

CITIES IN TRANSITION

Reinventing village life for a high-density world

With more than half our human population living in cities, we have to ask: *Will these cities be safe, pleasurable, sociable, and sustainable in the decades to come? Will they be resilient in the face of climate disasters, of growing poverty, of cyclical or sudden and precipitous shortfalls in basic resources like water, energy, and food? Perhaps most important: How will we sustain the cacophony of dreams that cities represent for people of all ages, all cultures, all over the world?*

If diversity in the wild is plummeting, diversity in our cities is soaring. This diversity is perhaps the key to urban resilience, and it's also through this diversity that we can see the

emerging shape—many shapes—of cities in the 21st century. Urban planners and engineers will certainly propose mega-infrastructure projects that leverage robotics, reprogrammable biomaterials, smart grids, sensors, and massive waste recycling to sustain growing populations. But perhaps it's the day-to-day construction of our built environment from the bottom up that will more quickly transform our cities. Do-it-yourself will be the order of the day as people use social tools and social connections to create a patchwork of ad hoc and mobile infrastructures, to ensure a safe food supply, and to re-imagine the hyper-dense urban landscape as the context for new kinds of village lives.

SOCIALX INFRASTRUCTURES: AD HOC AND MOBILE

Our urban infrastructures form a social exoskeleton: they both shape and are shaped by our social relationships. So it's not surprising that, as new social technologies diffuse through our cities, they will also change the character of our built environment. We can think of these as the SocialX infrastructures—the digital and physical components of social media, social finance, social health, and all kinds of social production from energy to food to manufactured goods.

For example, mobile phones become tethers for digital connectivity, creating ad hoc wifi zones for larger appliances like computers, televisions, and even digital fabbing machines. Already much discussed, small-scale solar and wind solutions add up to flexible, sometimes mobile, energy infrastructures when connected to a smart grid. Even financial infrastructures can be built or rebuilt from the bottom up, with open money platforms that “bank” the value of all kinds of individual transactions. These SocialX components have three features that can improve urban resilience: 1) they are affordable for individuals, 2) they provide immediate value whether there are hundreds or millions of them in use, and 3) they can be rigged, hacked, and shared by do-it-yourself householders.

URBAN AGRICULTURE: RESETTLING THE CITIES

In the cyclical nature of human history, we are settling down to farming again. If farming villages were the first era of our agrarian experiment, vertical farms, rooftop gardens, community gardens, and urban gleanings are poised to define a new agrarian era. The drivers of this urban food movement are intimately tied to the evolution of our urban economies: the spread of urban brownfields in the wake of decaying industries; the high costs of long-distance shipments of food; and the growth of urban poverty that creates so-called food deserts in the urban landscape.

In pursuit of food resilience, cities will become agricultural hot spots on a new scale. Seeking urban sustainability, cities across the industrialized world are rezoning large tracts of land to encourage urban farming and setting targets for levels of food production ranging from modest to complete self-sufficiency. In many cities in the global south, urban farming is already essential to food security, with some cities producing more than 50% of the food they consume. As urban farmers change the physical landscape of the city, they will also change the social and political landscape, testing new platforms for everything from landsharing to participatory budgeting.

SUBURBAN REINVENTION: THE CHALLENGE AT THE EDGES

Cities have many kinds of edges. The spatial edges that define the suburbs and exurbs. The economic edges that reflect the hundred-fold disparity between the richest and poorest living in cities. The edges of resilience that are defined by the capacity of a city to adapt to energy, water, and climate shocks. And the cultural edges created by social innovation, as people explore new and diverse forms of community, identity, and expression.

All these dimensions combine to define a spectrum from suburb to slum. Over the next decade, cities around the world will confront the challenges that arise as their edges shift along this spectrum—as more of the poor move into US suburbs, as China expands its urban landscape at a possible rate of 1000 square miles per year, as slum dwellers grow to one third of the urban population worldwide by 2020. These challenges will pit the quest for personal autonomy against the resilience of living together in groups. And this fundamental social dilemma may ultimately lead us to re-invent the ways we find and live in communities of choice.

SUPERSTRUCTING CITIES IN TRANSITION: How will **you** live this forecast?



The **Superstruct Strategies** emerged from IFTF's 2008 massively multiplayer forecasting game, **Superstruct**. They suggest innovative ways to respond to this forecast.

EVOLVABILITY:

Nurture genomic diversity and generational differences

EXTREME SCALE:

Layer micro and massive scales for rapid adaptation

AMBIENT COLLABORATION:

Leverage stigmergy with environmental feedback

REVERSE SCARCITY:

Use renewable and diverse resources as rewards

AMPLIFIED OPTIMISM:

Link amplified individuals at massive scales

ADAPTIVE EMOTIONS:

Confer evolutionary advantage with awe, appreciation, and wonder

PLAYTESTS:

Challenge everything and everyone in fun, fierce bursts

EXTREME SCALE + REVERSE SCARCITY + PLAYTESTS

Experiment with open money platforms in financially challenged urban communities. Many of these communities already have robust informal economies in which trading in goods and services is a way to hedge against the uncertainties of jobs, income, and prices. Give people ways to “bank” the value of services such as child and elder care, of food shared from their gardens, or of time maintaining local infrastructures as a way to generate more wealth in a community and also build more security. Leverage open banking platforms and mobile devices to open the benefits of personal accounts and mediated transactions to people who have been excluded from financial systems because they lack traditional money resources. Recognize the power of the gaming metaphor—and the growing skills among young people worldwide in game strategy—to build a robust trade around alternative transactions.

EVOLVABILITY + EXTREME SCALE + AMPLIFIED OPTIMISM

Develop platforms for sharing and scaling urban experiments. The coming decade will be one of rapid experimentation in urban and suburban infrastructures and the lifestyles that come with them. As a company or a community, help seed lots of small, local experiments in everything from food production to transportation to small-scale manufacturing centers. Look for ways to scale these experiments, whether it's replicating them across many local communities or testing the innovations at city or even regional scales. Create platforms that allow individuals and local communities to see how their experiments add up to big wins for the larger community—leveraging alternative measures of well-being, such as happiness, resilience, and legacy.

AMBIENT COLLABORATION + ADAPTIVE EMOTIONS + PLAYTESTS

Turn the city into a futures gameboard. Find ways to make alternative visions of the city visible. Use augmented reality tools and online models to help people imagine their way into future spaces, but also use tangible physical markers (such as chalk on the street or installations) to create game zones where people can win points for seeing their urban environment in new ways. Use these game zones to identify potential garden spaces and designs, new manufacturing hubs, and new sites for urban mining of materials and resources. Use game interactions to simulate, from the bottom up, future urban economies, the impacts of development, and new kinds of winners and losers. Reward winning visions with resources to make them real. Think of it as bottom-up urban redesign and development.



