

How green are China's cities?

A new index shows mixed results in the country's push for sustainable urban development.

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Around the world, sustainable development has become a top policy issue as countries struggle to achieve economic growth without compromising the future. Nowhere is the matter more pressing than in China, where urban areas and their economies are expected to grow rapidly over the next few decades and resource use and environmental quality are already grave concerns. National and local leaders have responded by making sustainable development a priority.

Using a new metric—the urban sustainability index—we have found mixed results for this nascent effort.¹ The index revealed a significant gap between the best- and worst-performing Chinese cities across a number of indicators. China’s current model of urban growth does not meet global benchmarks for sustainability, but some cities offer positive examples that could be copied elsewhere in the country and in other developing markets.

We turned to China as a test bed for our index partly because of the country’s staggering rate of urban growth. The McKinsey Global Institute has estimated that the urban population there will expand from about 600 million in 2008 to 926 million in 2025 and more than one billion in 2030. In addition, information from China’s National Bureau of Statistics has become more detailed, reliable, and available in recent years. Finally, the creation of the Ministry of Environmental Protection, in 2008, and other recent initiatives suggest that China’s leaders understand the urgency of the issue and have begun to respond.

To discover underlying trends, we evaluated 112 Chinese cities selected by the national government as the focus of sustainable development and collected data about them for the years 2004 to 2008. Without doubt, cities in China generally lag behind those in developed countries on most sustainability measures, though many show progress and the best are improving rapidly. By primarily comparing China’s cities with one another, we weighed policy successes and failures in urban areas that have similar financial constraints, policy environments, and experiences. Such conditions can be found throughout the developing economies, suggesting that the index may have broader applicability.

Measuring sustainability

Sustainable development—economic growth that improves lives without polluting the environment or exhausting natural resources—is an especially serious matter in developing countries, where mass urbanization is occurring at a time when humanity’s impact on the environment has reached a critical juncture. Yet history offers few examples of sustainable development during the early and middle stages of urbanization. As a result, this issue has become a defining policy challenge of our time.

¹The report on which this article is based, “The urban sustainability index: A new tool for measuring China’s cities,” is available on urbanchinainitiative.typepad.com. The report was published by the Urban China Initiative, a collaboration among Tsinghua University’s School of Public Policy and Management, Columbia University’s Global Center for East Asia, and McKinsey.

Cities in the developing world are the focal point of this struggle because of their exceptional growth rates. It is there that new ideas—to address building codes, transit systems, and indeed the overall urban model—are needed to create sustainable growth. These cities are struggling to house and employ millions of migrants each year as policy makers seek answers that are both straightforward and affordable. A lack of information or an accepted framework for evaluating success often prevents officials from discovering and implementing solutions.

The United Nations, the World Bank, and many other institutions have developed ways to measure a city's overall sustainability. While some of these may offer valid snapshots of the status of urban areas in developed countries, most fail to take into account the data constraints in emerging markets. Our new index tries to bridge this gap, taking advantage of the data available specifically in China.

Our index is designed to measure the performance of Chinese cities across a common set of sustainability categories (exhibit). We created a comprehensive five-part definition of sustainable development, encompassing 18 individual indicators. Our goal was to gauge not only the environmental sustainability of the cities being analyzed but also the level of services required to handle their growing urban populations and each city's efficiency in using resources. These are the five categories:

- **Basic needs.** Access to safe water, sufficient living space, and adequate health care and education are priority needs that help sustain urban populations.
- **Resource efficiency.** Functional resource management (for instance, the efficient use of water and energy and the effective recycling of waste) provides benefits in urban and rural areas alike.
- **Environmental cleanliness.** Limiting exposure to harmful pollutants and improving the efficiency of waste management help make urban environments cleaner.
- **Built environment.** Equitable access to green space, public transportation, and dense, efficient buildings make communities more livable and efficient.
- **Commitment to future sustainability.** An increase in the number of employees and in the level of financial resources devoted to sustainability suggests how vigorously city governments are meeting their commitments to implement national and local policies and standards.

