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From Gray to Green

How Energy-Efficient Buildings Can Help Make China's Rapid Urbanization Sustainable

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October 2009

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The Boston Consulting Group's (BCG) offices in China and the Natural Resources Defense Council's (NRDC) China Program have worked closely over the last few months to produce this White Paper and extensive supporting materials. We sincerely hope that this effort can make a meaningful contribution to improving building efficiency and the environment in China.

China's rapid economic development and urbanization over the last three decades has meant new opportunities for hundreds of millions of Chinese. Increasingly, however, this same development has led to rising concerns about some of the byproducts of growth—in particular the strain on China's environment and natural resources.

To be sure, China's central government has already made significant moves to address these concerns. Its Eleventh Five-Year Plan (2006–2010), for example, decreed a 20 percent cut in energy consumption per unit of GDP by 2010. Still, delivering on such goals has been and will continue to be challenging—particularly since they can appear to clash with other priorities, such as faster economic growth and greater profits.

Fortunately, several actions can be undertaken to avoid such conflicts. One of the most effective measures would be improving the operational energy efficiency of Chinese buildings, both residential and commercial. Collectively, buildings represent one of the country's largest drains on energy. Consequently, improvements in their energy efficiency would have a significant impact on resource consumption. At the same time, these enhancements could be achieved at low cost or no cost. Indeed, "greening" China's buildings could actually have a positive impact on both growth and profits.

The challenge is to align all the diverse stakeholders in energy efficiency, as no single actor or entity—private or public—can address the issue alone. We believe, however, that with greater awareness, accurate information, and the right policies, all the stakeholders can be motivated to play their part and overcome the obstacles, including the challenge posed by "split incentives."[1] This report aims to facilitate such increased awareness and alignment. It identifies the role of each stakeholder group and suggests key actions for moving forward.

A Critical Issue That Can Be Addressed

Buildings are one of China's largest energy "consumers": their day-to-day operational demands for lighting, air conditioning, heating, and appliances account for one-fourth of the country's total energy use.[2] (See Exhibit 1.) In fact, residential and commercial buildings in China use more energy than do the country's iron, steel, and cement industries combined.

China's rapid urbanization—around 270 million Chinese are expected to move from rural areas to cities by 2020—and its ever-growing middle class ensure that the energy consumed by buildings will remain a pressing issue well into the future.[3] Indeed, per capita personal electricity use is more than three times higher for city dwellers than for rural residents.

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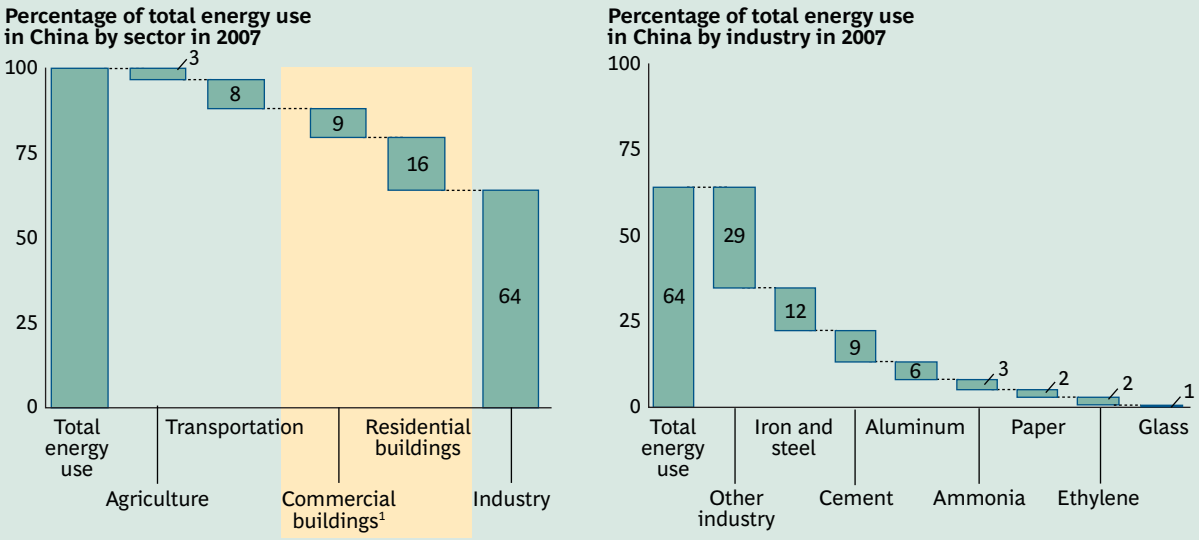
1. Split incentives result from the fact that much of the up-front investment in green technologies is not borne by the immediate beneficiaries of those technologies. Therefore, achieving alignment among stakeholders and developing a shared set of priorities are critical.

2. If we include the entire "building life-cycle," which also comprises the manufacturing of building materials and construction, buildings account for an *additional* 5 to 15 percent of China's annual energy consumption. Under this broader definition, buildings account for 30 to 40 percent of the country's total energy use. This report focuses on reducing the energy use from building operations, but consideration of the building life-cycle is also important and offers additional opportunities for saving energy.

