Sustainable city

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A **sustainable city**, or **eco-city** is a city designed with consideration of environmental impact, inhabited by people dedicated to minimization of required inputs of energy, water and food, and waste output of heat, air pollution - CO_2, methane, and water pollution. Richard Register first coined the term "ecocity" in his 1987 book, *Ecocity Berkeley: Building Cities for a Healthy Future*.[1] Other leading figures who envisioned the sustainable city are architect Paul F Downton, who later founded the company Ecopolis Pty Ltd, and authors Timothy Beatley and Steffen Lehmann,[2] who have written extensively on the subject. The field of industrial ecology is sometimes used in planning these cities.

There remains no completely agreed upon definition for what a sustainable city should be or completely agreed upon paradigm for what components should be included. Generally, developmental experts agree that a sustainable city should meet the needs of the present without sacrificing the ability of future generations to meet their own needs. The ambiguity within this idea leads to a great deal of variation in terms of how cities carry out their attempts to become sustainable.[3] However, a sustainable city should be able to feed itself with minimal reliance on the surrounding countryside, and power itself with renewable sources of energy. The crux of this is to create the smallest possible ecological footprint, and to produce the lowest quantity of pollution possible, to efficiently use land; compost used materials, recycle it or convert waste-to-energy, and thus the city's overall contribution to climate change will be minimal, if such practices are adhered to.

It is estimated that over 50%[4] of the world's population now lives in cities and urban areas. These large communities provide both challenges and opportunities for environmentally-conscious developers, and there are distinct advantages to further defining and working towards the goals of sustainable cities. Humans are social creatures and thrive in urban spaces that foster social connections. Because of this, a shift to more dense, urban living would provide an outlet for social interaction and conditions under which humans can prosper. Contrary to common belief, urban systems can be more environmentally sustainable than rural or suburban living. With people and resource located so close to one another it is possible to save energy and resources things such as food transportation and mass transit systems. Finally, cities benefit the economy by locating human capital in one relatively small geographic area where ideas can be generated.

Contents

Practical achievement

These ecological cities are achieved through various means, such as:

- Different agricultural systems such as agricultural plots within the city (suburbs or centre). This reduces the distance food has to travel from field to fork. Practical work out of this may be done by either small scale/private farming plots or through larger scale agriculture (e.g. farmscrapers).
- Renewable energy sources, such as wind turbines, solar panels, or bio-gas created from sewage. Cities provide economies of scale that make such energy sources viable.
- Various methods to reduce the need for air conditioning (a massive energy demand), such as planting trees and lightening surface colors, natural ventilation systems, an increase in water features, and green spaces equaling at least 20% of the city's surface. These measures counter the "heat island effect" caused by an abundance of tarmac and asphalt, which can make urban areas several degrees warmer than surrounding rural areas—as much as six degrees Celsius during the evening.
- Improved public transport and an increase in pedestrianization to reduce car emissions. This requires a radically different approach to city planning, with integrated business, industrial, and residential zones. Roads may be designed to make driving difficult.
- Optimal building density to make public transport viable but avoid the creation of urban heat islands.
- Solutions to decrease urban sprawl, by seeking new ways of allowing people to live closer to the workspace. Since the workplace tends to be in the city, downtown, or urban center, they are seeking a way to increase density by changing the antiquated attitudes many suburbanites have towards inner-city areas. One of the new ways to achieve this is by solutions worked out by the Smart Growth Movement.
- Green roofs
- Sustainable transport
- Zero-energy building
- Sustainable urban drainage systems or SUDS
- energy conservation systems/devices
- Xeriscaping - garden and landscape design for water conservation
- Key Performance Indicators - development and operational management tool providing guidance and M&V for city administrators.[5]

Architecture

Buildings provide the infrastructure for a functioning city and allow for many opportunities to demonstrate a commitment to sustainability. A commitment to sustainable architecture encompasses all phases of building including the planning, building, and restructuring.

