Building Energy Efficiency in China

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I. YESTERDAY: WAS BUILDING ENERGY EFFICIENCY NEEDED IN CHINA?

This was the question asked by Natural Resources Defense Council (NRDC) when we first entered China early in 1998. To our surprise, we found few people interested in energy efficient buildings. In contrast with the aggressive energy standards for buildings in the United States, few Chinese provisions expressly pertained to energy efficiency in its numerous building codes and standards. At that time, the whole country had only one national building standard dealing with energy savings, which covered only residential buildings in the northern zone and was poorly implemented in any case.[1]

The lack of concern about energy use was endemic, apparent not only in the building sector, but also in most of China's industrial sectors. The only good news was that a few innovators within the Ministry of Construction were able to create and promote a few efficient building pilot projects in Beijing and Tianjin, but none of these projects were

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1. Min yong jian zhu jie neng she ji biao zhun (cai nuan ju zhu jian zhu bu fen) [Energy Conservation Design Standard for New Heated Residential Buildings—Heating Part] (promulgated by the Ministry of Constr., effective August 1, 1998), *available at* http://www.china5e.com/laws/index2.htm?id=200407140036.

successful enough to bring policy makers' and the public's attention to the need for energy efficient buildings.[2]

Consequently, our first question was answered rather quickly: China's buildings were inefficient and little progress was being made to change this. From here, we began to ask another question: how can we develop sufficient support in China for building energy efficiency programs?

II. INITIATIVES BY NRDC IN CHINA

Since 1978 when China began the current high economic growth period, problems of energy supply deficiencies and environmental impacts began to emerge. In the absence of regulatory capacity to improve energy efficiency in buildings, commercial and residential building construction and day-to-day operations continued to consume large amount of energy, water and materials.

Since 2000, the floor space of China's new buildings has been growing at a rate of nearly two billion square meters every year.[3] Almost twenty seven percent of China's total national energy consumption occurs from building sector use.[4] The rate of growth of the building sector and the monumental amount of current energy use offers immense challenges. Given China's increasing national focus on energy use and efficiency, however, these challenges have created fertile ground for the seeds of policy and technological innovation.

Scientific studies have predicted that, assuming future economic growth consummate with recent growth patterns, the energy consumed by buildings in China may reach 1.1 billion tons of standard coal equivalent by 2020, assuming no improvements to building energy performance.[5] The need for efficiency was apparent and, increasingly, data was available to show the urgency of improving building energy use.

NRDC has been promoting improved energy performance in China's buildings since 1998. NRDC took quick actions in multiple ways by lobbying government ministries and policy makers, by supporting cooperative local administrations in developing energy-efficiency

2. Several pilot energy efficiency building projects were built in the 1990s, such as the Kaili residential community in Tianjin and State Planning Committee Residential Apartments in Beijing.

3. National Bureau of Statistics, China Statistic Yearbook (2007), Jianzhu ye fang shi jian zhu mian zhi [Construction Area of the Building Industry], *available at* http://www.stats.gov.cn/tjsj/ndsj/2007/html/O1537C.xls.

4. Liang Jinqiang. *Situation and Innovation of China Building Energy Efficiency* 6 Construction Science & Technology 15 (2008).

5. Qiu Baoxing, Vice Minister of Ministry of Constr., *China's Four Strategies on the Development of Green Buildings,* Speech given at the Symposium of Mex. Green Bldg. Ass'n. (Mar. 28, 2006), *available at* http://www.jljsw.gov.cn/default3.aspx?id=4005

building codes and regulations, and by advocating green building strategies through workshops, trainings, and technology demonstrations.[6]

