

## **INTEGRATED APPROACH TO ENVIRONMENTAL MANAGEMENT: A CASE FOR DISTRICT HEATING IN THE PRC**

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### **ABSTRACT**

The People's Republic China (PRC) has enacted several environmental and energy efficiency laws under the "Blue Sky laws". These have not been translated into action due to lack of supporting regulations. As a result of this and the lack of enforcement and monitoring programs, the PRC is confronted with widespread environmental pollution including acid deposition and smog. The down stream effects of these environmental problems translate into local and national economic and health costs.

The PRC's total energy use has gone up from 27 quadrillion Btu in 1990 to 36.7 quadrillion Btu in 2000, and is projected to increase to 97.3 quadrillion Btu by 2020<sup>2</sup>. Acid deposition resulting from coal combustion is one of the PRC's greatest environmental problems. Average annual sulfur dioxide concentrations are more than three times World Health Organization standards in at least 10 Chinese cities. Transboundary migration of sulfur compounds is raising concern in both Korea and Japan. Carbon emissions in 1990 amounted to 620 MMT and increased to 822 MMT by 1997. It is projected that the PRC will have carbon emission of 2,091 MMT by the year 2020 - higher than that for USA. The PRC will probably become the world's largest greenhouse gas (GHG) producer by 2030, elevating concerns over the country's energy policy beyond the local and regional level.

In addressing the environmental issues facing the country, Chinese officials will need to enhance their programmatic and policy framework in an integrated way. The system described in this paper, aims to integrate key components of a comprehensive environmental management system (EMS) to develop a robust mechanism to improve environmental conditions.

Using this integrated system, a prototype for energy efficient district heating can demonstrate how legislation and policy mandates are implemented for environmental and economic sustainability. A system that integrates issues spanning energy demand and supply, pollution emissions (local and global), cost-benefit evaluations, regulation and enforcement, and mechanisms for private sector investments, benefits all the players. The national, economic and environmental drivers for such an integrated system is spread across all levels of government - the federal and provincial government, at the state level (for example the State Environmental

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<sup>2</sup> The bulk of this energy comes from coal-combustion. In spite of this increase in energy consumption, the energy intensity has been steadily dropping, primarily as a result of the significant efforts of the Chinese government to increase energy efficiency.

Protection Agency), and the municipal authority (e.g. Beijing Municipality). It also benefits the power utility company, which currently holds a monopoly over district heating supply and distribution. The prototype district heating program encourages the PRC to develop and apply SO<sub>2</sub> and CO<sub>2</sub> credit mechanisms, to meet Kyoto Protocol commitments, and participate in the Clean Development Mechanism.

**KEYWORDS** district heating, integrated environmental management, climate change

## I INTRODUCTION

### 1.1 Scope of the paper

This paper highlights the key national and provincial issues/barriers in implementation of a prototype (integrated) system with specific reference to district heating. The paper evaluates institutional, technical and socioeconomic issues that currently exist and the changes needed to successfully implement an integrated system.

The integrated system proposed here builds on an existing framework. Special attention is given to institutional linkages that condition markets for district heat suppliers (supply side management), and provide more comfortable living environments for consumers (residents) through increased energy efficiency of appliances, building skin, air conditioning, windows, etc. (demand side management).

The paper also highlights the socioeconomic and environmental benefits of the proposed integrated system, and demonstrates how it will help place the PRC in a leadership position regarding CO<sub>2</sub> and SO<sub>2</sub> trading.

***Project objectives:*** The overall objective of the project is to catalyze development of high efficiency buildings, cogeneration, renewable energy for buildings projects throughout PRC, to promote comfortable living for the residents. The goal is also to help develop effective and sustainable markets for district heating providers, and promote comfortable living for the residents in the PRC.

***Project strategy:*** In order to successfully reach the project objectives, we have begun to demonstrate (through demonstration projects) that a judicious use of existing technology tied together by good systems design, can provide developers/builders with buildings that appear functionally the same to their tenants. The new building cost the same (or less) to build, while saving up to 50% of the total energy cost of the building operations (compared to existing buildings).

