Case studies of urban sustainability

INTRODUCTION TO PART SIX

What follow are brief case studies – in text and images – that illustrate the reality and practicality of many of the urban sustainability ideas discussed in this book. This list is not exhaustive, to be sure, but includes many inspiring recent examples of urban sustainability practice. Following each brief description are sources and websites for learning more about these positive examples.

URBAN SUSTAINABILITY AT THE BUILDING AND SITE SCALE

Commerzbank Headquarters, Frankfurt

Designed by Norman Foster architects, this commercial office building has become the tallest building in Europe (See plate CS1). This 53-story, nearly 300-meters-tall building, completed in 1997, is designed to incorporate creatively a number of environmental and sustainability features. The building takes a triangular form, with a continuous atrium in its center, extending the entire length of the structure.

A major design element is a series of sky gardens (See plate CS2). The triangular building incorporates these gardens every four floors, with a larger garden open to the elements on the 43rd floor. Ten gardens in all are provided, each with trees and vegetation, and serving both as places for employees to visit and relax, and also for climate control regulators for the building. Convection in summertime draws air through the sky gardens and the atrium, providing natural cooling and serving as a "natural chimney."

Other ecological elements of the structure include reliance on natural ventilation (operable windows in all offices), extensive daylighting, sensors that automatically adjust artificial lighting inside, and low-emissity windows (windows coated to allow in short wavelength solar energy but reduce radiant loss of interior heat). The building is enclosed in a high-tech double skin with the space between acting as a thermal buffer. The city's district heating system provides the building with heat. The building is predicted to use about one-third less energy than a conventional office building.

For more information, see: www.fosterandpartners.com.

Menara Mesiniaga bio-climatic skyscraper, Kuala Lumpur, Malaysia

Designed by architect Ken Yeang, the IBM headquarters building in Kuala Lumpur, Malaysia represents an important built example of what Yeang calls "bio-climatic" skyscrapers (See plates CS3 and CS4). Such buildings are designed from the start to take full advantage of local climate, to incorporate plants and vegetation, and to substantially reduce their energy and resource consumption levels compared with typical high-rise structures. The exterior of the Menara Mesiniaga tower serves as an "environmental filter" rather than a hard façade; a permeable membrane that allows movement of air and natural ventilation and breaks up the visual monotony of the exterior. Extensive exterior louvers provide shading on the east and west sides of the building, also adding to the building visual distinctiveness. Perhaps most impressively is the "vertical landscaping," as Yeang calls it, that spirals up and around the structure and connects with a series of recessed "sky courts." These sky courts facilitate ventilation and act as thermal buffers. A sun-shaded roof is designed as important habitable space, and includes a gym and pool. A partially louvered sunroof also acts as a wind scoop, directing air back into the interior of the structure. Other elements of the design include placement of the elevators and core services on the hottest side of the structure. The building rises out of a green terraced base, and is intended to connect the fifteen-story building to earth and land.

Completed in 1992, this is perhaps Ken Yeang's best example of a completed bio-climatic skyscraper design. Other important examples include the UMNO Tower in Penang, the planned EDITT Tower in Singapore, and a new design for a ecotower as part of a comprehensive redevelopment scheme for the Elephant and Castle area of London.

For more information, see: Ken Yeang, *Bioclimatic Skyscrapers*, revised edn (London: Ellipsis London Press, 2000); *The Green Skyscraper: The Basis for Designing Sustainable Intensive Buildings* (New York: Prestel, 2000).

Adelaide EcoVillage (Christie Walk)

A new ecological co-housing project is under construction in the Southern Australian city of Adelaide, with the first five units occupied in 2002. Green city ideas have a long history in Adelaide, under the advocacy of Paul Downton, and the organization Urban Ecology Australia. This project, known as Christie Walk (See plates CS5 and CS6), is an example of ecological infill. When completed it will include four townhouses, six apartments and four straw-bale cottages. A community house is also included. Ecological features include onsite sewage treatment and graywater recycling. Stormwater is retained onsite and used for toilet flushing.

The homes are designed to be very energy-efficient, and include both active and passive solar. The building designs take advantage of high thermal mass, extensive insulation, and a natural ventilation system. Stairwells act as ventilation flues. Vegetation and landscaping using native plants cools the air.

Extensive use has been made of recycled materials (e.g., flyash in concrete, recycled timber in windows, reuse of brick and stone from demolished buildings), as well as non-toxic paints and finishes. The outer shell of the building has been designed to last longer than 100 years, with interior doors and walls made from renewable resources. A rooftop garden is included, as well as a community garden where food will be produced for the neighborhood.

Siting this development on an L-shaped parcel in the heart of Adelaide reflects its sustainability values as well. Its urban location will permit living with little or no dependence on cars. Public transit and shopping are nearby. In recognition of the project's location, some relief from the city's parking requirement was given – only ten parking spaces were required for these fourteen units.

For more information, see: "Urban Ecology Australia – Christie Walk," at www.urbanecology.org.au/christiewalk/main.html

Condé Nast building (4 Times Square), New York

Nicknamed the "green giant," the Condé Nast building, also known as 4 Times Square, is the first major office structure in New York City designed and built around sustainability principles (See plates CS7 and CS8). Completed in 1999, the building is forty-eight stories in height and includes 1.6 million square feet of space. Designed by the architectural firm Fox and Fowle, the structure incorporates many impressive sustainability features. These include a very energy-efficient building design, utilizing large low-emissity windows (that capture sunlight and retain heat) that provide extensive daylight to the building, natural gas absorption chiller/heaters, added insulation, thin film photovoltaic panels (on the south and east façades, on the top nine floors of the building, producing about 15 kW at peak), and two 200-kW fuel cells that produce enough energy to operate the building in the evening. The building's unique ventilation system delivers much more fresh air to building occupants than a typical building – five times the amount required by code.