Success stories

China has achieved its greatest successes in meeting urban residents' basic needs, such as improved access to water, health care, and education, as well as providing more living

Exhibit

China's cities have made progress toward sustainability in some categories while lagging behind in others.

Conditions for cities in China, 2004–08
 ▲ Improving ► Constant ▼ Getting worse

Urban sustainability index	Indicators ¹	Meets developed-world's standards?
Basic needs: access to clean water, safe living conditions, and health and education services	▲ Water supply	Yes
	▲ Housing	No
	▲ Health	No
	▲ Education	Yes
Resource efficiency: efficient use of energy, power, and water; efficient waste recycling	► Electric-power consumption	No
	▲ Domestic water demand	Yes
	▲ Industrial-waste recycling	N/A
	▼ Heavy industry's share of GDP	N/A
Environmental cleanliness: clean air and water; efficient waste management	▲ Air pollution	No
	▲ Industrial pollution	No
	▲ Wastewater treatment	Yes
	▲ Domestic waste management	No
Built environment: dense, public-transit-oriented cities; green design; energy-efficient buildings	▲ Urban density	Yes
	▲ Mass-transit usage	Yes
	▲ Public green space	No
	► Buildings' heating efficiency	N/A
Commitment to future sustainability: investments in human and physical assets	▲ Green jobs	N/A
	▲ Investment in environmental protection	N/A

¹ For information on how indicators are measured, see full report on urbanchinainitiative.typepad.com.

Source: Urban China Initiative

space. This achievement shows that many cities have effectively translated economic growth into practical improvements that meet the primary needs of their people.

But China's cities have lagged behind in areas with starker trade-offs between income and the environment. Sulfur dioxide emissions, though declining rapidly, and air pollution remain well above their levels in the developed world and World Health Organization standards. China remains overly reliant on heavy industry. Further, electricity use per unit of GDP remains much higher than it is in the developed world and changed little during the period we studied. (In more recent years, however, national statistics show a significant improvement on this front.)

Yet China's cities approach these challenges with two notable advantages. First, they have relatively high densities, so government investment in improved public transportation

and “smart” grid technologies is attractive. In addition, there are concrete indications that China’s leaders are committed to improved sustainability. Almost three-quarters of the cities in our sample, for instance, increased funding for environmental protection between 2005 and 2008.

Since the index did not reveal any causal relationship between economic growth and environmental performance, our research exposed an unmistakable opportunity for other cities in China to learn from the practices of their better-performing peers and from successes farther afield. Indeed, China’s cities have shown great dexterity over the past few decades in learning from others, an advantage that will serve these cities well as their development model undergoes needed structural shifts.

Almost a third of the cities in our sample expanded economically while improving their sustainability. How have these “sustainable growers,” the vanguard of China’s urban development, built their economies while protecting the environment and the standard of living? We found that such cities—“all-rounders”—performed strongly across most dimensions of the index. Moreover, when we analyzed the policies and programs of some of the best performers, we found four common themes: industrial restructuring linked to land renewal, “green” urban planning, transparent standards and charges, and integrated large-scale recycling. In addition, urban administrators in these cities had restructured government bodies to enhance cross-departmental coordination and to promote long-term sustainability initiatives.

[Industrial restructuring linked to land renewal](#)

Each of the top-performing cities we visited in the course of our study is promoting a shift in urban industrial strategy. Although our study period was a time of heavy industrialization, a directional swing is noticeable. Rising costs and tighter national environmental standards—particularly for sulfur dioxide emissions—have made many city officials press heavy industries to shutter urban factories and relocate in new industrial parks or in suburban development and economic zones.

