from Lester R. Brown, *Plan B 2.0 Rescuing a Planet Under Stress and a Civilization in Trouble* (NY: W.W. Norton & Co., 2006).

11

Designing Sustainable Cities

As I was being driven through Tel Aviv from my hotel to a conference center a few years ago, I could not help but note the overwhelming presence of cars and parking lots. Tel Aviv, expanding from a small settlement a half-century ago to a city of some 3 million today, evolved during the automobile era. It occurred to me that the ratio of parks to parking lots may be the best single indicator of the livability of a city—an indication of whether the city is designed for people or for cars.[1]

The world's cities are in trouble. In Mexico City, Tehran, Bangkok, Shanghai, and hundreds of other cities, the quality of daily life is deteriorating. Breathing the air in some cities is equivalent to smoking two packs of cigarettes per day. In the United States, the number of hours commuters spend going nowhere sitting in traffic-congested streets and highways climbs higher each year, raising frustration levels.[2]

In response to these conditions, we are seeing the emergence of a new urbanism. One of the most remarkable modern urban transformations has occurred in Bogotá, Colombia, where Enrique Peñalosa served as Mayor for three years, beginning in 1998. When he took office he did not ask how life could be

improved for the 30 percent who owned cars; he wanted to know what could be done for the 70 percent—the majority—who did not own cars.[3]

Peñalosa realized that a city that is a pleasant environment for children and the elderly would work for everyone. In just a few years, he transformed the quality of urban life with his vision of a city designed for people. Under his leadership, the city banned the parking of cars on sidewalks, created or renovated 1,200 parks, introduced a highly successful bus-based rapid transit system, built hundreds of kilometers of bicycle paths and pedestrian streets, reduced rush hour traffic by 40 percent, planted 100,000 trees, and involved local citizens directly in the improvement of their neighborhoods. In doing this, he created a sense of civic pride among the city's 8 million residents, making the streets of Bogotá in this strife-torn country safer than those in Washington, D.C.[4]

Enrique Peñalosa observes that "high quality public pedestrian space in general and parks in particular are evidence of a true democracy at work." He further observes: "Parks and public space are also important to a democratic society because they are the only places where people meet as equals.…In a city, parks are as essential to the physical and emotional health of a city as the water supply." He notes this is not obvious from most city budgets, where parks are deemed a luxury. By contrast, "roads, the public space for cars, receive infinitely more resources and less budget cuts than parks, the public space for children. Why," he asks, "are the public spaces for cars deemed more important than the public spaces for children?"[5]

In espousing this new urban philosophy, Peñalosa is not alone. The reform he initiated in Bogotá is being carried on by his successor, Antanas Mockus. Now government planners everywhere are experimenting, seeking ways to design cities for people not cars. Cars promise mobility, and they provide it in a largely rural setting. But in an urbanizing world there is an inherent conflict between the automobile and the city. After a point, as their numbers multiply, automobiles provide not mobility but immobility.[6]

Some cities in industrial and developing countries alike are dramatically increasing urban mobility by moving away from the car. Jaime Lerner, the former mayor of Curitiba, Brazil, was

one of the first to design and adopt an alternative transportation system, one that does not mimic those in the West but that is inexpensive and commuter-friendly. Since 1974 Curitiba's transportation system has been totally restructured. Although one third of the people own cars, these play a minor role in urban transport. Busing, biking, and walking totally dominate, with two thirds of all trips in the city by bus. The city's population has doubled since 1974, but its car traffic has declined by a remarkable 30 percent.[7]

Aside from the growth of population itself, urbanization is the dominant demographic trend of our time. In 1900, 150 million people lived in cities. By 2000, it was 2.9 billion people, a 19-fold increase. By 2007 more than half of us will live in cities—making us, for the first time, an urban species.[8]

In 1900 there were only a handful of cities with a million people. Today 408 cities have at least that many inhabitants. And there are 20 megacities with 10 million or more residents. Tokyo's population of 35 million exceeds that of Canada. Mexico City's population of 19 million is nearly equal to that of Australia. New York, São Paulo, Mumbai (formerly Bombay), Delhi, Calcutta, Buenos Aires, and Shanghai follow close behind.[9]

The Ecology of Cities

Cities require a concentration of food, water, energy, and materials that nature cannot provide. Concentrating these masses of materials and then dispersing them in the form of garbage, sewage, and as pollutants in air and water is challenging city managers everywhere.

