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S U S T A I N A B I L I T Y & R E S O U R C E P R O D U C T I V I T Y P R A C T I C E

Building the cities of the future with green districts

Better design can make sense aesthetically, environmentally—and economically.

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At the current pace of urbanization, the world's cities will add 65 million inhabitants a year between now and 2025.¹ The resulting demand for infrastructure will mean that each year, India alone will need to add as much floor space as exists in all of Chicago, and China more than twice that. The way the world builds now will determine urban sustainability—in emissions, waste production, and water use—for decades.

In this article, we examine what could become the building blocks for the sustainable cities of the future: “green districts.” The term is new and still imprecise. Our definition of a green district is a densely populated and geographically cohesive area that is located within a city and employs technologies and design elements to reduce resource use and pollution.

In general, green districts deploy design principles that lead to dense, transit-oriented, mixed-use developments; they also consider using renewable energy sources. EcoDistricts, a Portland, Oregon–based nonprofit that specializes in helping governments and others to develop sustainable cities, notes that green districts are interesting because they are “small enough to innovate quickly, and big enough to have a meaningful impact.”²

Interest is growing. The US Green Building Council has started a program, based on its successful Leadership in Energy and Environmental Design (LEED) rating system for individual buildings, to evaluate the concept of sustainable neighborhoods. Known as LEED for Neighborhood Development (LEED-ND), it is the first system of its kind; according to the council, the idea is to integrate

the principles of smart growth, new urbanism, and green building. So far, more than 300 projects have earned the LEED-ND rating. Estidama, a program in the Middle East, launched a similar rating system in 2010.

Several organizations are supporting the development and promotion of green districts worldwide. In June 2014, the Clinton Global Initiative and EcoDistricts began the Target Cities program. The idea is to revitalize neighborhoods in eight North American cities (Atlanta; Austin; Boston; Cambridge, MA; Denver; Los Angeles; Ottawa; and Washington, DC) and in the process to create models from which other communities can learn.

There are three reasons to believe that green districts will continue to grow.

Green districts are economically viable

To date, the self-defined green districts that have been built, including the Upton development in Northampton, England, and the 1,145-acre Civano project in Tucson, Arizona, have concentrated on offering environmental benefits. There has been less attention to the question of whether they are economically sustainable. For example, one estimate is that Civano, which is slated to have 2,600 families with sharply lower waste, energy, and car use, cost \$20 million more to develop than a “similarly sized, conventional master-planned community.”³

But that does not take into account return on capital and long-term payback. To evaluate this question, we created a model that compares the cost of building a green district versus that of a conventional one. We looked at 15 well-developed green-district technologies, covering buildings, waste, water, transport, and utilities. We also considered ten design elements, such as permeable pavements, green space, bike lanes, and building orientation

(Exhibit 1). We then applied this analysis to three geographic areas that have different needs but share an interest in the subject: northern North America, the Yangtze River Delta in China, and the Persian Gulf region.

In North America, cities such as New York; Portland, Oregon; and Toronto are building or planning to build green districts. In China, the government has made ecocities part of its newest five-year plan. In the Persian Gulf, entire new cities such as Masdar, United Arab Emirates, and Energy City Qatar are being built with explicit sustainability goals.

In each market, we used the model to assess a greenfield location—that is, a new district built from scratch. (The model can, however, be adapted to brownfield or infill developments.) The model calculated how much the various technologies and design choices affect the cost of building and maintaining a green district versus a traditional one. It considered such variables as baseline energy demand, density, population, and per capita floor space; then it estimated how much these affect annual operating costs and rate of return. Looking at a one-square-kilometer district with a mix of 70 percent residential and 30 percent commercial use, we assumed application of all relevant technologies. We took into account that the mix of technologies deployed will vary. A green district in Canada will not look or operate like one in Saudi Arabia.

To illustrate, when we ran the model for a hypothetical city in the coastal provinces of the Yangtze River Delta in central China, we found that optimizing building orientation and installing permeable pavements that reduce the flow of water to treatment systems delivered the greatest return on investment. In addition, the former delivered sizable savings on energy, and the latter on water that can be collected and reused. Other technologies,

Exhibit 1 Twenty-five technologies and design elements move beyond green buildings to green districts.