Many industries that relocated in this way have invested money raised through the sale of land-use rights in urban cores to buy state-of-the-art technology and emissions control equipment, as well as to cover the relocation costs. In response to a national effort to cut industrial sulfur dioxide emissions by 10 percent, for example, Tianjin closed many small, inefficient power plants and used part of the resulting relocation funds to upgrade the infrastructure of factories. Although the trend is just beginning, indications are that consolidating heavy industry away from urban centers brings economies of scale large enough to offset the costs of sophisticated infrastructure retrofits and new equipment. And that’s not to mention the substantial environmental benefits from reduced sulfur dioxide emissions and other pollutants. Industries also appear to be using resources more efficiently.

To ease this restructuring, urban leaders are experimenting with a variety of projects, hoping to transform an industry-based economy into a more service-oriented one. In Tianjin, for example, smokestack industries are moving east from the city center into some parts of the Binhai New Development Zone. In Qingdao, manufacturing industries are relocating across Jiaozhou Bay and into rural regions northwest of the city. Shenyang successfully removed almost all traces of heavy industry from its core between 2008 and 2010.

One critical component of urban industrial regeneration is “brownfield” redevelopment. As heavy industry moves from urban cores, it leaves behind abandoned or badly used tracts of land. Such sites provide large-scale opportunities for planning because they are often sizable plots of land in high-value inner-city locations. Brownfield redevelopment poses an array of governance problems, however, and usually requires intensive investments for site cleanup.

Shenyang offers one example of successful brownfield redevelopment. Spurred on by tightened industrial and zoning regulations, industries began leaving the Tiexi District around 2003. In the following years, the city converted, redeveloped, and ultimately revitalized the district. The improvement enhanced the urban image of the city and helped it use real-estate investment to drive economic development.

[Green urban planning](#)

Chinese cities that have successfully balanced sustainability and growth incorporate both objectives when they create mass-transit networks and urban amenities. Efficient and attractive mass transit takes cars off urban roads, cutting emissions and congestion. Green space provides environmental oases that help refresh the air of cities and make them more attractive places to live and work. The best-performing ones have recognized these benefits and included efforts to enhance mass transit and green space in their development programs.

The substantial bus ridership in Chinese cities is a token of potential demand for transit-oriented development. Buses have remained the predominant mode of mass transportation even as midsize Chinese cities built subway systems. They will probably be the linchpin of urban mass transit for the foreseeable future. Ridership is significant even when there is little development in the immediate vicinity of bus stops, so developers have a large opportunity to increase ridership even further by encouraging business, commercial, or residential development and creating green space within, say, 600 to 800 meters (about 2,000 to 2,600 feet) meters of stops. Qingdao, for example, not only added routes and transit hubs but also focused some of its redevelopment projects along bus lines to prod city residents and visitors away from private transportation. Between 2005 and 2008, bus ridership per capita increased by 17 percent in Qingdao. As part of the economic shift from

manufacturing to tourism, the city has rezoned industrial space for commercial use and begun building mixed-use residential and entertainment-oriented developments along major transit lanes.

Financing is perhaps the most difficult aspect of public transit. China's city officials are seeking ways to manage subsidies, expanding services with minimal public funds. Reasonable fares and a proper regulatory framework for private participation are essential for the long term. In Shenyang, for instance, the municipal public-transport company contracts with private owner–operators and transport firms to supplement its own services. Hoping to minimize delays and improve the reliability of public-transit services, Shenyang has also followed smaller cities, such as Kunming, in giving buses priority on the roads.

To filter out dust particles emanating from vehicles, industrial development, and other sources, urban woodlands and green areas are essential. They also absorb carbon dioxide, helping to clean the air further. Nanning, in the southwestern province of Guangxi, created a “green city” during a ten-year program that included planting an average of two million trees a year. Along the banks of the Yongjiang River, the city has developed three major greenbelts outfitted with trail systems, water conservation areas, and buffers between conservation areas and high-density and industrial areas. In 2009, Nanning proposed a new environmental design to integrate river and marsh systems into the urban landscape by engineering two dams that would split the Yongjiang River into 18 smaller waterways and create 80 lakes within the city.