3. This estimate of urbanization in China is from an Economist Intelligence Unit forecast.

Exhibit 1. Buildings Account for One-Fourth of China's Energy Use

Buildings Use More Energy than China's Iron, Steel, and Cement Industries Combined



Sources: Lawrence Berkeley National Laboratory; BCG/NRDC analysis.
[1]Commercial buildings include shopping malls, office buildings, hospitals, schools, hotels, and government buildings.

Fortunately, the problem has a credible solution: increasing the energy efficiency of buildings. Beijing's Agenda 21 building and numerous other green constructions across China have proved that it is possible to achieve up to a 70 percent savings in energy consumption by applying existing energy-efficiency technologies to buildings.[4,5] If all of China's buildings could realize a comparable degree of efficiency improvement by 2015—admittedly an extremely ambitious goal—the impact would be enormous: the annual energy savings would be equivalent to the power generated by 370,000 wind turbines.[6] But the benefits of even a modest greening of buildings would still be substantial. (See Exhibit 2.) If by 2015, for example, 5 percent of existing buildings and 60 percent of new ones could achieve levels of energy consumption that are 50 percent lower than those of comparable buildings in similar climate zones, the subsequent annual energy savings would be equivalent to turning off all the lights in the United States for one month. The potential rewards and market opportunities that will arise from improving building efficiency are also vast.

Improving energy efficiency in buildings can be a highly cost-effective approach for meeting China's green targets. (See Exhibit 3.) This lever can have a positive return on investment and a potentially positive net impact on economic growth. In fact, for many investments in building efficiency, the resulting annual cost savings can exceed the annual depreciation charges incurred. In contrast, many levers for enhancing the energy efficiency of industrial operations—such as dry-quenching processes for iron and steel and the use of heat-efficient kilns for cement—require significant capital expenditures or have lower returns on investment.

Still another important difference exists between levers that improve building efficiency and those that improve industrial efficiency. Levers for building efficiency generally have a broad application—that is, the same levers can be applied effectively to a wide range of structures. Many levers for improving industrial efficiency, meanwhile, are highly specific to individual industries and vary considerably. Although it is true that a few industrial levers cut across industries—for example, efforts to improve the efficiency of motors,

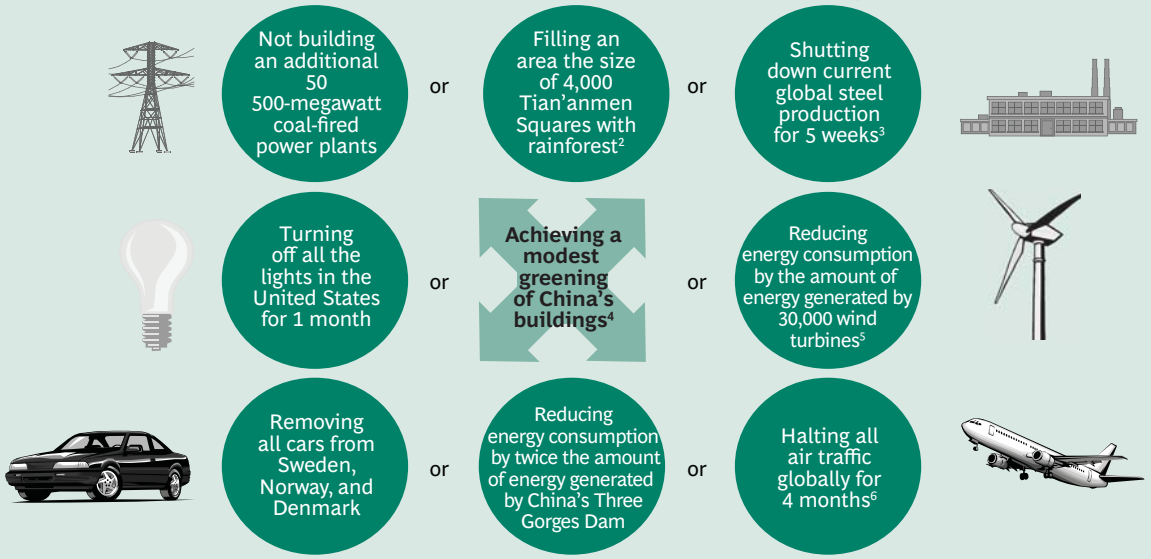
4. Agenda 21 was the first building in China to receive Gold certification from LEED (Leadership in Energy and Environmental Design). LEED is the U.S. Green Building Council's widely adopted and cited system for rating green buildings.

5. Energy savings are expressed relative to the energy consumption of the average comparable building in a similar climate zone.

6. This estimate reflects the use of new 2-megawatt turbines at typical levels of efficiency and utilization. It also assumes energy savings of around 70 and 55 percent, respectively, for commercial and residential buildings. The estimate excludes energy savings from inherently more-efficient residential appliances and more-efficient use of those appliances.