URBAN INFRASTRUCTURE

THE SCALE OF THE URBAN CHALLENGE

In 2005, the world's population totaled 6.5 billion, with 3.2 billion, or 49%, living in cities. By 2025, at least 65% of the total population will live in cities, growing to 4.6 billion urbanites. Of those, 3.9 billion will live in cities in the developing world—more than those who live in all the cities of the world today.

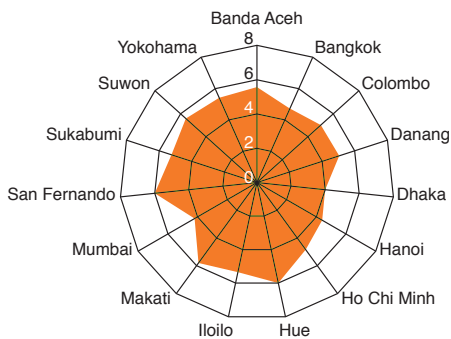
This growth will put tremendous pressure on traditional urban infrastructures—from roads, water, and power to institutions—while climate change and energy constraints demand technological innovation and reinvention throughout our built environment. Morgan Stanley estimates that revitalization of the world's infrastructures will require investments of at least \$41 trillion worldwide over the next 20 years. And this will occur in a decade in which the urban poor are growing much faster than those with high or even medium incomes (Figure 1). The challenge to finance urban infrastructure under these conditions is formidable.

RISK, RESILIENCE, AND SOCIALX INFRASTRUCTURES

Climate change will be a galvanizing threat to cities in the coming decades. Traditional city infrastructures—and the built environment in general—are highly vulnerable to the kinds of disasters that climate change portends. Flooding, drought, hurricane winds, and fires all hit cities harder than rural areas, and cities tend to cluster in the most hazardous areas of the world (Figure 2).

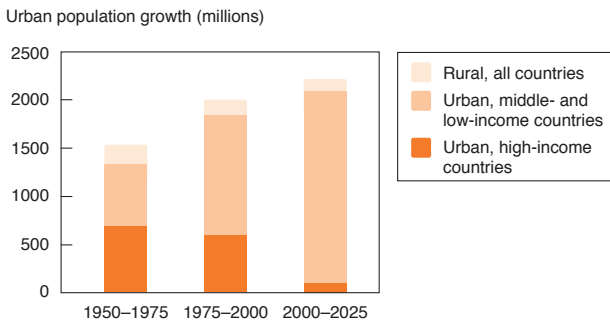
Many factors, however, can decide either risk or resilience. Natural, physical, social, economic, and institutional factors all contribute to urban resilience indexes (Figure 3). Poor social systems, in particular, can exacerbate climate change risk. But if poor social systems increase risk, SocialX infrastructures can be expected to increase resilience. And because they rely heavily on virtual structures as well as small, modular physical components, they tend to fail at smaller scales. Therefore their failures are less disruptive, and they cost less to rebuild than traditional physical infrastructures. The growth of the information and communication infrastructures that underly these SocialX infrastructures thus provides an alternative lens for viewing the resilience of cities worldwide (Figure 4).

FIGURE 3 Natural, physical, social, economic, and institutional dimensions shape the resilience of Asian megacities.



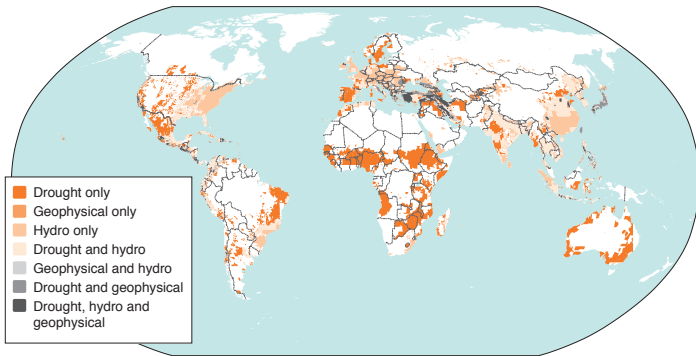
Source: Rajib Shaw, City Profile: Climate and Disaster Resilience, Kyoto University, undated. www.unescap.org/.../Japan-Rajib-Shaw-CLIMATE-DISASTER-RESILIENCE.pdf

FIGURE 1 Poor and middle-class countries will experience the greatest population growth in their cities.



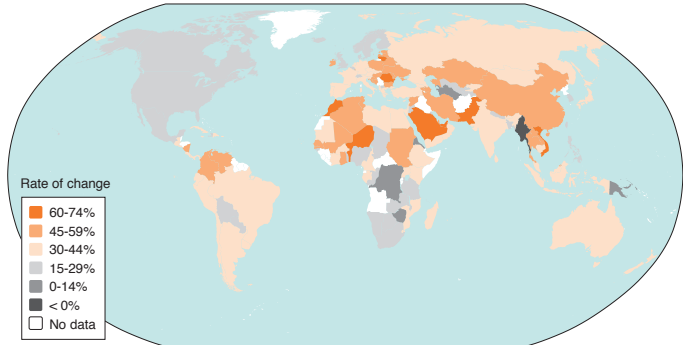
Source: United Nations, World Urbanization Prospects, 2008.

FIGURE 2 Urban areas tend to cluster in the locations with the highest economic risk from disasters.



Source: Maxx Dille et al, Natural Disaster Hotspots: A Global Risk Analysis, Synthesis Report, 2005. <http://sedac.ciesin.columbia.edu/hazards/hotspots/synthesisreport.pdf>

FIGURE 4 The rate of change in the information technology and communications infrastructure between 2002 and 2007 is one indicator of resilience.



Source: ITF from data in ITU, Measuring the Information Society: The ICT Development Index, 2009. http://portal.unesco.org/ci/en/ev.php-URL_ID=28407&URL_DO=DO_TOPIC&URL_SECTION=201.html

HOW WE WILL FEED OUR URBAN POPULATIONS

Worldwide, 15% of the population—1.02 billion people—goes hungry every day. And while the world's rural poor still outnumber the urban poor, people living in poverty in cities are more vulnerable to food crises and ongoing hunger. As the rural poor enter cities, they often find themselves facing higher food costs, less dependable incomes, and social alienation. For the urban poor, food costs can absorb 60–80% of the household budget.

Like the urban infrastructure, the urban food system is also vulnerable to climate change and energy constraints. The cost of petroleum inputs, the rising costs of food processing and transport, and disruptions from climate events all threaten food security. So do the general decline of arable land worldwide (Figure 5) and the growing risks of food contamination and food-borne disease.