Most of today's cities are not healthy places to live. Urban air everywhere is polluted. Typically centered on the automobile and no longer bicycle- or pedestrian-friendly, cities deprive people of needed exercise, creating an imbalance between caloric intake and caloric expenditures. As a result, obesity is reaching epidemic proportions in cities in developing as well as industrial countries. With more than 1 billion people overweight worldwide, epidemiologists now see this as a public health threat of historic proportions—a growing source of heart disease, high blood pressure, diabetes, and a higher incidence of several forms of cancer.[10]

The evolution of modern cities is tied to advances in transport, initially for ships and trains, but it was the internal combustion engine combined with cheap oil that provided the mobility of people and freight that fueled the phenomenal urban growth of the twentieth century. As the world urbanized, energy use climbed.

Early cities relied on food and water from the surrounding countryside, but today cities often depend on distant sources even for such basic amenities. Los Angeles, for example, draws much of its water supply from the Colorado River, some 970 kilometers (600 miles) away. Mexico City's burgeoning population, living at 3,000 meters, must now depend on the costly pumping of water from 150 kilometers away and must lift it a kilometer or more to augment its inadequate water supplies. Beijing is planning to draw water from the Yangtze River basin nearly 1,500 kilometers away.[11]

Food comes from even greater distances, as is illustrated by Tokyo. While Tokyo still depends for its rice on the highly productive farmers in Japan, with their land carefully protected by government policy, its wheat comes largely from the Great Plains of North America and from Australia. Its corn supply comes largely from the U.S. Midwest. Soybeans come from the U.S. Midwest and the Brazilian *cerrado*.[12]

The oil that provides much of the energy to move resources into and out of cities itself often comes from distant oil fields. Rising oil prices will affect cities, but they will affect even more the suburbs that many cities have spawned.

It is widely assumed that urbanization will continue. But this is not necessarily so. The growing scarcity of water and the high cost of the energy invested in transporting water over long distances may itself begin to constrain urban growth. For example, some 400 cities in China are already facing a chronic shortage of water.[13]

Against this backdrop, Richard Register, author of *Ecocities: Building Cities in Balance with Nature*, says it is time to fundamentally rethink the design of cities. He agrees with Peñalosa that cities should be designed for people, not for cars. He goes even further, talking about pedestrian cities—communities designed so that people do not need cars because they can walk to most of the places they need to go or take public transportation.[14]

Register also says that a city should be seen as a functioning system not in terms of its parts but in terms of its whole. He makes a convincing case that cities should be integrated into local ecosystems rather than imposed on them.[15]

He describes with pride an after-the-fact integration into the local ecosystem of San Luis Obispo, a California town of 50,000 north of Los Angeles: "[It] has a beautiful creek restoration project with several streets and through-building passageways lined with shops that connect to the town's main commercial street, and people love it. Before closing a street, turning a small parking lot into a park, restoring the creek and making the main street easily accessible to the 'nature' corridor, that is, the creek, the downtown had a 40% vacancy rate in the storefronts; and now it has zero. Of course it's popular. You sit at your restaurant by the creek…where fresh breezes rustle the trees in a world undisturbed by car noise and blazing exhaust." San Luis Obispo is surrounded by both natural and agricultural landscapes.[16]

For Register, the design of the city and its buildings become a part of the local landscape, capitalizing on the local ecology. For example, buildings are designed to be heated and cooled by nature as much as possible. Later in this chapter we discuss how cities can largely live on recycled water that is cleaned and used again and again. The "flush and forget" water system will become too costly for many water-short cities in a world after oil. Urban food production, particularly fresh fruits and vegetables, will expand in vacant lots and on rooftops as oil prices rise.[17]

In the years ahead, urbanization could slow or even be reversed. In a world of land, water, and energy scarcity, the value of each resource may increase substantially, shifting the terms of trade between the countryside and cities. Ever since the beginning of the Industrial Revolution, the terms of trade have favored cities because they control capital and technology, the scarce resources. But if land and water become the scarcest resources, then those in rural areas who control them may sometimes have the upper hand. With a new economy based on renewable energy, a disproportionate share of that energy, particularly wind energy and biofuels, will come from nearby rural areas.[18]

Beyond resource shortages, the evolution of the Internet, which is changing how we think about distance and mobility, could also affect urbanization. Among other things, the potential for telecommuting may reduce the advantages of living in a city. Internet commerce, offering more options than any shopping mall, may also lessen the role of urban shopping centers as sources of a wide variety of goods and services.

Redesigning Urban Transport

Urban transport systems based on a combination of rail lines, bus lines, bicycle pathways, and pedestrian walkways offer the best of all possible worlds in providing mobility, low-cost transportation, and a healthy urban environment. Megacities regularly turn to underground rail systems to provide mobility. Whether it is these rail systems, light-rail surface systems, or both depends in part on city size and geography. For cities of intermediate size, light rail is often an attractive option.