Exhibit 2. Even a Modest Greening of China's Buildings Would Have a Significant Environmental Impact

Actions with an Equivalent Environmental Impact[1]

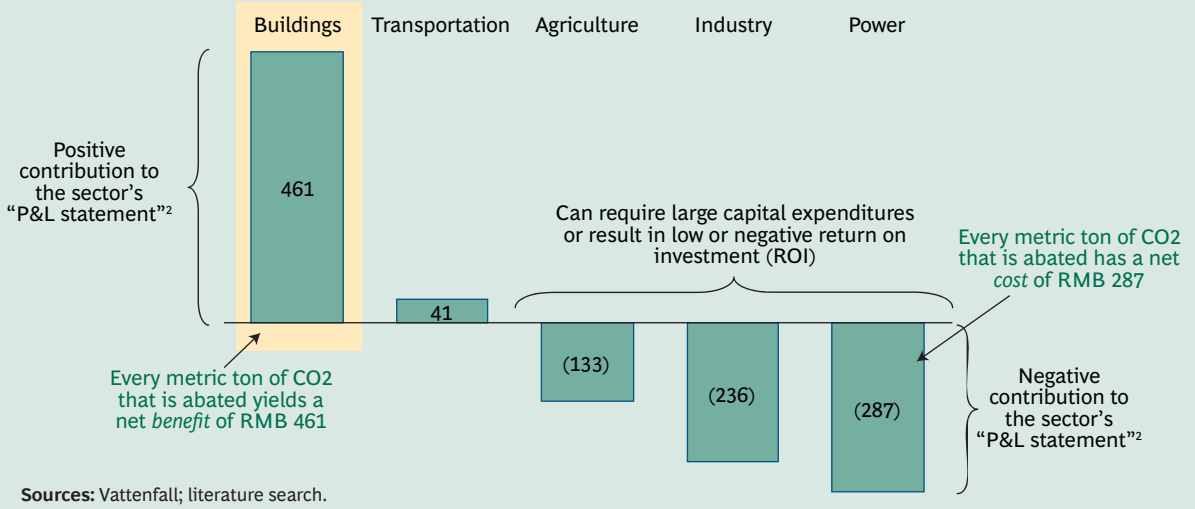


Sources: BCG/NRDC analysis; China's National Energy Bureau; International Energy Agency; U.S. Department of Transportation; U.S. Department of Energy; U.S. Energy Protection Agency; International Monetary Fund; World Wildlife Fund; The World Factbook; literature search.

[1]Any one of these actions would either save 170 billion kilowatt hours of energy use or reduce CO2 emissions by 170 million metric tons.
[2]This figure is based on the carbon contained in a representative area of rainforest.
[3]This figure is approximately 2.5 times the annual capacity of China's Baosteel Group.
[4]We define a modest greening of China's buildings as 5 percent of existing buildings and 60 percent of new buildings achieving, by 2015, levels of energy consumption that are 50 percent lower than those of comparable buildings in similar climate zones. The modest greening scenario covers savings achieved only through operating efficiencies and excludes savings that result from the more-efficient use of residential appliances.
[5]This figure was calculated assuming the use of new 2-megawatt wind turbines at typical levels of efficiency and utilization.
[6]This figure was calculated using the amount of CO2 resulting from air travel.

Exhibit 3. Tackling Energy Efficiency in Buildings Is a Highly Effective Lever for Meeting Green Targets

Estimated Cost or Benefit of Investment in CO2 Abatement by Sector (RMB)[1]



Sources: Vattenfall; literature search.
Note: We converted the original data from euros to RMB using the average 2008 exchange rate of RMB 10.25 to €1.
[1]The following formula was used to calculate the annual cost or benefit of investments in CO2 abatement by sector: (annual cost savings less annual amortization of initial capital expenditure)/annual metric tons of CO2 abated.
[2]These figures exclude the marginal social benefits and costs that would result from the investments.

pumps, lighting, and air conditioning and heating—many of these, of course, relate to the operating efficiency of the buildings and factories that the industries use. Thus, from a technical standpoint, it may be easier to make a significant difference by boosting the aggregate energy efficiency of buildings than by increasing the aggregate energy efficiency of industry in China.

Much effort has been devoted to improving the energy efficiency of industry in China. While there remains work to do on that front and that focus remains critical, we believe that addressing the energy efficiency of buildings is a task of equal—and possibly even greater—importance.

Greening Efforts Would Benefit a Wide Range of Stakeholders

Each of the major stakeholder groups—from local governments to civil society—stands to benefit from a campaign to improve the energy efficiency of buildings. Thus each group has the incentive to act—and to act now.

Local Governments

Improving energy efficiency in buildings can provide local governments with a cost-effective means for reaching current energy-conservation targets set by the central government. And it offers several other benefits as well.

First, increasing building energy efficiency can reduce a local government's energy bills as well as those of local residents and firms, making the city or region more attractive, especially for businesses. Second, greening efforts can also strengthen the local economy by creating new industries and jobs—including highly skilled jobs—along the entire property-development value chain. Third, such efforts can also preempt the public's environmental concerns, which are both significant and rising. According to a recent BCG survey exploring Chinese attitudes toward the environment, more than 70 percent of respondents said that their efforts to stop climate change had already led to a significant change in their own lifestyle and behavior.[7]

Fourth, it would be prudent for local governments to initiate greening programs now so as to avoid more significant problems in the future. National building-efficiency targets are expected to become more specific and stringent over time. Given the lag time for the design and construction of new buildings and for retrofits of existing buildings, local governments will need to start early if they hope to reach efficiency targets. Encouragingly, some cities have already initiated significant efforts to improve building efficiency and are succeeding. (See the sidebar, "At the Vanguard: Several Cities Are Driving China's Green-Building Agenda.")