***Project to-date:*** In preparation for this project, several agencies and institutions have been contacted.

- Ministry of Construction (MOC)
- State Environmental Protection Agency (SEPA)
- State Economic and Trade Commission (SETC)

- State Development and Planning Commission
- Energy Conservation Office, Shanghai Municipal Government
- China Building Energy Efficiency Association
- Tongji University

## 1.2 Background

The rapid growth of the Chinese economy and the increasing standards of living among the urban community has translated into the escalating use of electrical appliances and demand for

### Current PRC Laws, Policies and Programs Influencing Energy Efficiency

- Energy Conservation Law (ECL), 1997. ECL covers energy conservation management, rational energy utilization, technology progress, legal liabilities and supplementary rules.
- Provincial regulations under this the Energy Conservation Law (amended in 1999) requiring provincial-level administrations to formulate sets of implementing regulations in accordance with ECL, taking into account local economic and environmental conditions.
- Tenth Five Year Plan (2001-2005). The Beijing Energy Efficiency Center (BECon) under the Energy Research Institute (ERI) has been given the responsibility of preparing the plan.
- Energy Conservation Project. Three Energy Management Companies (EMCs) have been set up in Shandong, Beijing, and Liaoning through the World Bank Energy project. These centers function as energy service companies (ESCOs).
- Energy Conservation Centers. PRC has established over 200 such centers in various local administrations and sectoral agencies to assist enterprises in designing energy efficiency projects provide training and information.
- China Energy Conservation Investment Corporation (CECIC) A state-owned company that supervises lending for energy efficiency investment projects.
- Green Lights Program (1996) To raise awareness of availability of energy efficient lighting technologies.

quality energy services. This has resulted in a steady increase (although at a slower pace) in the amount of energy consumed in buildings (residential and commercial) for lighting, heating, cooling and entertainment - accounting for 25-30% of the PRC's commercial energy consumption. Households have continued their rapid switch from coal to gas fuels and electricity.

The PRC has enacted environmental and energy efficiency laws which cut across sectors. These laws have not been fully implemented due to the lack of supporting regulations. As a result, PRC has had to deal with widespread environmental pollution issues such as acid deposition and smog. The downstream effects of these environmental problems translate into economic, and health costs locally and nationally.

The PRC's activities in promoting energy efficiency have played a role in the reduction in total energy consumption in the country since 1996.<sup>3</sup> On the supply side, coal use as primary energy has reduced considerably since 1997, while oil and electricity consumption has continued to grow. Several coal mines have also been closed and production has been curtailed. On the demand side, slowing of economic growth and industrial sector reforms, have reduced output

<sup>3</sup> Jonathan Sinton, Mark Levine, et al., *Status Report on Energy Efficiency Policy and Programs in China*, December 1999.

and thereby energy consumption.<sup>4</sup> Also, coal, oil and natural gas are found in parts of the PRC where the demand is low, requiring transportation to high-demand areas (primarily to the east of the country). This increases the cost of fuel transport tremendously. For instance, construction of even a relatively short pipeline from Siberia would cost nearly \$7 billion.<sup>5</sup>

Performance standards for household appliances are being set as recently as 1999. Several of the household appliances are new and standard setting is an effective way to improve energy efficiency. The Ministry of Construction (MOC) is responsible for building energy efficiency and for setting efficiency standards. While no new standards exist, residential building energy codes that cover urban areas in the “heating zone”<sup>6</sup>. There is encouragement to develop residential building energy efficiency standards in the “transition zone”<sup>7</sup>. Canada is assisting the MOC (CIDA/Energy Efficiency in Buildings Project - CN/19157) to develop energy efficiency standards for commercial buildings.

## II ELEMENTS OF AN INTEGRATED SYSTEM

The integrated system proposed here brings together complementary elements related to fuel and technology options, private sector investment, performance standards, monitoring, and market mechanisms such as CO<sub>2</sub> and SO<sub>2</sub> trading. The system takes into account factors determining fuel and technology options such as resource supply and availability issues, and socioeconomic of the region. Also, the integrated system will factor in institutional and coordination issues between governments and agencies, creating the path for successful implementation of the national agenda of environmentally sustainable growth.

The integrated system is described using the case of district heating and building efficiency in the city of Beijing. A mutually beneficial relationship may be established between the district heating monopoly and real estate developers. This association can provide the district heating company with a long-term market and incentives to adopt cleaner fuels (currently coal is the primary fuel used for district heating purposes), while assuring real estate companies with reliable and clean source of energy. Further, this association can lead to corporate image building for both parties involved.