[Use of transparent standards and charges](#)

One sign of commitment to sustainable development is a clear and consistent sense of responsibility, at the leadership level, that translates into visible efforts to enforce standards and pass on costs to users. In our study, we have seen that when cities adopt clear goals and publicize their progress in meeting them—and ensure accountability for not meeting them—environmental management becomes more effective. In fact, progress on environmental indicators can be attributed not only to a high level of political commitment and the administrative capacity to roll out initiatives rapidly but also to a new accountability system that links their implementation to the performance assessments of local officials. We found that superior environmental supervision and strict monitoring of digital information put cities like Qingdao at the top of the index.

Part of Qingdao's consistent performance in wastewater treatment is the result of pressure from Shandong Province officials, who identified the region's 1,000 biggest polluters in a public listing and set aggressive waste reduction targets for each of them. By 2008, more than 1,000 companies and 170 wastewater-treatment plants in the province were being monitored. Each company on the list was required to provide digital data on its status regularly. Such policy enforcement at the provincial level in effect places cities in a healthy public competition that helps push improvements.

Indeed, the best-performing cities take one-upmanship to new heights. Shandong, for example, began requiring companies to monitor and report water quality every two hours. Qingdao, wanting to maintain its status as the province's leading environmental city, then mandated monitoring every half hour. In addition, Qingdao sends staff from the environmental-monitoring department to check first-hand the accuracy of the digital data. These inspections occur every 10 to 30 days, depending on a company's place on the list of polluters.

Integrated large-scale recycling

Creating efficient local linkages among industrial products from different sectors is a critical component in the efforts of the best-performing cities to reach environmental sustainability. In the next five years, leaders of rapidly industrializing small and midsize cities in China must find ways to reduce the consumption of resources and to use them more efficiently. One promising approach links manufacturing or utilities plants in a given locale. Tianjin's Binhai New Area, for example, started with two ambitious projects to make desalinization its industrial base and has gradually formed a cluster around desalination expertise. Tianjin officials we visited pointed to its Beijiang Power Plant as an example of resource efficiency: the project links water, power, sea salt production, waste reuse, and land conservation in an elegant desalinization system.

During the project's first phase, launched in 2005, the city invested 1.3 billion renminbi (around \$160 million) to construct two 1,000-megawatt generators that would provide 200,000 tons of water a day for city residents as a by-product of power generation. In phase two, which began in 2010, two 1,000-megawatt clean, coal-fired generating units and saltwater-cooling towers will be added. The whole system is expected to provide 400,000 tons of fresh water a day, as well as 11 billion kilowatt-hours of power, 450,000 tons of salt, and 60,000 tons of minerals² a year. Fly ash and other waste will be sold cheaply to construction companies for building materials.

In Qingdao, Tsingtao Beer, one of China's best-known brands, has partnered with a local university to explore ways to reuse brewery wastewater and other waste. One of the techniques tested, bio-contact oxidation, treats high volumes of bio-solids efficiently by adding live cultures to the wastewater so that waste clumps together: removal rates for chemical and biological discharges reached 80 percent and 90 percent, respectively, from 2005 to 2008. This method of treating wastewater that has high levels of organic content is becoming popular in Hangzhou, Shenyang, and Zhejiang breweries because methane generated in the process can be piped to households for cooking, while the remaining waste is used in fertilizers and animal feed.

²Bromine, potassium chloride, magnesium chloride, and magnesium sulfate.

Related thinking



“Meeting the challenges of China’s growing cities”

A significant number of China’s cities are making rapid progress toward sustainability, and another group is at serious risk of falling behind. Unless the latter make strenuous efforts to improve their performance, this gap will continue to grow, with consequences for the country’s overall living standards and environment. China’s leaders have recognized this truth, so we expect that efforts to meet the challenge will form a core part of the upcoming 12th Five Year Plan. The urban sustainability index highlights initiatives that really work and can help cities in China and other emerging markets to achieve sustainable development. [○](#)

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