The Central Government

Many officials in the central government acknowledge the importance of improving building efficiency. And some have already begun to take action, as we can see from the rapid increase in regulations related to building efficiency since 2004. The central government deserves credit for these forward-thinking actions.

These steps should yield significant social and economic benefits. Efforts to enhance energy efficiency in buildings can help the central government meet several of its critical goals in a highly cost-effective manner—and with fewer tradeoffs than many alternatives require. Specifically, such efforts can help ensure the sustainability of China's economic growth and, in the process, maintain social stability. China's environment has suffered severely during the last three decades of rapid economic development. Further degradation of the country's natural resources could seriously threaten productivity, health, and ultimately the economy itself. More than 30 percent of China's total landmass, for example, is affected by acid rain, which results from coal-fired power generation.[8] Improving energy efficiency in China's buildings could significantly reduce the amount of coal the country burns without posing a threat to economic growth, employment, or the social fabric.

7. The 2008 survey polled more than 1,000 representative adults, 18 to 65 years old, across seven Chinese cities.
8. This figure is cited at http://www.worldwatch.org/node/4496.

At the Vanguard
Several Cities Are Driving China's Green-Building Agenda

A number of cities in China have already launched significant building-efficiency projects and are seeing tangible results. Selected cities and their actions are highlighted below.

Baoding

- Built the country's first self-sufficient tower powered by solar energy
- Provides subsidies for investments in solar energy

Beijing

- Implemented building energy standards across urban and rural areas
- Subsidizes energy-efficient housing for rural residents

Chongqing

- Included building energy reduction in the key performance indicators for evaluating local officials
- Established a building-efficiency association to provide information to key stakeholders

Hangzhou

- Started a program to retrofit 600 large public buildings in 2007
- Built an energy-audit database for all existing building types, including rural buildings

Shanghai

- Established an agency dedicated to building energy efficiency
- Allocates funds for research and development of products that enhance building efficiency

Shenzhen

- Encourages and allocates funds for the research and development of innovative green products
- Plans to provide discount loans to tenants who lease space in energy-efficient buildings

Tianjin

- Retrofits district heating systems for 6 million square meters of building
- Audits and evaluates investments in projects consuming more than 3 million kilowatt hours annually

Wuhan

- Has started to conduct an energy audit on large public buildings
- Raises public awareness of building energy efficiency by running advertisements on major local media
- Implemented MOHURD's building standard for the Hot Summer and Cold Winter Climate Zone

Xiamen

- Provides comprehensive government support—including loans with low interest rates
- Provides incentives and technical training to encourage developers to adopt energy-efficient technologies

Making buildings more energy efficient would also reduce China's dependence on energy imports and limit the economy's exposure to future volatility in oil prices.[9] It would also burnish China's image abroad by more closely aligning the country's energy use with international standards. (China's current energy consumption per unit of GDP is five to eight times that of the G7 countries.[10]) Finally, it would give the country greater credibility and influence in discussions about climate change.

9. According to the International Energy Agency, China's net oil imports will increase as a percentage of the country's oil supply to more than 60 percent by 2015, from 34 percent in 2000.

10. This calculation is from the Energy Information Administration of the U.S. Department of Energy.

Developers

Developers that could create more-efficient buildings would enjoy several advantages. First, they would have an edge over competitors in meeting future efficiency targets, which are expected to become both more numerous and more stringent. For example, only five energy-efficiency regulations were passed from 2002 through 2004, but 37 were passed from 2005 through 2007. At the same time, the cost of noncompliance is rising. Recent laws and regulations give local governments the power to suspend the licenses of noncompliant developers and impose significant fines.

Second, developers of energy-efficient buildings will also increasingly be able to differentiate their offerings and command a premium from buyers and tenants, as the strong financial performance of energy-efficient buildings elsewhere demonstrates. (See the sidebar, "China's Green Buildings: Efficient, Practical, and Cost Effective.") In the United States, for example, energy-efficient buildings generate an annual net present value of more than U.S.$100 per square meter. They also generate profits that are 10 to 15 percent higher—and have occupancy rates up to 4 percent higher—than those of less efficient buildings. And developing buildings with greater energy efficiency is not as expensive an endeavor as is often thought. Typically in China, developers pursuing this route face a relatively modest cost premium of 4 to 5 percent.

Third, energy-efficient building projects may also win developers incentives and additional policy benefits—such as exemptions and expedited approvals on planning—from local authorities. Fourth, over time, developers of energy-efficient buildings stand to gain a reputation as socially responsible corporations. This could have a material impact on their companies, particularly as environmental concerns grow among consumers and others. BCG's recent study exploring Chinese attitudes toward the environment found that around 90 percent of Chinese consumers already consider a company's environmental record to be important or very important.[11]

11. The 2008 survey polled more than 1,000 representative adults, 18 to 65 years old, from across seven Chinese cities.

China's Green Buildings
Efficient, Practical, and Cost Effective

Green buildings can deliver on a range of fronts, from building functions to financial returns. The Ministry of Science and Technology's (MoST) energy-efficient demonstration office building in Beijing is a great example.