Cleaner fuels and building efficiency are high on the agenda for the local, state and national governments as is described in the *Background* section of this paper. The institutional linkages between the various levels of government, and the public (district heating company) and private (real estate developers), can make this demonstration pilot a model for replication and lessons learned. Through national policies, state laws and regulations, and local implementation, this integrated environmental management system, can provide incentives for fuel switching, benchmarking, performance standards, and monitoring and evaluation.

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<sup>4</sup> Total power consumption in 1990 was 1,002 TWh increasing only slightly to 1,104 TWh in 1997 (a growth rate of 8.7%).  
Source: *Developing Countries & Global Climate Change: Electric Power Options in China*, PEW Center on GCC, 2000.

<sup>5</sup> Jeffrey Logan and William Chandler, *Natural Gas Gains Momentum*, The China Business Review, July-August 1998.

<sup>6</sup> In northern parts of the country, where home heating is mandated in the winter months.

<sup>7</sup> Primarily in the central belt of the country, where demand for space heating and cooling exists.

Figure 1 shows the elements of the proposed integrated system. The PRC, at one point or another, has tried to implement individual elements of the system. As such, there is a clear recognition that these elements are important in and of themselves. What has been missing is the ability to integrate all the elements into one coherent system such that the synergies between key elements are fully exploited.

### **Element 1: Alternative fuels/fuel-switching**

With environmental and energy demand issues in the forefront, a replacement for coal will need to come sooner or later. The advantages in considering alternative fuels (gas, biomass, solar, etc.) and technologies (combined-heat-and-power, cogeneration, etc.) include:

- Relatively (to coal) clean
- Alternative fuels are more cost effective in the long run
- Gas and renewable sources (biomass, solar, etc.) are easily available
- Expanded demand-side uses.

### **Element 2: Increased private sector investment**

As district heating accounts for a large percentage of the energy consumption, it is a suitable point of entry for piloting an integrated approach to reform the utility sector. The utility monopoly in Beijing providing district heating to the city, for example, faces many challenges, including local and global environmental pressures. Increased private sector investments in district heating will:

- Infuse more money into the company and benefit the company
- Allow the utility monopoly to become more competitive benefiting consumers (promotes market reform)
- Enhance environmental performance of the firm.

### **Element 3: Environmental performance standards**

While some efficiency standards exist, there are no performance standards for different technologies and the various industries. Performance standards provide the baseline for performance and form the basis for monitoring and enforcement. Performance standards may be ratcheted up (tougher standards) every year once the baselines have been established.

Environmental performance standards will:

- Ensure quality of delivery
- Increase competition
- Form the basis for monitoring and enforcement
- Potentially open avenues for collecting environmental dues (or “user fees”) from polluters based on the “polluter pays” principle.

### **Element 4: Monitoring System**

Monitoring systems are essential for benchmarking - a system necessary to quantify and qualify proposed and potential improvements. Monitoring will assist in setting performance standards and environmental auditing measures that will feed into a coherent system of performance and programmatic monitoring as well as the issues of environmental data analysis for health improvement and abatement strategies.

We envision the development of a public sector institution (supported by private (accredited) facilities for testing and analysis) to conduct programmatic/environmental monitoring, as well as performance monitoring.