URBAN AGRICULTURE

Urban agriculture offers a solution that doesn't compete with agricultural land already in production. In cities around the world, vacant lots add up to vast acreage available for agricultural use. In industrialized countries, these lots are often brownfields where failed industries have abandoned the city, leaving unemployment and hunger in their wake. In the developing world, the land is often unsecured public land or privately held land that has never been developed. Turning these lots into urban and peri-urban farms not only promises to boost urban food production. It can also provide jobs, create green buffers against climate events, reduce the energy costs of food production, support some urban waste recycling solutions, and increase social inclusion for people living on the fringes of urban society (Figures 6 and 7).

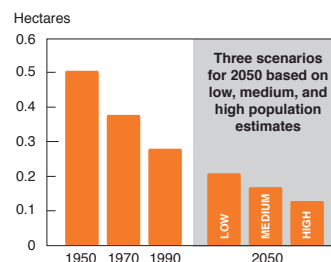
Today, urban farmers represent only 1% to 7% of the total agricultural population, depending on the region. (Among emerging economies, cities in Eastern Europe, Central Asia, the Middle East, and North Africa have the highest percentage of urban farmers; South, East, and Southeast Asia have the lowest.) Like alternative energy, which today represents a small portion of total energy production, urban agriculture is poised for growth as cities attempt to meet the challenge of global hunger. Among emerging megacities, Accra, Beijing, Brasilia, Bulawayo, Havana, Rosario, and Nairobi all have pro-urban-agriculture policies.

SOCIALX INFRASTRUCTURES FOR URBAN FOOD

The greatest barrier to the urban agricultural movement is social. Small urban farmers often lack basic social structures for cooperation in production and marketing and for participation in decisions that affect their ability to succeed. Yet in cities across the world, from Detroit, Michigan, to Rosario, Argentina, to Hyderabad, India, and Dakar, Senegal, city farmers are beginning to find that social organization is helping them build productivity.

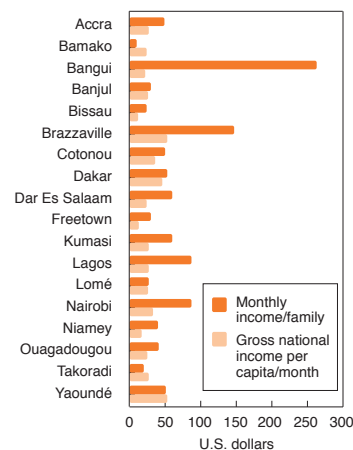
At the same time, innovations in SocialX infrastructures suggest ways to support very small-scale urban farming. Worldwide, many organizations now have web platforms for matching small-scale farmers and gardeners with resources they need to make their gardens grow better or to bring their produce to market (Figure 8). Open finance and alternative currencies are also emerging as new tools for building the economics of urban farming. Over the next decade, these innovations are likely to change the social and physical landscape of the world's cities, both large and small.

FIGURE 5 Urban sprawl and land degradation from industrial agricultural practices threaten food security worldwide.



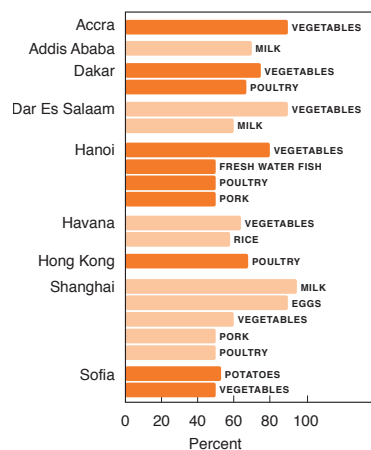
Source: FAO, "Food For All". <http://www.fao.org/docrep/x0262e/x0262e25.htm#TopOfPage>

FIGURE 6 Urban farms in emerging world cities contribute positively to the economy, with farm incomes exceeding gross national income per capita.



Source: Hallegatte, et al, The Economics of Climate Change Impacts and Policy Benefits at City Scale, OECD, 2008. <http://www.sourceoecd.org/rpsv/cgi-bin/wppdf?file=5kz804l2gbzt.pdf>

FIGURE 7 Urban or peri-urban agriculture presently provides more than half of total consumption in basic food categories in some cities in the Global South.



Source: Hallegatte, et al, The Economics of Climate Change Impacts and Policy Benefits at City Scale, OECD, 2008. <http://www.sourceoecd.org/rpsv/cgi-bin/wppdf?file=5kz804l2gbzt.pdf>

FIGURE 8 Worldwide, social land-sharing platforms are emerging to support urban gardeners and farmers.



Sources: <http://landshare.channel4.com/listings/map> <http://www.growfriend.org/> <http://hyperlocavore.ning.com/> <http://www.urbangardenshare.org/> <http://www.sharingbackyards.com/>

SUBURBS AND SLUMS

THE SUBURB–SLUM SPECTRUM

As cities expand, they grow both at the core and from the edges. In industrialized countries, and especially in the United States, this expansion often takes the form of suburbs. But in less developed countries, the expansion more often leads to large-scale slums, embedded in poverty. Nevertheless, suburbs and slums exist on a continuum, and any given community may find itself shifting along that continuum depending on population changes, economic factors, environmental conditions, or social innovations and societal patterns (Figure 9).

CITIES WITHIN THE CITY

Another way to view the spectrum of cities within a city comes from the UN Human Settlements Programme, which recognizes six classes of cities. These may co-exist within a metropolitan area or megacity, and they represent the different aspirations and realities of their inhabitants (Table 1). Of these, the informal city (or city of illegality) is perhaps the most disruptive because it tends to threaten the stability of the other five: it is the seat of many social innovations, both positive and negative. Inherently entrepreneurial, it may offer inspiration for building sustainably dense cities; on the other hand, it may also contribute to human misery by profiting from human trafficking, child labor and bondage, prostitution, drugs, and piracy. Informal cities are growing fastest, and it may be in these informal cities that humans pursue the most daring experiments in social and economic reorganization for the coming century.

TABLE 1 Different classes of cities can co-exist in “an almost virtual network, where it is possible to travel through the city ... while barely being aware of the adjacent network being used by other classes.”

The luxury and controlling city: a locus of power and profit, consumption and relaxation.
The gentrified city of advanced services: home to professionals in the knowledge economy
The suburban city of direct production: habitat of blue-collar and nonprofessional workers, situated near their factories and offices
The tenement city of unskilled workers: an enclave of immigrants, lower-paid wage earners, and the “respectable poor.”
The abandoned or residual city: the refuge of the permanently unemployed with income from marginally legal or illegal activity
The informal city of illegality: where services are inadequate and residents are invisible to legal status systems

Source: UN Human Settlements Programme, *The Challenge of the Slums*, 2003.

FIGURE 9 The spectrum between suburbs and slums will be a zone of experimentation and shifting experience as cities cope with expansion and contraction.