A rail system provides the foundation for a city's transportation system. Rails are geographically fixed, providing a permanent means of transportation that people can count on. Once in place, the nodes on such a system become the obvious places to concentrate office buildings, high-rise apartment buildings, and shops.

As noted earlier, some of the most innovative public transportation systems, those that move huge numbers of people from cars into buses, have been developed in Curitiba and Bogotá. The success of Bogotá's bus rapid transit (BRT) system TransMilenio, which relies on special express lanes to move people quickly through the city, is being replicated not only in six other Colombian cities, but in cities elsewhere too: Beijing, Mexico City, São Paulo, Seoul, Taipei, and Quito. Several more cities in Africa and China are also planning BRT systems. Even industrial-country cities, such as Ottawa and—much to everyone's delight—Los Angeles, are now considering BRT systems.[19]

Many cities are reducing traffic congestion and air pollution by charging cars to enter the city. Singapore, long a leader in urban transport innovation, has imposed a tax on all roads leading into the city center. Electronic sensors identify each car, and then debit the owner's credit card. This system has reduced

the number of automobiles in Singapore, providing its residents with both more mobility and cleaner air than in most other cities.[20]

Singapore has been joined by London and by several Norwegian cities, including Oslo, Bergen, and Trondheim. In London—where the average speed of an automobile a few years ago was about the same as that of a horse-drawn carriage a century ago—a congestion tax was adopted in early 2003. The £5 charge on all motorists driving into the center city between 7 a.m. and 6:30 p.m. immediately reduced the number of vehicles, permitting traffic to flow more freely while cutting pollution and noise.[21]

During the first year after the new tax was introduced, the number of people using buses to travel into the central city climbed by 38 percent. Since the congestion charge, the daily flow of cars into central London has been reduced by 65,000–70,000, a drop of 18 percent, while delays have dropped by 30 percent. The number of bicycles and mopeds has increased by 17 percent, and vehicle speeds on key thoroughfares have increased by 21 percent, from 8.7 to 10.6 miles per hour.[22]

Contrary to the fear about falling profits, 65 percent of businesses in London's inner city have not noticed any effect on their bottom line. A substantial majority of business owners think the reduced vehicle flow has had a positive effect on the city's image. A similar tax is now being considered in Cardiff for adoption within the near future. Other cites considering the measure include Stockholm, São Paulo, San Francisco, Milan, and Barcelona. French officials are looking at a congestion charge to deal with the suffocating air pollution in Paris. This highly successful use of taxes to restructure urban transport systems is discussed in terms of restructuring the overall economy in Chapter 12.[23]

The bicycle, a form of personal transportation, has many attractions. It alleviates congestion, lowers air pollution, reduces obesity, increases physical fitness, does not emit climate-disrupting carbon dioxide, and has a price within reach for the billions of people who cannot afford an automobile. Bicycles increase mobility while reducing congestion and the area of land paved over. Six bicycles can typically fit into

the road space used by one car. For parking, the advantage is even greater, with 20 bicycles occupying the space required to park a car.[24]

The bicycle is not only a flexible means of transportation, it is an ideal way of restoring a balance between caloric intake and expenditure. The opportunity to exercise is valuable in its own right. Regular exercise of the sort provided by cycling to work reduces cardiovascular disease, osteoporosis, and arthritis and strengthens the immune system. Millions of people pay a monthly fee to use a fitness center, which they often drive to, where they ride stationary bikes, trying to achieve the same benefits.

Few methods of reducing carbon emissions are as effective as substituting the bicycle for the automobile on short trips. A bicycle is a marvel of engineering efficiency, one where an investment in 13 kilograms (28 pounds) of metal and rubber boosts the efficiency of individual mobility by a factor of three. On my bike I estimate that I get easily 7 miles (11 kilometers) per potato. An automobile, which requires 1–2 tons of material to transport even one person, is extraordinarily inefficient in comparison.

The capacity of the bicycle to provide mobility for low-income populations was dramatically demonstrated in China. In 1976, China produced 6 million bicycles. After the reforms in 1978 that led to rapid economic growth, rising incomes, and a market economy in which people could exercise their preferences, annual bicycle production started climbing, eventually soaring over 40 million in 1988. Once the market was largely saturated, production dropped somewhat and remained between 30 million and 40 million a year through the 1990s. Since 1999, production has taken off once again, rising to 79 million bicycles in 2004. The vast surge to 545 million bicycle owners in China since 1978 provided the greatest increase in human mobility in history. Bicycles took over city streets and rural roads. Although China's 7 million passenger cars are getting a lot of attention, especially in the large cities, it is the bicycle that provides personal mobility.[25]