The building is a marvel of energy efficiency. Compared with similar-sized buildings, it uses 74 percent less energy, 40 percent less water, and reduces water waste by 60 percent. It also cuts annual carbon dioxide emissions by 1,700 metric tons. Driving these efficiencies are several innovative design features and efficiency measures, among them:

- A cross-shaped floor plan that introduces more natural light and natural ventilation
- Reflectors that send more daylight into the building
- A rooftop heat-recycling system
- A "green" (that is, vegetation-covered) roof that keeps the building cooler in the summer and collects rainwater for reuse
- A chlorofluorocarbon-free cooling system

Because the building uses more expensive energy-saving materials and products, its up-front construction costs were approximately 8 percent higher than those of standard, similar-sized buildings. But the investment is paying off rapidly, as the operational savings exceeds RMB 800,000 per year, and the expected payoff period for the building is about five to six years.

The private sector has constructed many equally impressive buildings in China. These buildings can deliver energy savings of 20 percent or more over similar-sized buildings—and comparable or greater savings in water usage. Again, the construction-cost premium for such buildings over standard buildings can be modest, at 4 to 5 percent or less, with estimated payback periods under 10 years.

Such buildings can also have a positive impact on their occupants. One typical response we heard was made by a manager: "Our employees feel healthier and happier to work in this building, and their productivity has improved as a result."

The rewards of developing energy-efficient buildings are clear, and highly energy-efficient buildings already exist in well over 20 cities in China. That being said, creating capacity for energy efficiency does not happen overnight, and many new energy-efficient products and construction techniques must be mastered before success can be achieved. Therefore, developers will find that establishing their credibility early on with a proven track record of certified buildings will be extremely beneficial from a commercial perspective.

Commercial Tenants

For commercial tenants, energy-efficient buildings are a wise choice. Leasing a green building can yield positive returns, since the rental premiums commanded by such buildings are typically smaller than the associated savings in energy and water bills. Similarly, retrofitting can deliver energy cost savings of 10 to 50 percent. Returns on energy-efficiency investments can be as high as 65 percent for insulation retrofits and 85 percent for lighting retrofits. And individual energy-efficiency levers can act together to create synergies, so that net savings can be even greater—and the payback period even shorter—than expected.[12]

Choosing energy-efficient buildings can also yield nonfinancial benefits. Better ventilation, more natural light, and the use of nontoxic construction materials can translate into higher productivity, improved health, and lower rates of absenteeism among employees. In the United States, some companies with green buildings have been rewarded with productivity increases of 11 to 15 percent and reductions in absenteeism of up to 5 percent. Having a green office can also enhance a company's appeal to prospective employees and retention of talented employees.

Civil Society Stakeholders

Civil society stakeholders—namely the local media and recognized nongovernmental organizations (NGOs)—also have incentives to contribute to improving building energy efficiency. As noted, greening efforts can yield a disproportionate payback and do much to serve the greater good, as they contribute to sustainable growth, job creation, and energy security. The local media and NGOs are well positioned to raise awareness and generate enthusiasm for these efforts and, in the process, to drive meaningful change in China. Recognized NGOs that can demonstrate their effectiveness in these efforts could also help promote their international fundraising efforts in this way.

Action Steps for Stakeholders

Each stakeholder group has an important role to play in securing the rewards of improved energy efficiency in buildings. (See Exhibit 4.) Local and central governments need to ensure that the right policies are in place and properly enforced. Developers and commercial tenants should "play by the rules," respond to appropriate incentives, and help improve policy. Local media and NGOs, and the public and private sectors, should educate industry and society about the importance of—and potential for—improving building efficiency.

Each stakeholder should take measures now. Below we highlight what we consider the top five actions for each group. We also provide specific suggestions for implementation.[13]

Local Governments and the Central Government

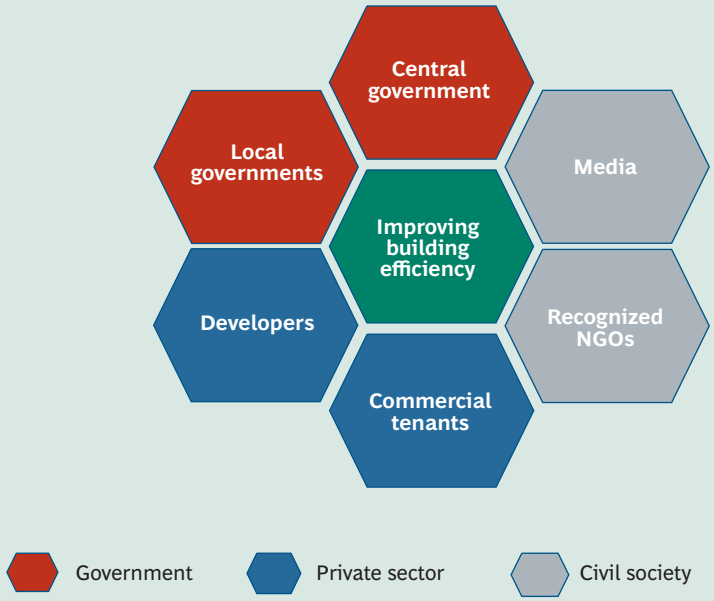
As noted earlier, China's central government and many local governments have already made significant progress in improving building energy efficiency. However, we believe that some additional initiatives will help China achieve its efficiency goals even faster.