	SUBURBS	SLUMS		
Geo-spatial	US: Suburbs grew 5X faster than urban core in 2000s US: Suburban population is about 3X urban population, down from 9X in 1950	Western Europe: 64% of urban population lives in suburbs (about 2X urban core) Europe: 33% of urban population lives in slums; Eastern Europe & Southern Mediterranean face depopulation trend	Latin America: Has 14% of global slum population Africa: Has 20% of global slum population Asia: Has 60% of global slum population	Worldwide: 2 billion to live in slums by 2050, compared to 924 million in 2001 (31% of urban population)
Economic	US: Poverty rate of suburbs grew by 15% in the last decade. 1.5 million more poor people now live in suburbs than cities Beijing: Peri-urban share of municipal budget rose from 20% to 60% between 1980s and 2000s	Worldwide: Cities under 300,000 have 30% living in unauthorized housing; cities over 5 million have 25% in unauthorized housing Worldwide: Structural Adjustment Programs (SAPs) increase the size of the informal economy	Transitional Countries: Extreme poverty increased from 14 million to 168 million in the 1990s, while dropping in China and SE Asia	Worldwide: 1/3 of slum dwellers live in extreme poverty (<\$1/day); one half earn less than \$2/day
Environment	Worldwide: Nearly 200 Transition Towns worldwide seek to make suburban areas more sustainable	US: Only 5-10% of housing is in walkable urban areas US: 1/3 of survey respondents would prefer mixed-use walkable urban; 1/3 prefer traditional suburbs; 1/3 have mixed feelings	US: Suburban & urban areas are 2-10° warmer than nearby rural areas US: 1° rise in temperature increases residential water use by 290 gallons per month—about 4 days worth.	Worldwide: Infrastructure deficiency is 32-34%
Societal	US: Planners seek to convert suburbs to “life-long communities” to support aging population, perhaps replacing retirement cities US: “Lifestyle centers” replace regional malls	China: New edge cities are created for specific (desirable) populations, such as artists	Turkey: Laws supporting squatters' rights + incentives to invest in homes improve slum conditions Worldwide: Slum entrepreneurs, slum tours create alternate narratives	Megacities: Security of tenure becomes more important than land ownership

Source: IFTF, based on: UN Human Settlements Program; Demographia.com; *Forbes*; *The Atlantic*; *New York Times*; *Wall Street Journal*; *Business Week*, Scientific Blogging, Chinese Embassy.

MAKING THE CONNECTIONS

In a complex world, forecasts intersect. These are key intersections between Cities in Transition and other 2010 forecasts.



CITIES + WATER: Community-Scale Waste Water Treatment



Of all the urban infrastructure costs, water infrastructures are perhaps the most expensive to build and maintain. A recent UK study suggests that the average capital intensity (expenses against revenues) of the water infrastructure far out-distances electricity, telecommunication, and gas (Figure 10). A large portion of this expense goes into maintaining large-scale wastewater treatment plants and connecting new developments to them. In developed as well as developing economies, cities are beginning to seek small-scale, decentralized solutions beyond the traditional well and septic systems, which tend to degrade the quality of aquifers over time. These community-scale treatment plants can be as small as a cargo container, serving from 10 to 10,000 households, and they offer several advantages over both large-scale sewage treatment facilities and private septic systems. Because they process wastewater locally, they reduce the possibility of toxic leakage as wastewater travels large distances through old pipes to centralized facilities. Tapping advanced technologies, including so-called bioreactors that use micro-organisms to clean the water, these systems purify wastewater better than traditional septic systems and then return the water to local aquifer. Such community-scale solutions also help build community cohesiveness by keeping local neighbors focused on their shared responsibility for safe water.



CITIES + CARBON: Cities and Their Carbon Footprints



Over the next decade, carbon management will likely become a potential profit-and-loss center for corporations and cities alike. The economic well-being of many cities will depend not only on their ability to increase the energy efficiency of their public infrastructures, but also on their ability to engage their corporate and development communities in lowering the carbon footprints of their assets. In the United States, this burden will unfortunately fall on those cities whose industries are most challenged, not only by the carbon economy, but also by the transformation of the manufacturing industry worldwide. Many of the US cities with the highest carbon footprints fall in the rustbelt, where corporate and citizen resources alike are the lowest (Figure 11). The development of sustainable urban strategies for these cities will likely focus not so much on retrofitting existing infrastructures as on experiments in new infrastructures.

FURTHER READING

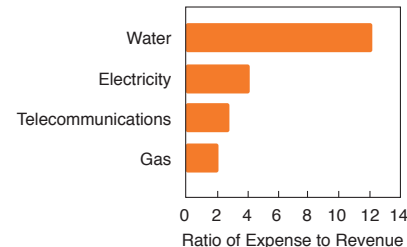
Marilyn Brown, et al., "Shrinking the Carbon Footprint of Metropolitan America, Brookings Institute, 2008, http://www.brookings.edu/~media/Files/rc/reports/2008/05_carbon_footprint_sarzynski/carbonfootprint_report.pdf

FAO, "Profitability and sustainability of urban and peri-urban agriculture," 2007. <ftp://ftp.fao.org/docrep/fao/010/a1471e/a1471e00.pdf>

Fifth Urban Research Symposium, "Getting to Carbon Neutral: A Review of Best Practices in Infrastructure Strategy," 2009. www.urs2009.net/docs/papers/Kennedy.pdf

United Nations Human Settlement Programme, *The Challenge of the Slums, Global Report on Human Settlements*, 2003. <http://www.unhabitat.org/pmss/listItemDetails.aspx?publicationID=1156>

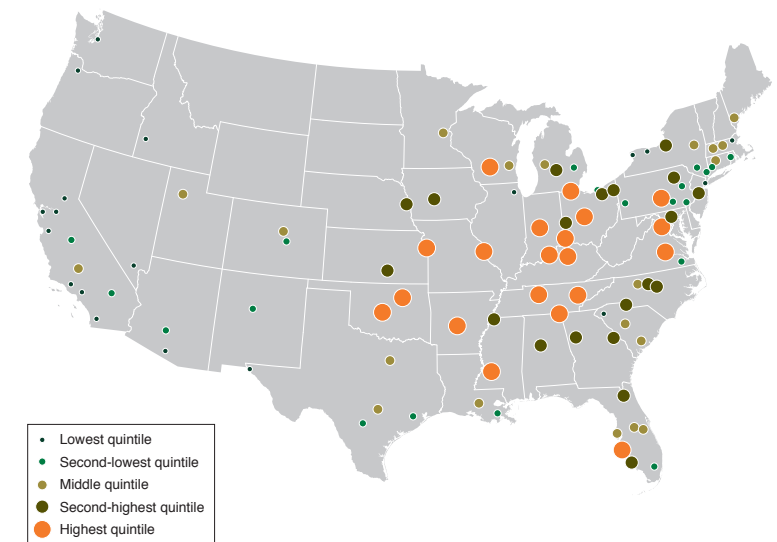
FIGURE 10 Urban water infrastructures are much more capital-intensive than other utilities.