Many cities are turning to bicycles for numerous uses. In the United States, more than 80 percent of police departments serving populations of 50,000–249,999 and 96 percent of those serving more than 250,000 residents now have routine patrols by bicycle. Officers on bikes are more productive in cities partly

because they are more mobile and can reach the scene of an accident or crime more quickly and more quietly than officers in cars. They typically make 50 percent more arrests per day than officers in squad cars. For fiscally sensitive officials, the cost of operating a bicycle is trivial compared with that of a police car.[26]

Urban bicycle messenger services are common in the world's larger cities. Bicycles deliver small parcels in cities more quickly than motor vehicles can and at a much lower cost. As the information economy unfolds and as e-commerce expands, the need for quick, reliable, urban delivery services is escalating. For many competitive Internet marketing firms, quick delivery wins customers. In a city like New York, this means bicycle delivery. An estimated 300 bicycle messenger firms are operating in New York City, competing for $700 million worth of business annually. In large cities, the bicycle is becoming an integral part of the support system for e-commerce.[27]

The key to realizing the potential of the bicycle is to create a bicycle-friendly transport system. This means providing both bicycle trails and designated street lanes for bicycles. These should be designed to serve both commuters and those biking for recreation. In addition, bicycle use is enhanced by the provision of parking facilities and showers at workplaces. Among the industrial-country leaders in designing bicycle-friendly transport systems are the Dutch, the Danes, and the Germans.[28]

The Netherlands, the unquestioned leader among industrial countries in encouraging bicycle use, has incorporated a vision of the role of bicycles into a Bicycle Master Plan. In addition to creating bike lanes and trails in all its cities, the system also often gives cyclists the advantage over motorists in right-of-ways and at traffic lights. Some traffic signals permit cyclists to move out before cars. Roughly 30 percent of all urban trips in the Netherlands are on bicycle. This compares with 1 percent in the United States.[29]

Spain, one of the latest countries to climb on the bicycle bandwagon, began converting abandoned railway lines into recreational paths in 1993. The 52 new "greenways" include 1,300 kilometers of bicycle trails throughout the country.[30]

Within the Netherlands a nongovernmental group called Interface for Cycling Expertise (I-ce) has been formed to share the Dutch experience in designing a modern transport system

that prominently features bicycles. It is working with other groups in Brazil, Colombia, Ghana, India, Kenya, South Africa, Sri Lanka, Tanzania, and Uganda to facilitate bicycle use. Roelof Wittink, head of I-ce, observes, "If you plan only for cars then drivers will feel like the King of the Road. This reinforces the attitude that the bicycle is backward and used only by the poor. But if you plan for bicycles it changes the public attitude."[31]

Both the Netherlands and Japan have made a concerted effort to integrate bicycles and rail commuter services by providing bicycle parking at rail stations, making it easier for cyclists to commute by train. In Japan, the use of bicycles for commuting to rail transportation has reached the point where some stations have invested in vertical, multi-level parking garages for bicycles, much as is often done for automobiles.[32]

The combination of rail and bicycle, and particularly their integration into a single, overall transport system, makes a city eminently more livable than one that relies almost exclusively on private automobiles. Noise, pollution, congestion, and frustration are all lessened. We and the earth are both healthier.

Farming in the City

While attending a conference on the outskirts of Stockholm in the fall of 1974, I walked past a community garden near a high-rise apartment building. It was an idyllic Indian summer afternoon, with many people tending gardens a short walk from their residences. More than 30 years later I can still recall the setting because of the aura of contentment surrounding those working in their gardens. Nearly all were elderly; they were absorbed in producing not only vegetables, but in some cases flowers as well. I remember thinking, "This is the mark of a civilized society."

In June 2005, the U.N. Food and Agriculture Organization (FAO) reported that urban and peri-urban farms—those within or immediately adjacent to a city—supply food to some 700 million urban residents worldwide. These are mostly small plots—vacant lots, yards, even rooftops.[33]

Within and near the city of Dar es Salaam, capital of Tanzania, there are some 650 hectares of land producing vegetables. This land supplies not only the city's fresh produce but a liveli-

hood for 4,000 farmers who intensively farm their small plots year-round. On the far side of the continent, an FAO project has urban residents in Dakar, Senegal, producing up to 30 kilograms of tomatoes per square meter each year with continuous cropping in rooftop gardens.[34]

In Hanoi, 80 percent of the fresh vegetables come from farms in and immediately adjacent to the city. These urban farms also produce 50 percent of the pork and the poultry consumed in the city. Half of the city's freshwater fish are produced by enterprising urban fish farmers. Some 40 percent of the egg supply is produced within the city or in its shadow. Urban farmers ingeniously recycle human and livestock waste to nourish plants and to fertilize fish ponds.[35]