1. Accelerate the nationwide adoption of building energy audits and the disclosure of results. Government and other large public buildings collectively account for 20 percent of all the energy used by buildings in China. Therefore, starting audits of these structures would be a significant step forward. Several pilot projects for measuring and publishing the energy consumption of government buildings have

12. It should be noted that interactive effects could also reduce savings.

13. We have developed and collected additional recommendations, ideas, lessons, and examples for each stakeholder group. For details, contact NRDC in Beijing.

Exhibit 4. Improving Building Efficiency Requires Action by Multiple Key Stakeholders



Source: BCG/NRDC analysis.

already been conducted in five cities—Chengdu, Chongqing, Fuzhou, Shenzhen, and Wuhan. These efforts should be scaled up. Broadly applying energy auditing to public buildings would set an example for private sectors to follow and would raise public awareness of building efficiency. It would also create capacity for energy auditing and open a potentially large market for energy service companies.

What to do now:

- Contact the Shanghai Research Institute of Building Sciences for information on how Shanghai conducted its pilot project in auditing building energy.
- Read *Study on the Energy Conservation Management Policies for Large-Scale Public Buildings in China,* published by the National Development and Reform Commission.[14]

2. Fully implement a national building-energy-labeling standard for new and existing buildings. This implementation should be based on the Ministry of Housing and Urban-Rural Development's (MOHURD) five-star building-energy-rating system, which was introduced in April 2008 and is currently being piloted in 11 cities.[15] The use of building labels will drive awareness, understanding, and ultimately demand for green buildings among end-users. Labels will also serve as a credible marketing and valuation tool, thus helping to create a functioning market for both the sales and leasing of efficient buildings. Building-energy labels can also be referenced by a new incentive system, as we explain below.

What to do now:

- Read about the implementation of building-energy-labeling systems in other countries, such as Russia's "energy passport," a document verifying energy performance in building design, construction, and operation.[16]

14. For the study, see http://www.efchina.org/CSEPCN/FReports.do?act=detail&id=219.

15. The rating system is being piloted in Beijing, Chengdu, Chongqing, Hangzhou, Harbin, Lanzhou, Nanjing, Shanghai, Shenzhen, Tianjin, and Zhengzhou. To date, six institutes of building science and technology have been designated as official assessment agencies for these cities.

16. For more about Russia's energy passport, see http://www.cenef.ru/file/paper-final.pdf.

3. Develop an integrated and comprehensive incentive system to encourage efforts to improve building efficiency. This system could be based on the research and experience of NRDC experts—both within and beyond China—in building-efficiency policy. The system should have several key attributes. For example, incentives should be based on building performance or the metered energy savings—rather than on building-efficiency investments. Incentives should also be tiered to match different levels of building efficiency, preferably tied to a building-energy label.[17]

The incentive system should target key stakeholders whose decisions drive the market, and it should be supported by an objective and transparent rating and labeling standard. Furthermore, the incentive system should be coordinated with other incentives, such as those targeting utilities. For instance, incentives should encourage utilities to help end users improve energy efficiency rather than to invest in new power plants. Finally, the incentive system should be transparent, with clear and straightforward procedures for stakeholders.

Note that incentives need *not* be a significant drain on government funds. Examples of local government incentives that have minimal negative fiscal impact include expedited approvals of planning and building permits, beneficial land-use rights, and relaxed density requirements. One low-cost incentive that can be offered by both local governments and the central government is accelerated depreciation on investments to improve building efficiency.

What to do now:

- Contact NRDC in Beijing for a fact sheet summarizing our research on international incentive systems for improving building efficiency.

4. Drive the private sector to improve building efficiency. Government actions on building energy efficiency will have several benefits. Most obviously, it will lower the government's energy bills. It will also have a strong signaling effect to the private sector and will help generate capacity among building designers, developers, and contractors. Finally, it will spur growth of green material and product suppliers and encourage competition among them.

Several Chinese cities have been taking significant steps in this area. Beijing is currently retrofitting multiple government buildings by improving HVAC (heating, ventilation, and air conditioning) and lighting systems, Chongqing is undertaking similar projects for various government buildings, and Shenzhen is planning to retrofit more than 20 public buildings by 2010.

What to do now:

- Contact NRDC's China office to learn more about the Ministry of Science and Technology's Agenda 21 office building in Beijing, China's first LEED certified (LEED-Gold) building.[18]

5. Quickly implement building codes and standards across lagging provinces and strengthen enforcement for new buildings throughout the country. The 11 provinces identified by a MOHURD report as lagging in energy-efficiency efforts should immediately mandate the 50 percent energy saving standard.[19] They can adapt existing policies and regulations from other provinces in similar climate zones. Meanwhile, the rest of China should follow Beijing, Tianjin, and other pioneers by implementing more stringent energy standards that call for energy savings of 65 percent.

Governments should strengthen enforcement of efficiency standards for new buildings throughout the country. Compliance rates vary significantly across China. While the official compliance rate is close to 100 percent, some Chinese experts estimate that the national average could be as low as 20 percent. The

17. It might be worthwhile to consider the use of incentives in cities where buildings have particularly low levels of compliance with energy efficiency standards, in order to encourage buildings in those locales to meet the minimum mandated requirements.

18. LEED (Leadership in Energy and Environmental Design) is the widely adopted and cited green-building rating system created by the U.S. Green Building Council.