		<ul style="list-style-type: none"> ▶ Design elements ◆ Technologies 		
Systems				
Resources	Green buildings	Moving beyond green buildings to district scale		
	Buildings	Transport	Open space	Utility infrastructure
Energy¹	<ul style="list-style-type: none"> ◆ Solar water heating ▶ Building envelope² ▶ Efficient windows ▶ Building design³ ◆ Rooftop photovoltaic systems ◆ Energy-efficient lighting ◆ Power-use submetering 	<ul style="list-style-type: none"> ▶ Dedicated bus/car-pool lanes ▶ Bike infrastructure ▶ Pedestrian-only streets ▶ Pedestrian-friendly streetscapes⁴ 	<ul style="list-style-type: none"> ◆ Energy-efficient street lighting ▶ Trees/urban forestry 	<ul style="list-style-type: none"> ◆ Pneumatic waste-transport system ◆ Combined heat and power ◆ Liquid-desiccant air conditioning
Waste	N/A	N/A	<ul style="list-style-type: none"> ◆ “Smart” waste bins (eg, solar-powered compactors) 	<ul style="list-style-type: none"> ◆ Composting ◆ Anaerobic digestion
Water	<ul style="list-style-type: none"> ▶ Green roofs ◆ Water-use submetering ◆ Water-efficient faucets and appliances ◆ Rainwater collection 	<ul style="list-style-type: none"> ▶ Permeable pavement and green alleys 	N/A ⁵	<ul style="list-style-type: none"> ◆ Gray-water system

¹ All forms of energy, including electricity, fuel for vehicles, and natural gas.

² Combination of best practices for insulation, roofing, wall materials, and so on.

³ Optimal building configuration, layout, and orientation.

⁴ Wider sidewalks, less surface parking, and distributed mix of uses, including street-level retail, less surface parking, and wider sidewalks.

⁵ Solutions to reduce runoff in open spaces are highly dependent on specific configuration and terrain, so costs and benefits are highly variable.

Source: McKinsey analysis

such as enhanced building insulation, which delivered the greatest return in a midwestern North American city, dropped down the scale for return on investment in the Yangtze River Delta due to its more moderate heating and cooling needs.

In contrast, there are things like water submetering that can work anywhere. In this practice, individual households or businesses pay for the water they use,

which is a great incentive to take shorter showers. That requires installing more meters (one per apartment, for example, rather than one for an entire building) so the short-term economics are almost neutral; but the savings in water use is substantial, on the order of 30 percent compared with conventional technologies. In short, we believe that in any city, there is a list of green-district technologies that makes sense, but the specifics will vary.

Across all three case studies, we found that while not every green solution costs more than the conventional alternative, green districts overall do have higher construction costs (by about 10 percent). That comes out to \$35 million to \$70 million per square kilometer, or \$1,000 to \$4,000 per resident. However, annual owner operating costs are lower, with savings of \$250 to \$1,200 per resident. The internal rates of return range from 18 percent to 30 percent. All this translates into a breakeven rate of three to five years, depending on the region and technologies deployed. And this does not take into account the substantial benefits of improved environmental quality.

Our conclusion, then, is that green districts are economically viable, as long as planners take care to match the right technologies to the location, taking into consideration climate, resource costs, regulation, and technology costs, including subsidies. In many cases, making the economics work is not so much a matter of cost as of timing. For example, installing a combined-heat-and-power system costs about twice as much as a conventional natural-gas system. But the operating costs are less than half, and the payback on the higher incurred costs is about five years. And that does not even take into account

the associated environmental benefits, such as 30 to 50 percent lower emissions.

Green districts are environmentally beneficial

Compared with standard building and construction practices, and depending on the region, the total impact of the technologies considered in our model are substantial: 20 to 40 percent lower energy consumption; 60 to 65 percent less freshwater consumption and wastewater production; 25 percent less solid waste going to the landfill. Private-vehicle kilometers traveled were 50 to 80 percent less.

The savings associated with green districts result from how the different technologies work together. While buildings represent the single most important element in energy and water savings, for example, the benefits are not just about what happens within the four walls. Other factors include where these buildings are located and how people move between them.

Green districts have the greatest potential to produce economic savings in areas with high resource demands and costs. For example, technologies for reducing water use have a much faster payback period in the desert nations of the Middle East than in regions with more water. Similarly, a temperate

Green districts are economically viable, as long as planners take care to match the right technologies to the location, taking into consideration climate, resource costs, regulation, and technology costs.



city will likely have a significantly longer payback period for district-heating technologies than one in a cold climate. Logically, if local districts are resource intensive or resources are costly, the district has a greater potential to produce savings than if resources are cheap or already are consumed efficiently.