Source: Richard Franceys, *Urban Water and Sanitation*, Cranfield University, 2003.

FIGURE 11 Most of the US cities with the largest per capita footprints are located in the older manufacturing regions that may have the least resources to revitalize their infrastructures in the coming decades.

Total carbon emissions per capita by quintile



Source: Marilyn A. Brown, et al., "Shrinking the Carbon Footprint of Metropolitan America," Brookings Institute, 2008.



GROWTH

Smart Cities



In a decade of moderate growth, cities get smarter by creating large-scale intelligent infrastructure solutions, from semi-autonomous personal transportation vehicles to iTunes-like models for access to proliferating urban data. Sensors multiply alongside mobile and embedded devices to make it faster, easier, safer, and more resource-efficient to do just about everything, from getting across the city to getting healthy. The market for this convenience and urban well-being is vast, and the competitors range from the traditional industrial and retail

sectors to online innovators, open-source communities, and even the informal sector, whose ranks continue to swell with the urban poor. The latter has its own markets, channels, and uses for urban data, often in support of marginal and illicit enterprise. In response to this challenge from the shadow economy, digital security looms large, with increasingly ubiquitous surveillance extending well beyond urban cameras to transit cards, RFID-tagged commerce, PDAs, and mobile phones

- While small-scale infrastructure technologies like containerized waste-to-energy conversion and wastewater treatment systems represent a strong growth industry in the Global South, more advanced megacities are leveraging their growth to create mega-infrastructure that exploit a 3D grid, rising higher above the city and digging deeper below to sustain 20th-century lifestyles in an increasingly dense urban environment.
- In China, a disproportionate investment in energy-efficient, peri-urban development pays off not only in a vastly expanded and robust urban infrastructure but also in carbon credits that give the country a double return on investment. Hand-in-hand with carbon management goes cultural management, as various “new cities” are devoted to different lifestyle communities, such as artists or technological innovators.
- Worldwide, the trade wars between auto manufacturers and food producers pale compared to the competition to provide sensor systems and the services that leverage their data streams. By 2010, Asian companies are beginning to penetrate US and European markets.
- City managers, commercial institutions, and citizens all use urban dashboards to guide their daily decisions and fine-tune strategy—over shorter and shorter time-frames—to respond to both opportunities and threats.
- Robotics becomes increasingly visible in the cityscape—not so much as android forms but as conveyances, maintenance units (think street-scale Roombas and automated micro-jet paint sprayers), and mobile security systems.
- The proliferation of urban sensor systems creates a new experience of 4D cities: urban landscapes that can be navigated not only in the three familiar spatial dimensions, but also in a data dimension, both historical and future. This 4D urban experience guides development strategies, but more important, it also gives the city entirely new sensory contours that, in turn, shape human behavior.
- Commercial enterprises and communities alike take advantage of sensor data and the rapidly growing art and science of persuasion to manage behavior in both public and private spaces.
- Autonomous and semi-autonomous vehicles begin to solve some of the problems of congestion within the limits of well-defined spaces and often following fixed or user-definable routes. These vehicles redefine public transportation at a smaller and more flexible scale.
- Technologies of embedded governance—from construction permit applications that “know” whether your project meets building codes to cars that “know” when you’ve exceeded the legal limit of blood alcohol—are increasingly adopted in the name of safety and security.
- The combination of urban dashboards and increased monitoring makes the various strata—and flows—of city life more visible, prompting more awareness of urban poverty and more experiments in solutions, with more immediate feedback about the results.



SIGNALS OF GROWTH IN CITIES IN TRANSITION

SMART VEHICLES

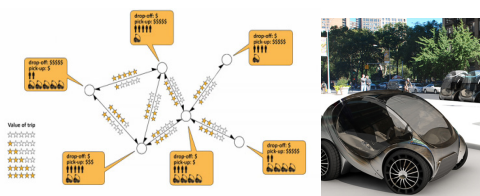
As cities attempt to reduce the impact of transportation on the environment and the quality of daily life, they are turning to robotics and smart design to change the way people get around. Semi-autonomous vehicles are beginning to emerge with simple sensing mechanisms that intervene when safety is an issue—if another car is too close or the driver is incapacitated in some way. The French robotics company, Robosoft, has prototyped a fully autonomous passenger transportation system called robuRIDE. Meanwhile, MIT's Media Lab has redesigned the small urban car not only to make it more sustainable but also to change the model of car ownership.

The robuRIDE is like an autonomous streetcar that can sense people waiting for a ride and take them along its route without rails, wires, or human drivers.



Source: <http://robots.net/article/2743.html>

MIT's Citicar is a small, fold-up electric vehicle that is designed to be picked up and dropped off anywhere in the city. Smart logistics set dynamic pricing to manage perennial car-sharing problems like the cost of moving cars from outlier sites to more popular pickup locations.

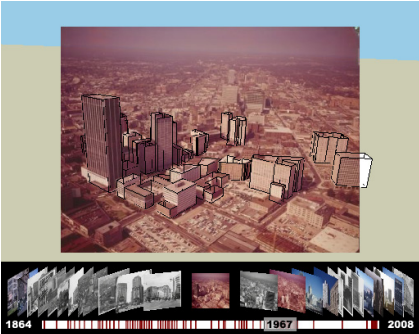


Source: <http://cities.media.mit.edu/>

4D CITIES

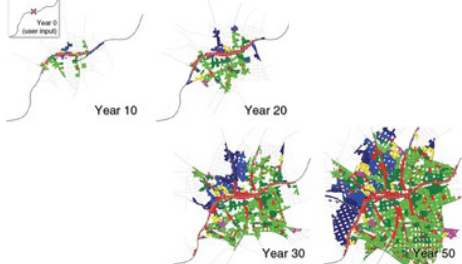
Digital media make it possible to view cities in four dimensions, adding the dimension of time by adding data about the past and the future. A number of new urban modeling systems create the foundation for re-experiencing an urban past or even collaborative design of the future of a city. Commercial services and civic innovations alike will build on these foundations to do everything from anticipating logistical challenges five years in advance to exploring redevelopment under alternative scenarios.

A modeling system at Georgia Tech builds on large collections of urban data to access and view a 3D model of Atlanta from year to year from 1864 to 2008.



Source: <http://www.cc.gatech.edu/4d-cities/dhtml/index.html>

Procedural, Inc. has advanced the art of urban modeling by moving beyond familiar grid-based representations to build a “complete and inherently geometric simulation that includes exact parcel boundaries, streets of arbitrary orientation, street widths, 3D street geometry, building footprints, and 3D building envelopes.”