Careful planning of construction deliveries (reducing engine idling), and management and recycling of construction waste were also important elements. Other green elements of the building include non-CFC air-conditioning, use of energy-efficient, variable speed motors and pumps, use of low-water-use fixtures, and extensive use of recycled materials in its construction. All floors are equipped with waste recycling chutes. A set of tenant guidelines has been prepared to suggest ways in which tenants can reduce their environmental impacts (e.g., by selecting environmentally friendly furniture).

An important urban sustainability dimension of the building is its location in the center of Manhattan. Built on the foundations of a former building, this is an urban infill project, embedded in a very pedestrian urban environment, with great access to transit. In fact, the building provides no parking.

For further information, see: USDOE, Office of Energy Efficiency and Renewable Energy, undated. Case Study: The Condé Nast building at 4 Times Square, found at www.eere.energy.gov/buildings/documents/pdfs/29940.pdf

URBAN SUSTAINABILITY AT THE NEIGHBORHOOD OR DISTRICT SCALE

Kronsberg Ecological District, Hannover, Germany

This model ecological housing district is Hannover's newest growth area. Designed and built as a model development for the 2000 World Expo, it incorporates almost every urban sustainability or ecological design element imaginable. The sustainability dimensions begin with its basic form: relatively high-density, multi-family housing, sited along a new line of the city's tram system (with three very accessible new tram stops), and with a car-minimal grid street pattern. The entire district is a traffic-calmed (30-km restricted) zone, with extensive bike lanes and onsite car sharing providing additional alternatives to the automobile. The district's new town hall takes sustainability as a key theme. This building is constructed from sustainable materials, with PVs on its rooftop, and houses social service offices, meeting space, and a library specializing in the environment.

The district captures and contains all stormwater onsite through an innovative system of treatment bioswales that feed into two long stormwater retention boulevards, serving also as important green features and delightful pathways (See plate CS9). The Germans refer to this as the Mulden-Rigolen-System, or gulley and trench system. Through this stormwater collection system and a number of other water design elements, water is present and made visible in this community. Other sustainability features include extensive use of green rooftops, green courtyards and water features, and community gardens.

This model district demonstrates a number of important energy features. Homes are designed to meet an impressive low-energy standard, and two very efficient combined heat and power plants provide heat for about 3,000 units in the district's first phase of development. (One of these power plants is actually in the basement of a building of flats!) Three wind turbines have also been built, including one large 1.8-MW turbine, and all are but a few hundred meters away from the housing. A number of solar energy technologies and design ideas are being tried, including a centralized solar hot water heating system (plate CS10) which serves one portion of the district (and stores hot water in a partially underground 2,800-square meter tank, which doubles as a children's play area). Other sustainability elements include a demonstration ecological farm, a sustainable landscape management plan, and a green elementary school.

For more information, see: KUKA, *Living in Kronsberg* (Hannover: Kronsberg-Umwelt-Kommunikations-Agentur GmbH (KUKA), 2000).

Beddington Zero Energy Development (BedZED), London

Beddington Zero Energy Development (BedZED) is an impressive new ecological housing project in the Hackbridge neighborhood in South London. Designed by Bill Dunster architects, it is billed as the first carbon-neutral development in the UK (See plate CS11). The project includes a mix of housing and workspace (eighty-two homes, including fourteen home/work units), on a reclaimed sewage works. These three-story buildings are oriented with living space to the south to capture the sun, with most units provided with rooftop sky gardens. Well insulated, and with floors and walls providing extensive thermal mass, these buildings provide a unique system of natural ventilation is provided through a visually distinctive set of windcowls (plate CS12) that rotate into the wind, capturing fresh air but also extracting heat from outgoing air. Most construction materials were obtained within a thirty-five-mile radius of the site, and wood both for construction and to burn as fuel in the new combined heat and power plant comes from local forests. Other elements include photovoltaic panels to provide enough electricity to recharge a fleet of electric car-sharing vehicles.

Much of the credit for this bold project goes to the Peabody Trust, a London housing association known for its support of innovative and sustainable design. A new, larger extension of the BedZED ideas is now in the works also in London: Ladbroke Green is a mixed-use project located on a former gasworks, where 308 units of ecological housing and 16,000 square meters of commercial space will be built on about ten acres. With photovoltaic panels covering the rooftops of this project, this mixed-use development will be the largest application of solar panels in the UK.

For more information, see: Beddington Zero Energy Development at: www.bedzed.org.uk/

Greenwich Millennium Village, London

This new ecological neighborhood in the heart of the city of London is built on a former industrial site. It will eventually consist of 1,377 homes and 5,000 m^2 of office space on about twenty-nine hectares. Also included will be office and commercial space, a community center, cafés, and a large village green. Residents will be served by good transit (the Jubilee Line of the London Tube), and extensive bicycle and pedestrian routes have been included in the design (See plate CS13).

Buildings in the village, including the Ralph Erskine-designed phase one housing, will incorporate many green features, including sustainably harvested wood and climate-sensitive designs to maximize use of the sun and minimize effects of prevailing winds (See plate CS14). The goal of an 80 per cent reduction in energy in comparison with conventional development has been set. The Village will incorporate a combined heat and power plant (the first in Great Britain as part of a private housing development).