Green districts can improve the quality of life

Green districts are not only gentler to the natural environment but may also be kinder to the humans who inhabit them. As cities grow, they often become more congested; that can raise the costs of living and doing business. It also can mean more air pollution and thus more respiratory illnesses. For example, the World Health Organization estimates that of the 1,600 cities for which it has information, the air quality in most of them does not meet its standards. Traffic congestion is not only an annoyance but also an expense: according to recent research, congestion's cost, partly from wasting the time and patience of commuters, equals 1.5 to 4.0 percent of GDP.⁴ Through better transit design and energy planning, green districts can set a course toward cleaner, less congested, more livable cities.

Most self-defined green districts, such as Malmö in Sweden, the Shipyard District in San Francisco, and South Korea's Songdo International Business District, are attractive and livable spaces. Some are also designed for social diversity. The Kronsberg development just outside Hannover, Germany, for example, provides housing of various sizes and types, including condominiums, semidetached, and single-family homes, as well as multiple forms of housing finance and ownership. The goal is to attract a wide range of residents, including the disadvantaged.

Green districts can also be part of urban revitalization, transforming vacant or changing areas in existing cities. Hammarby-Sjöstad in Stockholm, formerly a run-down, underused industrial district, is now a thriving "eco-village." Its 25,000 residents benefit from a transportation system that generates 30 to 40 percent less carbon dioxide per household than a comparable nearby district, primarily because of 40 percent fewer trips by private car. It also has a wastewater-treatment system, the hot water from which is used in the local district's heating system, and substantially lower energy costs (by 32 to 39 percent).

The way ahead

Given these advantages, why haven't green districts already become the norm? The case for them is strong, but real life can get in the way. One issue is that developers pay the bulk of the extra costs for green districts up front, but they are often unable to charge more when they sell, because owners see only the higher sticker price and not the long-term benefits of lower spending on water, energy, and sanitation. If developers cannot recoup their costs, they are not going to bother.

The simplest way to overcome this difficulty is for the developer and the operator to be the same—for example, in new districts built by universities, government complexes, and medical centers

(Exhibit 2). These may therefore be the most logical places to start the movement, because they are well positioned to test the value of green-district technologies and design features.

However, if green districts are to scale up, new business models are required. One possibility is for developers to own and operate the districts they build until they recover the additional costs, after which, they sell. This is a change from the traditional business model of developers selling properties as quickly as possible, often even before they are complete. Another option is for owner-operators to step into the gap to take advantage of this opportunity. This is a role cities might consider assuming, given that many utilities are municipally owned, and this is where a lot of the operating savings are.

Exhibit 2 There are different ways to encourage creation of green districts.

Potential incentive scenarios	Campus development	Municipal effort	Comprehensive service-provider arrangement
Description	A single entity is simultaneously developer, operator, owner, and user ¹	Municipality (with public utilities) owns and operates green districts	Private-sector entity owns and operates green districts ⁴
Distribution of benefits	Campus-scale institution recoups higher initial costs through resource savings	Developers get incentives to cover higher capital costs ² Developers pass building-specific costs to occupants City benefits by having other providers besides public utilities ³	Developer sells green district to operator, which charges users to recoup costs

¹ Applicable entities are campus-scale institutions, such as corporate headquarters, government centers, medical centers, military bases, and universities.

² Incentives could include subsidies and zoning easements.

³ City benefits from usage fees as well as from avoided utility subsidies and costs to build or expand utility infrastructure.

⁴ A developer could play this role if it were able to maintain involvement in the district for an extended period of time.

Source: McKinsey analysis

Given their environmental and commercial potential, green districts can become increasingly important in an urbanizing and resource-limited world. Green development will not make a bad deal a good deal; like any other project, it requires the right location, marketing, and design. But green development can make a good deal a great one by maximizing a district's economic, social, and environmental potential. On that basis, green districts have a future—and possibly a big one. ■

¹ See “How to make a city great,” September 2013, mckinsey.com.

² *The EcoDistricts™ Framework: Building Blocks of Sustainable Cities*, EcoDistricts, May 2013, wsdot.wa.gov.

³ Simmons B. Buntin, “Unsprawl case study: Community of Civano, Arizona,” *Terrain.org*, Autumn 1999, terrain.org.

⁴ Susanne Dirks, Constantin Gurdgiev, and Mary Keeling, *Smarter Cities for Smarter Growth*, IBM Institute for Business Value, 2010; Li-Ren Duan, Li-Zeng Mao, and Hong-Ge Zhu, “The social cost of traffic congestion and countermeasures in Beijing,” *Sustainable Transportation Systems*, 2012, pp. 68–76.

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