People living in wetlands in the region of East Calcutta in India manage wastewater fish ponds that cover nearly 3,500 hectares. The city's sewage water is kept in ponds and moved through various stages so the bacteria can break down the organic waste. This, in turn, supports the rapid growth of algae that supply food for the various local strains of herbivorous fish. This system provides a steady supply of fish for the city, fish that are consistently of better quality than any entering the Calcutta market.[36]

The magazine *Urban Agriculture* describes how Shanghai has in effect created a nutrient recycling zone around the city. In order to have enough land to recycle the city's night soil, the boundary was extended to include 300,000 hectares of surrounding farmland. This land supplies 60 percent of this megacity's vegetables. Half of Shanghai's pork and poultry and 90 percent of its milk and eggs come from the extended city and the immediately surrounding region.[37]

In Caracas, Venezuela, a government-sponsored FAO-assisted project has created 4,000 microgardens of one square meter each in the city's barrios, many of them located within a few steps of family kitchens. As soon as one crop is mature, it is harvested and immediately replaced with new seedlings. Each square meter, continuously cropped, can produce 330 heads of lettuce, 18 kilograms of tomatoes, or 16 kilograms of cabbage per year.[38]

Venezuela's goal is to have 100,000 microgardens in the country's urban areas and 1,000 hectares of urban compost-

based gardens nationwide. Leonardo Gil Mora, vice minister of integrated rural development, points out that "in the barrios as in Venezuela in general, people are the most important thing we have. Through urban agriculture, we hope to increase the poor's self-confidence, and so increase their participation in society."[39]

There is a long tradition of community gardens in European cities. As a visitor flies into Paris, numerous community gardens can be seen on the outskirts of the city. These small plots produce not only high-quality food but a sense of well-being and community.

As a result of a national campaign in Cuba to expand urban farming after the loss of Soviet support more than a decade ago, Havana now produces half of the vegetables its residents consume. The city-state of Singapore has 10,000 urban farmers who produce four fifths of the poultry and a fourth of all the vegetables eaten there. A 2003 *Urban Agriculture* study reports that 14 percent of London's 7.6 million residents produce some of their own food. For Vancouver, Canada's largest west coast city, the comparable figure is an impressive 44 percent.[40]

In the U.S. city of Philadelphia, community gardeners were asked why they gardened. Some 20 percent did it for recreational reasons, 19 percent said it improved their mental health, and 17 percent their physical health. Another 14 percent did it because they wanted the higher-quality fresh produce that a garden could provide, 10 percent did it for spiritual reasons, and 7 percent said it was mostly economic—cost and convenience. Urban gardens are social gathering places that engender a sense of community. In addition, those who garden three to four times a week get the same physical benefits as people who engage in moderate walking or bicycling.[41]

In some countries, such as the United States, there is a huge unrealized potential for urban gardening. A survey indicated that Chicago has 70,000 vacant lots, and Philadelphia, 31,000. Nationwide, vacant lots in cities would total in the hundreds of thousands. The Urban Agriculture report summarizes why urban agriculture is so desirable. It has "a regenerative effect…when vacant lots are transformed from eyesores—weedy, trash-ridden dangerous gathering places—into bountiful, beautiful, and safe gardens that feed people's bodies and souls."[42]

Given the near inevitable rise in future oil prices, the economic benefits of expanding urban agriculture, even in affluent societies, will become much more obvious. Aside from supplying more fresh produce, it will help millions discover the social benefits and the psychological well-being that urban gardening can bring.

Reducing Urban Water Use

The one-time use of water to disperse human and industrial wastes is an outmoded practice, made obsolete by new technologies and water shortages. Water enters the city, is contaminated with human and industrial wastes, and leaves the city dangerously polluted. Toxic industrial wastes discharged into rivers and lakes or into wells also permeate aquifers, making water—both surface and underground—unsafe for drinking. And their toxic wastes are destroying marine ecosystems, including local fisheries. The time has come to manage waste without discharging it into the local environment, allowing water to be recycled indefinitely and reducing both urban and industrial demand dramatically.

The current engineering concept for dealing with human waste is to use vast quantities of water to wash it away, preferably into a sewer system where it will be treated before being discharged into the local river. The "flush and forget" system is water-intensive, it disrupts the nutrient cycle, most of humanity cannot afford it, and it is a major source of disease in developing countries.