An interesting feature of the houses is the design of flexible living spaces. The units use sliding interior walls which allow adjustment and reorganization of the spaces as family needs change. Structural systems are designed, as well, to accommodate upgrades and modifications later (e.g., the addition of balconies).

For more information, see: "Greenwich Millennium Village" at: www.greenwich-village.co.uk

Nieuwland (solar suburb), Amersfoort, Netherlands

One of the largest demonstrations of a community organized around solar energy, this new district in the Dutch city of Amersfoort has been nicknamed the "solar suburb" (See plates CS15 and CS16). The sustainability of this unique town begins with orientation – some 85 per cent of the buildings are oriented to the south in this otherwise unique circular urban form containing a town center (with grocery, post office, shopping) at the core. Everything is within walking distance, and the community is served by a good bus service. Both photovoltaic and solar hot water panels are used throughout. PVs on building rooftops and façades generate 1.35 megawatts. Major institutional buildings, including two elementary schools, a sports complex, a kindergarten, and multi-family social housing, all have photovoltaics on their rooftops. Two pilot energy-balanced homes have also been constructed here. These are grid-connected homes that generate as much energy as they need over the course of a year.

The unique energy features of this community have benefited from substantial technical and financial support from the regional energy company REMU (Regionale Energiemaatschappij Utrecht), as well as from the Dutch Energy Agency (Novem) and the European Union. The positive environmental impacts of this project are tremendous, with an estimated reduction in carbon dioxide of almost 89,000 kilograms/year (approximately 98 tons).

For more information, see: REMU, *Building Solar Suburbs: Renewable Energy in a Sustainable City* (Utrecht: REMU, 1999).

Village Homes, Davis, California

The brainchild and creation of husband and wife team Judy and Michael Corbett, this sustainable neighborhood in Davis, California, has been an inspiring model since the late 1970s (See plates CS17 and CS18). This mostly single-family community (240 units on 60 acres) is organized around a series of interior green fingers, which collect the development's stormwater (there is no conventional stormwater collection system), and provides a beautiful network of community green spaces and walkways. Relatively small homes on small lots are grouped in clusters of eight, with small green spaces connecting to larger spaces. Narrower than typical streets provide access to the rear of the homes (homes front on the connected green spaces), and the east–west orientation allows for solar access which most of the homes take advantage of. Fruit trees and edible landscaping pervade the neighborhood, and there is

a vineyard, orchard, and community gardens. Three hundred almond trees are harvested commercially, providing a portion of the funds needed to pay for the three full-time gardeners.

While the Corbetts faced significant obstacles in building Village Homes (such as objections to the natural drainage system by the city's public works department and the fire department's opposition to the narrow streets), they were able to creatively overcome them. For example, a compromise on street width was reached, providing for a three-foot clear zone on each side, to allow emergency vehicle movement. The project has been a success on virtually every measure: the homes are highly sought after, residents tend to know each other, and crime in the neighborhood is very low compared with nearby conventional suburban-style development. The natural stormwater system has worked well, and incidentally resulted in a $600-per home saving, providing much of the funding for the neighborhood's impressive landscaping and green features.

For more information, see: Michael Corbett and Judy Corbett, *Toward Sustainable Communities: Learning from Village Homes* (Washington, DC: Island Press, 1996).

Los Angeles Eco-Village

Los Angeles Eco-Village is located three miles west of downtown in an ethnically diverse working-class neighborhood. Its focus is on transforming and retrofitting an existing urban neighborhood, rather than building a new community from scratch. Under the inspiration and guidance of Lois Arkin, the village, which consists of two city blocks, was initiated in 1993. About 500 residents are involved in the Eco-Village, and its primary goal is "to reduce our environmental impacts while raising the quality of neighborhood life."

A number of ecological retrofitting activities have occurred in the neighborhood, including the purchasing and renovation of two apartment buildings, the planting of fruit trees and community gardens, traffic calming (including neighborhood meals where tables are placed in the streets), ecological demonstration projects (e.g., graywater reclamation), and neighborhood dinners and meals and other gatherings (See plates CS19 and CS20). An Ecological Revolving Loan Fund, operated by Arkin's non-profit Cooperative Resources and Services Project, has provided the funds for purchasing and retrofitting the apartment buildings.

The LA Eco-Village project demonstrates clearly the potential of transforming older urban neighborhoods into more sustainable places. Many of the basic building blocks of urban sustainability are already in place – a more compact, walkable urban form, access to transit, stores, and so on. On top of these elements are then layered new forms of participation and new strategies for greening, together creating urban communities that exert a small ecological footprint and at the same time build community.

For more information, see: "Los Angeles Eco-Village Overview" at www.ic.org/laev

Civano and Armory Park del Sol, Tucson, Arizona

Civano is a relatively large new development on the outskirts of Tucson, a productive combination of ecological design and new urbanist thinking. Growing out of an early effort to build solar homes (See plate CS21) (and originally known as the Tucson Solar Village), the development will eventually contain 2,600 homes on 1,200 acres. The community's master plan reflects the desire to create a complete community, with housing, schools, parks, and employment within walking distance (See plate CS22). Much of the site is to be protected in a nature preserve. Amenities include a solar-heated pool, and extensive hiking and biking trails.

Sustainability is reflected in this development in other ways as well: The homes are built to a more stringent energy standard. Homes are estimated to use 50 per cent less energy than homes typical for the area. A double-water system is used (one line for potable water, another for less clean reclaimed water), and the houses and buildings take advantage of solar orientation. Civano has been substantially underwritten by Fannie Mae's American Communities Fund.