Eco-industrial park

The purpose of an eco-industrial park is to connect a number of firms and organizations to work together to decrease their environmental impact while simultaneously improving their economic performance.[6] The community of businesses accomplishes this goal through collaboration in managing environmental and resource issues, such as energy, water, and materials.[6] The components for building an eco-industrial park include natural systems, more efficient use of energy, and more efficient material and water flows[6] Industrial parks should be built to fit into their natural settings in order to reduce environmental impacts, which can be accomplished through plant design, landscaping, and choice of materials. For instance, there is an industrial park in Michigan built by Phoenix Designs that is made almost entirely from recycled materials.[7] The landscaping of the building will include native trees, grasses, and flowers, and the landscaping design will also act as climate shelter for the facility.[7] In choosing the materials for building an eco-industrial park, designers must consider the life-cycle analysis of each medium that goes into the building to assess their true impact on the environment and to ensure that they are using t from one plant to another, steam connections from firms to provide heating for homes in the area, and using renewable energy such as wind and solar power.[6] In terms of material flows, the companies in an eco-industrial park may have common waste treatment facilities, a means for transporting by-products from one plant to another, or anchoring the park around resource recovery companies that are recruited to the location or started from scratch.[6] To create more efficient water flows in industrial parks, the processed water from one plant can be reused by another plant and the parks infrastructure can include a way to collect and reuse storm water runoff.[6]

Urban farming

Urban farming is the process of growing and distributing food, as well as raising animals, in and around a city or in urban area. According to the RUAF Foundation, urban farming is different from rural agriculture because "it is integrated into the urban economic and ecological system: urban agriculture is embedded in - and interacting with- the urban ecosystem. Such linkages include the use of urban residents as labourers, use of typical urban resources (like organic waste as compost and urban wastewater for irrigation), direct links with urban consumers, direct impacts on urban ecology (positive and negative), being part of the urban food system, competing for land with other urban functions, being influenced by urban policies and plans, etc".[8] There are many motivations behind urban agriculture, but in the context of creating a sustainable city, this method of food cultivation saves energy in food transportation and saves costs. In order for urban farming to be a successful method of sustainable food growth, cities must allot a common area for community gardens or farms, as well as a common area for a farmers market in which the foodstuffs grown within the city can be sold to the residents of the urban system.[8](Read more on the Urban Agriculture page)

Urban infill

Many cities are currently in a shift from the suburban sprawl model of development to a return to urban dense living. This shift in geographic distribution of population leads to a denser core of city residents. These residents provide a growing demand in many sectors that is reflected in the architectural fabric of the city. This new demand can be supplied by new construction or historic rehabilitation. Sustainable cities will opt for historical rehabilitation wherever possible. Having people live in higher densities not only gives

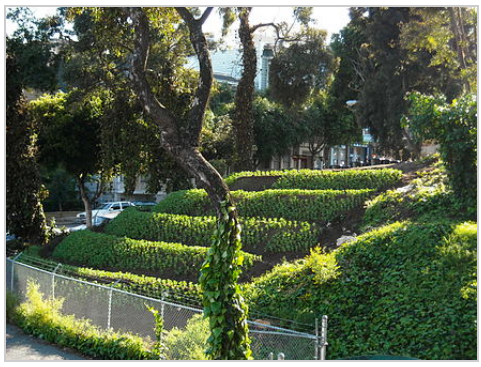
economies of scale but also allows for infrastructure to be more efficient.

Walkable urbanism

Walkable urbanism is a development strategy in opposition to suburban sprawl. It advocates housing for a diverse population, a full mix of uses, walkable streets, positive public space, integrated civic and commercial centers, transit orientation and accessible open space. It also advocates for density and accessibility of commercial and government activity.

New Urbanism

The most clearly defined form of walkable urbanism is known as the Charter of New Urbanism. It is an approach for successfully reducing environmental impacts by altering the built environment to create and preserve smart cities which support sustainable transport. Residents in compact urban neighborhoods drive fewer miles, and have significantly lower environmental impacts across a range of measures, compared with those living in sprawling suburbs.[9] The concept of Circular flow land use management has also been introduced in Europe to promote sustainable land use patterns that strive for compact cities and a reduction of greenfield land take by urban sprawl.