As water scarcity spreads, the viability of water-based sewage systems will diminish. Water-based sewage systems take nutrients originating in the soil and typically dump them into rivers, lakes, or the sea. Not only are the nutrients lost from agriculture, but the nutrient overload has led to the death of many rivers and to the formation of some 146 dead zones in ocean coastal regions. Sewer systems that dump untreated sewage into rivers and streams are a major source of disease and death.[43]

Sunita Narain of the Centre for Science and Environment in India argues convincingly that a water-based disposal system with sewage treatment facilities is neither environmentally nor economically viable for India. She notes that an Indian family of

five, producing 250 liters of excrement in a year and using a water flush toilet, requires 150,000 liters of water to wash away its wastes.[44]

As currently designed, India's sewer system is actually a pathogen-dispersal system. It takes a small quantity of contaminated material and uses it to make vast quantities of water unfit for human use, often simply discharging it into nearby rivers or streams. Narain says both "our rivers and our children are dying." India's government, like that of many other developing countries, is hopelessly chasing the goal of universal water-based sewage systems and sewage treatment facilities—unable to close the huge gap between services needed and provided, but unwilling to admit that it is not an economically viable option. Narain concludes that the "flush and forget" approach is not working.[45]

This dispersal of pathogens is a huge public health challenge. Worldwide, poor sanitation and personal hygiene claim 2.7 million lives per year, second only to the 5.9 million claimed by hunger and malnutrition.[46]

Fortunately, there is a low-cost alternative: the composting toilet. This is a simple, waterless, odorless toilet linked to a small compost facility. Table waste can also be incorporated into the composter. The dry composting converts human fecal material into a soil-like humus, which is essentially odorless and is scarcely 10 percent of the original volume. These compost facilities need to be emptied every year or so, depending on design and size. Vendors periodically collect the humus and can market it as a soil supplement, thus ensuring that the nutrients and organic matter return to the soil, reducing the need for fertilizer.[47]

This technology reduces residential water use, thus cutting water bills and lowering the energy needed to pump and purify water. As a bonus, it also reduces garbage flow if table waste is incorporated, eliminates the sewage water disposal problem, and restores the nutrient cycle. The U.S. Environmental Protection Agency now lists several brands of dry toilets approved for use. Pioneered in Sweden, these toilets work well under the widely varying conditions where they are now used, including Swedish apartment buildings, U.S. private residences, and Chinese villages.[48]

At the household level, water can be saved by using appliances that are more water-efficient, including showerheads, flush toilets, dishwashers, and clothes washers. Some countries are adopting water efficiency standards and labeling for appliances, much as has been done for energy efficiency. When water costs rise, as they inevitably will, investments in composting toilets and more water-efficient household appliances will become increasingly attractive to individual homeowners.

For cities, the most effective single step to raise water productivity is to adopt a comprehensive water treatment/recycling system, reusing the same water continuously. With this system, only a small percentage of water is lost to evaporation each time it cycles through. Given the technologies that are available today, it is quite possible to recycle urban water supplies comprehensively, largely removing cities as a claimant on scarce water resources.

Some cities faced with shrinking water supplies and rising water costs are beginning to recycle their water supplies. Singapore, for example, which buys its water from Malaysia at an ever higher price, is beginning to recycle water, reducing the amount it imports. For some cities, the continuous recycling of water may become a condition of their survival.[49]

Individual industries facing the same water-related issues as cities are beginning to move away from the use of water to disperse industrial waste. Some companies segregate effluent streams, treating each individually with the appropriate chemicals and membrane filtration, preparing the water for reuse. Peter Gleick, senior author and editor of the biannual report *The World's Water,* writes: "Indeed, some industries, such as paper and pulp, industrial laundries, and metal finishing, are beginning to develop 'closed-loop' systems where all the waste water is reused internally, with only small amounts of fresh water needed to make up for water incorporated into the product or lost in evaporation." Industries are moving faster than cities, but the technologies they are developing can also be used in urban water recycling.[50]

Saving water in cities depends primarily on two household appliances: toilets and showers, which together account for over half of indoor use. Whereas traditional flush toilets used 6 gallons (or 22.7 liters) per flush, the legal U.S. maximum for new

toilets is 1.6 gallons (6 liters). An Australian-produced toilet with a dual-flush two-button technology uses only 1 gallon for a liquid waste flush and 1.6 gallons for a solid waste flush. Shifting from a showerhead flowing at 5 gallons per minute to a 2.5 gallons-per-minute model cuts water use nearly in half. With washing machines, a horizontal axis design developed in Europe uses 40 percent less than the traditional top-loading U.S. models. In addition, this European model now being marketed internationally also uses less energy.[51]

The existing water-based waste disposal economy is not viable. There are too many households, factories, and feedlots to simply try and wash waste away on our crowded planet. To do so is ecologically mindless and outdated—an approach that belongs to an age when there were many fewer people and far less economic activity.