The emphasis on natural plants and vegetation carries over to Civano's commercial nursery, which specializes in such plants. Among other things, the nursery provides workshops on xeriscaping and native planting, and has salvaged some 6,000 plants and trees from Civano development sites.

One goal is to provide at least one job for every two households, as a way to minimize automobile commuting. Already a solar panel company, Global Solar, has located in Civano's commercial center.

Despite its many positive sustainability features, Civano's location on a greenfield location, at the edge of the city of Tucson, raises serious questions about its ultimate value as a model. Another green development in Tucson, much smaller in size, is Armory Park del Sol. In contrast, Armory Park del Sol is being build at a much higher density (99 units on about 15 acres) within an existing historic neighborhood, within Tucson city. The brainchild of John Wesley Miller, who originally conceived of the Tucson Solar Village, each of these homes will be Energy Star rated and will provide 1 kW of power from rooftop photovoltaic panels.

For more information, see: www.civano.com

EcoCity Cleveland and Cleveland EcoVillage

Cleveland is emerging as a testing ground for many new urban sustainability ideas. In the heart of the Midwest rustbelt, much of the growing interest in sustainability there has been the result of the creative advocacy of a small non-profit organization named EcoCity Cleveland. With a full-time staff of about three, the organization has accomplished much in terms of promoting new ideas and thinking, building a new awareness about the ecology of the city and region, and showing the potential benefits of a more sustainable urban direction. EcoCity Cleveland has been a tireless campaigner, publishing an award-winning newsletter, issuing policy papers, networking and partnering with other groups. It has published a sort of biological owner's manual for the region as well as bioregional maps, and each year gives out its Bioregional Hero awards.

Much success has been seen, and a considerable shift in thinking experienced in that city. Accomplishments have included new commitments to bikes and bicycling in the region, a new Green Environmental Center that will house several local environmental groups, new and renovated buildings incorporating green features, and fresh attention being given to urban sustainability in a number of recent and ongoing planning initiatives in the city (e.g., a new waterfront development initiative).

The Cleveland EcoVillage is perhaps the most tangible new reflection of these efforts. Here, a west end neighborhood, near a transit station slated for redevelopment, has been reconceptualized as a green urban village. As David Beach, founder of EcoCity Cleveland says, the goal is "to develop a model urban village that will realize the potential of urban life in the most ecological way possible" (Scott, 2002). Community meetings have been held, and a conceptual plan (See plate CS23) for the neighborhood has been prepared. Important elements of the vision include new infill housing, built with ecological design features, a renovated neighborhood park, community gardens, and the rapid transit station, itself to reflect a green theme (incorporating passive and active solar features, a roof from recycled materials, native landscaping), and within a short walk for residents of the neighborhood.

The first of twenty new green townhouses have been completed (See plate CS24), homes that incorporate a variety of green features (solar energy, high energy-efficiency, non-toxic materials, recycled and flyash in concrete, and use of ISC-certified wood, among others).

For more information, see the EcoCity Cleveland website: www.ecocitycleveland.org

REFERENCE

Scott, M. Robert (2002) Gettin' Easier Bein' Green: Eco-city Thrives in Cleveland. *Ohio Realtor*, September.

URBAN SUSTAINABILITY AT THE CITY AND REGIONAL SCALE

Vancouver, British Columbia

Vancouver, BC, with a population of a little over two million, has been a model of a relatively compact, sustainable North American city and region. It has been able, especially in recent years, to guide much of its growth into compact, dense, walkable, urban neighborhoods. The Vancouver development style has largely been one of accommodating much growth in tall, thin skyscrapers, benefiting, certainly, from spectacular mountain views there.

Growth in the city is governed by a comprehensive set of urban design guidelines that, among other things, stipulate a minimum number of affordable units, and a minimum number of family-friendly units (e.g., units where day care and schools are within a certain walking distance). Buildings are oriented toward the street, and great importance is given to promoting a vibrant street life and amenity-rich urban environment. High-rise buildings must be flanked by four-to-six-story structures that serve to soften the visual effects of the skyscrapers, and advance a human street scale (See plate CS25).

A regional livability strategy has been in place for fifteen years, administered by the Greater Vancouver Regional District (GVRD). The plan calls for steering development in the region into designated town centers (one of these being Vancouver), lying along the route of the SkyTrain, an elevated rail system. Much rural land in the region is contained in an Agricultural Land Reserve (ALR) and is thus off-limits to suburban development.

There are many explanations for Vancouver's success, including its relatively strong planning framework. The fact that Vancouver essentially has no major highways (Canada has never had an interstate highways program like the US's) is also helpful, and residents there must choose to live closer in if they wish to have access to cultural amenities, schools, housing, and so on.

The success of Vancouver's land use policies has been demonstrated in a recent analysis of land use trends there between 1986 and 2001. While the region grew in population during that period by almost 50 per cent, the portion of the city living in more compact, walkable neighborhoods actually increased. A joint study by Northwest Environment Watch and Smart Growth BC concluded that the percentage of residents living in compact neighborhoods (defined as neighborhoods with twelve or more residents) rose impressively from 42 per cent to 62 per cent during this period.

Building on these planning successes, much attention in recent years has been given to pursuing a broader sustainability agenda. The GVRD, for instance, has been developing a Sustainable Region Initiative. This agency is serving as a catalyst to promote sustainability initiatives and projects throughout Vancouver (e.g., by sponsoring regional workshops and publishing case studies), by taking action directly (e.g., through employee trip reduction programs), and by looking for ways to implement its regional programs more sustainably (e.g., combined greenway and utility corridors) (See plate CS26).