Capitalizing on government relationships developed since 1998, from 2000 to 2005 NRDC assisted the Ministry of Construction in developing geographically-specific building energy efficiency standards for both residential and public buildings in the largest cities in southwest China. The standard eventually developed required 50 percent energy savings based on a building's energy consumption during the 1980s, calculated using average consumption by building type within a designated climate zone, and set rules for building specifications and design methods for building envelop and mechanical systems.[7] Along with these new rules came performance compliance methods and inspection procedures. The groundwork laid by NRDC's cooperative efforts with the Ministry of Construction resulted in the first national building energy standard, adopted by the central government in 2007 to require a 50 percent reduction of a building's total operational load and was adopted by China's Eleventh Five Year Plan.[8] The finalized standard is enforced by the Ministry of Construction and local Departments of Construction, and allows these bodies oversight and inspection powers throughout design, construction and completion evaluation, with some punishment provisions to regulate noncompliant construction activities and buildings. These enforcement provisions, stronger than previous building codes, gave the standard additional support from within the judicial branch. Also to promote compliance and help the public understand new methods of energy savings required by the standard, a supporting system of measures was adopted by the government, including revising the design regulations for HVAC systems and setting energy saving evaluation procedural requirements and inspection systems, along with other detailed regulations on engineering design and market management.[9] With these measures, the framework of China's building energy efficiency policies was greatly strengthened, but as with other environmental regulatory structures in China, much work still needs to be

6. For more information on the variety of work undertaken by NRDC's China Clean Energy Project in the Building Sector, *see* NRDC's Clean Energy Project, Green Buildings, http://www.nrdc.org/air/energy/china/greenbuildings.asp (last visited Oct. 10, 2008).

7. Guan yu shi shi xia re dong leng di qu ju zhu jian zhu jie neng she ji biao zhun de tong zhi [Design Standard for Energy Efficiency of Residential Buildings in Hot Summer and Cold Winter Zone] (promulgated by Ministry of Hous. and Urban-Rural Dev., Nov. 11, 2001), *available at* http://www.cin.gov.cn/zcfg/jswj/jskj/200611/t20061101_158394.htm.

8. Regulation on Energy Efficiency of Civil Buildings (promulgated by the St. Council., draft released for provisional enforcement July 2, 2007, final standard effective Aug, 1, 2008), *available at* http://www.cin.gov.cn/jnjp/jzjn/zcfb/index.htm.

9. For more information about these measures, see MINISTRY OF HOUS. AND RURAL-URBAN DEV *Regulations and Policies of the Ministry of Housing and Urban-Rural Development* http://www.cin.gov.cn/jnjp/jzjn/zcfb/index.htm (last visited Oct. 10, 2008).

done in improving enforcement capacity and standardization and proving that energy efficiency pilot projects have real and calculable benefits.

III. TODAY: STANDARDS AND CODE DEVELOPMENT, PUBLIC AWARENESS AND PILOT DEMONSTRATIONS

There are great challenges in implementing and enforcing building energy codes, especially given that most market actors from both the private sector and the public sector are focused on economic development as their first priority. From NRDC's experiences in improving building efficiency in the United States, we feel that policy enforcement capacity development, public awareness campaigns and technology demonstrations are the most practical ways for China to increase the efficiency of its buildings.

Currently, cooperative efforts between NRDC and Chinese national and local governments are focused on further developing building energy-use standards and promoting their implementation and enforcement. For example, NRDC has been cooperating with the Beijing Environment and Energy Efficiency Center and the Beijing Development Reform Commission on planning and implementing Beijing municipality's existing building efficiency retrofit program, which focuses on retrofitting government buildings and large commercial buildings. The next steps in these still-preliminary cooperative efforts will be developing clear and effective building retrofit technical standards and financial incentive policies. Furthermore, outside of Beijing, NRDC serves as a consultant to the Chongqing Building Technology Development Center of the Chongqing Construction Commission to help adapt the Moscow energy passport system to be implemented there.

A. Shanghai Energy Building Standard Development and Implementation

In order to build up a sustainable incentive system of building energy code enforcement, NRDC is now participating in a major effort to implement a building efficiency code in Shanghai; the code has been developed through a partnership between NRDC, the Shanghai Real Estate Science Research Institute, and the Residential Energy Services Network (RESNET), an American quality assurance organization for energy ratings.[10]

This project is an attempt to develop a market-oriented energy efficiency building code enforcement system which not only increases government enforcement and code compliance, but also incorporates

10. Ji you min yong jian zhu neng xiao ping gu biaoshi [Basic Civilian Building Energy Rating Code] (promulgated by the Shanghai Const. and Trans. Comm., Shanghai Mun. Gov., Mar. 24 2008, effective July 1, 2008) *available at* http://www.ccsn.gov.cn/Norm/putOnDir/show.aspx?id=555.

market policies by integrating a building's energy savings level into the real estate property valuation process. Shanghai, the most developed city of China, plans to retrofit forty million square meters of existing building space in compliance with the national energy standard by 2010.[11] This accounts for a huge proportion of the current national goal of "efficiency retrofitting" one hundred fifty million square meters of existing buildings in the same time period.