The Challenge of Urban Slums

Between 2000 and 2050, there is little population growth projected for the industrial countries or for the rural developing world. Thus nearly all of the projected world population growth of some 3 billion people by 2050 will be added to the cities of developing countries, much of it in squatter settlements.[52]

Squatter settlements—whether they are *favelas* in Brazil, *barriadas* in Peru, or *gecekondu* in Turkey—typically consist of an urban residential area inhabited by very poor people who do not have any land. They simply "squat" on vacant land, either private or public.[53]

Life in these settlements is characterized by grossly inadequate housing and a lack of access to urban services. As Hari Srinivas, coordinator of the Global Development Research Center, writes, these rural-urban migrants undertake the "drastic option of illegally occupying a vacant piece of land to build a rudimentary shelter" simply because it is their only option. They are often treated if not by apathy then by antipathy by government agencies, who view them as invaders and trouble. Some see squatter settlements as a social "evil," something that needs to be eradicated.[54]

Urban slums include not only squatter settlements but also severely rundown older parts of cities, which are also over-

crowded and often lacking in rudimentary urban services, such as sewage disposal.

One of the best ways to make rural/urban migration manageable is to improve conditions in the countryside. This means not only providing basic social services, such as basic health care and education for children, as outlined in Chapter 7, but also encouraging industrial investment in small towns throughout the country rather than just in prime cities, such as Mexico City or Bangkok. Such policies will slow the flow into cities to a more orderly pace.

The evolution of cities in developing countries is often shaped by the unplanned nature of squatter settlements. Letting squatters settle wherever they can—on steep slopes, on river floodplains, or in other high-risk areas—makes it difficult to provide basic services such as transport, water, and sewerage. Curitiba, on the cutting edge of the new urbanism, has designated tracts of land for squatter settlements. By setting aside these planned tracts, the process can at least be structured in a way that is consistent with the official development plan of the city.[55]

Among the simplest services that can be provided in a squatter settlement are community composting toilets. Beyond these, taps that provide safe running water at intervals throughout the squatter settlement can go a long way to control the spread of disease in overcrowded settlements. Regular bus service can enable workers living in the settlements to travel to their place of work. If the Curitiba approach is widely followed, parks and other commons areas can be incorporated into the community from the beginning.

Some political elites simply want to bulldoze squatter settlements away, but this treats the symptoms of urban poverty, not the cause. People who lose what little they have been able to invest in housing are not richer as a result of the demolition, but poorer, as is the city itself. The preferred option by far is in situ upgrading of housing. The key to this is providing security of tenure to the squatters and small loans, enabling them to make incremental improvements over time.[56]

Upgrading slums depends on local governments that respond to them rather than ignoring them. Progress in eradicating poverty and creating stable, progressive communities depends on establishing constructive links with governments. In some

cases, government-supported micro-credit lending facilities can help not only establish a link between the city government and the squatter communities but offer hope to the residents.[57]

Although political leaders might hope that these settlements will be driven away or demolished, the reality is that they will likely expand over the next several decades. The challenge is to integrate them into urban life in a humane way that provides hope through the potential for upgrading. The inevitable alternative is mounting resentment, spreading social friction, and violence.

Cities for People

As the new century begins, it is becoming evident to urban dwellers, whether in industrial or developing countries, that there is an inherent conflict between the automobile and the city. Urban air pollution, often from automobiles, claims millions of lives. Congestion also takes a direct economic toll in rising costs in time and gasoline.

Another cost of cities that are devoted to cars is a psychological one, a deprivation of contact with the natural world—an "asphalt complex." There is a growing body of evidence that there is an innate human need for contact with nature. Both ecologists and psychologists have been aware of this for some time. Ecologists, led by Harvard University biologist E.O. Wilson, have formulated the "biophilia hypothesis," which argues that those who are deprived of contact with nature suffer psychologically and that this deprivation leads to a measurable decline in well-being.[58]

Meanwhile psychologists have coined their own term—ecopsychology—in which they make the same argument. Theodore Roszak, a leader in this field, cites a study that documents humans' dependence on nature by looking at the rate of recovery of patients in a hospital in Pennsylvania. Those whose rooms overlooked gardens with grass, trees, flowers, and birds recovered from illnesses more quickly than those who were in rooms overlooking the parking lot.[59]

One of the arguments for community gardens is that in addition to providing food, they also provide greenery and a sense of community. Working with soil and watching things grow has a therapeutic effect.

Throughout the modern era, budget allocations for transportation in most countries—and in the United States, in particular—have been heavily biased toward the construction and maintenance of highways and streets. Creating more livable cities and the mobility that people desire depends on reallocating budgets to emphasize the development of rail- or bus-based public transport and bicycle support facilities.