For more information, see: Northwest Environment Watch and Smart Growth BC. 2002. *Sprawl and Smart Growth in Greater Vancouver*, September 12, found at: www.northwestwatch.org/press/Vancouvergrowth.html. See also www.gvrd.bc.ca/sustainability/index.html

Bogotá, Colombia

It is remarkable what can be accomplished in a city like Bogotá, in a country, Colombia, that is essentially at war. Bogotá, a city of seven million people, has emerged as a place of innovation and inspiration, forging ahead with an impressive agenda to make the city more livable and sustainable. Largely through the leadership of former Mayor Enrique Peñalosa, the city has undertaken a number of creative transportation strategies. Like Curitiba, it is now using a bus-only transit system, with articulated buses operating like a subway (See plate CS27). Called TransMilenio, it operates along two main corridors, but plans are that twenty-two corridors will be in operation by 2015 (80 per cent of the city's population will be within 500 meters of a bus-stop).

Other accomplishments include 300 km of new bicycle paths, hundreds of new neighborhood parks, and a new greenway. One of the boldest actions was to convert a major street in the downtown to pedestrians only. This 17-kilometer-long street, which includes pedestrian amenities, has become cherished public space. Bogotá has also started something it calls its Ciclovia – the closing every Sunday of the city's main road arteries, some 120 km in all, in order to make them available to bicycles, walking, and socializing (See plate CS28). Former major Peñalosa, a champion of this idea, calls it a "marvelous community building celebration," and it attracts an incredible 1.5 million residents each week. Even more impressive is the number of people who participate when the city closes those same streets on a Christmas evening – some three million residents participate.

For more information, see: Enrique Peñalosa, "Urban Transport and Urban Development" at: www.worldbank.org/html/fpd/urban/forum2002/docs/peñalosa-pres.pdf

Gaviotas, Colombia

This small community, a sixteen-hour jeep ride from Bogotá, Colombia, has been called Colombia's model ecological city. Really a village more than a city, about 200 people live here. Its founder, Paolo Lugari, thinks of it not as a utopia, but a real place. Gaviotas and its residents have found many creative ways to live more sustainably. The emphasis here has been on low-tech ideas and tools, and on designing and building and creating those things uniquely suited to this wet savanna environment. Groundwater for the village is extracted through a specially designed hand pump, so easy to operate that it has been fashioned into a children's see-saw (See plate CS29). There is extensive use of solar energy – for providing hot water, for generating electricity, and for purifying drinking-water. Specially designed small windmills capture the modest wind energy. Travel is by way of a specially designed bicycle. Food is produced through a hydroponics system. Gaviotas is, essentially, a solar-powered, self-sufficient ecological village.

It is also an ecologically restorative village. One important economy-building step was the planting of some 20,000 acres of new forest. Caribbean pines were planted specifically because they were discovered to be unusually suited to the region's acidic soil. Turpentine is distilled from the bark resin of these trees, and has become a major economic product for the village. In addition, a rich undergrowth has become re-established in this new forest, with a flourishing of plants and wildlife. Eventually, the pines will be replaced by this regenerated rainforest.

The village's hospital, the only one within a half a day's car ride, is also designed to function ecologically. Its unique ventilation system brings cool air from a nearby hillside, its electricity is generated from PV panels, and hot water and distilled drinking-water are provided from solar hot-water panels. Methane is extracted from livestock dung and sent to the hospital (See plate CS30).

Gaviotas has become a model of sustainable village building, in Colombia as well as in other parts of Latin America. The water pump, for instance, is now in use in some 700 other Colombian villages, and the windmills, solar water-heating systems, and other technical innovations have been replicated elsewhere also. Gaviotas shows the power of creative innovation and place-based sustainable living.

For more information, see: Alan Weisman, *Gaviotas: A Village to Reinvent the World* (Post Mills, VT: Chelsea Green, 1999).

Auroville, India

This ecological, utopian new town is located in southeast India, about 160 kilometers south of Madras. Planned to eventually have a population of 50,000, there are now about 1,600 residents, representing about thirty different countries. Auroville has been conceived as a "universal township," inspired by the

thinking of philosopher and yogi Sri Aurobindo, as a place where "men and women of all countries are able to live in peace and progressive harmony, above all creeds, all politics and all nationalities." Human unity is a central ideal behind the town. The town's physical form is in the shape of a galaxy (See plate CS31), with a matrimandir, or large golden temple, in the very center. This spiritual center of the community, or Peace Area (See plate CS32), also contains a Banyan tree and an amphitheater for community events. The community's more elaborated master plan sets out a series of zones, essentially concentric circles, that extend out from the town's center. These include residential, international, industrial, and cultural zones, as well as a large Green Belt. The nearly 1500-hectare Green Belt is home to agriculture, forests, and biodiversity.

Auroville's many other ecological elements include extensive efforts at environmental regeneration of the landscape (planting of more than two million trees, extensive soil and water conservation, training programs in sustainable farming), the use of earth construction techniques in building (use of onsite, locally produced compressed earth blocks), and extensive use of renewable energy (e.g., thirty windmills, and a solar community kitchen producing 900 meals a day with 50 per cent of the energy coming from a "giant mirrored solar dish"), among others.

The region around Auroville contains thirteen villages and 40,000 people. Much of the work of Auroville has focused on improving the quality of life and sustainable practices in these surrounding villages. This has happened through training and workshops, for instance, and through co-operative projects.

