New models for sustainable growth in emerging-market cities

A new tool, the urban sustainability index, highlights five themes of sustainable development for cities in emerging economies.

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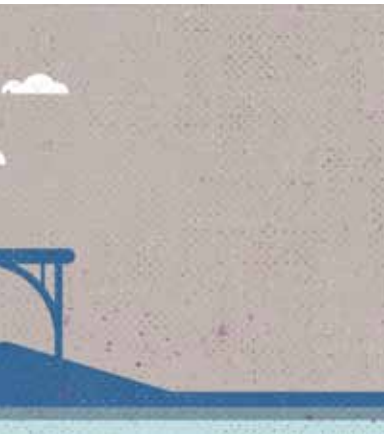
The need to prioritize sustainability has never been more urgent than it is today. This is particularly true in emerging markets, which are entering a period of mass urbanization that could dramatically raise productivity and standards of living but that also poses environmental and other threats that could significantly reduce the benefits of growth.

Many emerging markets are already pursuing sustainable development—economic growth that improves lives without exhausting the environment or other resources—but the absence of accepted frameworks for evaluating success in emerging-market cities often prevents officials from discovering and implementing effective solutions.

We created a new metric, the *urban sustainability index*, to address this gap and help policy makers in emerging markets identify approaches that will work in their cities.[1] The index is designed to measure the performance of cities in five sustainability categories: how well they are meeting their citizens' basic needs, resource efficiency, environmental cleanliness, built environment, and commitment to future sustainability.

We turned to China as a test bed for the index for a number of reasons. It has more emerging cities than any other country, and they are growing faster than any other cities in the world. Moreover, the necessary data are increasingly available in China,



and the country's leadership is showing increasing commitment to urban sustainability.

By analyzing the policies and programs of some of China's most sustainable cities, we identified five common themes for achieving sustainability in emerging-market cities: industrial restructuring linked to land renewal, "green" urban planning, transparent standards and charges, integrated large-scale recycling, and cross-departmental coordination.

A question naturally emerges as to whether the insights gleaned in China would be relevant in emerging markets elsewhere. Certainly regional variations would yield differences in the particulars of policy, and ultimately cities will benefit from using the index to conduct analyses in their specific geographies. But in the interim, our experience working in cities around the world suggests that the themes we identified in China are generally valid across cities in emerging markets, and thus policy makers, companies, and civic organizations in other emerging markets can use the findings from China to advance sustainability in their own cities.

Rapid growth, little guidance on sustainability

Our analysis indicates that 423 emerging-market cities will generate more than 45 percent of global GDP growth from 2007 to 2025. The population of these cities will grow by an estimated 40 percent over this period, and the average income (measured in GDP per capita, adjusted for purchasing power parity) will more than double from $13,000 to $31,000. As a result, these cities will account for nearly 20 percent of the global population and about 30 percent of global GDP by 2025.[2]

Cities in these regions lag significantly on sustainability when compared with cities in the developed world, but they face challenges so different that the benefits of the comparison are limited. Moreover, there is very little sustainability data on emerging-market cities, so it has been difficult even to identify reference points against which these cities could measure their performance.

When data are available, they can be difficult to compare across countries due to differences in language, standards of measure, and conventions for gathering and codifying information. The IT and administrative systems used by different countries are often incompatible. Indeed, countries use different criteria to determine what constitutes a city.

While the United Nations, the World Bank, and other institutions have made great contributions by developing approaches that measure sustainability in cities, incompatibility remains a challenge. As the World Bank's Dan Hoornweg has observed, "the vast majority of indicator programs have not proven sustainable over time for reasons of cost, complexity, or lack of political or institutional support. Many were developed just once. No single organization or Web site has emerged as a global portal for city indicators, and there is no one source that presents even the most basic information about city performance in a consistent, comparable manner."[3]

The urban sustainability index

We created the urban sustainability index to fill the gap in current analysis of sustainable development. The index measures the performance of cities in emerging markets on a common set of sustainability categories. Our

goal was to gauge not only the environmental sustainability of cities but also city officials' commitment to handling their growing urban populations in a sustainable way, and their efficiency in using resources.