Source: <http://www.procedural.com/company/publications/urban-simulation.html>

EMBEDDED GOVERNANCE

Increasingly, computer intelligence will be used to embed laws and legal processes into the world around us. Sometimes referred to as “the cop over your shoulder,” embedded governance is not just about enforcement. It’s also about streamlining many legal processes and making sure that the law is applied equally across jurisdictions and populations.

Project CALC

Computer Assisted Legal Compliance

Stanford Center for Computers and Law (Codex)

Source: <http://codex.stanford.edu/calc/projectdetail.html>

Project CALC at Stanford University is exploring various forms of embedded governance that “enable computers to help individuals know and comply with the laws that govern them.”



CONSTRAINT

Transition Towns

In a world where global lifestyles realign around targets for societal and environmental well-being, cities mobilize for a rapid transition to low-impact lifestyles. Around the world, this transition runs the gamut from building entirely new sustainable cities, to reinventing the suburbs, to integrating the world's slums into local and national legal frameworks. Reducing the footprint of urban transportation drives people to re-examine the relationship of the city core to its edges, striving to reduce

extreme commutes by creating neighborhoods where services and even work are available within walking distance: the so-called 20-minute neighborhood. As food shortages threaten urban stability, urban farming intensifies and cities begin to see themselves as foodsheds to be managed with the same kind of eco-science as watersheds. Urban measures of well-being proliferate, and with them, both voluntary and compulsory monitoring of household, business, and community footprints.

- Bottom-up global networks—like the Transition Town network—coordinate innovation and learning across hundreds of cities to speed the transition to sustainable practices and policies.
- Decentralized small-scale infrastructures—including neighborhood energy grids and community wastewater treatment solutions—begin to take shape. They form a diverse but resilient bricolage of communities.
- To counter a crisis in commercial real estate in the United States, developers and city planners redesign and reconstruct suburban strip malls and abandoned big box locations into mixed-use residential and commercial centers with an eye to creating new community centers and enhancing small-community identity.
- Eschewing so-called “underperforming asphalt,” cities look for ways to redesign their streets, plazas, malls, and parks for more sustainable lifestyles—with measurable targets for everything from local food production to walkability. Cities compete regionally and nationally for the best scores on these measures. Walkability and transportation scores become standard components of real estate listings.
- Following California’s lead, US cities rapidly roll out smart electric meters and provide tax incentives, subsidies, and low-cost loans for household-scale alternative energy solutions, such as solar and wind technologies.
- Urban and peri-urban farming grows worldwide, as cities change their policies to support rather than discourage urban farming. In China, the growing agri-tourism business surrounding its major cities pays double dividends in food production and tourist income. In cities throughout the global south, urban farmers win new land-tenure rights and gain official support for more market locations to reduce the burden of transport. In the cities of the developed world, zoning policies allow multiple forms of urban farming, from backyard gardens to community gardens to commercial urban farms.
- The alternative and local currencies movement gains strength from new open-money platforms that help people track and manage their assets—both traditional and alternative—independent of banks.
- Supported by new legal structures that aim to re-integrate much of the informal economy—as well as flexible alternative currency regimes—people living in slums begin to benefit from carbon credits inherent in their low-impact lifestyles. Perhaps more important, they begin to inform how people can live together in groups in the high-density world of the next century.

SIGNALS OF CONSTRAINT IN CITIES IN TRANSITION

BOTTOM-UP AND TOP-DOWN CITY NETWORKS

Around the world, networks are the key to rapid transition toward a more sustainable world. Many of these are organized at the city level—whether initiated by city governments with official city-to-city exchanges or from the bottom up by citizens who share templates for community organization to reinvent urban lifestyles.

The Transition Town movement has spread to almost 300 cities in all regions of the world, led by local community organizers who work with city governments and local citizens to design transition plans.



Source: <http://transitiontowns.org/TransitionNetwork/Transition-Communities>

In Asia, CITYNET is an organization of city governments working to learn from each other; for example, Makati and San Fernando in the Philippines are working to help Phnom Penh in Cambodia reduce solid waste to 33% of current levels, based on their own successes with community-based practices.



Source: www.citynet-ap.org/images/uploads/cityvoice/1922.pdf

NEW VISIONS OF SUBURBIA

Suburbs around the world pose special problems for sustainability, including transportation to and from the city core, resource-intensive construction requirements for infrastructure and shelter, and the degradation of the natural environment that is critical to carbon sequestering. Faced with these challenges, many efforts are underway to re-imagine, redesign, and reinvent suburbia.

The First Suburbs Coalition is a Kansas-based organization that is organizing communities built in the years following World War II to update their housing stock and public infrastructure as well as attract the businesses they need to guarantee vibrant local communities.



Source: <http://www.marc.org/firstsuburbs/>

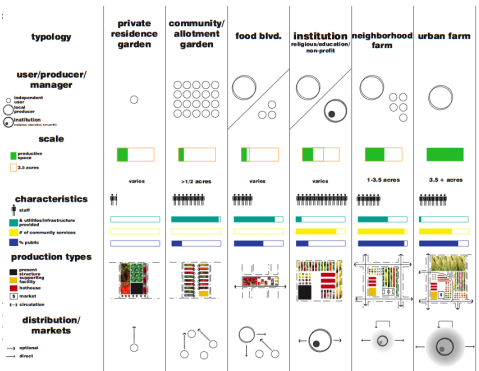
In 2009, *Dwell Magazine* and Inhabitat.com sponsored a design competition to reinvent the suburbs. Winning entries: plans to convert a McMansion into a biofilter water treatment plant; to redesign residential blocks into entrepreneurial incubators; and to rethink big-box stores as community greenhouses.



Source: <http://www.re-burbia.com/>

URBAN FARM PLANNING

In cities around the world, urban planners are beginning to take a serious look at urban farming as a means of sustainable urban growth. Urban farming is about more than just asking everyone to dig up their lawns and plant victory gardens. It's about putting in place all the systems needed for producing food on different scales in the city, creating viable market systems for urban farmers, and managing the safety of both the food and the surrounding residential or commercial-industrial landscape. In a design competition by ResilientCity.org, one of the winning entries even reconceptualized the urban food system as a public utility.



Source: Jason Grimm, et al., *Food Urbanism: A Sustainable Design Option for Urban Communities*, 2009. www.database.ruaf.org/ruaf_bieb/upload/3129.pdf

Using Ames, Iowa, as a case study, urban farming designers identified five types of urban food growers, each with their own needs and contributions to the urban food solution. Together with processing and distribution, these food producers can be seen as a new “food flow system.”