Berms of fava beans have been planted at Hayes Valley Farm, a community-built farm on the former Central freeway ramps of San Francisco.

In sustainable architecture the recent movement of New Classical Architecture promotes a sustainable approach towards construction, that appreciates and develops smart growth, walkability, architectural tradition and classical design.[10][11] This in contrast to modernist and globally uniform architecture, as well as opposing solitary housing estates and suburban sprawl.[12] Both trends started in the 1980s.

Individual buildings (LEED)

LEED, or Leadership in Energy and Environmental Design, is an internationally recognized green building certification system. LEED recognizes whole building sustainable design by identifying key areas of excellence including: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Locations & Linkages, Awareness and Education, Innovation in Design, Regional Priority.[13] In order for a building to become LEED certified sustainability needs to be prioritized in design, construction, and use. One example of sustainable design would be including a certified wood like bamboo. Bamboo is fast growing and has an incredible replacement rate after being harvested. By far the most credits are rewarded for optimizing energy performance. This promotes innovative thinking about alternative forms of energy and encourages increased efficiency.

Transportation

As major focus of the sustainable cities, sustainable transportation attempts to reduce a city's reliance and use of greenhouse emitting gases by utilizing eco friendly urban planning, low environmental impact vehicles, and residential proximity to create an urban center that has greater environmental responsibility and social equity.

Due to the significant impact that transportation services have on a city's energy consumption, the last decade has seen an increasing emphasis on sustainable transportation by developmental experts. Currently, transportation systems account for nearly a quarter of the world's energy consumption and carbon dioxide emission. In order to reduce the environmental impact caused by transportation in metropolitan areas, sustainable transportation has three widely agreed upon pillars that it utilizes to create more healthy and productive urban centers.[14]

Carfree city

The concept of Car free cities or a city with large pedestrian areas is often part of the design of a sustainable city. A large amount of the carbon footprint of a city is generated from cars so it is often consider being an integral part of the design of a sustainable city.

Emphasis on proximity

Created by eco friendly urban planning, the concept of urban proximity is an essential element of current and future sustainable transportation systems. This requires that cities be built and added onto with appropriate population and landmark density so that destinations are reached with reduced time in transit. This reduced time in transit allows for reduced fuel expenditure and also opens the door to alternative means of transportation such as bike riding and walking.

[15]

Transportation in downtown Chicago.

Furthermore, close proximity of residents and major landmarks allows for the creation of efficient public transportation by eliminating long sprawled out routes and reducing commute time. This in turn decreases the social cost to residents who choose to live in these cities by allowing them more time with families and friends instead by eliminating a part of their commute time.

Diversity in modes of transportation

Sustainable transportation emphasizes the use of a diversity of fuel-efficient transportation vehicles in order to reduce greenhouse emissions and diversity fuel demand. Due to the increasingly expensive and volatile cost of energy, this strategy has become very important because it allows a way for city residents to be less susceptible to varying highs and lows in various energy prices.

Among the different modes of transportation, the use alternative energy cars and widespread instillation of refueling stations has gained increasing notoriety. Also, the creation of centralized bike and walking paths remains a staple of the sustainable transportation movement.

Transportation access

In order to maintain the aspect of social responsibility inherent within the concept of sustainable cities, implementing sustainable transportation must include access to transportation by all levels of society. Due to the fact that car and fuel cost are often too expensive for lower income urban residents, completing this aspect often revolves around efficient and accessible public transportation.

In order to make public transportation more accessible, the cost of rides must be affordable and stations must be located no more than walking distance in each part of the city. As studies have shown, this accessibility creates a great increase in social and productive opportunity for city residents. By allowing lower income residents cheap and available transportation, it allows for individuals to seek employment opportunities all over the urban center rather than simply the area in which they live. This in turn reduces unemployment and a number of associated social problems such as crime, drug use, and violence.[16]

Urban strategic planning

Although there is not an international policy regarding sustainable cities and there are not established international standards, there is an organization, the United Cities and Local Governments(UCLG) that is working to establish universal urban strategic guidelines. The UCLC a democratic and decentralized structure that operates in Africa, Asia, Eurasia, Europe, Latin America, North America, Middle East, West Asian and a Metropolitan section work to promote a more sustainable society.[17] The 60 members of the UCLG committee evaluate urban development strategies and debate theses experiences to make the best recommendations. Additionally, the UCLG accounts for differences in regional and national context.