The exciting news is that there are signs of change, daily indications of an interest in redesigning cities for people, not for cars. One encouraging trend comes from the United States. Rising public transit ridership nationwide of 2.1 percent a year since 1996 indicates that people are gradually abandoning their cars for buses, subways, and light rail. Sharp rises in gasoline prices in 2005 are encouraging still more commuters to abandon their cars and take the bus or subway or get on a bicycle.[60]

Mayors and city planners the world over are beginning to rethink the role of the car in urban transportation systems. A group of eminent scientists in China challenged Beijing's decision to promote an automobile-centered transportation system. They noted a simple fact: China does not have enough land to accommodate the automobile and to feed its people. What is true for China is also true for India and dozens of other densely populated developing countries.[61]

Some cities are far better at planning their growth than others. They plan transport systems that provide mobility, clean air, and exercise—a sharp contrast to cities that offer congestion, unhealthy air, and little opportunity for exercise. When 95 percent of a city's workers depend on the automobile for commuting, as in Atlanta, Georgia, the city is in trouble. By contrast, in Amsterdam only 40 percent of workers commute by car; 35 percent commute by bike or walk, while 25 percent use public transit. Copenhagen's commuting patterns are almost identical to Amsterdam's. In Paris, just under half of commuters rely on cars. Even though these European cities are older, often with narrow streets, they have far less congestion than Atlanta.[62]

Not surprisingly, car-dependent cities have more congestion and less mobility than those that offer a wider range of commuting options. The very vehicle whose great promise was personal mobility is in fact virtually immobilizing entire urban populations, making it difficult for rich and poor alike to move about.

Existing long-term transportation strategies in many developing countries assume that everyone will one day be able to own a car. Unfortunately, given the constraints of land available for cars, not to mention those imposed by oil reserves, this is simply not realistic. These countries will provide more mobility if they support public transportation and the bicycle.

If developing-country governments continue to invest most of the public resources available for transportation in support of the automobile, they will end up with a system built for the small fraction of their people who own cars. Recognition now that most people will never own automobiles can lead to a fundamental reorientation of transport planning and investment.

There are many ways to restructure the transportation system so that it satisfies the needs of all people, not just the affluent, so that it provides mobility, not immobility, and so that it improves health rather than damaging it. One is to eliminate the subsidies, often indirect, that many employers provide for parking. For example, parking subsidies in the United States that are worth an estimated $85 billion a year obviously encourage people to drive to work.[63]

In 1992, California mandated that employers match parking subsidies with cash that can be used by the recipient either to pay public transport fares or to buy a bicycle. In firms where data were collected, this shift in policy reduced automobile use by some 17 percent. At the national level, a provision was incorporated into the 1998 Transportation Equity Act of the 21st Century to change the tax code so that those who used public transit or vanpools would enjoy the same tax-exempt subsidies as those who received free parking. What societies should be striving for is not parking subsidies, but parking taxes—taxes that begin to reflect the cost to the community of traffic congestion and the deteriorating quality of life as cities are taken over by cars and parking lots.[64]

Scores of cities are declaring car-free areas, among them Stockholm, Vienna, Prague, and Rome. Paris enjoys a total ban on cars along stretches of the Seine River on Sundays and holidays and is looking to make much of the central city traffic-free starting in 2012.[65]

In addition to ensuring that subways are functional and affordable, the idea of making them attractive, even cultural

centers, is gaining support. In Moscow, with works of art in the stations, the subway system is justifiably referred to as Russia's crown jewel. In Washington, D.C., Union Station, which links the city's subway system with intercity train lines, is an architectural delight. Since its restoration was completed in 1988, it has become a social gathering place, with shops, conference rooms, and a rich array of restaurants.

One of the more innovative steps to encourage the use of public transportation comes from State College, a small town in central Pennsylvania that is home to Pennsylvania State University. To reduce traffic congestion on campus and to address the lack of sufficient parking, Penn State decided in 1999 that it would provide $1 million to the bus-based local transit system in exchange for unlimited free rides for its students, faculty, and staff. As a result, bus ridership in State College jumped by 240 percent in one year, requiring the transit company to invest heavily in new buses to accommodate the additional passengers. This initiative by the university has created a far more pleasant, attractive campus—an asset in recruiting both students and faculty.[66]

As the new century begins, the world is reconsidering the urban role of automobiles in one of the most fundamental shifts in transportation thinking in a century. The challenge is to redesign communities, making public transportation the centerpiece of urban transport and augmenting it with sidewalks, jogging trails, and bikeways. This also means replacing parking lots with parks, playgrounds, and playing fields. We can design an urban lifestyle that systematically restores health by incorporating exercise into daily routines while reducing air pollution and obesity.