For more information, see: www.auroville.org

IBA Emscher Park, Germany

The Ruhr Valley in northwestern Germany is a landscape heavily scarred by industrialization and littered with the remnants of coal-mining and steel production. In 1989 the state of North-Rhine Westphalia along with the federal government embarked on an ambitious project to promote long-term rehabilitation and reuse of this immense industrial area covering 800 square kilometers (307 square miles) along a 70-kilometer (43-mile) urban corridor. Called the International Building Exhibition (IBA) Emscher Park, more than a hundred demonstration projects have been funded over a ten-year period, with a remarkable impact on the cities and landscape, and a new appreciation and pride for an industrial past that most in the region sought to hide or forget. An impressive array of projects and creative examples of land and landscape recycling has resulted. Projects have included the establishment of eleven technology centers, new ecological housing on reclaimed brownfield sites, and the conversion of industrial buildings to cultural uses (e.g., conversion of the gasometer in Oberhausen to an exhibition hall). One of the most creative projects is the Landscape Park in Duisberg-North (See plate CS33). Here, a former steel mill has been converted into a regional park and industrial monument, where formal gardens have been created and trees planted amidst the remnant buildings, and massive foundation pillars have been converted into areas for climbing and repelling (See plate CS34).

Mont-Cenis Academy, in Herne-Sodingen, Germany, is one of the most impressive buildings sponsored through IBA. This government training center, designed by Jourda and Perrandin, takes the form of a large glass building, a "vast timber framed hanger" that contains offices, seminar spaces, a library, town hall, cafés, restaurant, and hotel. Nine wooden buildings lie protected under this "glass weather shield." A series of computer-controlled flaps and louvers open and close, depending on outside weather patterns, to ensure comfortable temperature and ventilation inside the glass shield. The structure permits use much of the year with minimal heating, and allows natural cross-ventilation during the summer. Most dramatic of all are the photovoltaic (PV) cells, 10,000 square meters in all, on the building's rooftop. More power is produced than is needed by the structure. Careful thought was given (and simulation done) on how to configure or array the PV panels. In the end they were grouped in a way that they "form cloud-like patterns that magically diffuse light into the great greenhouse" (Kugel 1999). It is the largest solar roof in the world.

Sited on former coalfields, the project builds on this history in several ways. The architecture evokes its mining and industrial past; according to one observer, "its monumental scale and repetitive structure evoke the big sheds, furnaces and factories of the Ruhr's old industrial landscape" (Kugel 1999). A combined heat and power plant, moreover, takes advantage of this site in even more tangible ways, as it utilizes escaping methane to produce heat and electricity.

For more information, see: Claudia Kugel. 1999. "Green Academy." *Architectural Review*. October.

London, England

With the re-establishment of city-wide governance in London (the new Greater London Authority), an impressive new emphasis has been given to sustainability in this metropolitan area of 7.5 million people (See plates CS35 and CS36). The stated vision is to "develop London as an exemplary, sustainable world city." Already, a number of specific sustainability plans and actions have been developed in the city. Especially impressive is the city's newly prepared Biodiversity Strategy and draft Energy Plan (including greenhouse gas emission targets).

Under Mayor Ken Livingstone's leadership, new institutional structures have been formed to promote and consider sustainability, including the creation of the London Sustainable Development Commission. The key charge of the Commission is to establish the London Sustainable Development Framework. Elements of this framework include the development of a comprehensive set of sustainable indicators (a draft of these has been issued), and review of the proposed spatial plan for London. The city is making dramatic efforts to reduce automobile traffic in its center, through a bold and controversial road pricing scheme that now charges £5 per car entering central London. Further initiatives include a new spatial plan for the region and a new green procurement code.

A new city-commissioned study entitled *City Limits*, commissioned by the city, presents a detailed analysis of the material flows required by the city and calculates its ecological footprint. The first such detailed study for a city of this size, the report concludes that London's footprint is extremely large, nearly 300 times its own land area. The study documents a tremendous material flow of inputs and outputs. Londoners consume, for instance, 154,407 gigawatts of energy each year, two million tons of wood products, and 730,000 tons of vegetables. At the same time, they emit fifty million tons of carbon dioxide and produce eight million tons of sewage sludge.

For more information, see: Greater London Regional Authority, "Sustainable Development," at www.london.gov.uk/londonissues/sustainability.jsp

Chicago, Illinois

Popular five-term mayor Richard Daley has declared that he intends for Chicago to be the "greenest city in the world." This is not just political rhetoric, but has already been translated into a host of exemplary urban sustainability ideas and initiatives in this region of about eight million people. Under Daley's leadership the city has undertaken a number of greening programs, including programs for encouraging and subsidizing green rooftops (and the dramatic retrofitting of City Hall with a green rooftop (See plate CS37)), extensive tree planting, and conversion of former gas stations and brownfield sites into neighborhood parks. An ambitious new energy plan promotes renewable energy (photovoltaic panels have now been installed on the rooftops of many city buildings), and establishes the goal of providing at least 20 per cent of the city's energy needs through renewable energy. Through the city's brightfields initiative, a new Center for Green Technology has been built on a former industrial site. The city is also moving forward to reclaim and restore a large former industrial area, Lake Calumet, for purposes such as sustainable energy production. A large solar energy plant and methane recovery facility are envisioned.

A number of green pilot programs have been initiated, including a competition to design and build prototype green homes (five designs were selected and are being built), and a green bungalow retrofit program. Most recently, the city has issued a set of sustainability principles, called the "Chicago Principles," which encapsulate its urban sustainability values and goals, and which will serve to guide the city into the future.