In its details, the project aims to establish a regional effort in Shanghai for home inspections that is harmonized with the RESNET standard, pending approval by municipal authorities. The principal project output is an energy rating system for retrofitting existing inefficient buildings. This rating system is comprised of a guidebook on evaluation standards and tools, energy inspection measures, governance capacity development measures and the creation of an energy evaluation label for retrofitted buildings. The basic building energy performance rating standard entered into force in July 1 this year and will apply to all of Shanghai's existing buildings energy retrofitting projects.[12] Several supporting standards of building energy inspection methods and measurements, data analysis and calculation, and energy evaluation software are being developed cooperatively by NRDC and RESNET. Additionally, in order to test the codes by applying the new standard to retrofit existing buildings, two demonstration projects in Shanghai are being planned. To initially promote the new standard and to develop enforcement capacity, the Shanghai government has set the initial scope of project implementation to only mandate these standards for those building projects supported by government subsidies, such as demonstration projects, government, and public buildings.

If successful, there is hope that the RESNET-Shanghai building energy rating system may be promoted as an international standard for building energy evaluation. Another possible application of the rating system currently under discussion is to use the system to calculate carbon emission reductions (CER) achieved through building energy efficiency measures; this may be possible because the methodology that RESNET uses in the United States for CER calculation is approved by the United Nations' Clean Development Mechanism Executive Board. Allowing building renovation projects to generate CER credits would substantially increase the marketability of energy efficiency in China.

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11. Shanghai jian zhu jie neng 'shi yi wu' gui hua [Eleventh Five Year Plan on Building Energy Efficiency of Shanghai Municipality] (promulgated by the Shanghai Constr. and Transp. Comm., Shanghai Mun. Gov., Dec. 1 2006) *available at* http://www.shucm.sh.cn/gb/node2/node13/node23/node232/userobject7ai1468.html.

12. Ji you min yong jian zhu neng xiao ping gu biaoshi [Basic Civilian Building Energy Rating Code] (promulgated by the Shanghai Const. and Trans. Comm., Shanghai Mun. Gov., Mar. 24, 2008, effective July 1, 2008) *available at* http://www.ccsn.gov.cn/Norm/putOnDir/show.aspx?id=555.

B. Agenda21 Demonstration Building

In addition to the many cooperative efforts of standards development and implementation, one of the highest impact areas of NRDC's work in China's building sector may be through increases to public awareness through technology demonstration projects.

In 2000, the United States Department of Energy (DOE) and NRDC together launched a building energy efficiency demonstration project in Beijing to demonstrate how green buildings could dramatically reduce the nation's carbon dioxide emissions and other environmental impacts, and to experiment with best practices in promoting methods of saving energy within current China building practices. The project was launched in 1999 and completed in 2004 and was known as the Agenda21 Building. The one hundred thirty thousand square foot office building located in downtown Beijing was officially awarded a LEED Gold Plaque in March 2006 and became China's first LEED-certified building. The project also received the Ministry of Construction's first Green Building Innovation Award.

Data on the demonstration building's operational costs for the past few years indicate seventy-four percent energy savings, sixty percent water savings and exemplary indoor environmental quality, while the construction cost was near the average of similar buildings in China's urban eastern seaboard construction market. Today, the building's energy performance is still competitive compared to all new buildings in China. Energy monitoring shows the building reduces seventeen hundred tons of China's CO2 emissions each year. If all China's existing office buildings, totaling forty billion square meters, could be retrofitted to the same energy use level, enough energy would be saved to have made the Three Gorges Dam completely unnecessary.[13] Since the Agenda21 demonstration building was completed, thousands of visitors, including government officials, professionals and academics have visited the building to learn about the technology, management and design strategies of the construction effort. Currently NRDC is working with DOE and the Ministry of Science and Technology of China to coordinate the completion of an energy efficiency demonstration and learning center, called the Center of Excellence, on the second floor of the building. The purpose of the Center will be to promote public and professional education on green buildings and building energy efficiency.

