able to apply international experience, and, especially, to be able to organize the highest quality national experts to address critical issues in a concentrated way. The World Bank will continue to organize technical assistance and advisory activities, additional to those completed or ongoing, utilizing at least \$500,000 of associated financing (and probably substantially more). UNDP is providing critical support for MOC's development and implementation of building energy efficiency standards and codes, through the parallel GEF China End-Use Energy Efficiency Project, which highly complements the efforts of the proposed project. The Bank will also seek to mobilize and encourage additional international donor activities in support of the overall program of MOC, as the needs are so great. Within the proposed GEF project, an allocation of \$1.25 million has been made for MOC to implement targeted and highly focused policy development and implementation activities, especially those directly related to the implementation of specific demonstrations of the "two handed" approach at

local levels. The GEF financing will be used as a technical assistance facility to meet the most pressing needs identified during project implementation which other donor efforts cannot fulfill, in a timely, practical and operationally focused way over the life of the project. The full range of heat reform, regulatory policy development, technical evaluation, and building energy efficiency market transformation topics can be considered (see Annex 2), based on emerging needs.

**Project Management, Monitoring and Dissemination.** Central support, organized through MOC, is critical for the innovative aspects of the project to be implemented smoothly, and to ensure that lessons learned under the various project components will have maximum impact in other parts of northern China and even beyond. The subcomponent is expected to support project management, monitoring and dissemination of lessons learned. The MOC Project Management Office would be responsible for developing and implementing, with the support of local authorities, the monitoring and evaluation for the entire project, including collecting project performance information and reporting to the Government, within the MOC, the Bank, the GEF and others, on the impact and results of this project. This subcomponent will also provide project development support for the Other Northern Cities Component. GEF support of \$750,000 is proposed.

### **(C) Other Northern Cities Component**

This component will promote simultaneous development of both heat system restructuring and billing and pricing reform, and building energy efficiency improvements, (e.g., the “two-handed” approach) in 4-6 additional northern Chinese municipalities, in order to achieve broad, national impact. The component is critical for achievement of the project’s overall objectives — with emerging results from the Tianjin Component in hand, and national-level support, comprehensive development of heat reform and building energy efficiency measures must be rolled out in the coldest regions of China. In most cases, the challenges also are greater than in Tianjin, due to greater heating requirements in colder climates, relatively slow economic development in the northeastern and northwestern regions, and less progress in heat reform to date.

This component will operate in close association with the Central Government’s heat reform piloting program, which will be implemented during 2004-2006, based on the July 2003 Heat Reform Guidelines. Participating municipalities will be selected from the list of pilot heat reform municipalities included in the national reform program in Heilongjiang, Jilin, Liaoning and one other province, primarily based upon the commitment of municipal leadership to the implementation of the two-handed approach. This component will provide the Government and the Bank with a key vehicle for providing international advice to the pilot municipalities as they proceed with the reforms, and for supporting implementation of integrated packages of energy efficiency improvements in heating networks, conversion to consumer-controlled heating, adoption of new heat billing and metering technologies, development and construction of state-of-the-art energy efficient building designs, energy efficiency renovations in existing buildings (where appropriate), and implementation of improved local enforcement of building energy efficiency standards. The component is designed to meet emerging assistance needs, and to respond to new ideas, as the national pilot Heat Reform Program unfolds, and lessons are learned from experience. Hence, this component will be implemented in a phased approach.

In addition to demonstration of municipal leadership commitment to the heat reforms and enforcement of building energy efficiency standards, each participating municipalities will need to agree with MOC and the Bank on a city-wide heat reform and building energy efficiency program, based on the two-had approach, prior to agreement on any GEF investment financing

support. The city-wide programs will include a timeline of heat supply system modernization, heat reform, and building energy efficiency actions and deliverables. The agreed programs will include specific energy efficiency targets, and other monitorable indicators, which will be evaluated under the national component of the project as local implementation proceeds. The key output of the project in each of the 4-6 cities will be implementation of the agreed city-wide heat reform and building energy efficiency program, and the associated energy savings. Activities and investments receiving direct GEF support will be only a small part of the overall city-wide programs to be delivered under the project.

Proposed GEF financial support of about \$10 million is very small in comparison with the size of the undertaking, which will involve projected investment of at least \$650 million, and probably substantially more. Nonetheless, the GEF support is very important, because it provides a platform for direct Bank and MOC involvement, a mechanism to concentrate international, national and local attention on the implementation details which are critical for success, and a modest incentive for local authorities to work to overcome the great organizational and institutional barriers associated with applications of the two-handed approach in heat and housing developments for the first time. Support will include assistance for local policy development and implementation, and financing for about 30% of the incremental costs of certain energy efficiency innovations in heating systems and buildings, selected by the municipalities and agreed with MOC and the Bank as having maximum value for assisting the municipalities in their implementation of their city-wide heat reform and building energy efficiency programs. The support package for each municipality will be based on the on-the-ground needs of the localities, with different climatic, socio-economic, infrastructure and even cultural characteristics.

**Demonstration Projects and Heat Policy Reforms in Other Northern Cities Component**

	Total Estim. Project Cost USD M	Total Estim. Incremental Cost USD M	Total Indic. GEF Support USD M
<b>1 Investment</b>			
Total	657.8	26.7	8.0
Building Energy Efficiency	629.0	14.1	4.2
Internal Heating Network	13.1	6.0	1.8
Network and Substations	7.9	3.8	1.1
Heat Supply	7.8	2.8	0.8
<b>2 Technical Assistance</b>			
Total			
Technical Assistance	2.2	2.0	2.0

**C.2. Key policy and institutional reforms to be sought:**

The implementation of policy and institutional reforms is a key objective of the entire project. As described in section B.3, the barriers to be overcome for successful implementation of the interrelated heat reforms and building energy efficiency improvements are an enormous challenge, and success will require many years of collaboration of many groups in a concerted program led by the Government. The Bank's program and the GEF project are a vehicle to bring lessons learned, international experience and new ideas to bear to the Government's ongoing reform work.

### **C.3. Benefits and target population:**

The proposed project is part of a broad international assistance program that supports the Government's heat reform policy and building energy efficiency regulations. The Government's program is expected to have a major long-term impact on space heating energy demand in China with significant local and global environmental benefits. During winter, emissions from coal-fired central heating facilities are the primary cause of serious air pollution prevalent in northern Chinese cities, and are a cause of major health concern for the Government. The timing of the Government's program and the international assistance it has mobilized to support it is critical since the residential building stock is expected to triple in the next 20 years. Successful implementation of the Government's heat reform and building energy efficiency policies would improve the energy efficiency of 3.7 billion m<sup>2</sup> of new residential building stock by 2024, improving the thermal integrity of these buildings, the quality and cost-effectiveness of building and heat supply design and construction, as well as comfort in living quarters. The combined effect of heat commodification and improvements in the heat supply chain could reduce the amount of raw coal consumption in newly constructed residential buildings with central heating by 624 million tons over a 20 year period, thus reducing CO<sub>2</sub> emissions by 1.2 billion tons. There will also be a significant reduction of coal consumption in existing buildings due to heat commodification and thermal renovation in some of the building stock. In addition to its global benefits, the proposed project is expected to yield significant national and local environmental benefits through reduced emissions of fine particulates and sulfur dioxide.

Additional direct benefits of the project include cost savings for heat suppliers due to improved system design and operational efficiency, as well as cost savings for heat consumers due to improved energy efficiency. The realization of heat reform objectives also relieve the government from a non-discriminatory welfare heating regime and enable it use its resources more efficiently.

### **C.4. Institutional and implementation arrangements:**

MOC will be responsible for overall project coordination and implementation. The Tianjin Municipal Government will be responsible for the implementation of the Tianjin Municipality Demonstration Project Component. MOC will be responsible for the implementation of the National-level Policy Support and Project Management Component, and the identification of sub-components for the Other Northern Cities Component (in consultation with the Bank). Once agreed, implementation of the sub-components under the Other Northern Cities Component will be the responsibility of the associated provincial and/or municipal governments.

A Project Management Office (PMO) was established by the Ministry of Construction (MOC) as the entity charged with day-to-day implementation of the project. Staff from the Center for Energy Efficiency in Buildings (CEEB), a non-governmental organization affiliated with the MOC's Science and Technology Department, have been engaged by the PMO for support. MOC's Science and Technology Department, and its PMO and support staff, are managing the PDF B grant, and this Department also is overseeing the building energy efficiency component of the UNDP End-use Energy Efficiency Project. Tianjin Municipal Government has assigned responsibility for implementation of the Tianjin Component to its Construction Commission, under which a PMO which also is responsible for several other World Bank projects has been assigned implementation responsibilities for this project. As specific subcomponents are developed, other cities are also expected to establish project implementation units within local Construction Commissions.

## **D: Project Rationale**

### **D.1. Project alternatives considered and reasons for rejection:**

In other related Bank/GEF projects in China, the Bank and GEF have contributed to major improvements in district heating, industrial coal-fired boiler design, and the development of energy management companies. The project is able to build on these experiences, but the building sector, especially residential buildings, presented new challenges not yet faced by either the supply side or demand side projects. During many consultations with national, provincial and municipal officials it became clear that a *one-hand* approach limited to supporting investment and market transformation for building energy efficiency only would ultimately not be successful to achieve real gains in space heating energy efficiency. Without responsibility for heat bill payments and ability to control heat consumption and payment according to consumption, prospective home buyers have no incentive to purchase or take advantage of more energy-efficient housing. Lessons learned from previous projects in Eastern Europe suggested that investments on the demand side need to be accompanied by improvements on the supply side in order to achieve substantial reductions in fuel consumption and thus energy savings.

MOC has recently become more active in addressing building energy efficiency improvements in the regions with cool winter and hot summer where energy consumption especially for air conditioning is soaring. However, the Bank and MOC agreed to focus only on the cold and severe cold regions in the proposed GEF project. The main reason for this was to focus all of the project's efforts on the most critical and challenging energy efficiency issue in the building sector. The combination of heat reform and building energy efficiency agendas, which, through successful demonstration supported by the proposed project, is considered the most effective way of achieving sustained and increasing energy efficiency gains in space heating.

### **D.2. Major related projects financed by the Bank and/or other development agencies (completed, ongoing and planned).**

Sector Issue	Project	Latest Supervision (PSR) Ratings (Bank-financed projects only)	
		Implementa- tion Progress (IP)	Development Objective (DO)
<b>Bank-financed</b>			
Energy-efficiency and environmental improvements	Energy Conservation Project	S	S
Energy-efficiency and environmental improvements	Second Energy Conservation Project	S	S
Energy-efficiency and environmental improvements	<i>Efficient Industrial Boilers</i>	S	S
Energy-efficiency and environmental improvements	<i>Shandong Environment Project</i>	S	S
<b>Other development agencies</b>			
Energy-efficiency and environmental improvements	UNDP China: End-Use Energy Efficiency Project (EUEEP)	NA	NA

IP/DO Ratings: HS (Highly Satisfactory), S (Satisfactory), U (Unsatisfactory), HU (Highly Unsatisfactory)

### **D.3. Lessons learned and reflected in proposed project design:**

The proposed project design takes lessons learned from several Bank / GEF projects in Europe and Central Asia (ECA)<sup>3</sup> and several district heating and energy efficiency projects in China (see D.2). The overall Bank heat reform and building energy efficiency program in China, of which the proposed project is a part, has already provided rich early lessons through its technical assistance activities. The building energy efficiency projects in ECA have focused on an array of energy efficiency problems in residential buildings, public facilities as well as industrial sectors. There are several differences to keep in mind when applying lessons in ECA countries to the situation in China. One important difference is that ECA countries have focused mainly on renovation issues in the building sector. Due to China's construction boom in the residential sector this project focuses on energy efficiency issues in new construction.

The most important lessons from previous Bank experience taken into account in project design include:

- Enabling consumers to control the quantity and quality of heat and to pay according to their consumption, needs to be addressed from the very beginning of heat reform, to allow consumers to adjust their heat bills to their income and to prevent massive problems with collections at a time of heat tariff reforms introducing full cost recovery with upward pressure on heat prices.
- Most internationally supported projects supporting heating system modernization or thermal renovation of buildings focused on one or the other, but rarely support investments that address the major components in both systems simultaneously. As pointed out in B.3, serious gains in energy efficiency can be realized only if modernization of heat supply systems and serious implementation of building energy efficiency measures are implemented together, supported by heat reform measures. Accordingly, this project adopts an integrated approach. While this is ambitious, the strength of Government support in the case of China provides an environment where success is possible.
- In project design aimed at accelerating market penetration of energy efficiency measures, individual and collective preferences need to be carefully considered. In demand-side demonstration projects in ECA, home owners become interested if savings are demonstrated, but energy savings may not be at the top order of preferences when making investment decisions. In the case of China, the project has selected a market-driven mechanism, through real estate developers, to introduce energy efficiency measures that are commercially saleable to new homebuyers. Through project implementation experience, more knowledge will be gained on the appropriate positioning of energy efficiency in the order of consumer preferences to maximize its marketing potential.