COLLAPSE

Feral Cities

At the intersection of government bankruptcies, escalating urban poverty, climate hazards, and civil war, feral cities are proliferating worldwide. Long defined primarily by the dimension of lawlessness, the world's feral cities actually demonstrate a continuum of evolution from initial collapse of services to organization by illegitimate networks to adaptation and restoration, starting with restoration of the urban landscape. In a world where hunger is the dominant experience of daily

life for more than one-sixth of the world's population, food is at the core of this restoration, and cities in the adaptation phase are working to transform food deserts into urban farms that rebuild community as well as the flow of food. Meanwhile, mobile digital tools not only enable illicit networks of super-empowered hostile individuals; they also illuminate new forms of social order in the chaos of collapse.

- Continued weakness in the global economy—as well as the continuing growth in disparity between the richest and poorest citizens—set the conditions for a great civic divide, where those with resources live in walled enclaves, supported by local infrastructures that meet their needs even as the larger, traditional urban infrastructures around them fail. Outside those walls, people cluster in less obvious enclaves, occupying abandoned structures or building shanty towns from found materials and using social connections to meet their basic daily needs.
- In countries hit hardest by drought, flooding, and poverty, the failure of urban infrastructure—and urban governance—leads to embattled lifestyles. The patterns that emerged in the 2000s in megacities like Juarez (Mexico), Rio (Brazil), and Caracas (Venezuela) are now particularly visible in cities throughout the Global South.
- In the Global North, the decline or relocation of traditional industrial sectors, ranging from automotive to extraction to food, leaves many mid-size cities hollowed out. In Eastern Europe, Southern Italy, and Southern Spain, depopulation creates ghost cities. Across the United States, high-carbon cities are struggling to retain their lifestyles in the face of loan defaults and migration of the poor.
- The US suburbs continue to absorb more poor, while the exurbs become home to the first large squatter slums in the country. Poor construction and high carbon footprints of large portions of the suburbs and exurbs lead to rapid deterioration of the built environment as new occupants cannot afford repairs and retrofits.
- Even in less stressed communities, the collapse of commercial real estate has forced many services to relocate, often at a distance from those most in need of them. With transportation costs high, the suburban poor turn increasingly to alternative sources of health care, financing, and social support embedded in their local communities.
- Even though the diet of people with rising incomes in the global south is improving and attracting new growth in food services and groceries in secured communities, food is a major source of unrest amidst the lower-paid working classes and the extreme poor. Food protests and food theft go hand-in-hand with threats to food safety, including deliberate tampering with food supplies as acts of civic violence.
- In response to food crises, many cities are expanding their urban food production capacity. But it is particularly among cities that have gone through collapse and are starting on the road to rehabilitation that urban farming and local food production play the greatest roles: from Detroit in the United States to Monrovia in Liberia, food self-sufficiency is the platform of restoration, and large tracts of abandoned industrial or war-torn land are being reclaimed for food production.
- In both the Global North and South—but particularly in the developing cities of the South—communities are leveraging a weak carbon credit economy to create new income streams from such diverse adaptations as urban farming and small-scale solar appliances
- Across the globe, in poor and rich communities alike, digital connectivity provides a key lifeline in a world where it is harder, and often more dangerous, to get provisions. Knowing where services and goods are available is the key to safety and convenience among the well-heeled, but it is critical to survival among the urban poor. Open mapping of squatter settlements increasingly takes the place of more traditional resources like postal systems, telephone directories, and even central markets.

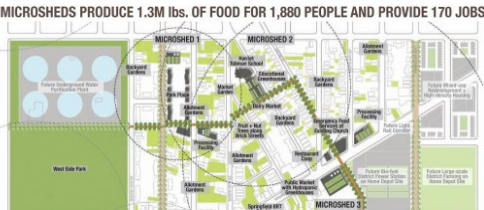


SIGNALS OF COLLAPSE IN CITIES IN TRANSITION

FOOD AS URBAN REHABILITATION AND RESTORATION

Around the world, cities in collapse are focusing on food systems as a path toward resilience. In Africa, the UN's Food and Agriculture Organization is helping to establish allotment gardens in cities with high food risks. In the Democratic Republic of the Congo, city authorities in Kinshasa, Lubumbashi, and Kisangani are working to develop 800 hectares of urban land to feed and produce income for 16,000 participating families. In Newark, New Jersey, a plan known as From the Ground Up seeks to introduce new food systems into neighborhood spaces. And in Detroit, Michigan—which is arguably the icon of feral cities in the United States—city officials and local communities alike are rehabilitating the city's 40 square miles of vacant lots to become the world's first 100% food-self-sufficient city.

The Grand Prize winner in the urban redesign contest by ResilientCity.org was “From the Ground Up,” which introduced the concept of food microsheds as a way of understanding all the interlocking systems that are necessary to make a city resilient.



Source: <http://architecturelab.net/2009/09/28/resilientcity-org-design-ideas-competition-winners-announced/>

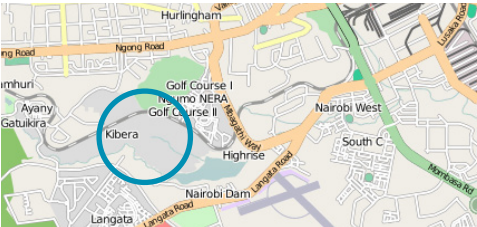
In Detroit, Michigan, community gardening networks, such as DetroitAgriculture.org, are at the heart of the city's efforts to become self-sufficient in food and repair the social fabric of the city.



Source: <http://www.detroitagriculture.org/>

SLUM MAPPING

Cities have surprising resources—including arable land—that could be used to increase the resilience of individual families and cities as a whole. In cities such as Cienfuegos, Dar es Salaam, Rosario, and Cagayan de Oro, official or bottom-up mapping projects have analyzed the cities for vacant land suitable for farming. In the slums of the world, these mapping efforts are even more important because they form the basis for possible services and commerce. And because authorities are often not trusted in these communities, bottom-up open mapping projects run by locals are more likely to be successful.



Source: <http://www.breakingnewskenya.com/2009/11/03/map-kibera-kiberas-first-complete-free-and-open-map-november-2009/>

Kibera, in Nairobi, is the world's second largest slum. In 2009, the community produced its first open map, using community mapping tools.

RESILIENCE OF THE POOR

While slums represent lifestyles that are poor and risky in the extreme, they also represent the first human experiments in hyper-dense living communities that make the most of the limited materials. Writing about the barrios of Caracas, Worldview blog says:

“The barrios represent a single highly democratic building process that promotes qualities that are not found anywhere else in the city. The metabolism of the informal city is impressively positive. Less trash is produced than in any other area of town. The high-density low-rise buildings offer a positive alternative to the high-rise developments promoted by the formal construction industry. The selection and use of building

materials is in direct response to climate, with low environmental impact and equally low investment costs. The barrio houses maintain a microclimate that is far superior to structures of comparable density in the formal city. Pedestrian access and its dependence on existing topographic elements are currently treated as negative characteristics but can be easily viewed as creative responses to a difficult problem.”