19. The 11 lagging provinces were highlighted in a MOHURD audit in 2007.

compliance rates can be increased by enforcing the rules that penalize noncompliant parties and by applying the experience of successful cities such as Beijing and Shanghai.

Improvements in compliance will save significant amounts of energy and reduce carbon emissions significantly. According to one conservative estimate, even increasing compliance by just one percentage point *among new buildings alone* would reduce carbon emissions as much as removing approximately 30,000 cars from Chinese roads would.

What to do now:

- Read the *Shanghai Residential Building Energy Efficiency Inspection and Evaluation Standard* and selectively apply best practices to your city.[20]

More details for each of the initiatives outlined above are available from NRDC in Beijing. BCG and NRDC have also developed an additional 18 suggested actions for government stakeholders.[21]

Developers

1. Build capacity in energy efficiency. Develop in-house expertise by, for example, understanding different certifications in building energy efficiency and government incentives. Hire new staff or establish partnerships in the design and construction of energy-efficient buildings.

What to do now:

- Contact a design or consulting firm that specializes in green building.
- Visit an energy-efficient residential development in your city.

2. Test drive new business models to improve building energy efficiency, such as energy management contracts (EMCs).[22] There are several EMCs in China. For the China Construction Bank's building in Wuhan, the building-solutions provider installed energy-saving appliances worth RMB 5 million in exchange for a share of the RMB 1.5 million in expected annual cost savings. Similarly, retrofitting the 5-million-square-meter Fourth Military Medical University has reduced its energy bills by more than RMB 1 million per month; the savings is being shared by the energy-solution provider and the university.

Other innovative but less-tested business models might also be worth exploring, including carbon-emissions trading. Under such a model, a party that pays high costs to reduce energy use or carbon emissions would pay a party that could achieve the same results at a much lower cost. This type of agreement could be struck between "overachieving" and "underachieving" buildings or developers. The same concept might even be extended across industries. For example, a company in heavy industry might offset its own industrial emissions or energy use by funding investments in building energy efficiency.

What to do now:

- Read the case study on the application of EMCs at the Fourth Military Medical University in Xi'an.[23]
- See http://www.chinagb.net, http://www.esco.com.cn, and http://www.emca.cn for additional Chinese-language case studies on energy-efficient buildings.
- Contact a provider of integrated building systems or solutions to explore innovative options.

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20. For more information about the standard, see http://co.rhvacnet.com/Standard_StandardProject_30.html, or contact the Shanghai Research Institute of Building Science or Shanghai Building Energy Conservation Office.

21. For additional materials, contact NRDC in Beijing.

22. Energy management contracts are arrangements under which one party (often a building-solutions provider) agrees to implement and pay for energy-saving investments on behalf of a second party (often a building owner) in exchange for a share of the energy cost savings resulting from the retrofit.

23. For the Chinese language version of the case study, go to http://www.hnemca.cn/bencandy.php?fid=125&id=781.

3. Develop specific tools and communication channels for reaching different audiences to promote the benefits of—and securing a price premium for—energy-efficient buildings. For example, train sales representatives to explain the benefits of energy efficiency and encourage consumers to buy energy-efficient homes.

What to do now:

- Contact your property agents and show them examples of how to advertise the benefits of energy efficiency to increase sales of efficient homes.

4. Form an industry alliance to work with government and help cultivate a market for energy-efficient buildings. Partner with government at all levels to create new incentive systems, raise public awareness of building energy efficiency, and drive development and adoption of voluntary standards beyond mandatory requirements. Working with government, the alliance can help provide relevant training on building energy efficiency to architects, engineers, and construction workers, and push for an effective national rollout of MOHURD's building-energy labeling system.

What to do now:

- Organize a meeting among like-minded developers to create an agenda for action and a plan for effectively collaborating with government on building energy efficiency.

5. Expand existing corporate social responsibility (CSR) projects to include building-efficiency initiatives. One example might be a project installing energy-efficient lighting at a hospital or school for free. Initiatives such as this will build brand value and demonstrate developers' contributions to energy efficiency and society overall.

What to do now:

- Explore opportunities in your city to help the public sector with energy-efficient building solutions.
- Contact NRDC's Beijing office for some simple examples of CSR initiatives undertaken by other companies.

Commercial Tenants

1. Identify energy-saving opportunities in lighting, office appliance, HVAC systems, and the building envelope. Simply changing default standby settings for office appliances, for example, can cut energy use by up to 33 percent. (For an illustration of key levers, see Exhibit 5.)

What to do now:

- Contact the Joint U.S.-China Cooperation on Clean Energy (JUCCCE) for information on the "Green Office in a Box" online decision-making tool.

2. Invest in and install energy-efficient equipment to reduce electrical load. Investments in efficient lighting, for example, can pay for themselves in a year or less. High-efficiency refrigerators and water heaters offer double-digit returns on investment. And energy-efficient office appliances can lower energy bills by 50 to 75 percent.

What to do now:

- Contact a provider of integrated building systems or solutions to discuss which investment options are cost effective.

3. When looking for new offices, take building efficiency into account. Define your energy-efficiency requirements, collect performance information on all candidate offices, and compare the total rental costs—including any upfront retrofitting costs and projected energy savings.