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<sup>3</sup> Belarus (*Social Sector Energy Efficiency Project*, 2001), Bulgaria (*District Heating Project*, IBRD 2003), Latvia (*Jelgava District Heating Project*, 2000) Lithuania (*Energy Efficiency/Housing Pilot Project* 1996 and *Vilnius District Heating Project* GEF 2003), Poland (*Podhale Geothermal District Heating and Environment Project*, GEF/IBRD 2000, *Krakov Energy Efficiency Project*, 2001, also, district heating projects in Gdansk, Gdynia, Katowice, Krakow and Warsaw), Romania (*Energy Efficiency Project*, 2002), Russia (*Municipal Heating*, 2000) and Serbia and Montenegro (*Serbia Energy Efficiency Project*, negotiations, early 2004), Ukraine (*Kiev District Heating Improvement*, 1998)



#### **D.4. Indications of borrower commitment and ownership:**

The timing for the proposed project is excellent. China's recent and continuing implementation of major housing reforms offers the opportunity to align end-user incentives in support of more efficient energy use in residential buildings. As families, as opposed to work units, buy and own their homes, their attention to heating and cooling comfort, and their interest in minimizing utility costs, can provide a powerful market-based lever for improving building energy efficiency if supporting policies and programs are put in place.

MOC's new Residential Building Energy Conservation Management Regulations became effective in October 2000, greatly tightening the requirements for local entities to comply with the 1995 building energy efficiency standards. In addition, the Central Government has lead a major campaign to eliminate the use of traditional solid bricks in urban building construction, requiring their replacement with more modern and energy-efficient materials. These policy steps are providing building developers with much more incentives to look for opportunities to improve building energy efficiency and utilize new building materials.

Perhaps most important, reforms required for the "commodification" of heat are now high on the national agenda. After the Central Government issued the Heat Reform Guidelines in mid 2003, many cities are now preparing detailed heat reform plans.. At the vanguard of the reform, Tianjin Municipality has been piloting key aspects since 2000 and has already become a focal pilot case for the national effort..

MOC and MOF have strongly endorsed the proposed project and the associated technical assistance initiatives of the World Bank. MOC leadership has requested long-term, multi-faceted cooperation between the Bank and Chinese Government on the difficult issues of implementing of heat reform and transforming building energy efficiency market.

#### **D.5. Value added of Bank and Global support in this project:**

The proposed GEF project anchors the entire Bank-sponsored international assistance program on heat reform and building energy efficiency in northern China. The GEF support provides a platform for direct Bank and MOC involvement, a mechanism to concentrate international, national and local attention on the implementation details which are critical for success, and a modest incentive for local authorities to work to overcome the great organizational and institutional barriers associated with applications of two-handed approach in heat and housing developments for the first time. As described in Section C3 and the incremental cost annex, the global environmental benefits of success in heat reform and building energy efficiency efforts in northern China are truly large, and sustained. Given the current pace of construction, the alternative of continued mediocre results will lock-in energy waste and excessive coal use for buildings and heating systems for many decades.

Meeting the complex, intertwined challenges and barriers described in Section B can only be achieved through a sustained effort of a half-dozen years or more. The key is the detailed implementation at local levels, not just policy development. To provide the needed assistance in implementation, it is essential to pursue both strong technical assistance efforts and direct involvement in implementation of concrete and large-scale investments in alternative, modern heating and heat use systems. GEF investment project support is by far the best vehicle to achieve this in China today, as described below. Furthermore, the returns on GEF investment, in terms of carbon dioxide emissions reduction, are expected to be particularly high.

On the investment side, GEF financing of a small portion of certain energy efficiency innovations in large heating and building energy efficiency integrated demonstration projects makes a major difference in the ability of these projects to proceed, even though GEF financing amounts to only some 1% of the total investment cost. The GEF financing provides a small incentive to the local Chinese companies to break with tradition and try new, more risky innovations. At least equally important, however, is the fact that GEF financing enables direct involvement of both the Bank and central Government, in the development, implementation and dissemination of national pilot projects. This attention is perceived as an additional major benefit by local developers, expanding their interest. For the Bank and MOC, the GEF financing of demonstration project allows the critical involvement in detailed implementation, and packaging of both technical innovations with implementation of policy reform, which enables on-the-ground results and program success. Finally, GEF financing allows small levels of investment support throughout the integrated projects—including heat supply, heat distribution, heat use and measurement, and building energy efficiency improvements. This would not be possible through loan financing packages (especially IBRD loan financing), where the institutional complexities of lending, repayment, and especially provision of counter-guarantees to so many potential borrowers for small sums precludes this approach. The Bank is continuing to solicit interest among local governments in IBRD loan financing as part of the overall China heat reform and building energy efficiency program. However, if acceptable potential borrowers do express interest, this will almost certainly need to focus on district heating supply systems, as sovereign guarantee arrangements for IBRD loans to commercial housing developers are not likely to be supported by the Government, and these firms have access to local, more convenient sources of loan financing.

On the technical assistance side, modest levels of GEF financing enable MOC to sustain practical, operationally focused assistance to local levels throughout the life of the project. At least as important, however, the proposed GEF project as a whole (a) provides a catalyst for organization and implementation of a series of policy development and implementation efforts by the Bank and other donors, as part the overall long-term assistance program, and (b) provides the operational focus of the national demonstration projects to anchor the broader technical assistance agenda in the realities of the day-to-day issues of implementation of reforms and new innovative technical approaches at local levels. In reality, the Bank's first review of options for improving energy efficiency in Chinese buildings, completed in 2000 as a foundation for the further work, was triggered by the Government's request for a possible GEF investment project in this field. Synergies have continued ever since. For example, the Bank's ongoing assistance to the Government in development of heat pricing policies has focused on the development of a new heat pricing policy for Tianjin Municipality, as a national case study, both to benefit from the MOC/Bank/Tianjin working relationship developed during GEF project preparation, and to help promote a key element in the heat reform package in Tianjin necessary for the success of the proposed GEF demonstration project there.

#### **D.6. Links to Related GEF Projects:**

The proposed GEF project will also help to reinforce building energy efficiency technical assistance efforts of the parallel UNDP/GEF *China End-Use Energy Efficiency Project (EUEEP)*. The EUEEP supports the strategic plan of the Chinese government to dramatically improve the efficiency of its major end-use sectors, buildings and industry. With its primary focus on assisting in the implementation of the 1998 Energy Conservation Law, development and implementation of energy efficiency standards of various types, and strengthening of institutional capacity for the Government to better play its role to promote energy efficiency in the emerging market economy,

the project can help fill critical gaps in the international support effort on energy efficiency in China. With its main thrust in building energy efficiency on the development and implementation of building energy efficiency codes and standards across all of China's climatic zones, the EUEEP complements this proposed project very well. Most aspects of the specifics of building energy efficiency code development and implementation needed in northern China have been omitted from the proposed project, except for certain bridging activities, and the proposed project will rely on EUEEP activities on this topic, which will be executed by the same Department in MOC which houses the PMO for this proposed project. In return, this proposed project offers an ability to reinforce the EUEEP efforts in areas in northern China, through synergies with planned support on heat payment, pricing and billing reforms, and investment in modern heat supply and innovative highly energy efficient building design and construction, to make a very effective medium-term support package.

## **E: Issues Requiring Special Attention**

### **E.1. Economic**

Economic evaluation methodology:

Cost benefit  Cost effectiveness  Incremental Cost  Other [specify]

Preliminary analysis of the incremental costs and the global environmental benefits of the project is outlined in Annex 3.

### **E.2. Financial**

The specific investments supported by the project will be designed to demonstrate the cost-effectiveness of introducing energy efficient materials and building designs and energy efficient heat supply technologies. The investments in the outer years of the project will be finalized after the start of project implementation.

### **E.3. Technical**

China has made significant progress in promoting building energy efficiency, especially in the area of introducing new thermal improvement technologies. However, major bottlenecks exist in scaling up the market for more energy-efficient buildings due to deficiencies in market infrastructure and regulation oversight in design and construction. Choices of building materials and the cost-effectiveness of different options under Chinese conditions are poorly understood. Training and retooling are needed for architects so that energy efficiency designs become a organic part of the design process instead of attempts to meet regulatory requirements. A systematic testing and certification system needs to be developed to ensure performance and quality of energy efficient building materials and products. Development of consumption-based heat metering and billing methods and the accompanying tariff systems, is a totally new area in China, with many complexities surrounding sound economics, cost efficiency, and adaptation to local social norms.

The existing heating systems will also need an overhaul in heat delivery and load control techniques as well as in operational management to be able to react to consumer-controlled heat demand. Designers of heating networks are not familiar with the many technologies that are now used customarily in Western and Central European heat supply systems to reduce energy losses and life-cycle costs, such as the use of plastic piping in low-temperature networks, the use of small automated substations, variable-flow technology, etc.. Chinese manufacturers are only

starting to produce such products but many are still of inferior quality. Testing and calibration centers for heat metering and controls are only beginning to be installed. The use of imported components would increase the front-end capital costs and is thus resisted by heating companies and developers intent on minimizing those costs.

The Chinese national and local technical communities are well aware of these challenges and have gained much experience in recent years through trials and errors and international cooperation. As part of the overall program, the Bank project team has been working with national and local technical institutions, through the coordination of the Ministry of Construction, on major technical issues associated with heat reform and building energy efficiency market transformation, and will continue to provide technical assistance through the GEF project and other tools of the overall program.

In the joint work undertaken during Bank sector work and project reconnaissance efforts, the Bank, MOC and national experts strongly agreed that the most meaningful efficiency gains and cost savings to both consumers and the country can be achieved through an integrated effort that simultaneously address all key technical and institutional elements of the space heating chain, setting up the basic framework for the overall program and the GEF project. In a completed TA to MOC under the program, an international team worked with national experts and made recommendations on basic technical options and key policy issues for China to adopt heat metering. With support from ESMAP, the Bank team is currently working with MOC to develop a pro-poor national policy framework for heat pricing and billing. An ASTAE supported TA in economic analysis of building energy efficiency measures is also underway, aiming to promote best energy efficiency practices in site planning, building designs, materials/products selection, and construction techniques, as well as to strengthen the capacity for testing and certification of building materials and components. Additional TA activities are proposed for the project as well as through other funding channels of the program, and are envisioned to provide timely assistance and advice to national and local endeavors in heat reform and building energy efficiency market transformation.

#### **E.4. Institutional**

Implementation of the “two-hand” approach, involving both heat supply modernization and pricing and billing reform as well as building energy efficiency improvement, requires very active, day-to-day coordination across departmental and institutional lines both within MOC and within local and municipal governments. Both MOC and Tianjin Municipality have already created leadership groups that incorporate authority and expertise in both the heat supply/reform and building energy efficiency areas. MOC, Tianjin Municipality and the municipalities joining the project later will need to further organize PMOs and experts groups which can devote sufficient time necessary to prepare and implement this complex, integrated project.

#### **E.5. Social**

*Resettlement.* An analysis of resettlement aspects is required for the subprojects financed under the Tianjin integrated demonstration project. Resettlement Action Plans (RAPs) will be prepared for the two subproject sites under the Tianjin Component in which land acquisition, resettlement, and relocation are taking place. For the Beixinzhuang site a post-evaluation of resettlement activities will be conducted to ensure that the affected people were compensated in accordance with national and municipal regulations. These due diligence activities would be carried out to

ensure that the beneficiary's regulations were being followed. The RAPs under preparation will serve as "best practice" analysis in a very visible national demonstration project.

The Other Northern Cities Component consists of investments and reforms to be identified and developed as project preparation and implementation for the other two components proceeds. Since the sites of the subprojects are unidentified, a Resettlement Policy Framework will be prepared to provide procedures for potential resettlement activities under this component. The framework will address the need for due diligence because of the presence of investment activities co-financed by the Bank GEF project. This framework and the resettlement analyses will be publicly disclosed before project appraisal.

## **E.6. Environmental**

### **a. Environmental Issues:**

Emissions from central heating facilities are the primary cause of the serious ambient air pollution prevalent in northern Chinese cities, and are a major public health concern of the government. The main environmental issue concerns the heat sources, especially, in the Chinese context, the development of coal-fired heating boiler facilities, associated with the project's demonstration subprojects. The overall impact of the project on ambient air quality will be positive since it supports cleaner and more efficient coal-fired heating systems that is part of the long-term air quality improvement program of the local governments. In addition, construction-related impacts may be a significant issue during construction (e.g., dust, noise, traffic, wastewater and sanitation) and operations (e.g., heat pollution, particulates, effects on groundwater quality and quantity).

### **b. Environmental Category: B - Partial Assessment**

### **c. Justification/Rationale for category rating:**

The project has been assigned Category B for environmental assessment due to the potential project benefits and because potential adverse impacts can be mitigated by known activities well within the capacity of the grantee. A partial environmental assessment will be carried out for the project in accordance with the policies and procedures of China and the Bank.

### **Timeline and status of EA**

EA start-up date:	November 2003
Date of first EA draft:	March 2004
Expected date of final draft:	May 2004

### **e. Proposed Actions :**

The two main aspects of the project's environmental impact assessment report would be an environmental assessment of the Tianjin demonstration component and a framework for screening and review of additional subprojects in other northern cities, to be applied during project implementation. The EIA for Tianjin and the environmental screening and review framework for other participating cities will be publicly disclosed before project appraisal.

The environmental impact assessment analysis will focus on environmental impacts and mitigation concerning the project's integrated heat system and housing complex demonstration

subprojects. Assessment of the fuel reduction benefits of the project will be conducted as a key part of the overall project appraisal and documentation. During the environmental assessment the attention of local authorities and experts will focus on the choice of scale and location, boiler technology, and emission control technologies in the expansion or new development of heating plants associated with the project. The Bank team has entered into an early and productive dialogue on how to reduce the overall air pollution impacts of relevant city heating systems during the next 3-10 years. In addition, a screening should be completed, and mitigation measures adopted where necessary, for possible negative environmental impacts associated with the heating network development and housing, as well as with the demolition of existing heat supply facilities.

The project EIAs will include an analysis focusing on the incremental effects only of the facilities and activities to be financed by the GEF, and a due diligence investigation will be conducted for the remainder of project. National and local environmental regulations and the performance by the beneficiary to date to help ensure that activities will be conducted according to Chinese regulations.

### **E.7. Participatory Approach**

#### **a. Primary beneficiaries and other affected groups:**

Reduced energy costs in production through energy efficiency improvements across heat supply and building construction yield benefits to Chinese consumers, and the avoided emissions resulting from reduced fuel consumption will have positive impacts on the local as well as global population.

Residents of residential apartment buildings in Northern China participating in the project will be one of the key direct beneficiaries. During project identification and various associated technical assistance activities in the Heat Reform and Building Energy Efficiency Program, households in many demonstration projects all over Northern China were interviewed about the experiences and satisfaction with energy efficient homes and consumption-based billing. Residents interviewed were generally satisfied with improved building envelopes. The heat billing systems, however, are still very rudimentary, not very transparent, and not based on a city-wide adoption of metered tariff systems. The Bank is working with MOC and the Tianjin government and heating companies to implement a heat pricing and billing system that takes into account the concerns of heat customers.

In addition, interviews in Tianjin's Hexi District with a group of low-income households were carried out to understand their experience with the low-income and heat payment support program and solicit their views about possible improvements. Most households who received such heat discounts were quite pleased with such policy. However, since the heat payment was collected once every heating season, for those with per capita monthly income at around Y240 per month, even the remaining payment of several hundred yuan was still quite difficult to manage. They suggested that if such payment were distributed evenly throughout the whole year, it would be more manageable for them. The new measure by providing heating subsidy as part of low-income people living allowance and distributed every month might provide a solution to such concern. Another concern raised by low-income groups is the fixed nature of the heat charge, based on size of apartments instead of consumed heat. A wider introduction of heat metering and control, heat tariff reform and consumption-based billing, supported by the project will allow individuals to control their heat consumption and thus their payments for heat.

b. Other key stakeholders:

The project depends critically on the participation of stakeholders in the building and heat supply industries. Consultations are being held with a wide range of project stakeholders in the central, provincial and local government, real estate developers and building material and boiler manufacturers, research units, and NGOs. Real estate developers in particular are critical sources of knowledge since they conduct on a regular basis market research to understand how best to sell their apartments. Consultations with Tianjin developers have informed project design to ensure an appropriate positioning of energy efficiency in the marketing of the development. In addition, price points of the market segments targeted by the developers were carefully considered when taking into account the incremental costs of the energy efficiency investments.

In addition, the participation of government officials involved in traditionally separate sectors, i.e. building construction and heat supply, is also critical to achieving the objectives of the project. Significant efforts are underway to coordinate activities of the project across institutional boundaries at the central, provincial and local government levels. Together with MOC officials, the project team held several meetings in various cities across northern China with government officials, developers and heat suppliers to discuss their ideas about commodifying heat and broadening and institutionalizing the development of more energy efficiency buildings. The consultations helped to inform design of the National and Other Cities components.

The specialists on the client and Bank side involved in the overall Bank program are working on related projects and studies in China. This has helped to link stakeholders involved in one or another activities with each other, greatly enhancing knowledge-sharing and incorporating lessons learned into project design. The UNDP GEF *China: End-Use Energy Efficiency Project (EUEEP)* is being managed by the same MOC department involved in the preparation and implementation of this project. This is helping ensure real coordination and complementarity take place among the two project activities. The EUEEP has helped inform in particular project design on testing and certification of building material equipment, helping identify gaps and capacity constraints that need to be addressed. The *GEF Industrial Boiler* project has helped to inform project design in the case of *Xindu* in Tianjin with information from Chinese boiler manufacturers on the various environmentally friendly boiler options that could be used. The *ASTAE Economic Analysis of Energy Efficiency Measures for New Residential Buildings* is helping to open lines of consultation among project stakeholders, research units and building material manufacturers in China. The ESMAP study on *Development of Pro-Poor Heat Pricing and Billing Policy* is also working in a similar fashion, linking NGOs, research units and specialists in ongoing consultations in particular on social impacts of heat reform.

The project has also pulled together the initiatives and experiences of various donors in the areas of heating system modernization and building energy efficiency. During project preparation the Finnish and Danish Governments have provided funding for experts to assist the Bank and Chinese teams in the development of practical heat metering and billing approaches and modern, demand-based heating systems, respectively. The Canadian and French governments as well as various US-based donors have collaborated extensively with MOC on the development of codes and standards and on demonstration projects for energy efficient buildings. Especially the latter experience is useful in advancing the objectives of this GEF project.

**E.8. Checklist of Bank Policies**

a. Safeguard Policies (check applicable items): [*must agree on applicable risk assessment*]

<b>Policy</b>	<b>Risk of Non-Compliance<sup>1</sup></b>
Environmental Assessment (OP4.01, BP4.01, GP4.01)	Yes [L]
Natural habitats (OP4.04, BP4.04, GP4.04)	NA
Forestry (OP4.36, GP 4.36)	NA
Pest Management (OP4.09)	NA
Cultural Property (OPN11.03)	NA
Indigenous People (OD4.20)	NA
Involuntary Resettlement (OD 4.30)	Yes [M]
Safety of Dams (OP4.37, GP4.37)	NA
Projects in International Waters (OP7.50, BP7.50, GP7.50)	NA
Projects in Disputed Areas (OP7.60, BP7.60, GP7.60)	NA

<sup>1</sup> H is High, M is Medium, L is Low

The project will not finance activities that would significantly convert or degrade any protected areas, known natural habitats, or established or proposed critical natural habitats as defined under the safeguards policy. The project EIA and subproject screening mechanisms will ensure that subprojects that impact natural habitats are identified. No subprojects that adversely affect critical natural habitats will be supported under the project.

b. Business Policies (check applicable items): [must agree on applicable business policies]

- Financing of recurrent costs (OMS 10.02)
- Cost sharing above country 3-year average (OP 6.30, BP 6.30, GP 6.30)
- Retroactive financing above normal limit (OP 12.10, GP 12.10)
- Financial management (OP 10.02, BP 10.02) [?]
- Involvement of NGOs (GP 14.70)

c. Describe issue(s) involved not already discussed above: N/A

## **F: Sustainability and Risks**

### **F.1. Sustainability and Replicability.**

The objective of this project is to achieve sustained and growing increases in energy efficiency of residential buildings in China's cold and severe cold regions and in the heating systems that supply them. The realization of this objective is critically linked to the successful implementation of the dual Government policy agenda in heat reform and building energy efficiency regulation. The timing, content, focus and location of the proposed project activities are designed to provide maximum impact for the Government's ongoing efforts on both fronts, providing timely assistance in removal of critical technical, institutional and organizational barriers. The effectiveness of the barrier removal, and thus the sustainability of the project results, will depend on the broad effect of the demonstration projects and related activities supported by the project on the construction and heating industries and the government agencies that regulate them. The project is designed to ensure demonstration projects are well prepared and consistent with the "two-hand" approach. The technical assistance and dissemination activities of the project will be managed centrally to ensure extensive knowledge sharing and broad policy dialogue.

The project will achieve sustainability of its outcomes by simultaneously:



- (a) supporting the heat reform initiatives of the Government which are key to the sustainability of future improvements in the energy performance of buildings and heating systems. The heat reforms and complimentary equipment such as meters and controls will allow consumers to control their energy consumption and pay according to this consumption. This will, together with awareness campaigns and education of consumers, provide an incentive for them to demand more energy efficient homes, creating the demand pull which is missing now;
- (b) demonstrating and disseminating international best practices in design and construction of more energy efficient buildings, as well as strengthening regulations and enforcement in building energy efficiency code compliance and quality assurance of energy-efficient building materials/components. These market transformation activities are critical to sustaining and scaling up the development of progressively energy efficient residential buildings; and
- (c) demonstrating that the integration of demand-driven modern heating systems with energy efficient buildings provides superior comfort and heat quality to consumers, energy and cost savings, and a much improved environmental performance. Together with other heat reform measures this will result in a commercially viable heat supply industry.

Project sustainability is enhanced by the strong commitment to reform and project ownership by the Ministry of Construction, the Tianjin Municipal Government and participating real estate developers. This is reflected in the results already achieved on the ground during the PDFB-supported project preparation activities. Other northern cities will be selected for participation in the project based on their commitment to the heat reform and building energy efficiency agenda.

The project outcomes are expected to lead to replication and scaling up of heat reform, heat supply modernization and building energy efficiency improvements across northern China, as the country's heat reform program proceeds. The sharing of implementation results and transfer of knowledge from project cities by the national government is a key instrument for supporting replication by other cities. The project is expected to prove, for the first time in China, that the project's two handed approach is applicable to Chinese conditions, feasible and will generate significant energy and cost savings. This outcome will create a strong incentive to implement similar integrated heat reform and building energy efficiency programs. The market transformation activities of the project will also contribute to speeding up of the development and implementation of these programs.

**F.2. Critical Risks (reflecting assumptions in the fourth column of Annex 1 “Project Design Summary”):**

The main risks of the project are associated the innovative “two-hand” approach in terms of organizational and institutional difficulties and the uncertainties that come with adoption of new technologies (see B.4 for more details). The project also involves relatively high initial costs to adapt energy efficiency concepts and new heat reforms to Chinese conditions. Overall risks associated with the GEF project are considered moderate, but risks to sustainability are rated substantial for the following reasons:

- Related HRBEE program activities, especially in the sector work on heat metering, billing and pricing, have shown there is little knowledge of international experience with the major

elements of the Government's heat reform program across Chinese cities. There is also little knowledge of national experiences with piloting aspects of reform. The lack of capacity in these cities to regulate market-based heating markets as well as the lack of coordination across levels and departments of government, and with these and the private sector and enterprises, could lead to institutional inertia in implementing necessary reforms. The inconsistent enforcement of building standards across cities is an example of one such challenge. Reticence may be reinforced by the perceived low individual ability to pay for heat bills. This project, and its emphasis on integrated approaches, is timely. Overall heat reform should have an important impact on the entire building stock, more than half of which will have been constructed within the next 15 years.

- The project preparation experience in Tianjin demonstrated the difficulty of convincing real estate developers unfamiliar with energy efficient materials and designs to take additional risk by adopting initially expensive energy efficiency improvements whose value has been untested in the real estate market. The experience thus far has, however, also shown that common misperceptions can be overcome and improvements can be accepted with less estimated incremental cost than perceived. Early experience is also encouraging when comparing overall GEF support with the total development costs incurred by the developers. Their interest in participating in the project provides some form of market sounding of the importance they attach to participating in an internationally-supported environmental project. Project support is critical to demonstrating that taking these risks are justified and profitable.
- In addition, some important measures, such as preinsulated plastic piping or reliable heat meters, are not domestically manufactured, making them extremely expensive in comparison to poorer quality domestically manufactured materials. Project assistance in stimulating demand for these products should help to create sufficient demand for domestic manufacturing. The economies of scale that could be achieved in the Chinese market would have a profound impact on the costs of these energy efficiency products and their utilization.
- There is a risk of technical failure and less than expected energy savings from building energy efficiency and heat supply improvements. The risk is mitigated by the use of proven and relatively simple technologies, projects where energy savings will be easy to monitor and verify, and selection of municipalities and developers which show ownership and competence towards executing their project responsibilities.

## **G: Project Preparation and Processing**

### **G.1. Has a project preparation plan been agreed with the borrower (see Annex 2 to this form)?**

Yes: November 2003

### **G.2. Advice/consultation outside country department:**

Within the Bank, the project team has included specialists with experience in heat reform and energy efficiency measures in the Bank's Europe and Central Asia (Infrastructure and Energy Department) and Latin America and Caribbean Regions. Outside of the Bank, it has also consulted with the Secretariat of the Global Environment Facility. See participatory approach for a more detailed description.



## ANNEX 1: PROJECT LOGICAL FRAMEWORK

Hierarchy of Objectives	Key Performance Indicators	Monitoring & Evaluation	Critical Assumptions
	<b>Sector Indicators:</b>	<b>Sector/ country reports:</b>	<b>(from Goal to Bank Mission)</b>
<b>a. Sector-related CAS Goal:</b> Environmentally sustainable development process facilitated  Business environment improved  Transition to a market economy accelerated		Ministry of Construction reports.	<b>Bank Mission:</b>  Continued macroeconomic stability and environmentally sustainable growth.
<b>b. GEF Operation Program:</b> Greenhouse gas emissions reduced	25 million metric tons of CO <sub>2</sub> avoided in project pilot cities due to the project.	Ministry of Construction reports.  Interim and Final Reports from each participating municipal government and at the national level on progress of implementing reforms and dissemination activities.	<b>GEF Mission:</b>  Continued implementation of environmentally sustainable economic policies.
<b>Project Development / Global Environment Objective:</b>	<b>Outcome / Impact Indicators:</b>	<b>Project reports:</b>	<b>(from Objective to Goal)</b>
Achieve sustained and growing increases in energy efficiency in residential buildings and the heating systems which supply them in China's cold and severe cold regions.	Energy use for space heating reduced by 10 million metric tons of coal equivalent (tce) due to the project.  By project completion (2011), 30 million m <sup>2</sup> residential floor area billed according to consumption;  By project completion (2011), 16 million m <sup>2</sup> housing constructed according to advanced building energy efficiency standards in pilot cities.	Periodic Project Monitoring Reports  Implementation review mission reports  Interim and Final Reports from each participating municipal government and at the national level on progress of implementing reforms and dissemination activities.	Central and Local authorities sustain commitment to developing and implementing integrated heat reform and building energy efficiency programs.

**Note:**

These performance indicators represent direct effects from investment in the 5-7 project pilot cities at project completion (end of 2011). Energy savings are accumulative amount by 2024 of all new residential buildings constructed during the project period (2005-2011), and do not account for residential buildings built after 2011. These calculations are different from those in the incremental cost analysis, which also include substantial additional indirect savings.

Output from each Component:	Output Indicator:	Project reports:	(from Outputs to Objective)
<p><b>A. Tianjin Municipality Project Component</b> Development and implementation of Tianjin city heat reform and energy efficiency program</p>	<p>A.1 (a) By 2011, 15 million m<sup>2</sup> housing connected to variable flow heat supply systems</p> <p>(b) By 2011, 15 million m<sup>2</sup> housing are metered and billed based on consumption.</p> <p>(c) By 2011, 8 million m<sup>2</sup> housing area are build according to advanced building energy efficiency standards.</p> <p>A.2 (a) 7 training workshops related to testing and calibration of heat meters</p> <p>(b) 7 training workshops in building energy efficiency compliance inspection</p> <p>A.3 (a) 3 completed regulatory/policy studies (b) 3 completed social and economic impact studies</p>	<p>Interim and Final Reports from each participating municipal government and at the national level on progress of implementing reforms and dissemination activities.</p>	<p>Central and Local authorities sustain commitment to developing and implementing integrated heat reform and building energy efficiency programs.</p> <p>Central government mobilizes sustained international assistance to help implement heat reform and building energy efficiency regulations.</p>
<p><b>B. National Level Coordination and Policy Support Component</b></p> <p>Strong project coordination</p> <p>Consolidation of national heat reform and building energy efficiency policies.</p> <p>Dissemination of practical application of aspects of heat reform to other cities in China.</p>	<p>B.1 (a) 10 seminars/workshops in training and dissemination, 500 specialists/officials trained. 7 annual project progress reports.</p> <p>(b) 30 cities implementing consumption-based billing.</p>	<p>Interim and Final Reports from each participating municipal government and at the national level on progress of implementing reforms and dissemination activities.</p>	
<p><b>C. Other Northern Cities</b></p> <p>Development and implementation of integrated city-wide heat reform and energy efficiency programs in 4-6 cities.</p>	<p>C.1 (a) By 2011, 15 million m<sup>2</sup> housing connected to variable flow heat supply systems installed.</p> <p>(b) By 2011, 15 million m<sup>2</sup> housing are metered and billed based on consumption.</p> <p>(c) By 2011, 8 million m<sup>2</sup> housing are built according to advance building energy efficiency standards</p>	<p>Interim and Final Reports from each participating municipal government and at the national level on progress of implementing reforms and dissemination activities.</p>	

<b>Project Components/Sub-components:</b>	<b>Inputs: (budget for each component)</b>	<b>Project reports:</b>	<b>(from Components to Outputs)</b>
<b><u>A. Tianjin Municipality Project Component</u></b>  A.1 Energy Efficient Buildings and Heat Supply Investment  A.2 Building Energy Efficiency Market Transformation Support  A.3 Technical Assistance to Tianjin Municipality	<b><u>\$ 434.7 m (GEF \$ 6.0 m)</u></b>  \$ 433.0 m (GEF \$ 5.1 m)  \$ 0.9 m (GEF \$ 0.6 m)  \$ 0.8 m (GEF \$ 0.3 m)	Periodic Project Monitoring Reports  Implementation review mission reports	Corporate financing for investments is available for real estate developers and heat supply companies.  Coordination efforts across government departments and industry stakeholders are successful.
<b><u>B. National Level Coordination and Policy Support Component</u></b>  B.1 Technical Assistance to Ministry of Construction  B.2 Project Management, Monitoring and Dissemination	<b><u>\$ 2.3 m (GEF \$ 2.0 m)</u></b>  \$ 1.45 m (GEF \$1.25 m)  \$ 0.85 m (GEF \$0.75 m)	Periodic Project Monitoring Reports  Implementation review mission reports	Central and Local authorities sustain commitment to developing and implementing integrated heat reform and building energy efficiency programs.
<b><u>C. Other Northern Cities</u></b>  C.1 Investment  C.2 Technical Assistance	<b><u>\$ 656.0 m (GEF \$ 10.0 m)</u></b>  \$ 653.8 m (GEF \$ 8.0 m)  \$ 2.2 m (GEF \$ 2.0 m)		Corporate financing for investments is available for real estate developers and heat supply companies.  Coordination efforts across government departments and industry stakeholders are successful.

## Annex 2 Detailed Project Description

### Summary of Estimated Total Project Costs and Indicative GEF Support

(in US\$ millions and percentages)

	Total Estim. Project Cost	Total Estim. Incremental Cost	Total Indic. GEF Support	GEF Support Percent of Incremental
<b>Total Project Cost</b>	<b>1,097.0</b>	<b>53.1</b>	<b>18.0</b>	<b>34%</b>
<b>A. Tianjin Municipality Demonstration Component</b>	<b>434.7</b>	<b>21.9</b>	<b>6.0</b>	<b>27%</b>
<i>Subcomponents</i>				
A.1 Energy Efficient Buildings and Heat Supply Investment in energy efficiency measures in new construction and heat supply	433.0	20.4	5.1	25%
A.2 Building Energy Efficiency Market Transformation Support Technical Assistance and supply of equipment for certification and calibration program for heat meters and building components	0.9	0.9	0.6	57%
A.3 Technical Assistance to Tianjin Municipality Technical Assistance for introduction of new pricing and billing, quality control of demonstration projects, technical studies, and communication / public awareness building.	0.8	0.8	0.3	38%
<b>B. National Level Coordination and Policy Support Component</b>	<b>2.3</b>	<b>2.3</b>	<b>2.0</b>	<b>87%</b>
<i>Subcomponents</i>				
B.1 Technical Assistance to Ministry of Construction Studies and policy advisory support for Government's heat reform program.	1.45	1.45	1.25	88%
B.2 Project Management, Monitoring and Dissemination Support for project management, monitoring and evaluation of entire project, and dissemination of lessons learned nationally and Internationally	0.85	0.85	0.75	83%
<b>C. Demonstration Projects and Heat Policy Reforms in Other Northern Cities Component</b>	<b>660.0</b>	<b>28.9</b>	<b>10.0</b>	<b>35%</b>
<i>Subcomponents</i>				
C.1 Investment Investment in energy efficiency measures in new and, potentially, existing construction and heat supply in selected cities in northern provinces of Heilongjiang, Jilin, Liaoning, and one other Province	657.8	26.7	8.0	30%
C.2 Technical Assistance Support for study, development and piloting of heat reforms, and investment project development and supervision in selected cities in northern provinces of Heilongjiang, Jilin, Liaoning and one other province	2.2	2.2	2.0	91%

A summary of estimated project costs and indicative GEF support is provided in the table above. The total estimated cost of the proposed project is US\$1.1 billion and it is proposed to include GEF support of US\$18.0 million. The project is designed to support the removal of barriers to heat reform, modernization of heat supply and improvements in building energy efficiency in China (See Sections B.3 and B.4 for a detailed description of these challenges).

The proposed project will be complemented by and will be integrated with a closely-related new French GEF project with the city of Harbin. The French GEF project will help improve energy efficiency at the building level in that city, and this project will create the supportive policy framework and an efficient heat supply system.

The proposed project comprises three components:

### **(A) TIANJIN MUNICIPALITY DEMONSTRATION PROJECT**

Tianjin is a municipality of provincial rank, 150 km southeast of Beijing, with more than 9 million permanent inhabitants of which about 6 million live in the urban areas. The urban building stock in Tianjin has increased dramatically since the mid 1990s to about 170 million square meters in 2001. A residential floor area of 66 million square meters is heated now by central heating systems, accounting for 74% of the total residential floor area. In total about 1.9 million tons of coal are used to produce about 754 GWh of heat during the official 120-day heating season.

Central heating started in Tianjin only in the early 1980s and slowly reached a market share of 33% by 1997, based mostly on supply from coal-fired small boiler houses. To reduce air pollution and improve living standards, the municipal government embarked on a 3 year “heatification” plan in 1999 to increase the rate of connection to central heating systems to more than 70% with a substantial increase in the provision of heat from large boiler houses and combined heat and power plants. While the plan was very successful in reaching more than 70% coverage by the end of 2001, the district heating sector is still very fragmented with more than 400 heating companies. Of the total installed capacity of about 5250 MW about one quarter is still in more than 400 boilers of less than 7 MW. As a consequence, the heating industry is the biggest contributor to air pollution in Tianjin during the winter. To address this, the Municipal Government is completing a 2003-2015 heat supply development plan, including the interconnection of the local systems, scrapping of the small boilers, and development of larger heat source stations which can provide heat with suitable environmental controls. This would be in compliance with the Tianjin “Blue Sky Program” which calls for the elimination of all coal-fired boilers equal to or under 7 MW for heating, and expanded use of district heating and cleaner fuels within Tianjin’s ring road.

Tianjin was the first city in China to embark on heat reform. The first step in 2000 was to transfer the responsibility for heat bill payment from the work unit to the heat consumer, accompanied by a salary reform for government employees, increasing their salaries by slightly less than the average heat bill. In several demonstration projects different heat metering technologies were tried out and consumption-based billing was experimented with. Only in 2003, however, work on developing a two-part heat tariff began with support from the World Bank’s ESMAP program. With the implementation of such a new tariff system and increased installation of metering and control equipment, consumers will be able to adjust their heat consumption levels and thus their heating bills, providing in turn incentives to invest in more energy efficient housing.



Housing construction in Tianjin has proceeded at a rapid rate during the past few years, adding more than 17 million square meters of total construction area annually during each of the past 3 years. The Tianjin Municipal Government promulgated their own building energy efficiency standards in 1991 and 1997, respectively, modeled on the national standards for residential buildings. Implementation rules, application drawings and management rules for wall material reform, forbidding the use of solid clay bricks, were issued as well. Developers are now reported to start using more energy efficient designs and materials, but coordination between the various parts of the chain from design to final supervision is still poor, implementation is uneven, materials are of varying quality, construction practices are not up to higher quality requirements, etc.. The Municipal government reports that less than half of all new residential construction abides by the 50% energy saving standard. Very few of the new developments, however, incorporate heat meters or controls at the apartment level and heating systems still largely operate in a supply-driven mode, rendering energy efficiency improvements on buildings themselves ineffective in terms of real energy savings.

Tianjin's early implementation of heat reform steps and its commitment to improve the energy efficiency of its new building stock made it an early partner of the Central Government and the World Bank in the development of a strategy to reduce energy consumption for heating. Municipal leaders welcomed the opportunity to embark on the design of a comprehensive demonstration of energy efficiency investments in both the heating systems and the buildings they supply, the use of variable-flow technology enabling the transformation of the heating systems from supply to demand-driven operation (with advice provided by Danish heating experts under a World Bank/Danish trust fund) and the implementation of further steps in heat reform such as heat pricing and consumption-based billing which is supported by the Bank's ESMAP program. Several innovative developers of new residential building complexes have been interested in cooperating in such an effort. The Bank's ASTAE program is supporting them in developing designs for improved buildings and proposing the use of innovative building components that will improve the thermal resistance of the buildings at small incremental cost. As a result, two residential building complexes with a total of more than 1 million square meters will for the first time in China demonstrate that the combination of modern heating systems and energy efficient buildings, in conjunction with heat reform measures, can indeed achieve 65% energy savings at low additional cost and improve the living comfort and reduce energy bills of inhabitants

The Tianjin demonstration project comprises three subcomponents:

### **Energy Efficient Buildings and Heat Supply Investment**

The subcomponent will support the introduction of modern heat supply and energy efficient building design and construction in two new large housing development projects. In both developments building construction improvements are expected to be designed to meet the goal set by the project of achieving 30 percent more energy savings than required by the existing 1995 standard. Modifications in architectural design and building shape will be introduced to reduce overall heat load and increase efficiency of the entire system with little or no additional cost.

***Xinduzhuangyuan Residential Garden*** Located just inside Tianjin city's ring road, the housing development at *Xinduzhuangyuan* will be developed by Tianjin Jintou Jinsha Real Estate Development Co. Ltd. in six stages over about six years. The whole development will comprise 740,000 square meters of residential and public building construction area and is expected to be fully completed by November 2009. In total the development will house 7,300 families. The

Tianjin municipality plans to construct four 58 MW “environmentally friendly” boiler installations to supply heating to *Xindu* and future residential developments, which will amount to about 3.7 million square meters.<sup>4</sup> The heat plant is planned to be constructed about 4 km away from the *Xindu* development. The Phase 1 of the development will use floor heating, which is a heating system that is increasing in use in new construction. Using of wall-mounted radiators also are considered for latter phases by the developer.

GEF support for physical investments will be phased-in with each progressive stage of construction. The *Xindu* investments in energy efficiency that could be supported by GEF are likely to include *inter alia*: (a) installation of a variable flow heat supply system with state-of-the-art chain grate boilers, associated management system and environmental controls; (b) installation of improved pre-insulated pipes for the primary and secondary network; (c) installation smaller, state-of-the-art substations with automatic temperature control equipment; (d) double piping in the staircase wells; (e) installation of apartment level meters and temperature control equipment; (f) improvements in exterior wall construction, including use of higher quality and / or thicker exterior wall insulation; (g) improvements in roof construction, including higher quality water proofing material as well as better quality and / or thicker roof insulation; (h) installation of push-open PVC windows with high thermal resistance and low infiltration; (i) installation of insulated doors to the building and apartments.

***Beixingzhuang Gardens*** Also located within Tianjin city’s ring road, the development at *Beixingzhuang Gardens* will be developed by Demaofeng Real Estate Development Co. over a period of 3 years (by 2006). The development will comprise about 183,100 square meters of residential and commercial building construction area. It will include flats for about 1,300 families in three high rise apartment complexes (28 stories each), several 8-11 story multi-family buildings, a high-end full service rental complex as well as a small portion of commercial space. In addition a kindergarden (5,200 m<sup>2</sup>) will be constructed and will be connected to the heat supply network. A combined heating and cooling system will be constructed utilizing water-source geothermjal heat pumps with 100 percent ground water re-injection and demand-driven system control technologies. A fan coil heating and cooling system will be used in each flat.

The *Beixingzhuang* investments in energy efficiency that could receive GEF support are likely to include *inter alia*: (a) use of high quality pre-insulated plastic pipes for the network; and items (d) to (i) listed for *Xindu* above.

GEF support of about \$ 5.1 million is proposed for this major subcomponent, accounting for about 1% of the total \$433 million investment of the two housing and heat supply projects. GEF support enables both international and national technical and organizational support, through MOC and the Bank, and assists the relevant corporate housing development companies to overcome the many risks involved in so many simultaneous changes, to allow this complex development of China’s first large integrated demonstration project using the “two hand” approach to proceed. GEF support covers about one-quarter of the estimated incremental costs of the major energy efficiency innovations, while Chinese counterpart funds will finance the remaining three quarters.

### **Building Energy Efficiency Market Transformation Support**

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<sup>4</sup> This includes an existing housing complex for resettled communities totaling 90,000 square meters which will be connected to the heat supply network.

In addition to the demonstration subcomponent, the project will assist the Tianjin Municipal Government to broaden the impact of its building energy efficiency program through activities targeted to address the greatest current weaknesses, including: (a) installation of equipment, related training and technical assistance to strengthen the local calibration and certification program for heat meters; (b) strengthening local testing and certification program for energy-efficient building materials and components; (c) introduction of innovative programs in building energy efficiency regulatory compliance enforcement, and (d) external communications to build awareness in the local area on the benefits of energy efficiency and in particular from results of the demonstration project. \$ 600,000 of GEF support is proposed.

### **Technical Assistance to the Tianjin Municipality**

The project will support the Tianjin Municipality through (a) studies, policy advice and training in the preparation of implementing regulations related to the introduction of cost-based pricing methodology and consumption-based billing. In addition, support will be provided to (b) monitoring and evaluation of the technical outcomes, (c) economic and social impacts of the two demonstration projects, including small studies which address knowledge gaps in the use of new technologies introduced in the demonstration projects such as small substations; and (d) education for new residents in the two demonstration projects on the use and benefits of consumption-based billing and heat metering, consumer control equipment. \$300,000 of GEF support is proposed.

Heat policy reform is a central element in Tianjin's application of the integrated approach. Having implemented the key reform in heat bill payment responsibilities during 2001-2, completion of the reform is now considered essential by the Municipal Government. The Bank and MOC have provided concrete assistance through past and ongoing policy study work to Tianjin, using the city as a primary case study for both metering and price reform support efforts. This technical assistance subcomponent will help to sustain this strong support.

## **(B) NATIONAL-LEVEL POLICY SUPPORT AND PROJECT MANAGEMENT**

As the focal point of the national heat reform and building energy efficiency programs, MOC's work on program development and implementation is critical for China to succeed in these overall efforts. The proposed project includes \$2.0 million in GEF support for partial funding of technical assistance efforts in policy and program development and implementation, to be complemented by other World Bank and donor financing, and for essential project management, evaluation and dissemination activities. It comprises two subcomponents:

**National Technical Assistance.** In line with the project's national scope, MOC requires technical assistance financing in a wide range of specific areas to develop and implement national heat reform and building energy efficiency policies, and to assist localities in the detailed implementation of the reforms. Assistance is required both to be able to apply international experience, and, especially, to be able to organize the highest quality national experts to address critical issues in a concentrated way. The GEF financing will be used as a technical assistance facility to meet the most pressing needs identified during project implementation which other donor efforts cannot fulfill, in a timely, practical and operationally focused way over the life of the project. As such, the scope of technical assistance activities could include, but not be limited to, the following:

- transfer of responsibility for paying heat bills to the individual;
- heat pricing and consumption based billing;
- heat metering;

- heat enterprise reform;
- assurance of a social safety net for vulnerable heat consumers;
- building energy efficiency standards and enforcement measures for new and old buildings;
- national regulation on testing and certification of energy efficient building materials and components; and
- promotion and dissemination of knowledge in heat supply and building energy efficiency technologies.

Within the proposed GEF project, the technical assistance will be targeted and highly focused on policy development and implementation activities, especially those directly related to the implementation of specific demonstrations of the “two handed” approach at local levels. The Bank will also seek to mobilize and encourage additional international donor activities in support of the overall program of MOC, as the needs are so great.

**Project Management, Monitoring and Dissemination.** Central support, organized through MOC, is critical for the innovative aspects of the project to be implemented smoothly, and to ensure that lessons learned under the various project components will have maximum impact in other parts of northern China and even beyond. The subcomponent is expected to support project management, monitoring and dissemination of lessons learned. The MOC Project Management Office would be responsible for developing and implementing, with the support of local authorities, the monitoring and evaluation for the entire project, including collecting project performance information and reporting to the Government, within the MOC, the Bank, the GEF and others, on the impact and results of this project. This subcomponent will also provide *project development support* for the *Demonstration Projects and Heat Policy Support in Other Northern Cities* component.

### **(C) DEMONSTRATION PROJECTS AND HEAT POLICY SUPPORT IN OTHER NORTHERN CITIES (Other Northern Cities Component)**

This component will promote simultaneous development of both heat system restructuring and billing and pricing reform, and building energy efficiency improvements, (e.g., the “two-handed” approach) in 4-6 additional northern Chinese municipalities, in order to achieve broad, national impact. The component is critical for achievement of the project’s overall objectives — with emerging results from the Tianjin Component in hand, and national-level support, comprehensive development of heat reform and building energy efficiency measures must be rolled out in the coldest regions of China. In most cases, the challenges also are greater than in Tianjin, due to greater heating requirements in colder climates, relatively slow economic development in the northeastern and northwestern regions, and less progress in heat reform to date.

This component will operate in close association with the Central Government’s heat reform piloting program, which will be implemented during 2004-2006, based on the July 2003 Heat Reform Guidelines. Participating municipalities will be selected from the list of pilot heat reform municipalities included in the national reform program in Heilongjiang, Jilin, Liaoning and one other province, primarily based upon the commitment of municipal leadership to the implementation of the two-handed approach. The component is designed to meet emerging assistance needs, and to respond to new ideas, as the national pilot Heat Reform Program unfolds, and lessons are learned from experience, in Tianjin and elsewhere. Hence, this component needs to be implemented in a phased approach.

Prior to project appraisal, the Bank and MOC will select one northern province, in addition to the key northeastern provinces of Heilongjiang, Jilin and Liaoning, for participation in the program. Provincial and municipal governments, heating companies and housing development companies in the pilot municipalities in these provinces are increasingly being engaged as part of ongoing World Bank technical assistance work. In order to participate in the project, municipalities in the four project provinces must:

- (a) be designated by the Government as national pilot heat reform cities based on the July 2003 Heat Reform Guidelines;
- (b) demonstrate municipal leadership commitment to implementation of the heat reforms and to enforcement of building energy efficiency standards;
- (c) demonstrate commitment to the “two-handed” approach of the overall Program; and
- (d) demonstrate strong management and organization capacity for this project, including abilities to organize both building energy efficiency and heat system development and reform aspects in an integrated and effective manner.

In addition to demonstration of municipal leadership commitment to the heat reforms and enforcement of building energy efficiency standards, each participating municipalities will need to agree with MOC and the Bank on a city-wide heat reform and building energy efficiency program, based on the two-had approach, prior to agreement on any GEF investment financing support. These city-wide program will provide the road map for all project activities in each municipality, and, especially, the leveraging and linkages of these activities to the achievement of broader, sustainable results throughout the participating municipalities. The city-wide programs will include a timeline of heat supply system modernization, heat reform, and building energy efficiency actions and deliverables. The agreed programs will include specific energy efficiency targets, and other monitorable indicators, which will be evaluated under the national component of the project as local implementation proceeds. The key output of the project in each of the 4-6 cities will be implementation of the agreed city-wide heat reform and building energy efficiency program, and the associated energy savings. Activities and investments receiving direct GEF support will be only a small part of the overall city-wide programs to be delivered under the project. In addition to TA activities targeted to resolve specific local issues, GEF support may be provided, depending upon local priorities, for demonstration projects which integrated packages of (a) energy efficiency improvements in heating networks; (b) operational modernization in heat supply systems to accommodate variable flow technology and consumer control, (c) adoption of consumer controlled heating systems and energy efficiency improvements in the heating systems within buildings, (d) adoption of new heat billing and metering technologies, especially in conjunction with heat pricing reforms, (e) development and construction of state-of-the art energy efficient building designs, (f) energy efficiency renovations in existing buildings (where appropriate), and (g) activities to support improved local enforcement of building energy efficiency standards.

Proposed GEF financial support of about \$10 million is very small in comparison with the size of the undertaking, which will involve projected investment of at least \$650 million, and probably substantially more. Nonetheless, the GEF support is very important, because it provides a platform for direct Bank and MOC involvement, a mechanism to concentrate international, national and local attention on the implementation details which are critical for success, and a modest incentive for local authorities to work to overcome the great organizational and institutional barriers associated with applications of the two-handed approach in heat and housing

developments for the first time. Support will include assistance for local policy development and implementation, and financing for about 30% of the incremental costs of certain energy efficiency innovations in heating systems and buildings, selected by the municipalities and agreed with MOC and the Bank as having maximum value for assisting the municipalities in their implementation of their city-wide heat reform and building energy efficiency programs. The support package for each municipality will be based on the on-the-ground needs of the localities, with different climatic, socio-economic, infrastructure and even cultural characteristics. Additional associated financing in support of the 4-6 municipal heat reform and building energy efficiency programs will be actively sought by MOC and the Bank, to further strengthen these efforts. The World Bank will also strongly consider requests from the municipalities for IBRD loans to leverage GEF resources in participating cities, especially for heat supply investments.

**Demonstration Projects and Heat Policy Reforms in Other Northern Cities  
Component**

	Total Estim. Project Cost USD M	Total Estim. Incremental Cost USD M	Total Indic. GEF Support USD M
<b>1 Investment</b>			
Total	657.8	26.7	8.0
Building Energy Efficiency	629.0	14.1	4.2
Internal Heating Network	13.1	6.0	1.8
Network and Substations	7.9	3.8	1.1
Heat Supply	7.8	2.8	0.8
<b>2 Technical Assistance</b>			
Total			
Technical Assistance	2.2	2.0	2.0

### **Annex 3: Incremental Cost Analysis**

#### **National Development and Global Environment Context**

China currently consumes about 180 million tons of raw coal per year for space heating in urban residential and commercial buildings in its cold and severe cold regions. Energy use per unit floor area is at least double that of buildings in similar cold climates in Western Europe or North America, yet far lower levels of comfort are achieved. During winter, emissions from coal-fired central heating facilities are the primary cause of the serious air pollution that is prevalent in northern Chinese cities, and are a major public health concern of the Government. Due to its major cost advantage, and shortages of alternatives, coal is expected to remain the dominant fuel for central heating systems for the foreseeable future. So the key to addressing these problems is to drastically improve the efficiency of coal-fired residential building heating systems.

Unfortunately there has been little real progress in improving space heating energy efficiency since the Government began to address the issue in the mid 1980s. As of year 2000, only 6% of new urban residential buildings in the cold and severe cold regions were constructed according to national building energy efficiency standards. The technologies and operations of centralized heating systems in China remain models of inefficiency. Heat metering and consumer control of heat are non-existent; heat consumption is billed per square meter of living space, not by energy consumed; and, in many cases, heat is paid for by employers, not consumers. Consequently, incentives to save energy in centralized residential heating system are minimal. Meanwhile, the stock of residential buildings connected to centralized heating systems doubled in the 1990s and is projected to almost triple in the next 20 years. It is thus critical to act now, with maximum effectiveness, to avoid perpetuating major energy waste in new residential buildings and major local and global environment damage for decades to come.

In response to the major local, national and global concern with this issue, this proposed project will support two key related national development reform goals: (1) transforming the urban heating sector from a government-supported welfare system into a market-based and self-sustaining commercial operation; and (2) achieving an energy efficiency transformation in urban housing development. Only by concerted efforts in carrying out fundamental heat reforms and implementing building energy efficiency regulations will China succeed in achieving sustained and growing increases in space heating energy efficiency and environmental improvement. By supporting the Government in these endeavors, the GEF will help China achieve substantial and sustainable coal savings, and thus a large reduction of CO<sub>2</sub> emissions from the rapidly growing urban housing sector.

#### **Baseline Scenario**

The incremental cost analysis was carried out for a projected 6 billion m<sup>2</sup> of net growth in the urban residential building stock and associated heating systems in the cold and severe cold regions between 2004 and 2024.

Under the baseline/business-as-usual scenario, improvements in the three key areas of the residential space heating “chain” will be very slow and limited in scale and scope, i.e.: (i) market penetration of more energy-efficient new residential buildings will occur very gradually, (ii) heat metering, consumer heat controls, and consumption-based billing will be introduced at a very modest pace; and (iii) a relatively small proportion of the huge and growing stock of residential building heat supply systems will adopt modern demand-driven operation and technologies.

More specifically, a realistic baseline scenario, based on current and likely future trends, is that:

- The share of buildings with relatively good energy efficiency performance (i.e. that are in compliance with the current national building energy efficiency standards) will increase by about 2 percentage points per year, rising from 10% in 2004 to reach 50% in 2024.
- 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.
- 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.

In other words, under the baseline scenario, by 2024, a large portion of the 6 billion m<sup>2</sup> of residential buildings built between 2004 and 2024 will **not** be able to reap the full or even the partial benefits of simultaneous improvements in the three key, inter-related areas of the space heating reform chain. They will either remain technically inefficient (with poor thermal integrity); and/or consumers will continue to squander energy, or be unable to achieve savings because the lack of the means (metering and consumer control and demand-driven variable flow systems) and/or have the incentives (consumption-based billing) to do so.

There are three major barriers that, under the baseline scenario, will prevent much faster, broad-based and effective implementation of the heat reform program and compliance with building energy efficiency standards. These three barriers are:

- 1. Lack of the multi-faceted, comprehensive approach, comprising both policy reform and technical improvements, that is needed to accelerate residential building energy efficiency improvement. It is clear from both a strategic perspective and from relevant (particularly eastern European) experience that the challenge of rapidly and sustainably improving the energy efficiency of the many large residential buildings in China's colder regions requires an integrated approach comprising simultaneous policy reform, regulatory enforcement and technical building energy efficiency design and operational improvements. Designing this complex, comprehensive or "two-handed" approach has, so far, been beyond China's technical and organizational capacity.
- 2. The challenge of multi-institutional collaboration and coordination, at both the national and the city levels, on both the design and implementation of a multi-faceted reform and technical improvement program. A second and closely related barrier is that the comprehensive approach also requires a much greater degree of institutional collaboration and coordination between both the heat supply and the housing development industries and the government units responsible for their respective regulation than currently exists. For example, on the heat reform side, one of the key challenges is managing the risks of negative social impacts from the reform of heat payment responsibilities. In addition, "commodification" of heat requires developing and implementing completely new pricing systems, metering systems, and billing practices; explaining their rationale and benefits to consumers; and wholesale changes in the operation and management of heating systems required for the switch-over to demand-driven systems. On the building efficiency side, the challenges are to incorporate energy efficiency standards and enforcement into the building design and construction regulation system at local level, to develop the demand for and supply of energy-efficient building materials and components, and to ameliorate the cost and demand concerns of the housing development industry. This challenge of achieving multi-institutional commitment and coordination has heretofore proved too great for the many Chinese partners that have to be involved.



- 3. Limited Chinese experience, knowledge and no proven track record of the ambitious integrated reform and technical improvement program approach. Even though several other countries have experience in undertaking heat system reforms and achieving higher building energy efficiency standards, there is little experience conforming to Chinese conditions and no Chinese demonstration of a successful, fully-integrated approach. On the heating side, for example, there is virtually no experience in China with billing of heat according to actual use or with the operation of heating networks where supply is determined by consumers and not the supplier. The impacts of heat pricing reform on heating companies and consumers are also uncertain. On the building energy efficiency side, lack of knowledge on the performance of different energy-efficient materials and components impedes their market uptake. There are no systematic compliance inspection procedures at the local level to ensure that energy-efficient building designs and improvements are observed and implemented during construction. There is also no empirical knowledge of how consumers value investment in building energy efficiency improvements and the consequential effect on demand for energy efficient housing. Most crucially, there is no experience with implementing the full package of technical improvements and policy reforms that is needed to achieve a much more rapid, substantial and sustainable improvement in residential building energy efficiency.

### **GEF Alternative**

Under the GEF Alternative Scenario, China will implement the comprehensive, multi-institutional package of reform and technical activities that is needed to overcome these barriers. This scenario will consist of three complementary initiatives - this proposed GEF co-financed project, (continued) World Bank/ESMAP technical assistance on policy analysis, and a parallel French GEF-supported building energy efficiency project in partnership with the city of Harbin.

The proposed GEF project has three major components that, in combination, will overcome the three main barriers that were outlined above:

**Component (a): Tianjin Municipality Integrated Reform and Technical Demonstration** (total cost about \$435 million, of which the GEF will finance \$6 million, \$5.1 million of which will co-finance new housing developments with advanced energy efficiency levels, associated with new heat systems with modern variable flow technologies and efficient substations, and heat use control and heat metering technologies; and \$0.9 million will fund technical assistance to the municipality to coordinate and support the heat reform and technical innovation programs). This component will demonstrate, for the first time in China and on a large and therefore convincing scale, a comprehensive, fully-integrated and simultaneously-implemented program of (i) residential building heat billing and pricing reform, (ii) introduction of modern, variable flow heat supply systems, and (iii) the construction of energy-efficiently designed new residential buildings.

This component will make a major contribution to removing barrier 1 by serving as the first Chinese demonstration of what a comprehensive residential building heat reform and technical improvement program comprises. It will also contribute to overcoming barrier 2 by showing how to achieve inclusive and effective institutional collaboration at the municipal level. And it will go a long way towards removing barrier 3 by generating the first “hard” experience in China of the technical, institutional and consumer behavioral challenges and results of applying a comprehensive approach to building energy efficiency improvement.

**Component (b): National-level Coordination and Policy Support** (total cost about \$2.3 million, of which the GEF will finance \$2 million. \$1.25 million of this will fund international technical assistance to the responsible central government institutions for design of the program's reform and technical elements, the balance of \$0.75 million will co-finance project management). This component will ensure that China benefits from the best available international experience and expertise in designing and implementing an integrated building heat reform and energy efficiency program, which will enhance the effectiveness of both the Tianjin Demonstration and Other Northern Cities components. It will also ensure effective and efficient project management and dissemination of the results and lessons of the Tianjin demonstration, which is crucial for achieving widespread replication of Tianjin's comprehensive reform and technical improvement model. In so doing, it will contribute significantly to the removal of barriers 1 and 3.

**Component (c): Other Northern Cities (Replication)** will replicate the comprehensive heating system and building energy efficiency investments and reform activities that were demonstrated in Tianjin in 4-6 other large northern Chinese cities, the selection of which will be finalized as implementation for the first two components proceeds, but will definitely include Harbin, where a complementary French GEF residential building energy efficiency project will be implemented. The total cost of this component is impossible to calculate accurately at this stage, but is conservatively estimated to be about \$656 million. Of this, the GEF is requested to co-finance \$10 million, of which \$8 million will fund the introduction of innovative building designs, energy efficient building materials, modern variable-flow heating systems, heat use controls, billing and metering equipment and \$2 million will finance technical assistance to the 4-6 participating cities.

The objectives of this component are (a) to show how the Tianjin model approach can be tailored to and successfully applied in other Chinese city contexts; and, by so doing, (b) trigger replication of the Tianjin comprehensive reform and technical efficiency model throughout China's northern region. The component will broaden and deepen the range of practical experience gained from the Tianjin demonstration, both in terms of technical options/results and institutional situations. This broader range of experience will then empower China to accelerate the replication program and push it nationwide. The component will thus scale-up barrier removal to the national level.

The projected impact/outcome of the GEF Alternative on residential building energy efficiency in China's northern regions is as follows:

- The proportion of new, centrally heated residential buildings that achieve good energy efficiency performance will accelerate by 4 percentage points per year, reaching 50% by 2014 then falling to 40% by 2024. In the mean time, the proportion of buildings with advanced energy efficiency features will rise to 20% by 2014 (from 0% in 2004), and reach 60% by 2024.
- The share of buildings with heat metering, consumer controls and consumption-based billing centrally heated residential buildings constructed after 2004 will reach 100% by 2024, at an average annual increment of 5 percentage points; and
- By 2024, all the heating systems that supply the residential buildings constructed after 2004 will operate according to variable heat demand.

In other words, by 2024, all 6 million m<sup>2</sup> of the residential building stock built between 2004 and 2024 in the northern regions will be able to reap the full or at least significant partial benefits of the comprehensive reform and technical improvement program, which will yield very substantial energy and CO<sub>2</sub> savings.

## Incremental Costs and Global Benefits

The project’s estimated global environment benefit is based on the successful implementation of the Government’s heat reform and building energy efficiency regulations, supported by the GEF Alternative. The analysis is based on an estimated net increase of 6 billion m<sup>2</sup> in centrally heated residential building stock located in China’s cold and severe cold regions in the 20-year period between 2004 and 2024. The analysis does not attempt to separate out the impact of the GEF Alternative from the overall Government efforts it supports because there would be no rationale for implementing the GEF Alternative without the Government’s supportive reform and policy efforts. The analysis estimates that a successful implementation of the Government’s reform and policy program would generate a reduction of about 620 million tons of raw coal needed to heat the new building stock, thus avoiding 1.2 billion tons of carbon dioxide emissions, compared to the Baseline where the business as usual prevails. The impact of the GEF Alternative, together with the Government’s complementary reform and policy program, will also extend beyond the new residential building stock to the existing centrally-heated residential building stock. However, while the GEF Alternative will have significant impact on whole residential stock, this is not reflected the analysis. For comparison purposes, however, a less conservative estimate of the project’s impact that takes account of its effects on the current residential building stock is that it will avoid over 1 billion tons of raw coal use or the equivalent of 2 billion tons of carbon dioxide emissions avoided in the same period.

Similar analysis was performed for Tianjin and six other cities which are candidates for the “other cities component.” The estimated reduction in coal consumption for residential space heating in the just seven cities over the 20-year period as a result of the comprehensive program is about 46 million tons of raw coal, equivalent to about 91 million tons of carbon dioxide emission reduction.

### Incremental Costs

The proposed GEF project will finance a portion (up to about 30%) of the estimated incremental costs incurred by real estate developers and heating companies to construct buildings and develop heating systems with demonstrable energy efficiency improvements. As an example, the table below summarizes the key estimated cost information and the portion of incremental costs associated with the Tianjin demonstration project component that is proposed to be supported by the GEF.

#### **Tianjin Demonstration Project** **Investment Subcomponent**

(in US dollars)

	Baseline	Project	Incremental	GEF Support amount	GEF Support % of Incr.
Total	412,763,893	433,157,388	20,393,495	5,100,000	25%
<b><u>Xindu</u></b>					
Total Cost	343,805,920	356,585,913	12,779,993	3,221,351	25%
o/w Heating System and Network	10,603,600	15,689,453	5,085,852	1,321,746	25%
Building Envelope	17,689,549	25,383,690	7,694,140	1,899,606	26%
Other building development costs	315,512,770	315,512,770	0	0	0%
<b><u>Beixinzhuang</u></b>					
Total Cost	68,957,973	76,571,475	7,613,502	1,878,649	25%
o/w Heating System and Network	2,317,446	7,452,229	5,134,783	1,234,462	24%
Building Envelope	2,317,446	6,774,943	4,457,497	644,186	14%
Other building development costs	64,323,081	62,344,303	-1,978,779	0	0%

The proposed GEF project identified the incremental costs associated with an additional 30 percent reduction in average building heat demand, based on the current regulation for building energy efficiency, as well as with the introduction of state-of-the-art heating systems. Use of the current standard for the purposes of calculating incremental costs is very optimistic, considering only 6 percent of the entire building stock is reported to have complied with the standard in 2000, and therefore the incremental costs associated with achieving an more stringent energy efficiency standard should be viewed as conservative. The developers and heating companies agreed to cover the remaining costs from corporate resources. The proposed GEF support for demonstration projects in other cities in North China will follow a similar approach, i.e. GEF support for investment is to be limited to about 30 percent of the eligible incremental costs.

### Basic Assumptions

Since the cold and severe cold regions of China cover more than half of the national territory with wide variation in winter climate, which affects heating degree-days and design requirements for building thermal performance and heating system design. In order to analyze space heating energy use for the all of cold and severe cold regions in a rational yet relatively simple manner, a proxy (Chende City in Hebei Province) of the average situation was chosen based on the medium value of heating degree-days of 110 of representative cities across the cold and severe cold regions. The key parameters for this proxy are summarized in the following table.

Official heating season duration	144 days
Corresponding heating degree-days (18 °C)	3240 degree days
Poor energy efficiency building heat consumption index	32.3 W/m <sup>2</sup>
Good energy efficiency building heat consumption index	21.0 W/m <sup>2</sup>
Advanced energy efficiency building heat consumption index	14.7 W/m <sup>2</sup>

Notes: *building heat consumption index* is a key indicator of building thermal integrity and is defined in Chinese building energy efficiency standards as: at outdoor mean air temperature during heating period, to maintain indoor design air temperature, heat consumed in unit time by unit floor area and to be supplied by indoor heating device.

Under current policies, the vast majority of the net new residential building stock is expected to be connected to large district heating systems. The analysis assumes that all new building stock is connected to district heating systems. Alternative centralized heating systems would be generally less efficient in terms of coal use. Basic assumptions of the global efficiency indicators of the heating systems are:

- Poor thermal efficiency of heat production 62%;
- Good thermal efficiency of heat production 77%;
- Transmission and distribution efficiency of net work using traditional pipes 75%; and
- Transmission and distribution efficiency of network using pre-insulated pipes 90%

The following emission factors were used to estimate carbon dioxide emission rates:

- 1.98 metric ton CO<sub>2</sub> per metric ton of raw coal.

### Global benefit

The accumulative coal savings over the 20-year span as a result of the GEF Alternative are 620 million tons of raw coal, and reduction in CO<sub>2</sub> emissions due to the coal savings is 1.2 billion tons. Of the 5 to 7 cities which will participate in the comprehensive program, the estimated accumulative coal savings over the 20 year span as a result of the GEF Alternative are some 46 million tons of raw coal, and the reduction of CO<sub>2</sub> due to the coal savings are about 91 million tons.

**Table: Incremental Cost Matrix / Benefit Analysis Summary**

<b>Component Activity Area</b>	<b>Baseline</b>	<b>GEF Alternative</b>	<b>Increment</b>	<b>Incremental Benefits/Impacts</b>
<p><b><u>Building Energy Efficiency</u></b></p>	<p>The rate of compliance with the current national building energy efficiency (BEE) standards is low and the scaling up of the development of more energy-efficient residential buildings is very gradual due to a lack of effective enforcement mechanisms, cost and quality concerns over insulation materials/techniques and other efficiency measures, as well as a lack of consumer awareness and interest.</p> <p>There will be little chance for the adoption of advanced energy-efficient measures in new residential buildings</p> <p>More specifically, it is assumed that only 30% of new housing construction in cold and sever cold urban regions will comply with the current BEE standard by 2014, reaching 50% by 2024. The rest in both years will be non-compliant new housing.</p>	<p>Barriers to BEE compliance is removed or mitigated and with the impetus provided by the heat reform and demonstration and replication of cost-effective and innovative BEE designs there is a fast increase of new residential buildings going above and beyond the current standards.</p> <p>More specifically, 50% of new housing construction will comply with current BEE standard by 2014. By 2024, 60% of new housing construction will comply with advanced BEE standard piloted under the GEF project, while the rest still complies with the current standard.</p>	<p>-- Demonstration and widespread replication of cost-effective and advanced BEE measures and techniques resulting in 30% reduction in building heat losses , compared with the current BEE standards;</p> <p>-- Technical assistance in promoting best BEE practices in site planning, building design and construction, resulting in much improved compliance capacity;</p> <p>-- Technical assistance in establishing an effective building energy efficiency compliance inspection system, resulting in much improved effectiveness of BEE compliance enforcement.</p>	<p><b><u>Domestic</u></b> Substantial improvement in thermal integrity of residential buildings, quality and cost-effectiveness of design, comfort in living quarters.</p> <p><b><u>Global</u></b> Combined with improvements in heating systems and a successful heat reform, heat loss reduction through BEE efforts will result in substantial and actual reduction of building energy use.</p>

<p><b><u>Heat metering, consumption based billing and consumer controls</u></b></p>	<p>Adoption of heat metering, consumer heat controls, and consumption-based billing will be introduced very gradually and in trickles, due to the slow progress in heat reform and a lack of full scale and convincing demonstrations to resolve technical uncertainties and remove serious doubts on the costs and benefits, penetrating only 50% of new urban housing construction in cold and severe cold regions by 2024.</p>	<p>Barriers to “commodifying” heat is removed, leading to rapid scaling up of heat metering and consumption-based billing, which will penetrate 50% of new housing construction by 2014 and 100% by 2024.</p>	<p>--Resolution of institutional and technical issues and uncertainties related to the introduction of consumer controls, heat metering and consumption-based billing in city heat reform programs and large scale demonstrations and replications, greatly accelerating the overall heat reform agenda.</p> <p>--Technical assistance in the formulation and implementation of cost-based pricing and consumption-based billing at national and local levels.</p>	<p><b><u>Domestic</u></b> Creating incentives and physical ability for consumers to save on heat bills and improve upon comfort in living quarters.</p> <p>Establishment of a rational and practical pricing and billing system.</p> <p><b><u>Global</u></b> Creates ability and incentive to reduce energy consumption through the combined effects of improved building energy efficiency and demand-driven heat supply.</p>
<p><b><u>Heat Supply Systems</u></b></p>	<p>Heating company technical innovation and upgrade are slow due to the slow pace of heat reforms. Incentives are weak for heating companies to improve their supply and management efficiency. The introduction of demand-driven variable flow heat supply system will reach only 50% of new urban housing in the cold and severe cold regions by 2024.</p>	<p>Barriers to heat supply system improvement and modernization are removed, forcing heating companies to become more efficient and use technologies that service variable heat demand.</p> <p>Specifically, 50% of new housing will be serviced with improved heating systems by 2014, reaching 100% by 2024.</p>	<p>--Demonstration and replication of design optimization, use of more advanced technologies with life-cycle cost savings and technical dynamics of a full scale and complete heat system under demand-driven operation.</p> <p>--Technical assistance in the operation and management of demand-driven systems to improve service and reduce costs</p>	<p><b><u>Domestic</u></b> Proliferation of modern variable-flow heat supply systems and improved heat supply operation and management efficiency.</p> <p><b><u>Global</u></b> The combined effect of improvements in supply chain reduces fuel consumption by 36% or the equivalent of 624 million tons of raw coal used for district heating over 20 years, avoiding 1.2 billion tons of CO<sub>2</sub> emissions.</p>

**Annex 4**  
**STAP Technical Review, Responses to STAP Comments,**  
**and GEF Focal Point Endorsement Letter**

STAP REVIEWER COMMENTS AND RESPONSE TO STAP REVIEWER COMMENTS

World Bank China: Heat Reform and Building Energy Efficiency Project

**Review and Comments**

by

William Chandler  
Senior Staff Scientist,  
Battelle Memorial Institute, Pacific Northwest National Laboratory

28 February 2004

**Summary and Conclusion**

The goal of this project, to promote policy reform and energy efficiency in heating in China is a worthy one. In this reviewer's opinion, this is exactly the kind of project that the World Bank and the Global Environment Facility should be undertaking. The project is consistent with widely accepted principles of political economy and is technically feasible and manageable. It reflects priorities identified in studies undertaken by leading western and Chinese laboratories and institutes.

The technical problems identified by the World Bank are familiar and widespread in Soviet-style heating systems. The problems of constant hot water flow, single-pipe vertical feeders, sequential radiator connections, and the overall lack of controls and appropriate heat exchangers are well-known and very serious impediments to energy efficiency and economic efficiency.

I did find the "Summary" section a little too truncated and lacking enough specificity to inform the reader as to the "deliverables" for the project and its means of implementation. Adding one or two crisp sentences on these points would be useful to set the context for what is to come later in the document.

**Scientific and technical soundness of the project**

The technical problems identified by the World Bank are familiar and widespread in Soviet-style heating systems, including those in China. The problems of unregulated hot water flow, single-pipe vertical feeders, sequential radiator connections, and the overall lack of controls and appropriate heat exchangers are well-known, serious impediments to energy and economic efficiency. The proposed solutions—standards, metering, and controls—have been proven in market economies as well as in dozens of demonstration and a few commercial projects in the transition economies.

Identification of the global environmental benefits and/or drawbacks of the project

How the project fits within the context of the goals of GEF, as well as its operational strategies, program priorities, GEF Council guidance and the provisions of the relevant conventions

This project is consistent with the climate change mandate of the GEF. The potential emissions reduction benefits are competently calculated using transparent, credible methodology.

**Replicability of the project (added value for the global environment beyond the project itself)**

This proposal addresses barriers to energy-efficiency investment that have been well-documented in the literature. By demonstrating a creative, innovative, yet unified approach to overcoming these barriers, the project will help to create a sustained market-oriented activity of potential very large scope. The project is replicable throughout at least the northern half of China and probably, as rising incomes increase the demand for both heating and air conditioning, throughout all of China. Other nations of the transition economies may also benefit from this experience, including areas of Russia, North Korea, and Ukraine.

**Sustainability of the project**

This project can be carried through to completion and then replicated only if adequate provision has been made for connecting decision makers for the policy and private financing aspects of the project. That is because the project planners expect to draw heavily on the use of private capital for construction. That assumption is not unreasonable, but there is no reason to expect that the incremental costs correctly identified as justifying the GEF investment in this project will not be a barrier to replication. That is, the incremental costs—the transactions costs—will not go away for the public policy measures proposed in this project unless the project designers find a way to entice the Chinese government to include them in future development projects, or simply mandate them.

In the case of target research project, it will be necessary to address the issue of the extent to which the project will contribute to the improved definition and implementation of GEF's strategies and policies, thus paving the way for more effective international, technical cooperation, assistance and investment projects.

**Linkages to other focal areas**

No specific comment.

**Linkages to other programs and action plans at regional or sub-regional levels**

No specific comment.

**Other beneficial or damaging environmental effects**

Benefits from this proposed effort would converge with local environmental and economic benefits. Energy waste is directly related to emissions of sulfur, nitrogen, and other noxious wastes and the energy savings that will be generated by this project will reduce those emissions. Energy waste is an obstacle to energy-sector liberalization in China, and this effort would increase consumers' ability to respond to energy costs and thus facilitate market—and environmental—reform.



These “co-benefits” from reduced local air pollution and coal production and transportation activities are perhaps underemphasized in the project description. As the World Bank as prominently pointed out, air pollution costs several percent of GDP in China.

**Degree of involvement of stakeholders in the project**

Appears appropriate to this reviewer.

**Capacity-building aspects**

This project usefully would rely on a local center of expertise, the Chinese Center for Energy Efficiency in Buildings, as a project implementation unit. This direct engagement of local experts will provide the opportunity to develop leadership and management capacities.

**Innovativeness of the project.**

This project is highly innovative in that it pulls together in a new way strategies for overcoming market barriers by using public policy solutions.

**Scientific and technical soundness of the project: Has the most appropriate and effective approach been used to remove the barriers?**

Yes, in the opinion of this reviewer. This proposal is creative, well-designed and based on sound economic and technical knowledge and experience. This reviewer strongly endorses this proposal.

**Has the most appropriate and effective approach been used to reduce the costs of the technologies?**

Yes, in the opinion of this reviewer.

**Was the potential market determined on the basis of RETs data and databases?**

NA

**Adequacy of the financing mechanism?**

More information is needed. It is not clear to this reviewer why the project developers are confident sufficient private financial resources will be brought to bear to accomplish the full project.

**Adequacy of the introduced financial incentives?**

See preceding comment.

**Comments on the design of demonstration project?**

NA?

**Will a process be put in place to monitor the project?**

NA.

**Is the barrier removal supported by an underlying policy framework?**

Yes, in the opinion of this reviewer.

**Is the proposed activity feasible from an engineering and technical perspective?**

Yes, in the opinion of this reviewer.

**Identification of global environmental benefits**

This proposal targets housing energy productive improvements and, as such, clearly will provide to achieving sustainable energy development. The proposed energy-efficiency measures offer cost-saving and productivity benefits to Chinese consumers and developers while at the same time cutting energy use. Because energy use ranks among the most important sources of environmental pollution, especially greenhouse gas emissions, energy savings measures provide important benefits to the global climate. Significantly, targets a nation that ranks among the most energy-intensive and energy-wasteful in the world. Because this project takes a market-based approach it can be replicated throughout much of the developing world—in conjunction with market reforms.

**How does the project fit within the context of the goals of the GEF**

Very well, in the opinion of this reviewer.

**Specific Comments**

***Sections A and B:***

I would like to suggest the following specific considerations to improve the Summary section, as well as Sections A and B on “Project Development Objective and Key Indicators,” and “Strategic Context:

- p.4. The document states that “Key performance indicators are likely to include total annual energy savings achieved through the project from adoption of energy-efficient improvements in buildings and heating system modernization and reform.” This statement sounds rather tentative, and could be improved to state specific, quantitative measures of success.
- p. 4. The document states that “In addition, a number of other quantitative and qualitative indicators will be monitored and reported in all regular project reports. The key performance indicators will be finalized during project appraisal and formally agreed at project negotiations.” These indicators could usefully be specified, at least in general terms, at this stage of project planning.
- p 5. The document states that “The project also supports a second CAS objective of *improving the business environment and helping accelerate the transition to a market economy*, mostly through knowledge transfer activities. The project is expected to improve knowledge of ways to introduce market economy principles to centralized heating, which is one of the last vestiges of the welfare state in China.” This reviewer

would find it useful to read about the project designers’ “theory of change” for how these goals will be accomplished. Specifically, what is the leverage that the project provides to effect change?

- p. 17. The policies and measures articulated here are excellent, and could usefully be summarized early in the project document.
- p. 18. It would be useful to articulate whether the project will promote the adoption of “performance standards” or “construction standards,” and the degree to which “enforcement of standards” is an issue to be addressed by this project.

In summary, I find this an excellent project, indeed the type of project that is so clearly creative and innovative and so well-targeted to produce tangible sustainable development, that it should serve as a model for exactly the kind of climate and energy project that the GEF and World Bank should be doing.

Thank you for the opportunity to review this project.

### **Response to STAP Reviewer Comments**

Responses to Mr. Chandler’s comments are presented following the order of the sections where the issues were raised. The original texts of the issues of concern are in italics.

### **Summary and Conclusion**

I did find the “Summary” section a little too truncated and lacking enough specificity to inform the reader as to the “deliverables” for the project and its means of implementation. Adding one or two crisp sentences on these points would be useful to set the context for what is to come later in the document.

The comments are taken into account in the text. More specifics on the “deliverables” of the project have been included in the text, especially concerning the adoption of the proposed integrated programs to reform heat pricing and billing, improve operational efficiency of heating systems, and increase building energy efficiency in 5 to 7 northern Chinese cities participating in the project, resulting in some 267,000 GWh energy savings between 2004 and 2024, while improving heating service. Adding in major additional savings through replication in other cities as the national heat reform promoted by the country’s leadership deepens, total energy savings associated with this Chinese program are estimated at about 3,629,000 GWh between 2004 and 2024.

The Tianjin program will proceed first, yielding lessons learned for other city-wide programs. Other cities’ programs will operate in close association with the Central Government’s heat reform piloting program, which will be implemented during 2004-2006, based on the July 2003 Heat Reform Guidelines. Four to six participating municipalities will be selected from the list of pilot heat reform municipalities included in the national reform program in Heilongjiang, Jilin, Liaoning and one other province, primarily based upon the commitment of municipal leadership to the implementation of the two-handed approach.

For more details of implementation please refer to Section C of the Project Brief and Section (c) of the Project Summary in the Executive Summary.

## **Sustainability of the Project**

*This project can be carried through to completion and then replicated only if adequate provision has been made for connecting decision makers for the policy and private financing aspects of the project. That is because the project planners expect to draw heavily on the use of private capital for construction. That assumption is not unreasonable, but there is no reason to expect that the incremental costs correctly identified as justifying the GEF investment in this project will not be a barrier to replication. That is, the incremental costs—the transactions costs—will not go away for the public policy measures proposed in this project unless the project designers find a way to entice the Chinese government to include them in future development projects, or simply mandate them.*

The design and text have been revised to reflect these comments. The project is joining the Government's own program of heat reform and improving building energy efficiency. The country's leadership have made it clear that reforms must proceed, and discussion has moved on to the specifics of how to implement a series of interrelated policy changes. The project will strengthen the Government's own heat reform program by providing concrete demonstrations of the benefits, especially the energy and cost savings, and practical feasibility of integrated reform. Implementation of the Government's program will provide the incentives for change among Chinese heating and housing development companies, while the project's demonstration activities will show means and benefits to change.

For more details please refer to Section F of the Project Brief and Section 3 of the Executive Summary.

## **Other Beneficial or Damaging Environmental Effects**

These "co-benefits" from reduced local air pollution and coal production and transportation activities are perhaps underemphasized in the project description. As the World Bank as prominently pointed out, air pollution costs several percent of GDP in China.

There are significant co-benefits produced by this project. The global environment objective of the project coincides strongly with priorities in urban air pollution control, one of China's key national environment policy priorities.

## **Adequacy of the Financing Mechanism**

More information is needed. It is not clear to this reviewer why the project developers are confident sufficient private financial resources will be brought to bear to accomplish the full project.

The scale of additional financing needed to cover housing developers' portion of the incremental costs is proportionately small compared to the overall financing. In the case of Tianjin the developers were drawn to the project in large part due to the credentials which the designation of an international and national demonstration will lend, a significant intangible marketing value to the developers. At least as important to the developers is the fact that compliance with national and local building energy efficiency standards and requirements of heat reform is a high priority to the Government and getting a head start could turn into long-term market advantages. The

risk of early start is partially compensated by the international and national technical and financial assistance.

### Specific Comments

*I would like to suggest the following specific considerations to improve the Summary section, as well as Sections A and B on “Project Development Objective and Key Indicators,” and “Strategic Context:*

- *p.4. The document states that “Key performance indicators are likely to include total annual energy savings achieved through the project from adoption of energy-efficient improvements in buildings and heating system modernization and reform.” This statement sounds rather tentative, and could be improved to state specific, quantitative measures of success.*
- *p. 4. The document states that “In addition, a number of other quantitative and qualitative indicators will be monitored and reported in all regular project reports. The key performance indicators will be finalized during project appraisal and formally agreed at project negotiations.” These indicators could usefully be specified, at least in general terms, at this stage of project planning.*

The main performance indicators are now more clearly defined in the text. See Section A2 of the Project Brief and Section 1 (b), Section 3 (e) and Annex 1 of the Executive Summary.

- *p 5. The document states that “The project also supports a second CAS objective of improving the business environment and helping accelerate the transition to a market economy, mostly through knowledge transfer activities. The project is expected to improve knowledge of ways to introduce market economy principles to centralized heating, which is one of the last vestiges of the welfare state in China.” This reviewer would find it useful to read about the project designers’ “theory of change” for how these goals will be accomplished. Specifically, what leverage that the project provides to effect change?*

The design and text have been changed to reflect these comments. The Government has committed to a program that will change the heating and building energy efficiency industries. The project is joining the Government’s heat reform and building energy efficiency pilot in northern Chinese provinces that the Government is using to launch the entire program. The project will strengthen the pilot program with lessons and ideas from international experience, and demonstration of the benefits and practical feasibility of integrating heat reform, heating system modernization and building energy efficiency improvements in the coldest regions of China. It will also support dissemination of this knowledge and experience as part of the Government’s own national effort to support provinces and municipalities as the country’s national heat reform program proceeds.

For more details refer to Sections B4, D3 and D5 of the Project Brief.

- *p. 17. The policies and measures articulated here are excellent, and could usefully be summarized early in the project document.*

Agreed. Comments have been incorporated in the text.

- *p. 18. It would be useful to articulate whether the project will promote the adoption of “performance standards” or “construction standards,” and the degree to which “enforcement of standards” is an issue to be addressed by this project.*

The focus of this project with respect to building energy efficiency standards is on the aspect of local implementation with support in promoting best practices in site planning, building design, materials selection and construction techniques, as well as enforcement approaches, through both target technical assistance and demonstration in city programs. Such an approach compliments well the building energy component of the EUEEP (UNDP/GEF), which focuses on the more upstream work development and implementation of building energy efficiency codes across all of China’s climate regions. The project does not deliberately promote the adoption of “performance standards” or “construction standards”, which will become a more natural selection process as relevant local capacity improves. and will depend on characteristics of particular housing development. Nonetheless, the prevailing characteristics of housing development in China require adoption of a set of key prescriptive requirements for residential designs and construction as well as the integration of key requirements into the conventional building quality and safety inspection system.

INTERNATIONAL DEPARTMENT

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October 28, 2002

To: **Robin Broadfield**  
GEF Coordinator  
East Asia Region, The World Bank

**China: Endorsement Letter for GEF PDE B Project**  
**Heating Reform and Building Energy Efficiency**

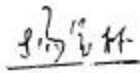
Dear Mr Broadfield

This is to advise you that the Ministry of Finance, as the GEF focal Point for China, would like to endorse the captioned project to be submitted by World Bank for GEF support

As the rapid development of city construction in the country, building energy efficiency has a great potential in reducing CO<sub>2</sub> emissions. Through the implementation of this project, it is expected that we may achieve improvement in the energy efficiency in residential buildings in the heating system. We believe that the proposed project would not only benefit the country but also contribute to deal with the issue of global warming. We are looking forward to fruitful cooperation with the World Bank on this project.

Best regards.

Sincerely yours,



(Jinlin Yang)  
Operational Focal Point for China

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