At a regional level, 160 organizations have joined forces in a unique coalition to create Chicago Wilderness. This is both an umbrella organization and a vision for a 200,000-acre system of protected lands and landscapes in the region. Chicago Wilderness has already accomplished much, including preparation of a regional biodiversity atlas, extensive habitat restoration work, and perhaps the first urban biodiversity conservation plan. Chicago Wilderness has also done much to raise awareness about biodiversity, and has sponsored numerous public workshops and educational programs throughout the region. Community-based conservation work has already taken place through this coalition.

For more information, see: City of Chicago, Department of Environment, www.ci.chi.il.us/Environment/

Austin, Texas

Austin, Texas began its Community Sustainability Initiative (CSI) in 1997 and has undertaken a number of key projects. The position of Sustainability Office was created to oversee these initiatives. Important projects and activities within CSI's first years have included a capital improvements program matrix used by city departments in evaluating proposed capital projects, the development of a set of sustainability indicators, and preparation of a set of sustainable building guidelines for city buildings and facilities.

A number of other initiatives in the areas of urban planning and environmental management have been undertaken in Austin, though outside the direct auspices of the CSI. Especially notable are Austin's Smart Growth Initiative and Green Builder Program. Under its Smart Growth Initiative, Austin prepared a Smart Growth Map (See plate CS38) indicating "desired development zones" where future growth is encouraged through a system of incentives. The goal is to discourage sprawl and to promote more compact, higher-density development within the existing urbanized areas of the city. Development proposals are evaluated through the City's Smart Growth Matrix and the resulting score (based primarily on the proposed location) determines the extent of financial incentives available in the form of infrastructure fee reductions or waivers. Fee waivers and expedited permit review are also available under the city's SMART housing incentives for the provision of affordable housing.

Austin's Green Builder Program is one of the oldest such efforts in the United States. Under this program, residential and commercial buildings are rated according to the extent and number of green features (receiving from one to five stars). The city provides technical assistance, convenes workshops and training for builders and designers, helps market green homes, and provides a variety of rebates and subsidies for green construction and rehabilitation (e.g., energy efficiency loans).

For more information, see: City of Austin, "The City of Austin Sustainable Communities Initiative," www.ci.austin.tx.us/sustainable.html

Portland, Oregon

Few American cities have accomplished as much as Portland, Oregon in the area of urban sustainability. This region of about two million people has developed a deserved reputation as an American testing ground for innovative urban planning ideas.

Promoting a more compact urban form is one of this region's key accomplishments. In part this was a response to the passage of Senate Bill 100 in Oregon in 1973. This law mandated, among other things,

that all cities adopt urban growth boundaries (UGBs) and that land use plans and regulations protect productive forest and farmland. UGBs are intended to delineate between developable or urbanizable lands and areas that are to be conserved and protected from development. Around Portland this UGB has been delineated on a regional basis, encompassing twenty-three smaller cities and portions of three counties. This regional scale growth management has been aided substantially through the establishment of a strong regional government, the Portland Metropolitan Services District, or "Metro" for short. The only popularly elected regional government in the USA, it has real powers especially in the areas of land use, transportation, parks and greenspaces, and solid waste management.

The City of Portland has itself taken many actions to reduce the reliance on private automobiles, to promote a more walkable city, and to protect its environment. A series of exemplary downtown plans have sought to increase the amount of housing in the center, to reconnect the city with its riverfront, and to create a highly attractive urban environment. A percent-for-art program has resulted in delightful street sculptures and public art. The city, moreover, has a long history of recapturing space from the automobile and giving it back to pedestrians. Dramatic examples include tearing out a riverfront highway and putting a park in its place – Tom McCall Waterfront Park – and removing a downtown parking garage to create Pioneer Courthouse Square, scene of many concerts, festivals, and other public events. A highly popular regional light rail system, the Metropolitan Area Express, or "MAX," (See plate CS39) connects much of the region in addition to an exemplary bus system, and much regional planning has occurred to guide growth along transit corridors. The city and region have also increased significantly the number of bikeways, now extending for more than 240 kilometers (149 miles).

Together these planning tools have led to a more compact regional development pattern than most other American cities with a much more vibrant urban core and relatively effective public transit. While the UGB has been extended several times, the overall pattern of development is gradually becoming denser and more pedestrian-friendly. A recently adopted, long-range regional plan, Region 2040, developed through an extensive public process, envisions maintaining the region's tight Metro urban form and steering much new growth into a series of centers along the spine of the MAX system (See plate CS40). The goal is that 85 per cent of new residents will be within a five-minute walk of a transit station.

While Portland has secured its reputation on these successful land use and transportation achievements, in recent years it has embraced a broader, more expansive urban sustainability agenda. It now boasts a city Office of Sustainable Development (formerly Portland Energy Office), housed in the Jean Vollum Natural Capital Center. The city has adopted a set of sustainable city principles and has been promoting a variety of other green city ideas. These have included green building, sustainable technologies and practices, energy conservation and efficiency, and solid waste and recycling. The City's Green Investment Fund has provided important funding to support green building, and a green building policy mandating minimum standards for city-funded facilities was adopted in 2001.

Portland has not been without its critics. Sharp rises in the price of housing in recent years have been blamed on its UGB and growth controls, for instance (though it is far from clear that this has been the cause). Others have been critical that while greater density and compactness have been achieved, the overall form this development takes is not dramatically different than other places; much of it still very suburban and car-dependent, critics such as new urbanist architect Andres Duany charge.