### **Element 5: Technology Options**

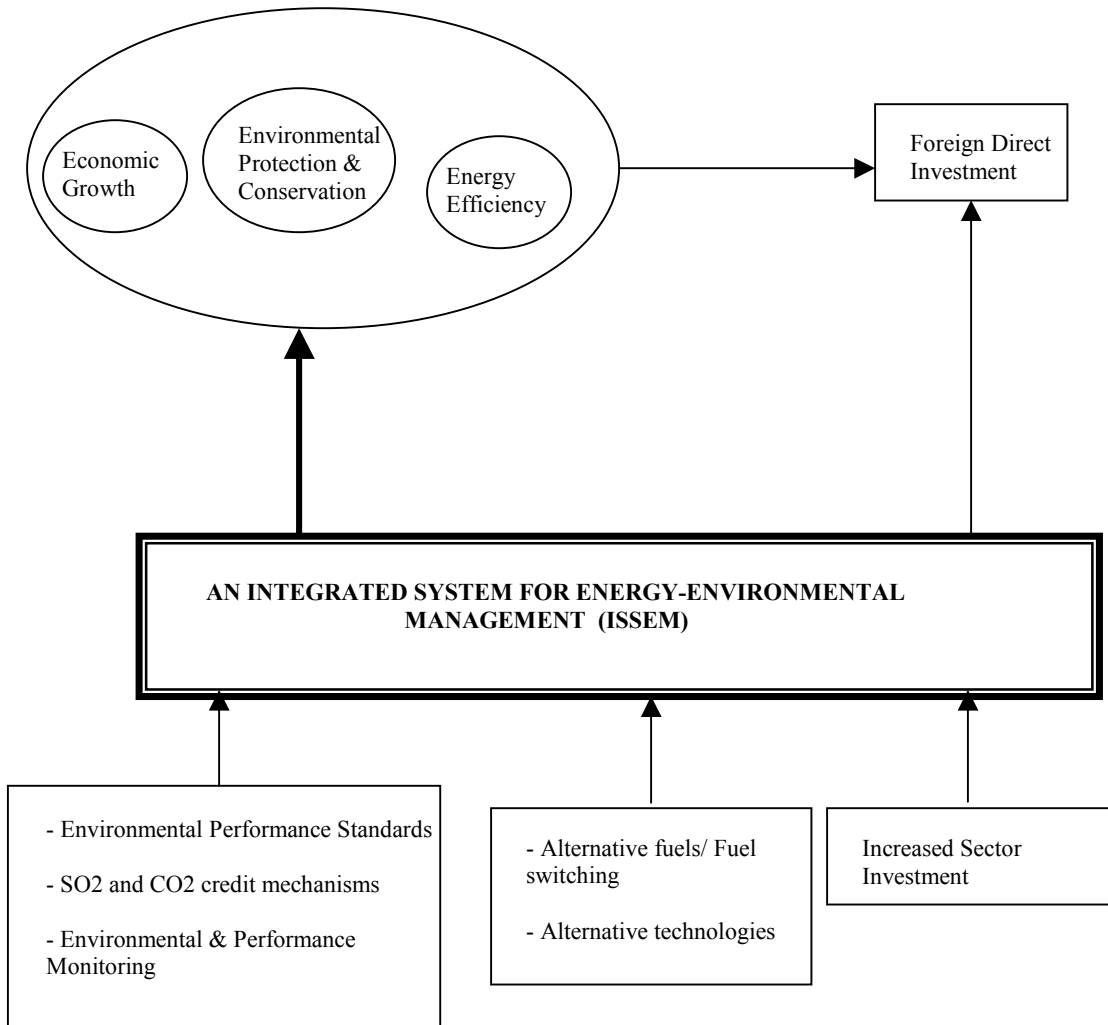
The PRC's vast coal reserves naturally encourage coal-based technologies. The technologies in use are inefficient, polluting and increasingly costly. New technologies need to be considered (such as gas-based district heating systems, cogeneration, and combined heat-and power system). Selection of technology(s) needs to be based on availability of energy resources (for example, if gas is easily available, and if transporting gas to a city where coal is in abundance makes economic sense). Socioeconomic issues also have to be considered while making a technology choice. For example, in Beijing, natural gas is already being piped in from Shaanxi Province; and further expansion is being planned. Technologies that may be considered for district heating in Beijing include

- Conversion of coal-fired to gas-fired boilers
- Combined cycle gas turbines
- Combined heat and power (cogeneration)
- Solar thermal
- Biomass-fired boilers.

### **Element 6: SO<sub>2</sub> and CO<sub>2</sub> Credits**

Technology changes and fuel switching provide the opportunity for the PRC to participate and take advantage of the Clean Development Mechanism (CDM). The PRC can leverage this opportunity to improve its environmental pollution problems, increase private investments to boost the economy, and simultaneously enhance its global standing on issues related to the Kyoto Protocol. In addition, Beijing Municipality can develop economic instruments, such as environmental funds and user fees, which will help in maintaining a source of income to run these programs.

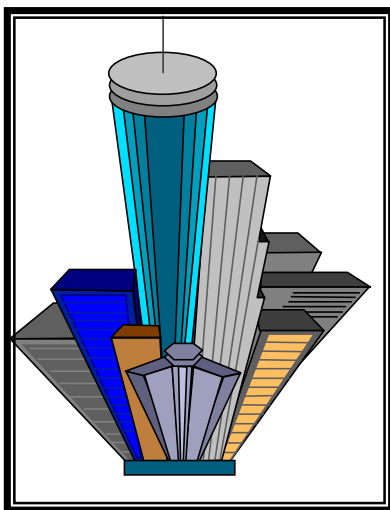
These elements of the integrated system provide several benefits. Economic benefits emerge from increased competition, improved environmental performance (reduced end-of-pipe abatement costs), foreign direct investments, and more efficient use of resources (natural and human). Environmental benefits are obvious and direct - through the increased environmental performance of facilities, energy efficiency and fuel substitution, enhanced monitoring and development of benchmarks, and cleaner technologies.