Development

Recently, local and national governments and regional bodies such as the European Union have recognized the need for a holistic understanding of urban planning. This is instrumental to establishing an international policy that focuses on cities challenges and the role of the local authorities responses. Generally, in terms of urban planning, the responsibility of local governments are limited to land use and infrastructure provision excluding inclusive urban development strategies. The advantages of urban strategic planning include an increase in governance and cooperation that aides local governments in establishing performance based-management, clearly identify the challenges facing local community and more effectively responding on a local level rather than national government and finally it improves institutional responses and local decision making.[17] Additionally, it increase dialogue between stakeholders and develops consensus-based solutions, establishing continuity between sustainability plans and the change in local government, it places environmental issues as the priority for the sustainable development of the city and serves as a platform to develop concepts and new models of housing, energy and mobility.[17]

Obstacles

The City Development Strategies (CDS) has evolved to address new challenges and to provide space for innovative polices that involves all stakeholders. The inequality in spatial development and socio-economic classes paired with recent concerns of poverty reduction and climate change are new factors in achieving global sustainable cities. According to the UCLG there are differences between regional and national conditions, framework and practice that are overcome in the international commitment to communication and negotiation with other governments, communities and the private sector to continual to develop through innovative and participatory approaches in strategic decisions, building consensus and monitoring performance management and raising investment.

Social factors of sustainable cities

According to the UN Habitat, around half of the world's population is concentrated in cities that is set to rise to 60% within a couple decades.[17] The UCLG has specifically identified 13 global challenges to establishing sustainable cities: demographic change and migration, globalisation of the job market, poverty and unmet Millennium Development Goals, segregation, spatial patterns and urban growth, metropolisation and the rise of urban regions, more political power for local authories, new actors for developing a city and providing services, decline in public funding for development, the environment and climate change, new and accessible building technologies, preparing for uncertainty and limits of growth and global communications and partnerships.

Examples


Location of UCLG's Headquarter Barcelona, Spain

Bilbao, Spain The country faced economic turmoil following the decline of the steel and port industries but through communication between stakeholders and authorities to create inner-city transformation, the local government benefited from the increase in land value in old port areas. The Strategic Plan for the Revitalisation of Metropolitan Bibao was launched in 1922 and have flourished regenerating old steel and port industries. The conversion from depleted steel and port industries to one of Europe's most flourishing markets is a prime example of a sustainable project in action.

Belo Horizonte, Brazil The city was created in 1897 and is the third largest metropolitan in Brazil with 2.4 million inhabitants.[17] The Strategic Plan for Belo Horizonte (2010–2030) is being prepared by external consultants based on similar cities infrastructure, incorporating the role of local government, state government, city leaders and encouraging citizen participation. The need for environmental sustainable development is led by the initiative of new government following planning processes from the state government. Overall, the development of the metropolis is dependent on the land regularization and infrastructure improvement that will better support the cultural technology and economic landscape.

Masdar is one of the most expensive new sustainable city developments with a large range of new technological developments aiming to achieve a zero carbon and zero waste. At huge cost, it has a new underground transit system and other very advanced efficiency solutions, although whether this development can be applied in less costly environments may be questioned.

Malaysia

The Federal Department of Town and Country Planning (FDTCP), Peninsular Malaysia is a focal point for the implementation of Malaysian Urban Rural National Indicators Network for Sustainable Development (MURNInets) (http://murninet.townplan.gov.my/murninets/) .MURNInets which include 36 sets of compulsory indicators grouped under 21 themes under 6 dimensions. Most of the targets and standards for the selected indicators were adjusted according to hierarchy of local authorities. In MURNInets at least 3 main new features are introduced. This include the Happiness Index, an indicator under the quality of life theme to meet the current development trend that emphasizes on the well-being of community. Another feature introduced is the customer or people satisfaction level towards local authority's services. It is through the introduction of these indicators the bottom-up approach in measuring sustainability is adopted.