For more information, see: Portland Office of Sustainable Development, www.sustainablePortland.org

Burlington, Vermont

This progressive city of about 40,000 people has made a name for itself for embracing and implementing a host of community sustainability measures. The city has adopted the Earth Charter, an international declaration of environmental principles, and has made significant commitments to sustainability. It boasts

one of the few successful pedestrian malls in the nation, and its town center is vibrant, walkable, and mixed-use.

Burlington is the center of many creative urban sustainability ideas. A non-profit organization called The Good News Garage, for instance, repairs donated automobiles, supplies them to low-income families at cost, and also provides job training. The Burlington Community Land Trust, formed in 1984 with seed funding from the City, is an innovative model for both conserving land resources and providing affordable housing. The first of its kind in the nation, the Trust buys land, builds housing, and then rents or sells the homes to low- and moderate-income families. The Trust has also been instrumental in securing new parks, healthcare, and other community facilities, and in restoring and recycling older buildings in the city, for instance, recently converting old bus and trolley barns into apartments.

Burlington residents give strong support to local organic agriculture. The Intervale Farm Area has become an important national model. Consisting of about 800 acres of floodplain land along the Winooski River, the Intervale is now home to two community supported agriculture (CSA) operations and several other commercial organic farms. Managed now by a non-profit foundation, the Intervale is also home to the Burlington Compost Program, a living machine (a biological system for purifying wastewater) producing a Tilapia fish, a gardeners' supply store, and a small farms incubator program. A Food Enterprise Center is currently under development.

Energy conservation and renewable energy are also important topics in Burlington. The McNeil Generating Station (See plate CS41), run by the city's Electric Department, generates 50 MW of electricity from burning wood from local private woodlands and mill wood waste. This plant generates nearly enough electricity for the city.

Perhaps most impressive is the Burlington Legacy Project, an extensive community-based process created in 1999 that developed a vision and plan for the city for the year 2030. The Burlington Legacy document lays out a common future vision, identifies and discusses key themes (economy, neighborhoods, governance, youth and life skills, and environment), sets goals and priority actions, and provides profiles of projects already underway. The bottom-up planning process involved unusually extensive opportunities for community participation and some unique elements, including community surveys, focus groups convened at the neighborhood level, active involvement of the city's youth (e.g., poster and essay contests, school focus groups), public hearings, and a "Summit on the City's Future," held in March 2000 (See plate CS42).

For more information, see: The Burlington Legacy Project," at www.cedo.ci.burlington.vt.us/legacy/strategies/index.html

San José, California

San José adopted its "sustainable city major strategy" in 1994, as an element of its new General Plan, San José 2020. But concern about sustainability in that city extends back at least to 1980, when an influential report was prepared for the city entitled *Toward A Sustainable City*. Since then San José has done many things already to become more sustainable. It has adopted an ambitious recycling program, including the provision of financial incentives, following its "close the loop" philosophy for the reuse of recycled materials. After decades of sprawl in the 1950s, 1960s, and 1970s, it has imposed relatively stringent growth management provisions, including an urban growth boundary, has invested in light rail transit, has adopted zoning changes and other policies to promote infill development, and has placed new importance on strengthening its downtown (See plates CS43 and CS44).

Under the city's energy management program, staff have converted its 48,000 incandescent and mercury vapor streetlights to use sodium lamps (incidentally saving $1.5 million per year in the process), and have prepared a set of solar design guidelines. San José is also one of a growing number of communities promoting green building practices, and is participating in a program to reduce the urban heat

island effect ("cool roofs"). Other environmental accomplishments have included water conservation and efficiency improvements, and a policy for purchasing recycled products.

For more information, see: Smart Growth Network, "San José, The Sustainable City Project" at www.sustainable.doe.gov/success/sust_city.shtml

Santa Monica, California

Santa Monica, a city adjacent to Los Angeles known for its progressive policies, initiated its sustainable city program in 1994. In 2001 a Sustainable City Working Group was formed to evaluate the program and recommend future directions. This led to the preparation of an updated Santa Monica Sustainable City Plan (and a change in name from "project" to "plan"). The new plan lays out a comprehensive vision of a sustainable city, delineating nine Guiding Principles, as well as goals, indicators, and targets. A new Sustainable City Steering Committee is envisioned, as well as an interdepartmental Sustainable City Implementation Group.

Santa Monica has already taken many actions to advance urban sustainability, and has a number of new initiatives in progress (See plate CS45). The municipality, for instance, has adopted a set of mandatory Green Building Design and Construction Guidelines, as well as environmental purchasing and toxic reduction policies. The city has added parks and planted trees, constructed the innovative Santa Monica Urban Runoff Recycling Facility (SMURRF) (See plate CS49), and planted organic gardens at all of its public schools.

Many impressive steps have also been taken in Santa Monica to support renewable energy. The municipality has undertaken extensive energy-efficiency improvements in government buildings, and boasts that it is the first city (perhaps in the world?) to purchase 100 per cent of its municipal power (the electricity needed to power street lights, city buildings and facilities) from green, renewable sources. The city was even willing to pay a premium to ensure that the sources of this power are renewable.

Santa Monica has developed a set of Sustainability Indicators and is using these to judge overall city progress. These indicators evaluate the city's success in several areas, including tons of waste sent to the landfill, water and energy usage, transit ridership, number of community gardens in the city, and the amount of public open space.

For more information, see: City of Santa Monica. 2003. *Santa Monica Sustainable City Plan*. Adopted February 11.