**Figure 1: Elements of the Integrated System**

## IV BENEFITS

An integrated system that brings together issues spanning energy demand and supply, pollution emissions (local and global), economics, regulation and enforcement, and mechanisms for private sector investments, has benefits for all players. The national, economic and environmental drivers for such an integrated system is spread across the all levels of government - the federal and provincial government, at the state level (for example the State Environmental Protection Agency), and the municipal authority (Beijing Municipality). It will also benefit the power utility company in Beijing, which currently hold the monopoly of district heating supply and distribution.



### **BETTER DESIGN CAN**

**Lower  
Lifecycle  
Costs**

**Improve  
Working  
Conditions**

**Lower First  
Costs**

Clean energy coupled with energy efficiency can provide widespread benefits both nationally and internationally.

Environmental benefits resulting from reduced emissions and reduced energy use, translates into national benefits of improved air, and thereby reduced emissions mitigation and health costs. Internationally, countries are focussing on energy efficiency and alternative fuels, making this project appropriate and timely.

Specific national and local benefits of this project include:

- National benefits include energy savings, reduced environmental pollution, reduced pollution abatement costs, and increased foreign direct investments
- Reduced local SO<sub>x</sub> and CO<sub>2</sub> emissions from the use of gas in the place of coal; and possibility of using the Kyoto credit line for emission reduction
- Improved energy efficiency from building materials will result in overall energy savings to the consumer thereby reduce energy bills and diverting “saved” energy into other productive sectors
- Increased investment in energy efficiency technologies and entry of private investment
- Increased capacity in the building sector

The integrated system proposed here provides incentives for each stakeholder to participate.

For the *Beijing municipality*<sup>8</sup>, the incentives include:

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<sup>8</sup> Local governments need to participate in enforcement and monitoring of environmental regulations. Local governments face a tradeoff between protecting the environment and safeguarding the financial and employment performance of local firms (World Bank, 1997). The integrated system proposed here, accounts for these tradeoffs and provides the Beijing municipality with appropriate incentives and opportunities to improve the environment as well as promote private investment and increase employment.



- Enhancing the ability of Beijing municipality to meet regulations under national environmental and energy efficiency laws.
- Making the city of Beijing a model for other cities in PRC.
- Opening new markets for private and foreign direct investment in district heating and other related areas.

For the *State*<sup>9</sup> environmental authorities such as SEPA, this integrated system will:

- Galvanize their attempts to move from command-and-control regime to one that is proactive.
- Provide the opportunity to pioneer the development and implementation of emissions performance standards (for district heating and further for other facilities).

*Nationally*<sup>10</sup> this integrated system provides economic and environmental incentives.

- Economic incentives for such an effort are both short-term and long-term: short-term being the potential to attract interest from multilateral agencies such as the United Nations Development Program (UNDP) and the Global Environment Facility (GEF); and long-term being the attraction of foreign direct investments.
- The integrated plan will help a system in place for cleaning the environment. It will also open doors for SO<sub>2</sub> and CO<sub>2</sub> trading mechanisms, and participation in international environmental agendas.

Finally, the protocols established for data collection, storage, analysis, and reporting are useful for a variety of reasons. Chief among these are (1) the information system will form the basis for a comprehensive monitoring, verification, and evaluation (MVE) program for economic growth, urban development, environmental management at the local, regional and national levels in the PRC; (2) the same system will be useful at the international level for purposes of applying for and implementing projects under the upcoming Clean Development Mechanism. The reporting requirements under this and other “flexible mechanism” systems defined by the Kyoto Protocol are similar to those required for MVE at the local, regional and national levels; and (3) commercial financial institutions can use the same information system for their own purposes – over time, this will increase the flow of funds into private provision of municipal and environmental services in the PRC.

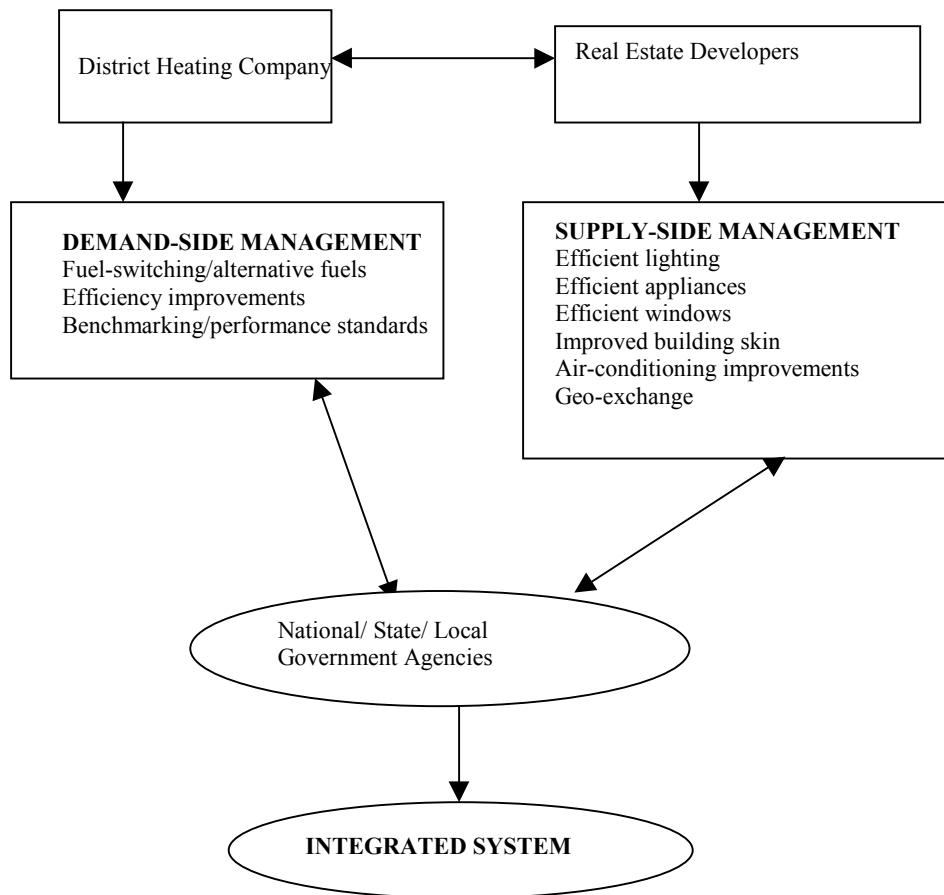
#### IV IMPLEMENTATION OF THE INTEGRATED SYSTEM

The district heating companies and real estate developers can leverage the proposed integrated system proposed, through various means as shown in the figure below.

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<sup>9</sup> Participation of the State environmental authorities is imperative in all aspects of environmental conservation and protection. Their role in developing environmental policies, programs, and legislation, and participating in new investment policies, will directly affect the environmental status locally and nationally.

<sup>10</sup> The National government is faced with regional and global economic and environmental challenges and pressures. Their involvement in developing and networking with local and state agencies is critical for the successful implementation of projects and programs.



Specific supply-side management issues include switching to cleaner fuels, improving generating and transmission efficiencies – these initiatives can improve the competitive position of those embracing them. Development of performance standards for district heating offers another platform for increasing market competition. Performance standards and benchmarking studies need to be coordinated through the involvement of the relevant government institutions. On the demand-side, lighting and air conditioning improvements, retrofits, and building skin improvements need special attention since new appliances and energy demand is increasing steadily. Efficiency standards, policy incentives to encourage the real estate developers and suppliers of efficient appliances, will again need government involvement. Overall, the government’s role in market conditioning is vital. Once the government sets up an “enabling environment”, private sector entities in the PRC can take advantage of the situation and promote different elements of the program in a coordinated fashion.

We have met with and started work with the relevant stakeholders to implement the integrated system. In the private sector, we have contacted real estate developers and appliance manufacturers, who have provided their commitment to support the program. In conjunction with the association of building designers, we are able to develop the detailed cost calculations to determine the net-benefits of implementing specific elements of the program at several locations. The relevant government agencies (listed in *Section 1.1*) have been contacted to discuss this

integrated system. Through specific agreements with different layers of city, municipal and national governments this program has the buy-in of government stakeholders. Currently, we are establishing the schedule for different activities such that the implementation of each element is orchestrated to synchronize with the implementation of other related elements along a critical path.

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