As prototypes of urban solutions that might evolve toward stability, security, and wealth, what can these settlements teach us?

Do the barrios of Caracas point to patterns for resilient cities of the future?



Source: <http://www.worldviewcities.org/caracas/barrios.html>



TRANSFORMATION

Biomimetic Cities

In a world of rapid urban redesign, urban architecture undergoes a renaissance, driven by three main factors: radical decentralization of services, the demand for a new urban agriculture, and a new biomimetic paradigm that leverages bio-based building blocks for everything from ultra-efficient construction materials to heating, cooling, and waste conversion systems. New materials transform the scale of what's possible—buildings can be taller than ever, reaching a mile

high, while microbe armies can be sent through the sewage streams of squatter cities to neutralize toxins and disease. But transformation in the city is not just about technology. It's also about new ways of using the urban built environment, whether by growing food up the sides of buildings or creating mesh communities that organize around shared media spaces—both physical and virtual. Demonstration projects abound and innovations spread virally.

- Confronted with shortages of conventional materials and facing new climate risks, planners, designers, and builders turn to new kinds of bio-based materials and designs. These are produced across a range of scales from naturally grown to molecularly engineered.
- These next-generation technologies come increasingly from a globally trained network of scientists, engineers, and DIY technologists who find themselves equally at home across the continents.
- More and more materials are reprogrammable: the metabolic pathways of living cells can be manipulated to act on materials or organisms, altering the characteristics of both. As much of this bio-innovation comes from the bottom up as from the top down, with amateur bioengineers designing their own materials and sharing their designs across networks of local producers and DIY users.
- China, continuing its push to house its growing urban population, takes the lead in experimentation with new architectural forms that exploit biomimetic design principles. India takes the lead in low-cost green housing.
- With small-scale technologies to improve infrastructure, squatter slums follow the pattern of gentrification that defined the 1970s and 1980s in core cities of the developed world. The compact lifestyles support a new vision of upward mobility in a world of population density, material constraints, social abundance, and cosmopolitan connectedness.
- All surfaces become possible growing substrates, as urbanites take responsibility for more of their own food production. Green walls bring communities together rather than separating them. Rooftops become valuable real-estate for institutional gardens—for hotels, hospitals, and corporate headquarters. Innovations in growing technologies and seed stock support these vertical gardens.
- The combination of innovations in material science, biomimetic design, and vertical farming engenders big leaps in the energy efficiency of both vehicles and buildings. People joke about “chia houses,” but bio-retrofits of existing buildings make a big difference. Ironically, this slows the move away from carbon-based fuels, since buildings and vehicles can be made significantly more fuel-efficient. Emissions still decline.
- Social media redefine citizenship, as distributed media production creates the pulse of civic life—defining not only which events and styles mobilize crowds and fads but also which urban experiences drive collective passion and action across the political scales of neighborhood, city, nation, and planet.
- Cities are increasingly managed as ecologies, with increased modeling and simulation of the links among natural and built features of the urban landscape; human resources and activities; and the flows of data and multiple alternative currencies. Even human neuro-patterns are tapped to provide feedback about the well-being of the urban organism.

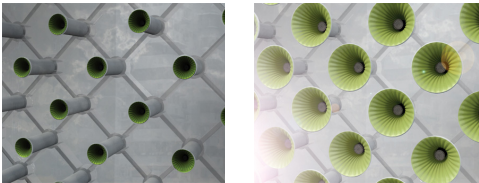


SIGNALS OF TRANSFORMATION IN CITIES IN TRANSITION

RADICAL ARCHITECTURE

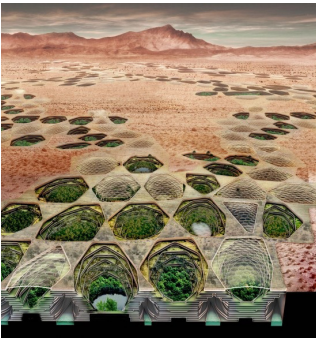
Taking inspiration from biology—and anticipating the need for radical solutions to support much larger populations in dense settlements—architects and designers are re-thinking the basics of shelter, infrastructure, and community. Already landmark new buildings like the Eastgate Center in Harare, Zimbabwe, mimic biological systems to reduce energy costs; in this case, the architects borrowed the concept of passive cooling from termite mounds. Pushing the boundaries further, future architects will draw on programmable or dynamic materials that change shape, density, or orientation based on embedded sensors or inherent qualities of the materials. And at the edge, architects and engineers are already experimenting with conceptual designs for new human settlements that mimic insect successes underground.

For China's Habitat2020 project, Siemens sought to demonstrate future building surfaces with “sensitive functional skins that are ‘alive’ and act as membranes to harness energy”—as well as collecting and channeling air, water, and light from interior to exterior.



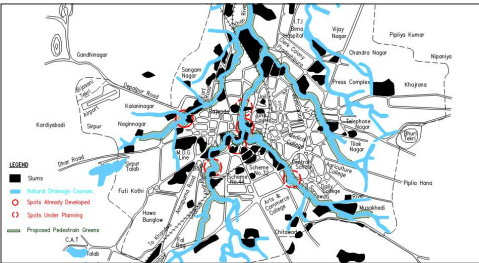
Source: <http://www.igreenspot.com/off-the-grid-sustainable-habitat-2020/>

The San Francisco design studio Matsys conceptualized an urban prototype for Sietch, Nevada, using water collection and storage as the first principle for design of a dense underground community. A network of storage canals forms the “grid” for residential and commercial life.

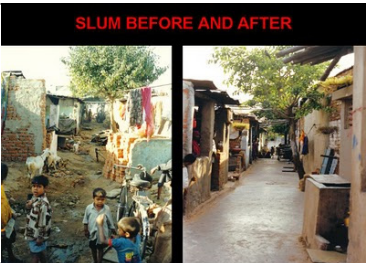


Source: Andrew Kudless et al., Sietch Nevada Project for MATSYS, <http://matsysdesign.com/2009/06/25/sietch-nevada/>

In a less technology-intensive approach, the Slum Networking Project in Ahmedabad and other Indian cities “exploits the correlation between slums and the natural riverine paths of the city” to provide quality, gravity-based water, sanitation, and drainage. A key element of the design is the networking of slum communities along the riverine paths to create system-wide solutions.



Source: <http://www.changemakers.com/en-us/node/6722>



GROWING SURFACES

A number of companies are already providing the technologies for growing food—as well as landscape plants—on vertical surfaces and roofs in urban settings. The innovation provides a number of potential benefits. It expands the growing area for food. It potentially increases carbon sequestration and other forms of atmospheric cleaning. And it often becomes the focal point for community efforts.



Source: <http://skyvegetables.wordpress.com/category/hydroponics/>

In Singapore rooftops are increasingly used for hydroponic farming.