Exhibit 5. Applying a Few Key Levers Can Yield Significant Savings for Commercial Tenants

Example: A Representative Office in Northern China

Energy application	Percentage of the office's total energy use	Key efficiency levers	Potential energy savings in application (%)[1]	Potential energy savings overall (% of the office's total energy use)	Annual cost savings (RMB)[2]
Space heating	36[3]	Insulation	65	23	21,000
		Thermal glass	55	20	18,000
Lighting	26	Efficient bulbs	85	22	20,000
		Motion sensors	8	2	2,000
Water heating	20	Water boilers	25	5	5,000
Cooling	17[3]	Efficient HVAC	23	4	4,000
Other	1	Efficient elevators	20	>1	918

Sources: NRDC expert interviews; *China Construction Energy Efficiency Annual Report 2008*, Building Energy Research Center of Tsinghua University.
[1]This calculation assumes that the lever is implemented in isolation; it excludes any interactive effects among levers.
[2]We calculated savings assuming an average annual electricity usage of 80 kilowatt hours per square meter of building space, a surface area of 1,700 square meters, and a price for commercial electricity of RMB 0.675 per kilowatt hour.
[3]Percentages reflect energy use patterns for northern China.

What to do now:

- Contact NRDC's Beijing office for additional recommendations that NRDC and BCG have prepared for green offices.

4. Educate your employees with energy-saving tips. Success in employee education requires several critical components: first, commitment from senior management; second, continuous training on energy efficiency; third, tracking and accountability for energy-efficiency results; and, finally, systems that make energy savings easier for your organization to achieve. (An example of a system component that could make energy savings easier to achieve would be optimized energy-saving defaults, such as lights that shut off automatically after certain hours or after an extended period during which no motion is detected in the office.)

What to do now:

- Contact NRDC's Beijing office for practical tips and tools.

5. Use credible energy-rating standards when choosing products and suppliers for your business. For example, key standards include China's energy-efficiency appliance standards and rating label. They also include the United States' ENERGY STAR label, a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy.

What to do now:

- Contact NRDC's Beijing office for a simple fact sheet that highlights these energy-rating standards and labels and explains how to use them to enhance your decision making when selecting products and suppliers for your business.

Civil Society Stakeholders

1. Raise public awareness on building efficiency. The media and NGOs can play a critical role in raising public awareness on the importance of building energy efficiency. Feature stories in magazines, in newspapers, and on television will help raise awareness among the public. Press releases or analysis from NGOs can target more-specific audiences. It is particularly critical to convey the fact that improving building efficiency can be a very cost-effective strategy.

What to do now:

- Organize a seminar on building energy efficiency with local media, and discuss this report and your local conditions with your target readers.

2. Act as a watchdog—especially in local areas—and use media exposure to deter energy-code violation. In large and dynamic countries, governments may not supervise all economic activities. With China's annual new construction reaching 2 billion square meters, it is impossible to inspect every single new building. Local media and NGOs can play a key role in disclosing any failures to comply with regulations or standards. Repeat offenders should be blamed publicly, sending a message not only to the violators but also to others. This type of media exposure can often be more effective than financial and other penalties.

What to do now:

- Create a list of new construction or existing buildings in your area that may not meet building-energy standards, and write an article about the problem or publish the information on your Web site.

3. Use favorable publicity to create motivations. It is equally important to acknowledge best practices in energy efficiency. The media's praise and good publicity can be a powerful motivator. Greater publicity for energy-efficient buildings, for example, can inspire others.

What to do now:

- Establish and promote award programs to recognize best practices in building energy efficiency.
- Publish a story or case study on your Web site about a local green building.

4. Disseminate knowledge and best practices. NGOs may be especially well equipped to advise decision-making stakeholders on the best ways to proceed with energy-efficient building design, construction, and operations. Such NGOs can publish focused recommendations or "guidebooks" that disseminate critical information. They can run seminars and organize conferences to share international and local best practices. Local media can also report on innovative approaches taken by local governments, developers, and tenants.

What to do now:

- Compare China's best-practice standards with the local standards—and disseminate the results.

5. Work with government to continue to push for building efficiency. Through detailed analysis, the local media can encourage regulators to continually improve building standards, refine incentive systems, and increase compliance rates. Continued vigilance by local media will ensure that building efficiency remains a priority. NGOs can also be instrumental in helping government by various channels and approaches, including private discussions with senior officials, collaboration with think-tanks and research institutes, public education efforts, and others.

What to do now:

- Identify key decision makers and influential advisors in your city and arrange an interview or conversation with them on building efficiency and its potential benefits.

Improving China's building energy efficiency is a critically important mission. It is also a challenge that requires sustained commitment and cooperation from all key stakeholders. Each stakeholder group can and should take action now. The costs of inaction, inertia, or apathy are significant and will ultimately deter economic growth. The potential rewards of getting it right—economically, socially, politically, and environmentally—promise to be sizable and long-lasting.

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The Boston Consulting Group's (BCG) offices in China and the Natural Resources Defense Council's (NRDC) China Program have worked together over the last few months to produce this White Paper and extensive supporting materials. If you are interested in obtaining additional information, please contact BCG's or NRDC's Beijing office.

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Acknowledgments

The authors would like to thank Matt Anestis; BCG's Philbert Fan, Aaron Lee, Ying Zhang, and Jerry Zhou; and NRDC's David Goldstein for their contributions to this article.

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