Australia

Melbourne

- City of Moreland. The City of Moreland in Melbourne's north, has programs for becoming carbon neutral, one of which is 'Zero Carbon Moreland (http://www.mefl.com.au/get-involved/zero-carbon-moreland.html)', amongst other existing sustainable implementations and proposals.
- City of Melbourne. Over the past 10 years, various methods of improving public transport have been implemented, car free zones and entire streets have also been implemented.

City of Greater Taree, New South Wales

The City of Greater Taree North of Sydney has developed a masterplan for Australia's first low-to-no carbon urban development.

Adelaide

Urban forests

Deforestation of native rain forest in Rio de Janeiro, Brazil for the extraction of clay for civil engineering (2009 picture). An example of non-sustainable land management.

In Adelaide, South Australia (a city of 1.3 million people) Premier Mike Rann (2002 to 2011) launched an urban forest initiative in 2003 to plant 3 million native trees and shrubs by 2014 on 300 project sites across the metro area. The projects range from large habitat restoration projects to local biodiversity projects. Thousands of Adelaide citizens have participated in community planting days. Sites include parks, reserves, transport corridors, schools, water courses and coastline. Only trees native to the local area are planted to ensure genetic integrity. Premier Rann said the project aimed to beautify and cool the city and make it more liveable; improve air and water quality and reduce Adelaide's greenhouse gas emissions by 600,000 tonnes of C02 a year. He said it was also about creating and conserving habitat for wildlife and preventing species loss.[18]

Solar power

The Rann government also launched an initiative for Adelaide to lead Australia in the take-up of solar power. In addition to Australia's first 'feed-in' tariff to stimulate the purchase of solar panels for domestic roofs, the government committed millions of dollars to place arrays of solar panels on the roofs of public buildings such as the Museum, Art Gallery, Parliament, Adelaide Airport, 200 schools and Australia's biggest rooftop array on the roof of Adelaide Showgrounds' convention hall which was registered as a power station.

Wind power

South Australia went from zero wind power in 2002 to wind power making up 26% of its electricity generation by October 2011. In 5 years to 2011 there was a 15% drop in emissions, despite strong economic growth.[19]

Waste recycling

For Adelaide the South Australian government also embraced a Zero Waste recycling strategy, achieving a recycling rate of nearly 80% by 2011 with 4.3 million tonnes of materials diverted from landfill to recycling. On a per capita basis this was the best result in Australia, the equivalent of preventing more than a million tonnes of C02 entering the atmosphere. In the 1970s container deposit legislation was introduced. Consumers are paid a 10 cent rebate on each bottle/can/container they return to recycling. In 2009 non-reusable plastic bags used in supermarket checkouts were banned by the Rann Government preventing 400 million plastic bags per year entering the litter stream. In 2010 Zero Waste SA was commended by a UN Habitat Report entitled 'Solid Waste Management in the World Cities'.[20]

Cameroon

- Bafut, is a town and traditional kingdom which is working towards becoming an eco-city by 2020, through the Bafut Council Eco-city Project.[21]

Canada

- Calgary, Alberta ranked as the top eco-city in the world in 2010 for its, "excellent level of service on waste removal, sewage systems, and water drinkability and availability, coupled with relatively low air pollution."
- Ottawa, Ontario ranked as third in the top eco-cities in the world. The survey was performed in conjunction with the reputable Mercer Quality of Living Survey.[22]

China

- Tianjin: The Chinese are working with investment and technology supplied by the Singapore government to build an ecocity in Binhai, named the "Sino-Singapore Tianjin Eco-city".[23][24]
- Dongtan Eco-city, Shanghai: The project, located in the east of Chongming Island developed by Arup and Parthers, was scheduled to accommodate 50,000 residents by 2010, but its developer has currently put construction on hold.[25] An additional project was made in 2007 in this area: an Eco-Village based on the concept made by an Italian professor from the School of Architecture of Tianjin University.
- Huangbaiyu, Benxi, