The Urban China Initiative

A joint initiative of Columbia University, Tsinghua University, and McKinsey & Company

The Urban Sustainability Index: A New Tool for Measuring China's Cities

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China's urbanization over the last twenty years has been a success. Since 1990, China's cities have grown by 380 million people, while per capita urban GDP has grown five times. China's leaders have recently called for a structural adjustment to China's growth model. This adjustment is needed if China's cities are to surmount two intertwined challenges: the scale of China's urbanization, and with it the pressures of social change and resources; and the need to meet the rising aspirations of China's citizens. While there is no shortage of technologies and initiatives available for tackling these challenges, there is a significant gap between knowing what is needed and knowing how to implement the solutions.

A new think-tank has been established with the express mission of finding and implementing effective solutions to China's urbanization challenge: The Urban China Initiative. To fulfill its mission, the Initiative has three specific aims:

- **Solutions** – Be the source of the best and most innovative solutions to urban development issues in China.
- **Talent** – Be a home for China's leading domestic and international urban thinkers and professionals, and a magnet for the best global thinkers
- **Dialogue** – Be the convenor of China's leading national, provincial and local dialogues on urban issues

By combining these aims, the Initiative will also pursue knowledge initiatives with the goal of developing solutions that can be applied across hundreds of cities in China. The Urban Sustainability Index (USI), the first-ever index for measuring and comparing urban sustainability across China is an example of the type of research that the Initiative will undertake.

The Initiative is a collaborative effort whose research will be led by three major founding institutions: McKinsey & Company, Columbia University, and Tsinghua University's School of Public Policy and Management. The Initiative maintains a strategic partnership with the Chinese Society of Urban Studies, and is advised and funded by leading domestic and multinational corporations.

November 2010

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Preface

This report represents the first in a series of research initiatives that will be undertaken by the newly-established Urban China Initiative, a non-profit organization jointly founded by McKinsey & Company, Columbia University, and Tsinghua University's School of Public Policy and Management. In line with the Initiative's mission to find solutions to China's most pressing urbanization challenges, the intent of this report is to provide a robust fact base for assessing and comparing where China's cities stand on their path toward sustainable development. It also provides a basis for sharing best practice examples linked to higher levels of sustainability in China.

In the course of our research, we developed a new methodology for measuring sustainable development that we call the Urban Sustainability Index. Because of the enormous scale and unique challenges that China faces in pursuing sustainable urban development, as well as the increasing availability of data, we chose China as the test bed for the development of the Index. However, the methodology we employed is one that can be applied to other developing economies.

This five-month research effort involved the support of several colleagues at McKinsey, including Luke Jordan, Ellen Chen, Alex Liebman, Kevin Li and many others. At Columbia, we wish to acknowledge Professor Steve Hammer's leadership role in defining the methodology for the index.

This work benefited immensely from numerous interviews with public and private sector leaders in several of China's cities.

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November 1, 2010

Introduction

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

Using a new metric, the Urban Sustainability Index, we've found mixed results for this nascent effort. While China's current model of urban growth does not meet global benchmarks for sustainability, there are cities offering positive examples of sustainable development that could be copied elsewhere in China and in other developing countries.

Sustainable development, economic growth that improves the lives of the people without exhausting the environment or other resources, is especially critical in developing countries, where mass urbanization is taking place at a time when man's impact on the environment has reached a critical juncture. Yet history offers precious few examples of such development during the early and middle stages of urbanization. As a result, sustainable development has become one of the defining policy challenges of our time.

Because of the exceptional growth rates they are witnessing, cities in the developing world are the focal point of this struggle for sustainable growth.

The challenges and the available responses will concentrate on cities in China, India and other developing economies around the world. It is there that new ideas to tackle building codes, transit systems, and indeed the overall urban model are needed to create sustainable growth.

Yet, 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 tried to develop ways to measure a city's overall sustainability. But while some of these may offer a valid snapshot of the status of cities in developed countries, most fail to take into account the data constraints found in emerging markets. To bridge this gap, we've developed the Urban Sustainability Index, which takes advantage of the data available specifically in China. The index gauges a city's performance across five relevant categories. Specific indicators that are available in developing markets were defined for each category.

We turned to China as a test bed for our index partly because urban growth there is unprecedented. 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 1 billion in 2030. Such growth makes China a major battleground in the fight to create sustainable urban development. In addition, information from China's National Bureau of Statistics has become more detailed, reliable and available over recent years, shortening the time needed for data collection. And finally, the creation of the Ministry of Environmental Protection in 2008 and other recent initiatives suggest China's leaders understand the urgency of the issue and have begun to respond rigorously to the sustainability challenge.

Without doubt, most cities in China lag those in developed countries across most measures of sustainability, though many are showing positive trends and the best are improving rapidly. But by primarily comparing China's cities against themselves, we weigh policy successes and failures against urban areas with similar financial constraints, policy environments and experience. Such similarities can be found throughout the developing economies, suggesting broader applicability for our Index.

The remainder of this report will:

- Look in more detail at the components of the Urban Sustainability Index,
- Analyze the results of applying the index to China's cities, and
- Examine some of the successful programs from among the country's best-performing cities.

The report presents the initial findings from the Index, but should not be seen as definitive or exhaustive. In coming years, we plan to continue monitoring progress toward urban sustainability on China, as well as other counties, and update these findings as necessary.

Measuring sustainability

The Urban Sustainability Index was created to fill a gap in current analysis of sustainable development. In recent years, there have been many efforts designed to compare economic growth and environmental sustainability. The World Bank, the United Nations, Yale and Columbia universities and others have all added to a growing fact base around this important issue. (See Appendix for more detail.)

Most of those efforts focused on the valuable work of creating the necessary theoretical framework for measuring sustainability, resulting in various models with substantial overlap. Only a few moved from theory to measurement, and those that did often focused attention on national-level statistics or on the developed world. As a result, little is available to measure the sustainability of developing country cities, where the challenge is often most acute.

In the Urban Sustainability Index we've attempted to begin addressing that gap. We worked to select indicators that are more readily available in developing economies and more relevant. For example, the Index looks at basic needs such as water availability, which varies widely in developing countries, but would be near universal in developed economies. Obviously, developing countries themselves span a wide range of statistical intensity. The Index, however, goes a step or two closer to capturing the relevant data from these countries.

We used China as a test bed for the Index for several reasons. The urban population in China is expected to exceed 1 billion by 2030, almost doubling the 600 million just two years ago. Such growth presents enormous policy challenges to the country's leaders at all levels. For the purpose of data collection, information was also readily available, especially since additional resources at the National Bureau of Statistics have improved the amount and quality of data available from China's cities over the past few years. We evaluated 112 Chinese cities that have been earmarked by the national government as the focus of sustainable development efforts[1]. We collected data about those cities spanning the years 2004 to 2008 to discover underlying trends.

The Urban Sustainability Index is designed to measure relative performance over time of Chinese cities across a common set of sustainability categories. We composed a comprehensive five-part definition of sustainable development encompassing 18 individual indicators to gauge not only the environmental sustainability of the cities being analyzed, but also the level of services required to handle a growing urban population and each city's resource efficiency. We believe these indicators represent the best set of data for commonly accepted indicators that are available in China from both national and local sources.

The Index measures a city's performance against five aspects we believe are critical to sustainable development:

1 The 11th Five Year Plan designated 113 cities for sustainable development and to strengthen environmental protection. We removed Lhasa from our analysis because of data limitations.

- Basic Needs: Access to safe water, sufficient living space, and adequate healthcare and education are priority needs that help sustain an urban population.
- Resource Efficiency: Efficient use of water and energy and effective waste recycling contribute to functional resource management, providing benefits in both urban and rural areas.
- Environmental Health: Lessening exposure to harmful pollutants and heightening waste management efficiency helps induce cleaner urban environments.
- Built Environment: Increased livability and efficiency of communities comes with equitable access to green space and public transportation, as well as dense and efficient buildings.
- Commitment to Sustainability: More staff and financial resources brought against sustainability challenges suggests how vigorously city governments are meeting their commitments to implement national and local policies and standards.

These categories draw from the experience of other research efforts and reflect our belief that sustainable development combines efforts being made today with initiatives that will maintain performance over time. To measure performance against these categories, we analyzed 18 relevant indicators (Exhibit 1).

Exhibit 1

5 indicators of urban sustainability

Categories	Definition	Indicators	Description of the indicators
Basic needs	▪ Access to safe water, living conditions, education and health services	▪ Water supply ▪ Housing ▪ Health ▪ Education	▪ Water access rate (%) ▪ Living space (sq.m per capita) ▪ Doctors per capita ▪ Student teacher ratio (primary school)
Resource efficiency	▪ Efficient use of energy, power and water; waste recycling	▪ Power ▪ Water demand ▪ Waste recycling ▪ % GDP from heavy industry	▪ Total electricity consumption (kwh per GDP) ▪ Water consumption (Liters per capita) ▪ Rate of industrial waste recycled and utilized (%) ▪ Heavy industry GDP/ Total GDP (bln RMB)
Environmental cleanliness	▪ Clean air and water ▪ Waste management	▪ Air pollution ▪ Industrial pollution ▪ Waste water treatment ▪ Waste management	▪ Concentration of SOx, NOx, PM10 (mg/cu.m) ▪ Industrial SO2 discharged per GDP (T/ RMB) ▪ Wastewater treatment rate (%) ▪ Domestic waste collected & transported (10,000 T per capita)
Built environment	▪ Dense, transit-oriented, green, efficient design	▪ Urban density ▪ Mass transit usage ▪ Public green space ▪ Building efficiency	▪ Persons per square kilometer of urban area ▪ Passengers using public transit (bus, trolley) ▪ Public green space per capita (sq.m per capita) ▪ Building heating efficiency
Commitment to future sustainability	▪ Investment in human and physical assets	▪ Green jobs ▪ Investment on environmental protection	▪ # of environmental professionals per capita ▪ Amount of environmental sanitation funds per GDP

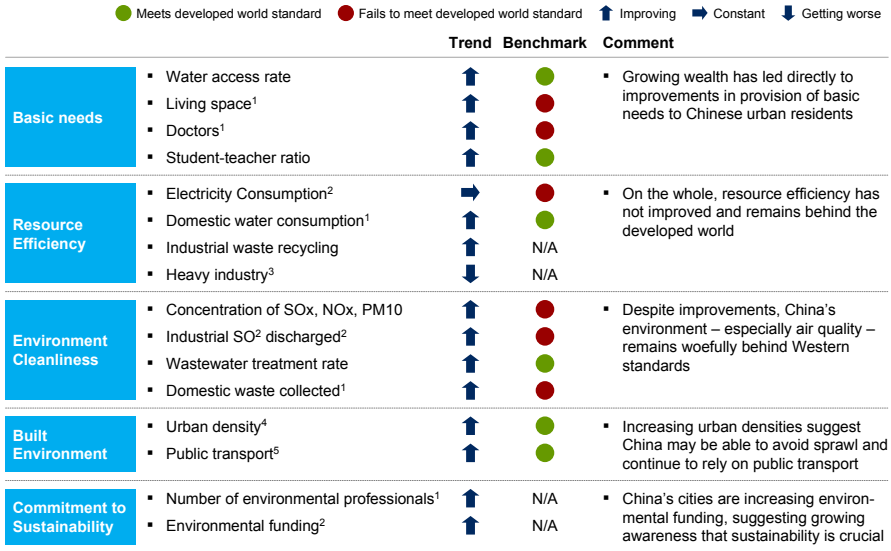
SOURCE: Team analysis

City performance by indicator

Over the last few years cities in China that we studied made noticeable strides toward becoming sustainable by developed country standards, but on the whole much more progress is needed before reaching that goal. Using the Urban Sustainability Index to chart performance, we have been able to pinpoint these disparities (Exhibit 2).

Exhibit 2

While China's cities have improved, by some indicators they remain well behind the developed world



		Trend	Benchmark	Comment
Basic needs	Water access rate	↑	●	Growing wealth has led directly to improvements in provision of basic needs to Chinese urban residents
	Living space[1]	↑	●	
	Doctors[1]	↑	●	
	Student-teacher ratio	↑	●	
Resource Efficiency	Electricity Consumption[2]	→	●	On the whole, resource efficiency has not improved and remains behind the developed world
	Domestic water consumption[1]	↑	●	
	Industrial waste recycling	↑	N/A	
	Heavy industry[3]	↓	N/A	
Environment Cleanliness	Concentration of SOx, NOx, PM10	↑	●	Despite improvements, China's environment – especially air quality – remains woefully behind Western standards
	Industrial SO^2 discharged[2]	↑	●	
	Wastewater treatment rate	↑	●	
	Domestic waste collected[1]	↑	●	
Built Environment	Urban density[4]	↑	●	Increasing urban densities suggest China may be able to avoid sprawl and continue to rely on public transport
	Public transport[5]	↑	●	
Commitment to Sustainability	Number of environmental professionals[1]	↑	N/A	China's cities are increasing environmental funding, suggesting growing awareness that sustainability is crucial
	Environmental funding[2]	↑	N/A	

1 Per capita; 2 Per unit GDP; 3 As share of GDP; 4 People per square kilometer; 5 Bus trips per capita

The country has marked the greatest successes in meeting the basic needs of its urban residents, such as improved access to water, healthcare and education, as well as providing more living space. This demonstrates that Chinese cities have been very effective at translating economic growth into practical improvements that meet urban residents' primary needs.

But China's cities have lagged behind in areas in which the tradeoffs between income and environment are starker. Air pollution and sulfur dioxide emissions remain well above developed world and World Health Organization standards, even though sulfur dioxide emissions are declining rapidly. China remains overly reliant on heavy industry. Further, electricity use as part of GDP remains much higher than the developed world and showed little change 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, which make government investment

in areas such as improved public transportation and smart grid technologies more attractive. Second, there are concrete indications that leaders are committed to improved sustainability. For example, almost three-quarters of the cities in our research sample increased funds targeted toward environmental protection between 2005 and 2008.

The Index has also revealed a significant gap between the best-performing cities and the worst across a number of indicators. A significant portion of China's cities are making rapid progress toward becoming sustainable, and another group is at serious risk of falling behind. Without strenuous efforts to improve performance, this gap will only grow, with serious implications for the country's overall living standards and environment.

In the remainder of this section, we outline some of the more interesting findings across the five categories.

Basic Needs

Under effective city management, fulfilling the basic needs of residents is a relatively straightforward task as a city's economy grows. If additional resources can be mobilized, utility infrastructure can be improved, more teachers and doctors can be hired, and more apartment blocks can be built. Our findings confirm the general impression that China's cities are highly effective in this area.

But while the Index confirms improvements in almost every city included in our study, it also revealed stark gaps between the best-performing cities and the worst. These gaps are likely to continue to grow under the status quo.

Education: The gap between cities with strong and weak primary school education narrowed between 2005 and 2008. In 2005, cities in the top quintile had 6.3 fewer students per teacher on average than those at the bottom, and by 2008 the gap had narrowed to 5.7 students.[2] Cities in the top quintile had just over 15 students per teacher on average in 2008, while those in the bottom quintile had just less than 21.

These numbers are comparable to international standards for primary education and better than those seen in other developing countries. France and Germany, for example, had 19 students per teacher in 2005, about the average for OECD countries. Developing countries were further behind, with Mexico, for example, showing 28 students per teacher in 2005.

Healthcare: In medical care, almost every city increased the number of doctors per capita, with the average growing from 2.5 doctors per 1,000 residents to 2.8 between 2005 and 2008. But, the disparities among cities

2 Although student-teacher ratios have less influence on the overall quality of education than many believe, we use the indicators here because of its availability and as a credible directional indicator. For more information, see, for example, Michael Barber, Mona Mourshed and Fenton Whelan, "Improving education in the Gulf," McKinsey Quarterly, March, 2007.

also grew. In 2008, cities at the bottom quintile had 2.0 doctors per 1,000 people, compared with 3.6 doctors for cities at the top quintile.

Overall, these ratios are aligned with those seen in other developing countries–Sao Paolo, for example, had 2.6 doctors per 1,000 people in 2009–but they fall short of developed world standards. New York City, for example, had more than 5 doctors per 1,000 residents in 2005.

Housing: Between 2005 and 2008, almost every Chinese city increased the amount of living space per capita. The increase showed a close correlation between the amount of growth and the amount of pre-existing living space. Those cities in the bottom quintile had a third less living space per capita than those in the top quintile throughout this period, with the gap in absolute area increasing sharply. Cities in the top quintile added three square meters of living space per capita on average during these four years, bringing the total to 24 square meters in 2008, while those in the bottom quintile only added two square meters for a total of 16 square meters in 2008.

Living space per capita in Chinese cities is comparable to more developed Asian countries, such as Japan, with 21 square meters per person in urban areas, and South Korea with 23, both from 2005.

Water Supply: Almost every resident of the cities we surveyed had access to running water in 2008. Most cities had near universal access, with only 15 percent of those in our study having coverage of less than 90 percent in 2008. In 2005, a quarter of the cities in our sample had less than 90 percent coverage.

Resource Efficiency

During the period under study—2005 to 2008—China's cities remained relatively static when considering resource efficiency, although there were areas in which use declined markedly. The data confirms that much of China's recent growth was driven by industries that are heavy users of resources, especially electricity. However, it is unclear whether the increased reliance on resources continued following the global economic crisis that began in late 2008 or how effective the nation's nascent attempt to rebalance its economy away from heavy industry has been. Early indications suggest there may have been some progress in this area in recent years.

Electricity: Despite the national goal of becoming less energy intensive, rapid economic growth supported by significant heavy industry drove the trend between 2005 and 2008 among China's cities to use more electricity, not less.[3] The average for the cities we surveyed went from 144 gigawatt hours of electricity per billion renminbi of production to 149 gigawatt hours during the period. The overall trend was driven by cities with very inefficient use of

3 The analysis for this report on Chinese cities stops at 2008, the latest year for which urban data is widely available. The period studied coincides with a boom in heavy industry in China, and more recent national data, as well as anecdotal evidence, suggests that China's cities generally may have begun cutting their electricity intensity in recent years.

electricity: use in the bottom quintile went from 177 gigawatt hours to 182 gigawatt hours per billion renminbi, while the top quintile improved from 83 gigawatt hours to 75 gigawatt hours per billion renminbi.

Urban electric use in China remains very high compared to global standards. Mexico City, for example, used only 10 gigawatt hours per billion renminbi in production in 2008, New York City 11 gigawatt hours in 2008, and Sao Paolo 26 gigawatt hours in 2007. Even Jakarta was more efficient, using 67 gigawatt hours per billion renminbi of production in 2007.

Water Demand: Even as access to water in China's cities increased, the domestic demand per capita fell across the board. Between 2005 and 2008, average urban domestic consumption fell from 33,000 liters per person per year to 32,500 liters. Best performers remained far ahead of the worst, with the top quintile consuming on average 16,000 liters per person per year in 2008 and the bottom quintile consuming on average 47,000. Compared to national averages in developed countries, China's record is superior. The average in the United States was 95,000 liters per person per year in 2008, in France 58,000 liters and in Germany 45,000 liters, for example.

Waste Recycling: During the period studied, while reliance on heavy industry increased in China's cities, more industrial waste was recycled. On average, the proportion of economic activity in China's cities from resource-intensive sectors increased slightly from 52 percent to almost 54 percent from 2005 to 2008.[4] The increase was more or less uniform across the spectrum of cities studied. At the same time, however, the percentage of industrial waste treated in cities rose from 75 percent in 2005 to 80 percent in 2008.

Environmental Health

China is making progress in industrial emissions and wastewater treatment, but air quality remains far below world standards. The three air pollutants we studied are closely associated with the drivers of China's growth: sulfur dioxide is caused by industrial emissions, nitrogen dioxide is largely a result of internal combustion engines and thermal power stations, and particulate matter (dust) is caused by construction and dryness. A broad-based adoption of new technologies and processes will be needed for these cities to meet international health norms, as well as China's own aspirations.

Industrial Pollution: Though industrial emissions have been declining, China's cities remain well above the standards seen in urban areas in developed countries. On average, sulfur dioxide emissions in China's cities

4 The period we studied coincided with a boom in heavy industry in China, and the trend cited here may have slowed or reversed in 2009 and 2010.

fell from 100,000 tons per year in 2005 to 87,000 tons in 2008. Considered in proportion to economic activity, emissions almost halved, going from 2,600 tons per billion renminbi of production to 1,700 tons.

However, new technology and policy initiatives have brought emissions considerably lower in developed countries. In the United States, for example, sulfur dioxide emissions per billion renminbi in economic production were 100 tons in 2008 and in France, 35 tons. Since successful measures such as sulfur dioxide scrubbers for thermal power plants are well understood and widely available, we expect they will be quickly adopted by China's cities, especially the best-performing ones, bringing the country's emission levels closer to standards in the developed world. Anecdotal evidence suggests that policy changes in 2009 and 2010 have brought more widespread use of proven technologies, sulfur scrubbers in particular.

Wastewater Treatment: China's cities have made significant progress in wastewater treatment, with the average city going from 56 percent of wastewater treated in 2005 to 72 percent in 2008. The improvement has been especially dramatic among the worst-performing cities, with the average on the bottom quintile moving from 36 percent to 60 percent. Treatment levels in China's cities are comparable to other developing cities, though these show very wide variation. Mexico City treats only 40 percent of its wastewater, while Sao Paulo treats 100 percent. On a national basis, Thailand and Brazil both treat about 50 percent of their wastewater, while South Africa treats 78 percent.

Waste Management: Domestic waste collection remained steady in China's cities during the study period, with the average annual pickup per person moving from 279 kilograms in 2006 to 288 kilograms in 2008. The change was reasonably uniform across the spectrum of cities we studied. The top 5 percent collected 480 kilograms per capita in 2006 and 486 kilograms per capita in 2008, while the bottom 5 percent collected 130 kilograms per capita in 2006 and 131 kilograms in 2008. China's urban record was on par for developing cities. Rio de Janeiro, for example, collected about 290 kilograms of domestic trash per capita and Sao Paulo 310 kilograms, both in 2007. New York City, on the other hand, collected almost 500 kilograms of domestic waste per capita in 2009[5].

Air pollution: Air quality in China's cities remains extremely poor with only modest gains seen during the study period. Concentrations of sulfur dioxide in the urban air fell from 50 micrograms per cubic meter to 46 micrograms on average between 2005 and 2008, concentrations of nitrogen dioxide went from 33 micrograms per cubic meter to 32 micrograms, and particulate

5 We would expect consumers in the developed world to generate more waste.

matter fell from 94 micrograms per cubic meter to 84 micrograms. These levels remain well above the standards set by the World Health Organization of 20 micrograms of sulfur dioxide or particulate matter per cubic meter and 10 micrograms of nitrogen dioxide. Less than 20 percent of China's cities meet WHO standards for sulfur dioxide and nitrogen dioxide, and almost none meet particulate matter standards.

Built Environment

Urban densities in China are on par with or better than those seen in developed countries. Trends suggest that urban areas in China will become even denser. High density is the cornerstone of sustainable urban development, and the record here is an encouraging sign for China's ability to reach its goal. High density brings less energy use per capita, for example, and our Index shows that already bus ridership in China's cities is on par with or better than ridership in cities in developed countries. If China can maintain dense urban cores and prevent sprawl, it may be able to avoid excessive reliance on automobiles and greatly increase its potential for sustainable development.

Urban Density: China's urban density is notoriously difficult to estimate because of the large number of migrants and the sprawling nature of the municipal administrative boundaries, which usually include large swaths of countryside or undeveloped land. The best available data suggests that at least 30 cities in China have dense urban cores with more than 10,000 people per square kilometer, compared to a density in New York City of 10,600 people per square kilometer. At the same time, China's metropolitan areas, which include the outlying areas, are often more densely populated than their counterparts in developed countries. Nearly 100 of the cities we studied in China had metropolitan densities of about 4,000 people per square kilometer, which compares to 1,800 for New York's metropolitan area, 3,300 for Paris, 3,700 for Berlin, and 5,700 for Sao Paulo.

For cities in China where data was sufficient to establish a trend, 71 percent increased their population density from 2007 to 2009. If this trend continues, increased urban density in China should generate ever greater economies of scale, improving the case for investment in public transport and smart grids, which will be vital to the future sustainability of China's cities.

Mass transit: Ridership for public transportation in China's cities has grown in recent years, bringing the country on par with levels seen in developed countries. The average number of bus trips per person in China's cities rose from 117 per year in 2006 to 150 in 2008. The trend was pushed by strong improvements in the bottom-quintile cities, where annual ridership rose 40 percent during the period, from 47 trips per person to 67.

These statistics are similar to those from cities with good urban transportation systems. Rio de Janeiro, for example, registered 130 bus trips per person per year in 2007 and New York City about 100 in 2009 (excluding the subway system). Individual cities in China boasted much stronger ridership, with Guangzhou reporting about 600 bus trips per person per year and Beijing and Shanghai both noting about 300.

Commitment

Most Chinese cities increased spending on environmental protection in recent years, but our study showed a large gap in investment growth. While it's possible that some cities showed a slower increase in environmental spending because they have already reached high performance, a closer look at the data suggests otherwise. There is little correlation, for example, between levels of air pollutants and investment growth. A more likely explanation is that increased funding for environmental protection reflects greater commitment. And, indeed, the best performing cities in our commitment category are already nudging the needle in areas such as air pollution.

Cities in China have increased funding dedicated to environmental protection by almost a third in recent years, but efforts by the best-performing cities far outstrip those by cities at the bottom of the Index, even when differences in development level are taken into account. On average, environmental funding in China's cities rose by about 30 percent between 2006 and 2008, going from 220,000 renminbi per billion renminbi in economic production to 300,000 renminbi. Cities in the top quintile outpaced the average, however, increasing funding for environmental protection by about 45 percent in the period to 470,000 renminbi per billion renminbi in production. Those in the bottom quintile showed a 26 percent increase, with average funding in 2008 reaching 120,000 renminbi per billion renminbi in economic output.

The rapid rise in funding coupled with the increase in the number of professionals in the field is encouraging. Comparing China on this score to other countries is much more difficult, given the different cost structures, levels of economic development and environmental and legal frameworks across geographies.

Overall index results

As we've seen, most of the cities we have studied still fall short of being seen as sustainable compared to benchmarks in developed economies, but along many dimensions some are showing positive trends. When we aggregate the indicators and consider the overall Urban Sustainability Index results, we find:

- Cities with strong absolute performance do well across many dimensions, not just on a small set of indicators.
- City leaders can improve city sustainability at any stage of economic development without impacting growth.
- A significant set of Chinese cities are becoming more sustainable while also achieving above-average rates of economic growth. These are the "sustainable growers."

High-ranking cities are all-rounders

With indicators aggregated across the Index, we tried to identify common characteristics among the cities that ranked highest, that is those that as of 2008 were the most sustainable.

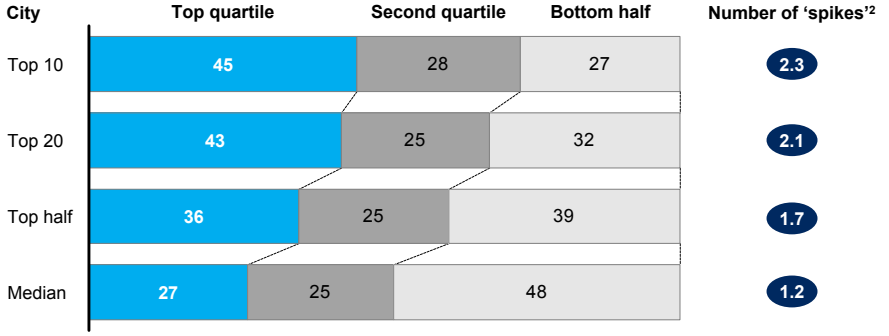
The top quintile of cities in the overall Index displayed an excellent, well-rounded performance on most, if not all, indicators, each with one or two "spikes," readings on an indicator in the top 5 percent of our sample (Exhibit 3). In addition, there was little difference in the average number of spikes between the top and the second quartile, but a big difference in the average number of indicators in which a city ranked in the top quartile . The difference between the top cities and average cities is not their performance on one or two indicators, but a difference across the board.

Exhibit 3

The most sustainable cities are 'well-rounded'

2008

Distribution of rankings for individual indicators, for average city in each group of cities when ranked by overall USI
Percent of indicators[1]



1 Three air pollution sub-indicators counted separately, so 100% = 20
2 Defined as a measurement in the top 5 for that indicator

SOURCE: Team analysis

Rather than focus on just one or two aspects of sustainable development, the best cities exercise a more holistic approach to sustainability.

Sustainability and growth

The Index also showed almost no correlation between a city's wealth and its ability to create sustainable growth (Exhibit 4). Most of the critical indicators that drive sustainability such as mass transit usage, waste water treatment, and environmental investment were unaffected by level of economic development. The only indicators in which we found even a weak correlation were power consumption, industrial sulfur dioxide emissions, and GDP from resource-intensive sectors. We found very little correlation between a city's economic growth and sustainability factors or between its growth and the overall index result. The relationship between sustainability and economic growth is not mechanical, but rather is a result of policy and leadership.

Sustainable growers

Following on the above results, we looked for cities that had managed to create a positive relationship between economic growth and improvements in sustainability. An emerging minority of cities witnessed noticeable improvement over both dimensions between 2005 and 2008. These cities are doing better than their peers in identifying opportunities for sustainable growth and present attractive opportunities to both foreign and domestic investors. More and more, these investors consider urban quality of life as a critical variable when making investment decisions.

After analyzing developments between 2005 and 2008 in the 112 cities in our study group, we segmented them into four groups based on recurring performance (Exhibit 5):

Sustainable Growers: These 33 cities managed an above-average increase in GDP per capita during the study period while at the same time improving their sustainability rankings.

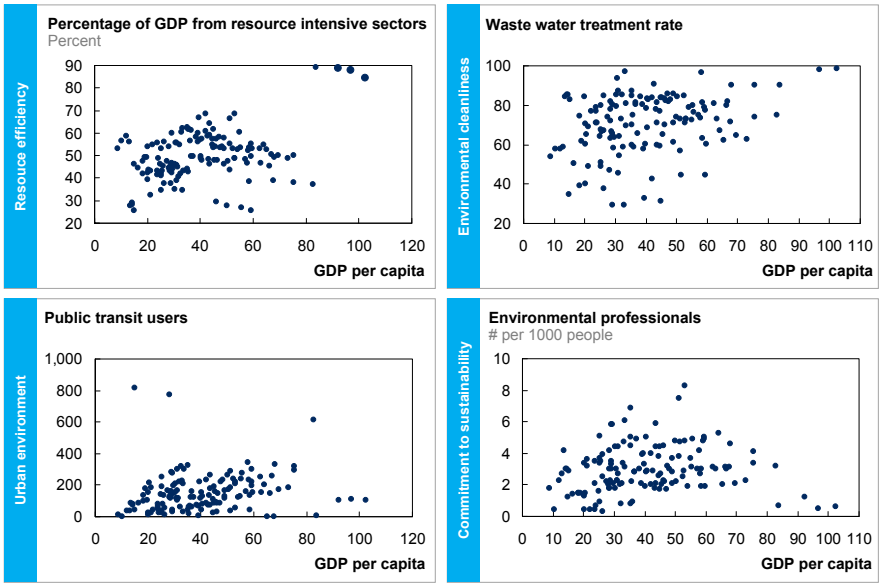
Sustainable Stragglers: These 21 cities improved their sustainability ranking, but their GDP per capita grew below average

Waverers: These 14 cities showed average or below-average growth in GDP per capita, but a slight decline in their sustainability rankings.

Unsustainable Growers: The remaining 44 cities experienced significant declines in their sustainability rankings over the period, losing on average 9 points on the index.

Exhibit 4

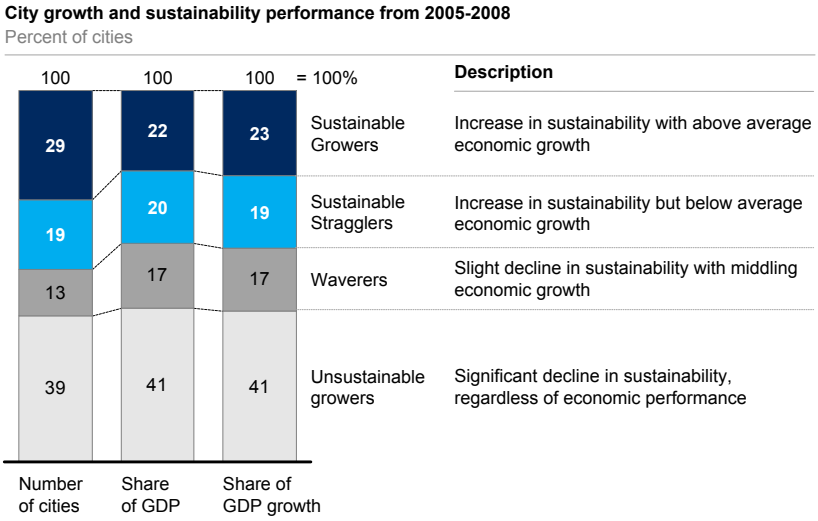
Sustainability does not correlate to wealth



SOURCE: McKinsey analysis

Exhibit 5

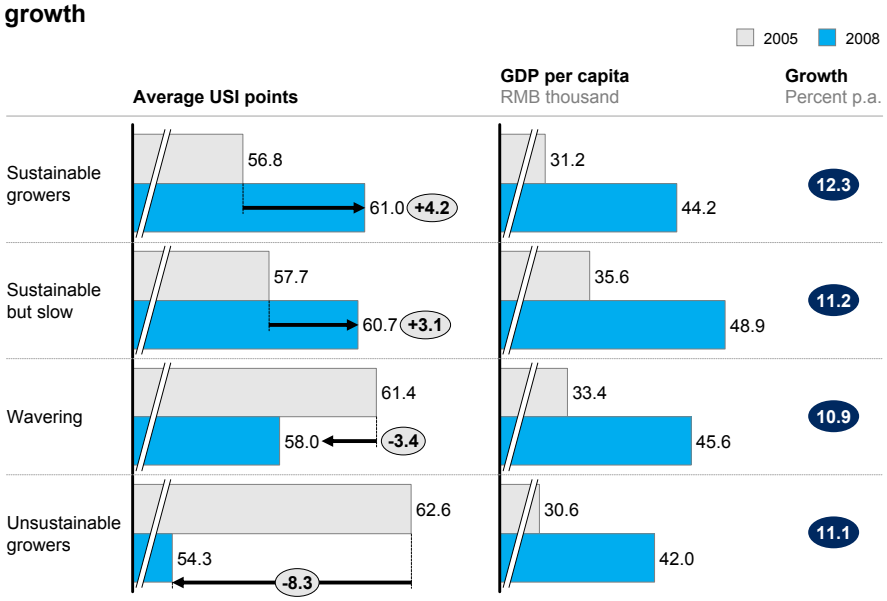
There is an emerging minority of cities showing sustainable development, but the majority of cities need help



On average, the Sustainable Growers segment outmatched the others in three key areas between 2005 and 2008 (Exhibit 6). Their score in our index increased an average 4 points, compared to a 9-point drop by the Unsustainable Growers, and GDP per capita grew an average 12.3 percent a year, compared to 11.1 percent for the latter group. Without question, these results show that growth need not be forfeited to create sustainability.

Exhibit 6

The sustainable growers outperform in sustainability and economic growth



Success stories

How have some cities been able to build their urban economy while protecting the environment and their standard of living? Using the Index as a guide, we conducted in-depth analysis of the policies and programs of some of the best-performing cities. Each was strong across four key aspects of sustainable development: industrial restructuring, environmental-based planning, transparency and accountability, and resource efficiency (Exhibit 7). In addition, urban administrators in these cities were well-versed in policy execution, bringing a coordinated and consistent response to the challenges they faced.

Cities were selected for more detailed study based on consistent high performance on the Index, as well as a desire to analyze cities of varying size and in different geographies. In addition to data analysis and other research, the study included visits to four stand-out cities and interviews with officials and other stakeholders.

Exhibit 7

Common initiatives among best-practice cities to drive sustainability

Initiatives	Description	Indicators Impacted
Link land to restructuring	Develop clear service industry promotion strategy and eliminate high pollution heavy industries, and link this to urban land renewal	▪ %GDP from resource intensive sectors ▪ %GDP from tertiary sectors ▪ Industrial SO2 discharged ▪ Concentration of Sox, NOx, PM10
Create a liveable built environment	Carefully planned mass transit and urban amenities	▪ Bus transit passengers ▪ Green space per capita
Set rigorous standards and prices	Increased intensity in monitoring standards with stepped-up enforcement and pricing structures	▪ Wastewater treatment rate ▪ Domestic waste collected ▪ Environmental sanitation funds ▪ Environmental professionals
Invest in economy	Projects that link industrial supply chain to maximize local resource efficiency	▪ Industrial water consumption ▪ Industrial waste recycled and utilized ▪ Total electricity consumption ▪ Heavy industry GDP as % of total
Coordinate Policy	Coordination & consistency in implementing sustainable development practices	▪ All

Link urban land renewal to industrial restructuring

As China's cities have grown, many have engulfed industrial areas that were once on the urban fringes. Others have discovered a need to diversify their economies away from an industry or even an individual company that was at the core of their initial growth.

The Sustainable Growers that we've identified have found that urban industrial restructuring is a critical tool for increasing energy and resource efficiency in the city, freeing valuable downtown land for redevelopment and promoting the growth of the service sector.

China's cities are experiencing a shift from their old model of industrialization. Under this model, designed to accommodate a production-based economy and decrease transportation costs, industry was mostly clustered along major transportation facilities in the urban core. For example, from the 1950s through the 1980s, some cities near the Yangtze River Delta took a "layered-cake" approach, with chemical factories along the urban edge, electroplating dotting the middle layer, and water-intensive industries located near the resources in the core.

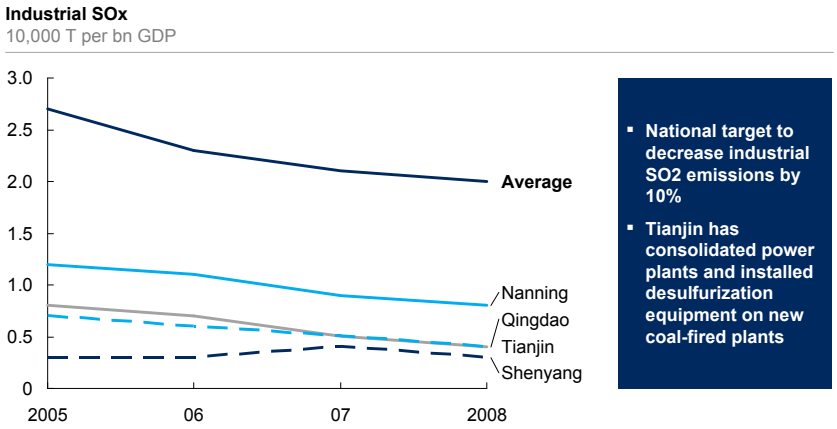
Each of the cities we visited is promoting a shift in urban industrial strategy, and, even though our study period encompasses a time of heavy industrialization, a directional swing is noticeable in the data. Rising costs and tighter national environmental standards, particularly urban sulfur dioxide emissions, have convinced many heavy industries to shutter their urban factories and relocate to new industrial parks or development and economic zones in the suburbs.

Also, many of the industries relocated in this way have used funds raised through the sale of land-use rights in urban cores to buy state-of-the-art technology and new emissions-control equipment, as well as to cover relocation costs. For example, in response to a national effort to cut industrial sulfur dioxide emissions by 10 percent, Tianjin closed down many small, inefficient power plants and used part of the resulting relocation funds to upgrade factory infrastructure (Exhibit 8).

Although the trend is just beginning, early indications suggest that consolidating heavy industry away from the urban center brings large enough economies of scale to offset the costs of sophisticated infrastructure retrofits and new equipment, even without considering the substantial environmental benefits from reduced sulfur dioxide emissions and other pollutants. Industries also appear to be using resources more efficiently. For example, industrial use of water in the cities we studied in detail declined significantly in the middle of the decade, then held steady from 2007-2008 as a result of new heavy industrial capacity. The new industrial sites, however, were much more efficient than those they replaced.

Exhibit 8

Cities are taking action to clean up heavy industries



SOURCE: Team analysis

To ease this restructuring, urban leaders are experimenting with a variety of projects, often with the intent of moving from an industry-based economy to a more service-oriented one (Exhibit 9).

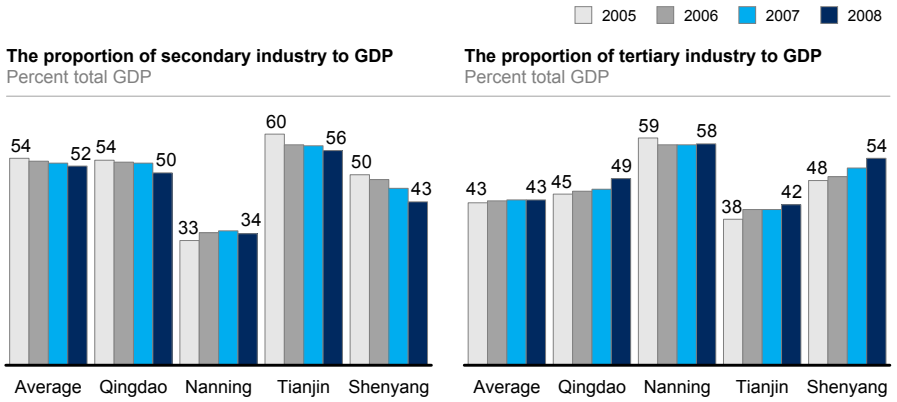
In Tianjin, for example, smokestack industries are moving east from the city center into some parts of the Binhai New Development Zone. In Qingdao, manufacturing industries are relocating across Jiaozhou Bay and into rural regions northwest of the city. Shenyang successfully removed almost all traces of heavy industry from its core between 2008 and 2010.

Though many municipal leaders are still moving ahead by trial and error, they recognize a shift away from a reliance on heavy industry will have a sweeping impact across a city's essence. Its spatial development pattern and transit needs will be heavily influenced by the shift, for example, and success would bring a concentration of higher valued-added industries that pollute less, such as financial services, tourism, information technology and research and development centers.

A critical component of urban industrial redevelopment is brownfield redevelopment. As heavy industry moves from the urban core, it leaves abandoned or badly used tracts of land. Such brownfield sites provide large-scale opportunities for urban planners because they often offer sizeable

Exhibit 9

Though the trend has yet to pick up, our case cities are generally shifting away from heavy industry as an economic base



- Qingdao & Shenyang have made the largest advances in switching to a service industry platform
- Nanning faces the challenge of increasing demand to accommodate industrial enterprises shifting from the East, but is limiting entry of heavy industries to petrochemical and steel

SOURCE: Team analysis

plots of land in high-value, inner-city locations. Brownfield redevelopment also poses an array of governance problems and usually requires intensive investments for site clean-up.

Shenyang offers one example of a successful brownfield redevelopment. Encouraged 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 city's urban image and helped drive economic development through real estate investment.

Shenyang's experience suggests three key aspects of brownfield redevelopment:

- Policy and planning: Starting with general policy guidelines from the central government, the city enacted legislation and set specific standards for redevelopment based on, for example, the attractiveness of the land, soil analysis and other considerations.
- Development: The city coordinated various agencies to prepare the land for redevelopment, for instance by collecting relevant data, gathering financial support, creating tax incentives and monitoring progress at the site. The city also coordinated between developers and relevant agencies to clean any contamination from the site, as well as demolish and remove

existing structures. During the process, neighbors and potential tenants were invited to offer comments on the redevelopment.

- Promotion and use: While the developer is responsible for marketing and managing the properties themselves, the city government promoted the new urban image and worked with the developer and tenants to establish clear and consistent branding.

In this case, as in many others, setting a quantitative target can help Chinese cities measure and manage improvement. Targets, of course, would vary depending on how brownfield sites are defined, assessed, and prepared, among other factors.

Create a livable built environment

Cities in China that have successfully balanced sustainability and growth incorporate these objectives when creating mass transit networks and urban amenities. Efficient and attractive mass transit takes cars off urban roads, cutting emissions and congestion. At the same time, green space provides environmental oases that help refresh the air and make cities more attractive places to live and work. Our case cities recognized these benefits and included efforts to enhance mass transit and green space in their development programs.

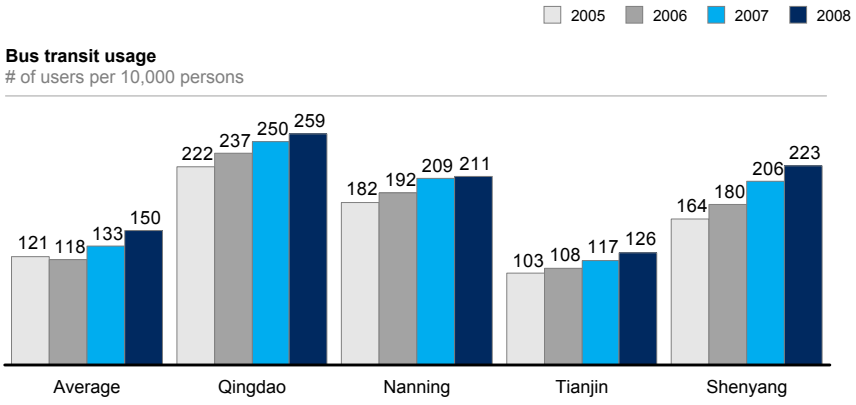
An appreciable bus ridership in Chinese cities indicates a potential demand for transit-oriented development (Exhibit 10). Buses have remained the predominant mode of mass transit even as subway systems spread into mid-sized Chinese cities, and they are likely to remain the linchpin for urban mass transit in China for the foreseeable future.

A critical observation from our city visits is that ridership is significant even when bus stops in general have little to offer in their immediate vicinity. This opens a large opportunity for city developers to increase ridership even further by encouraging business, commercial or residential development and creating green space within, say, 600 to 800 meters of bus stops.

For example, Qingdao added bus routes and transit hubs and focused some of its redevelopment work 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 addition, after monitoring flow and congestion at particular transit nodes, Qingdao transportation engineers redirected traffic through the old district using one-way streets and expanded the pedestrian zones to encourage non-motorized forms of transportation. As part of the economic shift from manufacturing to tourism, Qingdao has rezoned industrial space into commercial areas and begun building mixed-use residential and lifestyle developments along major transit lanes. Officials believe transit-oriented housing and continued dense development along major arteries will decrease transportation costs over time.

Exhibit 10

Chinese cities in general are seeing an increase in public transit ridership, with Qingdao in the lead



Tianjin faces the challenge of coordinating urban development amongst various departments in a complex administrative structure, as reflected in relatively underdeveloped mass transit between downtown and Binhai

SOURCE: Team analysis

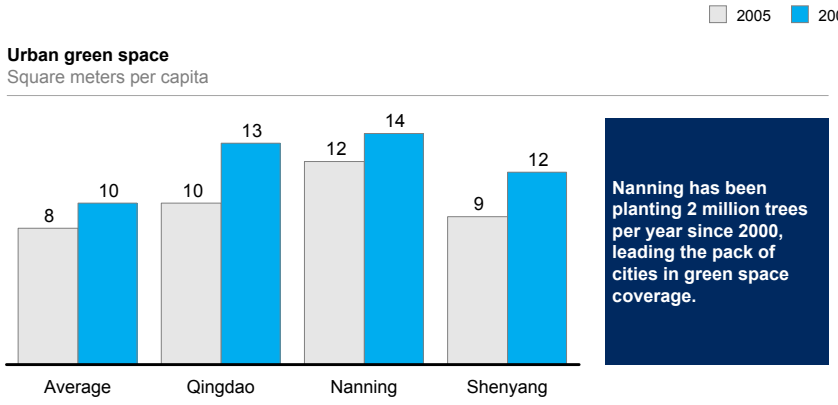
Financing is perhaps the most difficult aspect of providing public transit, and city officials are seeking ways to manage subsidies and expand services with minimum public finance. Reasonable fares and a proper regulatory framework for private participation are essential for long-term provision of public transportation. In Shenyang, the municipal public transport company contracts with owner-operators and transport companies for public transport services to supplement its own services. The city has also followed smaller cities such as Kunming in establishing measures to give buses priority on the roads, which minimize delays and improve the reliability of public transit services.

Based on mandates included in China's 11th Five Year Plan, cities have begun to introduce environmental specifications in urban design and redevelopment plans. We found that, on average, cities have shown a newfound commitment to environmental design, primarily in the form of expanded green space (Exhibit 11).

In a mayoral training session in June 2010, Qiu Baoxing, vice minister of housing and urban development, said, "First and foremost, Chinese cities should be concerned about improving the quality of life for its residents, not technological advancements or GDP. We can do this by increasing the competitiveness of cities by stylizing each city differently, creating unique districts within a city, and increasing public green space to 50 percent."

Exhibit 11

Case study cities are expanding green space coverage faster than the average, with Nanning taking the lead



SOURCE: Team analysis

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 further. Understanding that environmental design can be used to improve a city's air quality, urban planners in China have begun introducing a variety of measures such as rules addressing proximity of structures, overall building density, land use, and compulsory public green spaces.

For example, Nanning in the southwestern province of Guangxi created a "green city" during a ten-year program that included planting an average of 2 million trees a year. The city has developed three major greenbelts along the Yongjiang River, outfitted with trail systems, water conservation areas and buffer zones along the river's bank that conform to the city's greenbelt geometry. In 2009, Nanning proposed a new environmental design concept to integrate river and marsh systems into the urban landscape by engineering two dams on the Yongjiang River that would split the river into 18 smaller waterways and create 80 lakes within the city.

Qingdao is another champion of environmental design principles. From 2005 to 2007, the city increased its targets for green space coverage from 25 percent to 35 percent of the urban area. In addition, Qingdao's development guidelines ensure preservation of sightlines to the natural landscape through building height restrictions. Buildings near the sea and airport are low, and the cityscape steadily rises toward the mountains.

Use transparent standards and prices

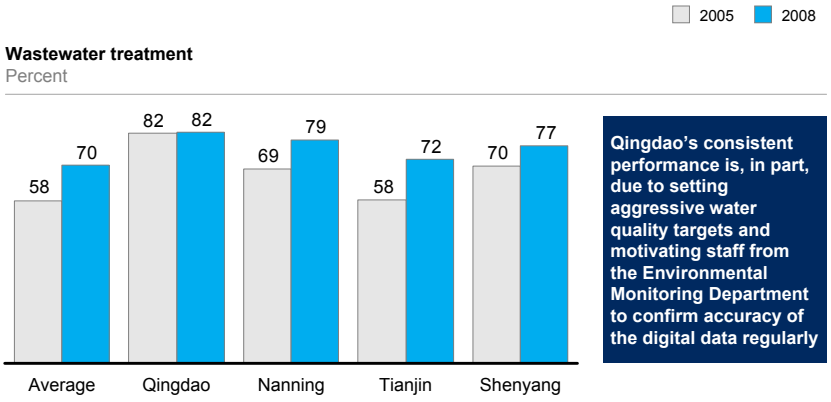
One sign of commitment to sustainable development is a clear and consistent sense of responsibility at the leadership level that translates in visible efforts at enforcing standards and passing on costs to users. In our study, we have seen that cities that create transparency around their goals and around progress toward meeting those goals, as well as public accountability, drive environmental management more effectively. Transparency and accountability create pressure to drive change, but they also produce an atmosphere of common purpose and achievement.

Progress on environmental indicators can be attributed not only to a high level of political commitment and adequate administrative capacity to roll out initiatives rapidly, but also to an adjusted accountability system that links implementation to performance assessment of local officials. We found that superior environmental supervision and strict monitoring of digital information places cities like Qingdao at the top of the Index (Exhibit 12).

Part of Qingdao's consistent performance in wastewater treatment is the result of pressure from Shandong Province officials. The province administration identifies the 1,000 biggest polluters in the region in a public listing and sets aggressive waste-reduction targets for each company. By 2008, monitoring within the province covered more than 1,000 companies and 170 wastewater treatment plants. Each company on the list was required to provide digital information on their status on a regular basis.

Exhibit 12

In recent years, a commitment to improve wastewater treatment rates has resulted in significant improvements



SOURCE: Team analysis

Such policy enforcement at the provincial level effectively places cities in a healthy, public competition that helps push improvements. But the best-performing cities take this one-upmanship to new heights. For example, when Shandong 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, mandated monitoring every half hour. In addition, Qingdao sends staff from the Environmental Monitoring Department to check first-hand the accuracy of the data being reported digitally. These inspections occur every 10 to 30 days depending on a company's place on the list of polluters.

Cities can achieve high standards through strict, regular monitoring, and also by adjusting prices to create the incentives for industry to change itself. For example, Shenyang gradually raised electricity tariffs for industry generally, but with special attention to high-polluting sectors, such as the Shenyang Cement Plant. The price charged was set in 2006 at 5 cents per kilowatt hour higher than the standard price, and then raised to 10 cents in 2007. Since electricity is a very large share of the costs for cement, the city in essence used market forces to remove a large source of pollutants in the city center.

Invest in building a cyclical economy

Creating efficient links between industrial outputs in different sectors–a "cyclical economy"–is a critical component in efforts by the best-performing cities to reach environmental sustainability. In the next five years, rapidly industrializing small and midsized cities in China will be challenged by the need to create greater resource efficiency linked to sustainable development. Leaders of these cities must find ways to reduce resource consumption and increase urban efficiency. For many, the solution lies in cyclical economy projects, where various facilities are linked to maximize local resource efficiency (Exhibit 13).

As an extension of efforts to shift heavy industry away from the urban core and into new industrial clusters, some cities are looking for ways to promote cyclical economies in those clusters, making them highly resource-efficient zones. Tianjin's Binhai New Area, for example, started with two very ambitious cyclical economy projects centered on desalinization as the industrial base and has gradually formed a cluster around desalinization expertise.

City officials we visited pointed to the Beijiang Power Plant as an example of resource efficiency. The project links water, power, sea salt production, waste reuse and land conservation into an elegant desalinization system. During the first phase of the project, launched in 2005, 1.3 billion renminbi was invested to construct two 1,000-megawatt generators that would provide as a byproduct of power generation a total of 200,000 tons of water a day for city residents. Phase 2, which started in 2010, will add two additional 1,000-

Exhibit 13

Some cities are rolling out cyclical economy projects in order to combat resource constraints, in particular water, energy and land

ILLUSTRATIVE

	Project	Description	Impact
Shenyang	Water reuse projects	▪ Sell water from industrial cooling at a low price to city for car wash, urban greening, and street cleaning	▪ By the end of 2006, municipal use of treated wastewater reached 50 million tons / day, with the water reuse rate at 30%
Tianjin	Beijiang power plant	▪ Link desalinization, power, sea salt production, fly ash reuse and land conservation through principles of optimizing resource efficiency and minimizing waste emission	▪ Provided 0.4 million T/day (water), 11 billion kwh (power), 450,000 T/ year (salt), and save 22 sq.km of land for salt production ▪ Produce about 60,000 T of rare chemicals
Qingdao	Desalinization plant	▪ Build-Operate-Transfer greenfield project using reverse osmosis to provide potable drinking water for municipal use	▪ Produce 20,000m^3/d of drinking water and 20,000m^3/d of boiler feed water for use by local industry

SOURCE: Team analysis

megawatt clean, coal-fired generating units and saltwater cooling towers. The whole system is expected to provide 400,000 tons of fresh water a day, 11 billion kilowatt hours of power annually, 450,000 tons of salt a year, and 60,000 tons of minerals (bromine, potassium chloride, magnesium chloride and magnesium sulfate) a year. Fly ash and other waste will be sold cheaply to construction companies as building materials.

Tianjin's Dagang Power Plant is another successful cyclical economy project that has provided 100,000 tons a day of water to urban residents. The plant is one of the first major environmental projects carried out by a foreign developer in China. Using a cutting-edge ultrafiltration seawater treatment system, it is China's largest reverse-osmosis desalination plant. The project incorporates a series of complex engineering solutions, such as using industrial cooling water to increase feedwater temperature, minimizing intake and increasing operating efficiency, even in the harsh winters.

In a similar effort, Qingdao recently approved a 25-year contract to build a desalinization plant with a daily capacity of 100,000 cubic meters. In an unusual financing package for an environmental project in China, the city secured 880 million renminbi, or 70 percent of the project's cost, through a 18-year loan from local banks, while a local company, Qingdao Soda Ash, covered an additional 8 percent of the cost in addition to providing land. The remainder of the funding was equity investment from several investors, primarily local state-owned groups.

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

On smaller scales, Shenyang initiated a project to extract methane from its Laohuchong garbage site. The annual energy output of the project provided electricity for more than 35,000 Shenyang residents.The city has also consolidated its district heating into a central plant that uses energy generated from underground water as electricity to help power the plant. This has removed 3.4 million tons of coal, 80 million tons of sulfur dioxide, and 150 million tons of industrial dust in the city. The use of underground water has recently been paused due to its effects on soil composition, but city officials hope to find technologies that will further its use in the future.

Coordinate policy execution

Well-designed projects and good intentions are, of course, not sufficient to create sustainable development. A blueprint that solves every challenge is useless if it doesn't move from paper to pavement. Our interviews with urban officials highlighted that successfully executing sustainable development projects is largely a factor of coordination among city agencies and other bodies.

In China, each initiative requires extensive coordination across various bureaucracies. Transit-oriented development projects, for example, bring in officials involved in urban planning, construction, and environment; recycling those from multiple industrial and planning jurisdictions; environmental transparency those working in industry, environment, and information management; and land renewal projects those focused on economic planning, land use, urban planning, and industry.

To overcome the challenge of interdepartmental coordination within Chinese cities, governments must first make sustainable development a top-level priority, typically through specific and actionable measures taken by city leaders, as was done with Nanning's vision of becoming a "Green City".

Second, successful cities we've studied develop incentives that encourage cooperation among agencies. Two in particular seem to work well:

- *Evaluation:* Strengthen coordination mechanisms and communications channels by linking successful implementation to an overall evaluation program. In one interview, we found that no harmonized policies and programs existed between environment, planning integration, human resources, water resources, housing, health, social affairs, and technological development departments. By formalizing the channels through which these departments communicate and setting targets on how often information exchanges should take place, municipal governments could foster a better sense of unity among departments.
- *Approval:* Include coordination evaluation in the final approval process. In Shenyang, all projects must be approved by a department directly affiliated with the State Council. If the project successfully passes, the departments involved—for instance environmental, urban planning, social and economic planning, or others—have met the city's standards for coordination. Such standardization of coordination efforts has helped Shenyang successfully execute district-, county-, and city-level projects.

Other examples were also found during our city visits and research. In Qingdao, the performance assessments of local officials were tied to project implementation, which increased the motivation to cooperate among departments. The effort was supported by sufficient administrative capacity and a newly implemented accountability system.

In contrast, at first glance planning in Tianjin seemed less coordinated. For example, the transportation systems were less efficient in how they matched supply and demand for transit, resulting in lower bus ridership than in the average city. When we looked closer, we saw the city government's organizational layout was different from that of other cities such as Shanghai's

Pudong initiative (Exhibit 14). In Binhai, all administrative districts have direct access to Tianjin municipal government. Though Tianjin has an intermediary administration coordination department that rests at the deputy/ministry level, districts generally chose to bypass this department since it holds the same organizational rank as other districts and administrative areas within Binhai.

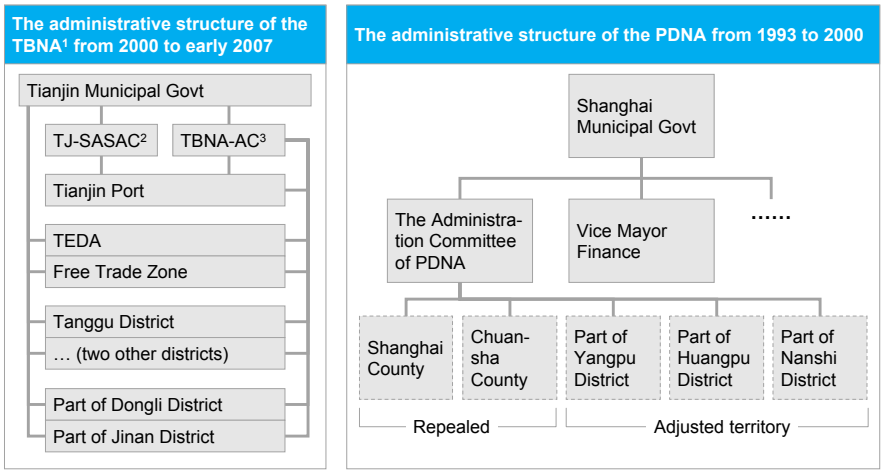
As a result, Binhai's organizational structure appeared to restrict the development of the city because it included overlapping functions, no delegation of authority from the administration coordination committee to take charge and resolve conflicts among administrative units, and ineffective interdepartmental communication. With such a structure, it can be difficult to implement any policy that requires coordination among multiple administrative units.

In one of our interviews, a high-level official noted the central government is considering organizational restructuring to establish a new coordination department based on the administrative coordination committee in Binhai. Instead of maintaining its rank at the deputy/ministry level, the new department will be directly linked to the State Council, and as a result wield more power.

Finally, whatever solution is chosen, it needs to be implemented with a long-term vision. In Nanning, for example, the municipal government managed to implement the tree-planting program consistently despite a succession of four party secretaries and three mayors.

Exhibit 14

Organizational structure should facilitate coordination and policy execution



1 Tianjin Binhai New Area
2 TJ-SASAC: Tianjin State-owned Assets Supervision and Administration commission
3 TBNA-AC: The Administration Committee of TBNA; its Director is Member of Standing Committee of Tianjin

SOURCE: Literature review

Conclusion

Analysis using the Urban Sustainability Index and subsequent field visits has shown that some Chinese cities are making clear strides toward sustainable development. Their success is based not only on execution capabilities, but on an unwavering focus on industrial restructuring, designing sensible transit systems and green space, pushing improvements through standards, monitoring and pricing, and exploring ways to make industries more resource efficient.

We found the best performing cities displayed a clear, long-standing commitment to achieving their sustainable "vision." They engineered a large degree of cooperation among relevant departments, for instance between those responsible for environmental protection and urban planning. And they maintained commitment to their overall goals through several changes in leadership.

Moreover, since we found no deterministic relationship between economic growth and performance on our Index, our research exposed an unmistakable opportunity for other cities in China to learn from the practices of their better-performing peers, as well as successes further abroad. Indeed, China's cities have shown great dexterity over the past few decades in their ability to learn from others, an advantage that will serve them well as their development model undergoes needed structural shifts.

Our work with the Urban Sustainability Index does not end with this report. We expect to continue to refine the Index as our research moves forward and to identify a larger suite of best practices for cities committed to sustainable development. In particular, we intend to understand better the cost and time tradeoffs implicit in these measures, explicitly searching for those that can be implemented rapidly with noteworthy results. At the same time, we will strive to identify the unique factors—for instance, intrinsic historic, geographic or natural advantages—that would make replication of these best practices more difficult.

The challenge facing rapidly growing cities in developing countries, especially China, is enormous. China's leaders have recognized this, and we expect that meeting this challenge will be a core part of the upcoming 12th Five Year Plan. Some cities in China are already forging ahead by devising solutions to this challenge. Using the Urban Sustainability Index as a yardstick to measure success in China and other emerging markets will help highlight initiatives that work and can help other cities achieve sustainable development.

Appendix A: Creating the urban sustainability index

The Urban Sustainability Index was built to evaluate how cities in developing countries are confronting the challenge of balancing environmental sustainability and growth. As sustainable development became a priority policy issue over the past decade or so, many institutions and researchers have tried to develop ways to gauge successes and failures in reaching this goal. They have produced multiple efforts to measure sustainable development and their research has generated a large and growing fact base (Exhibit 15).

Current research, such as the Siemens European Green Cities Index, has mostly drawn from experiences of European and North American cities, with indices built to reflect sustainable development in those contexts. Others, such as the UN Sustainable Development Index or the OECD's Environmental Performance Review, focus primarily on the national level. These efforts did not cover China explicitly, although since 2008 a few studies sought to evaluate urban sustainability in China, with a particular focus on household carbon emissions and environmental performance.

While each study offers a unique collection of sustainability indicators, they all draw generally from a common set of categories. For example, the Siemens Green Cities Index measures air pollution by carbon dioxide emission per capita, while the World Bank's Global City Indicators uses particulate matter (PM10) to measure environmental cleanliness and carbon dioxide and other critical emissions to measure atmospheric pollution.

Exhibit 15

MULTIPLE EFFORTS TO DEFINE SUSTAINABILITY TO DATE ILLUSTRATIVE

Name	Definition	Datasource
Bruntland report	Meeting the needs of the present generation without compromising the ability of future generations to meet their needs	World Development Report 1984
SustainLane	Maintaining standards of living and structural preparedness to meet the environmental challenges of an uncertain future	U.S. Census Bureau, surveys & interviews
UN	The integration of economic, social and environmental issues in decision and policy making	National publicly available data
World Bank	No explicit definition, but implicitly defined by a selection of indicators used to measure sustainability	Self-reported data on website with city member enrollment
OECD	Competitive green growth as defined through considerations of urban form, lifestyle and energy sources	Various development and multilateral agencies
Siemens	Acting responsibly on behalf of future generations to achieve economic, environmental and social progress	National statistics, local city authorities, national environmental bureaus
Yale - Columbia	Society's capacity to improve its environmental performance over time	WHO; Experts from Yale and Columbia
National Bureau of Economic Research	Greenness as defined by household carbon emissions	Chinese statistical yearbooks

1 Literature review

Drawing from these efforts, we developed a set of criteria to measure and rate the sustainability performance of cities in developing countries, beginning with those in China. Our indicators are drawn from data that is readily available from these cities—which may occasionally be different from those available in developed countries—and especially relevant in emerging market environments. These indicators were spread across five categories we believe encompass environmental sustainability, as well as a city's overall standard of living: basic needs, resource efficiency, environmental health, development pattern, and commitment.

To evaluate cities against the Index, we compiled data from 2004 to 2008 from sources including the Chinese City Statistical Yearbooks, individual city yearbooks, State Environmental Protection Administration Yearbooks, and Urban Construction Yearbooks. The effort focused on the 113 cities slated for environmental protection in the 11th Five Year, but in the end, one—Lhasa—was left out of our analysis because of data limitations.

Our sustainability rating is based on maximum demonstrated performance for each city, rather than theoretical absolute potential. We derived the aggregated score from an average of the indicators, after refining the numbers as necessary to achieve consistency. We did not assign weights to individual indicators when compiling the overall score to avoid any a priori evaluations of the relative importance of the indicators that would be difficult to justify rigorously. However, we experimented with weighting indicators based on data quality, but found the impact of this became negligible as we rounded out the data set and so abandoned the exercise.

To analyze any correlation between GDP growth and sustainability, once the index was computed and corrected for outliers, we ran a series of f-tests. While we recognize there are more sophisticated methods to weigh factors and test validity, for the moment we limited our testing to ANOVA, regression and factor analyses.Full details will be forthcoming in a subsequent publication.

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