The completion of the Agenda21 building was a milestone of the development of more efficient buildings in China. Based on successes and lessons learned in project implementation, China's first Green Building

13. Lin Shuangchuan, *Quan wei zhuan jia tan jian zhu jie neng* [*An Expert Talks about Building Energy Efficiency*], XINHUA WANG, Dec. 8, 2005, http://news.xinhuanet.com/banyt/2005-12/08/content_3894286.htm.

Standard ("the Standard") was developed and launched in 2005, and entered into force in June 2006.[14] The Standard is applicable to residential and commercial buildings, and it established a rating system including the evaluation of six aspects: area savings and outdoor environment, energy savings and energy utilization, water savings, material savings, operation management and life cycle performance (public buildings). The Standard defines in detail "Green Buildings" and thoroughly describes the six above indices of building efficiency. Based on these six indices, the standard categorizes residential and commercial buildings into three levels of efficiency achievements: one star, two stars and three stars (the best performance). Happily, this green building standard was only the first step in a national green buildings effort, and the Chinese national government has begun to escalate its system of promoting green buildings. In August 2007, a series of regulations on green building labels was released; the evaluation guidelines of this labeling system matched the current context and needs of China's construction industry and market.[15]

Lessons from this demonstration project and subsequent standards development processes indicates several insufficiencies of the current state of energy efficiency buildings in China. First, any energy saving construction regulatory requirements need to rely upon technologies and techniques which are feasible within the current market, which means that unpractical practices and technologies should be avoided, especially if they are not within the price range of the construction industry. Secondly, capacity building in design and construction of energy efficient buildings is a crucial part of improving building sector energy use in China; despite the increasing number of individual experts in the government and private sector, there is simply not enough successful experiences in China to have built up a critical mass of domestic expertise in energy efficient buildings. Indeed, this lacking expertise was shown through some of the costs of the Agenda21 Building which were incurred due to inexpert mistakes in design and construction. Thirdly, the Chinese market can not yet produce enough "energy saving" materials and equipment to meet the needs that would be established by full implementation of a national energy efficiency building standard, while imported products present prohibitively high costs. Lastly, the government absolutely needs to undertake capacity building efforts in the

14. Jian she bu guan yu fa bu guo jia biao shi <<lü se jian zhu ping jia biao zhun>> de gong gao [Evaluation Standard for Green Buildings] (promulgated by the Ministry of Constr., effective June 1, 2006) *available at* http://www.cin.gov.cn/gsgg/gg/jsbgg/200610/t20061031_155889.htm.

15. Regulation on Green Building Evaluation Labels, Implementation Rules on Green Building Evaluation Labels and Technical Instructions on Green Building Evaluation Labels, (promulgated by the Ministry of Constr., effective Aug. 21 2007)., *available at* http://www.mohurd.gov.cn/zcfg/jswj/jskj/200708/t20070827_158564.htm.

fields of supervision, incentives creation and inspection of building efficiency.

IV. TOMORROW: CHALLENGES AND OPPORTUNITIES

Unlike the preliminary attempts to decipher the needs and opportunities for building energy efficiency in China, the focus among experts has switched to asking how to better promote building energy efficiency in China.

Low levels of technological know-how and innovation and a lack of a market incentive to increase the speed of innovation are two main barriers for almost every industry in China. It is the same case in the building industry. This relationship between the market and slow technological innovation leads to ineffective policy making, an absence of interest in market supervision and guidance, a lack of a punishment mechanism, and insufficient technical resources. However, it is no longer disputed at the national policy-making level that pursuing building efficiency improvements will significantly benefit the country's economy. With this central support for national standards and local level policy experimentation, the future of increased relevancy of energy efficiency in the building sector is clear.