To that end, we created a comprehensive five-part definition of sustainable development, encompassing 18 individual indicators that are important in emerging economies and for which data are readily available (exhibit). For example, the index accounts for basic needs such as availability of drinking water, which, while nearly universal in developed economies, varies widely in emerging countries.

To determine elements that are critical to sustainability, we evaluated 112 cities selected by China's national government as the focus of sustainable development, using data for 2004 to 2008. We examined policy successes and failures in urban areas featuring similar financial constraints, policy environments, and experience.

Exhibit

A five-part index includes 18 indicators necessary for sustainable development in emerging economies.

Categories	Indicators	Description of the indicators
Basic needs	• Water supply • Housing • Health • Education	• Water access rate (%) • Living space (square meters per capita) • Doctors per capita • Student-teacher ratio (primary school)
Resource efficiency	• Power • Water demand • Waste recycling • % GDP from heavy industry	• Total electricity consumption (kilowatt-hour/GDP) • Water consumption (liters per capita) • Ratio of industrial waste recycled and utilized (%) • Heavy-industry GDP/total GDP (billion renminbi)
Environmental cleanliness	• Air pollution • Industrial pollution • Wastewater treatment • Waste management	• Concentration of SOx, NOx, PM10[1] (milligrams/cubic meter) • Industrial sulfur dioxide discharged/GDP (tons/renminbi) • Wastewater treatment rate (%) • Domestic waste collected and transported (10,000 tons per capita)
Built environment	• Urban density • Mass-transit usage • Public green space • Building efficiency	• Persons/square kilometer of urban space • Passengers using public transit (bus, trolley) • Public green space (square meters per capita) • Building heating efficiency
Commitment to future sustainability	• Green jobs • Investment in environmental protection	• Number of environmental professionals per capita • Amount of environmental sanitation funds/GDP

[1]Sulfur oxides, nitrogen oxides, and particulate matter.

Source: *The urban sustainability index: A new tool for measuring China's cities*, Urban China Initiative, a joint initiative of Tsinghua University, Columbia University, and McKinsey & Company, November 2010, p. 10 (www.urbanchinainitiative.typepad.com/files/usi.pdf)

The definition of sustainable development comprises five categories:

Basic needs. Access to safe water, sufficient living space, adequate health care, and education are fundamental priorities for urban populations.

Resource efficiency. A city's efficiency in such areas as the use of water and energy and the effective recycling of waste directly correlates to the quality of life of its citizens.

Environmental cleanliness. Limiting exposure to harmful pollutants is fundamental to a city's livability.

Built environment. Equitable access to green space, public transportation, and dense, efficient buildings makes communities more livable and efficient.

Commitment to future sustainability. An increase in the number of employees and the level of financial resources devoted to sustainability suggests how committed city governments are to implementing national and local policies and standards.

An encouraging finding is that sustainability does not come at the expense of wealth. Most of the critical indicators that drive sustainability—such as wastewater treatment, mass-transit usage, and environmental investment—were unaffected by level of economic development (see sidebar, "Sustainability does not hinge on wealth"). The only indicators for which we found even a weak negative correlation between sustainability and wealth were power consumption, industrial sulfur dioxide emissions, and GDP from resource-intensive sectors. Indeed, the best-performing cities in our study group improved sustainability while increasing GDP from 2005 to 2008 at an above-average rate.

Five themes for sustainable development

As a result of analyzing the policies and programs of some of China's best-performing cities, we identified five themes common to sustainable cities in emerging markets: industrial restructuring linked to land renewal, "green" urban planning, transparent standards and charges, integrated large-scale recycling, and cross-departmental coordination.

Industrial restructuring linked to land renewal. 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 build more modern plants in new industrial parks or in suburban development and economic zones. In Tianjin, for example, smokestack industries are moving east from the city center into some parts of the Binhai New Area, a 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 from 2008 to 2010. This phenomenon is common to many growing markets in the industrialization phase.

Many industries that relocated have invested money raised by selling land-use rights in urban cores to buy state-of-the-art technology and emissions-control equipment, as well as to cover their 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

Sustainability does not hinge on wealth

Affordability is often raised as a concern in discussions of sustainability in the developing world. Our research was encouraging in this regard, in that the index showed almost no correlation between a city's wealth and its ability to create sustainable growth.

This finding was reinforced by the segmentation analysis we conducted, which involved dividing the 112 Chinese cities we analyzed into four groups based on their performance: sustainable growers, sustainable stragglers, waverers, and unsustainable growers (exhibit).

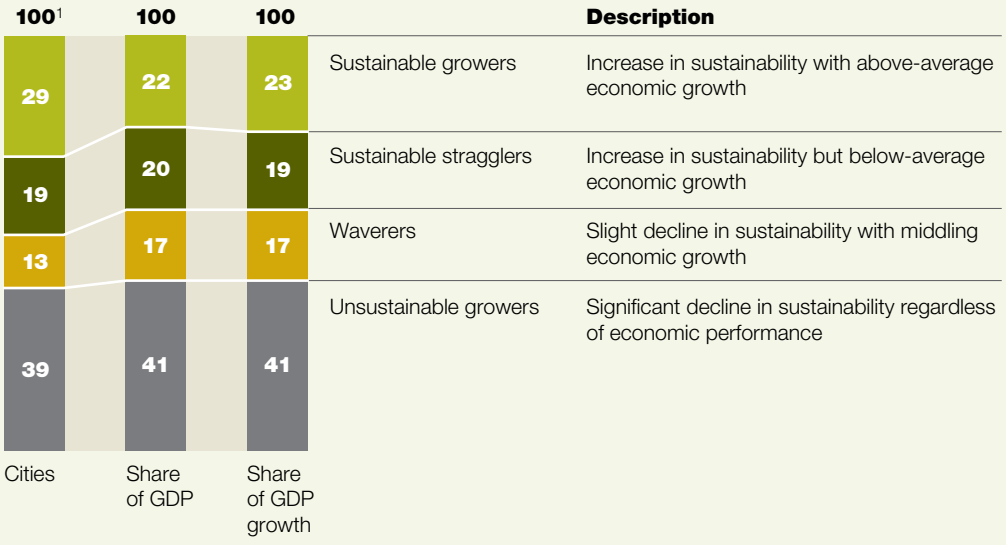
The 33 cities that qualified as "sustainable growers" managed an above-average increase in GDP per capita during the study period, while at the same time improving their sustainability rankings. Their score in our index increased an average of 4 points, compared with a 9-point drop by the "unsustainable growers," and their GDP per capita grew an average of 12.3 percent a year, compared with 11.1 percent for the latter group.

Since we found no deterministic relationship between economic growth and performance in our index, our research exposed an unmistakable opportunity for other cities in China to learn from the practices of their better-performing peers.

Exhibit

Best performers increased GDP while improving sustainability.

City growth and sustainability performance, 2005–08
%



[1]100% = 112 cities.

Source: *The urban sustainability index: A new tool for measuring China's cities*, Urban China Initiative, a joint initiative of Tsinghua University, Columbia University, and McKinsey & Company, November 2010, p. 21 (www.urbanchinainitiative.typepad.com/files/usi.pdf)

the funds from the sale of land-use rights to upgrade the infrastructure of their factories, now located in the Binhai New Area. 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.

That heavy industry can be moved without net cost is a crucial component of achieving urban sustainability. Equally crucial is "brownfield" redevelopment at the sites left behind. These sites provide large-scale opportunities for planning, because they are typically large plots of land in high-value inner-city locations.

Brownfield redevelopment usually requires intensive investments for site cleanup, so it is instructive to examine successful examples, one of which is offered by Shenyang. Spurred 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 area. 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. Urban forests and green areas serve as a net to filter dust particles caused by vehicles, industrial development, and other sources. They also absorb carbon dioxide, helping clean the air. The best-performing cities 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 an indication of potential demand for transit-oriented development elsewhere. Ridership is significant even when there is little development in the immediate vicinity of bus stops. Since people generally prefer walking short rather than long distances to work, developers have an opportunity to increase ridership even further by encouraging business, commercial, or residential development and creating green space within, say, 600 to 800 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.

Guangzhou received the 2011 Sustainable Transport Award from the Institute for Transportation and Development Policy for the sustainable transportation and greenway projects it launched in 2010. Modeled on programs developed in Curitiba, Brazil (see sidebar, "Curitiba's model public-transportation system," p. 61), Guangzhou's bus rapid transit system

carries more than 800,000 passengers per day. Its bike-sharing system deploys 5,000 bikes and 113 sharing stations. And its Donghaochong greenway project created four kilometers of off-street bikeway and walkway along the Donghaochong River.

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 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 10-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.

Transparent standards and charges. Our research indicates that cities are more likely to achieve high standards of sustainability if they adopt clear goals, publicize their progress toward meeting them, and hold responsible parties accountable for their performance. For example, superior environmental supervision and strict monitoring of digital information pay off for cities such as Qingdao.

Part of Qingdao's consistent performance in wastewater treatment is the result of pressure from Shandong province officials, who publicly identified the region's 1,000 biggest polluters 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 encourages 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 city with respect to environmental issues, then mandated monitoring every half hour. In addition, Qingdao sends staff from the environmental-monitoring department to check firsthand 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. The best-performing cities excel at creating efficient local linkages among industrial producers from

Curitiba's model public-transportation system

Curitiba is Brazil's eighth-largest city, with a population of 1.75 million people. It responded to the population boom of the late 1960s and early 1970s by developing a metropolitan economic strategy that made efficient urban transportation the cornerstone of a program to ensure a high quality of life.

The city established the Institute for Research and Urban Planning in Curitiba (IPPUC) in 1965 to oversee the development and implementation of its mass-transit plan. A major objective was to build two structural roads (subsequently expanded to five) that have two central lanes reserved for express buses. Public transportation consists entirely of buses. Land within two blocks of the transit arteries is zoned for high density, and zoned residential densities taper in proportion to distance from transit ways.

Urbanização de Curitiba (URBS), a state-owned company created in 1980, is charged with maintaining the city's transportation infrastructure and overseeing its bus operations. In 1987, a municipal law designed to reduce congestion required that bus companies be granted licenses and reimbursements based on kilometers traveled rather than number of people carried. Passengers are charged the same rate for service regardless of distance traveled, and the fare is set to ensure that carriers can cover their costs without requiring state subsidies.

The IPPUC and URBS have continued to implement innovations to improve the system, including installing bike paths as an alternative to motorized transportation. The city now has about 100 kilometers of paths that are used by some 30,000 bikers every day. In 1991, they installed elevated tube stations to help passengers board and disembark more quickly and to increase access for the disabled. They also introduced biarticulated buses, which are significantly longer than traditional buses, increasing the carrying capacity per vehicle and the overall efficiency of the fleet.

The popularity of Curitiba's system for bus rapid transit (BRT) has effected a modal shift from automobile to bus travel: 80 percent of travelers use the express or direct bus services, and estimates based on a 1991 traveler's survey indicate that BRT reduced the number of auto trips by 27 million per year, saving approximately 27 million liters of fuel annually. Curitiba uses about 30 percent less fuel per capita than eight other Brazilian cities of its size, and it has one of the lowest rates of ambient air pollution of any city in the country.[1]

[1] "Curitiba experience," *Issues in bus rapid transit*, US Department of Transportation, pp. 10–15 (www.fta.dot.gov).

different sectors. In the next five years, leaders of rapidly industrializing small and midsize cities must find ways to reduce the volume and increase the efficiency of resource consumption. One promising approach in China links manufacturing or utilities plants in a given locale. Tianjin's Binhai New Area, for example, started with two ambitious projects to transform itself into a desalination center. Tianjin officials we interviewed pointed to its power plant near Beijing as an example of resource efficiency: the project links water, power, sea-salt production, waste reuse, and land conservation in an elegant desalination 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 freshwater a day, as well as 11 billion kilowatt-hours of power, 450,000 tons of salt, and 60,000 tons of minerals[4] a year. Fly ash and other waste will be sold cheaply to construction companies for building materials.

In Qingdao, one of China's best-known brands of beer, Tsingtao, has partnered with a local university to explore ways to reuse brewery wastewater and other waste. For example, they have tested a technique called biocontact oxidation, which involves adding live cultures to wastewater to foster clumping of biosolids, thus facilitating the extraction of chemical and biological discharges. Methane generated in the process can be piped to households for cooking, while the remaining waste is used in fertilizers and animal feed. The technique enabled Tsingtao to achieve removal rates of 80 percent for chemical discharges and 90 percent for biological discharges from 2005 to 2008. In light of this success, Hangzhou, Shenyang, and Zhejiang breweries are beginning to use the technique as well.

Cross-departmental coordination. Our interviews with urban officials in China indicate that success in executing sustainable development projects depends on coordination among city agencies and other bodies. For example, successful transit projects typically involve experts in urban planning, construction, and the environment. Efforts to increase environmental transparency involve representatives from industry and information management. And land-renewal projects involve experts in economic planning, land use, urban planning, and multiple industries.

To break down silos and facilitate cooperation, municipalities should establish processes to ensure projects meet coordination requirements before they are approved. In Shenyang, for example, all projects must be approved by a department directly affiliated with the state council, and officials must demonstrate that they have met the city's standards for coordinating with all relevant departments.

Municipal governments should also establish formal channels of communication across departments and set targets indicating how often departments should exchange information. And they should track performance to ensure that departments interact regularly on issues of mutual concern. In Qingdao, the assessments of local officials are tied to project implementation and account for interdepartmental coordination. To ensure its assessments are rigorous, the city has implemented a performance-tracking system, which is maintained by designated administrators.

Every solution should account for contingencies that could jeopardize long-term success. Nanning has managed to continue its tree-planting program despite a succession of four party secretaries and three mayors.

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Our work with the urban sustainability index does not end with these findings. We will continue our efforts, including conducting primary research in emerging countries other than China, and we will refine the index as the analysis evolves. In particular, we intend to identify a larger suite of best practices for emerging-market cities that are committed to sustainable development. We expect to develop a better understanding of the cost and time trade-offs implicit in these measures, explicitly searching for those that can be implemented rapidly with noteworthy results. And we will strive to identify the unique factors—such as intrinsic historical, geographic, or natural advantages—that would make replicating these best practices more difficult.

The challenge facing rapidly growing cities in developing countries is enormous. Leaders in China and other emerging markets have recognized this and are already taking action to develop solutions to these challenges. Our ambition in creating the urban sustainability index is to provide a yardstick that cities can use to measure success and identify initiatives that they can implement to achieve sustainable development.

[1] For the full report on which this article is based, see *The urban sustainability index: A new tool for measuring China's cities*, Urban China Initiative, a joint initiative of Tsinghua University, Columbia University, and McKinsey & Company, November 2010 (www.urbanchinainitiative.typepad.com/files/usi.pdf).

[2] *Urban world: Mapping the economic power of cities*, McKinsey Global Institute, March 2011 (www.mckinsey.com/mgi).

[3] David Blaha and Dan Hoornweg, "The current status of city indicators," 2006 (www.cityindicators.org).

[4] Bromine, potassium chloride, magnesium chloride, and magnesium sulfate.

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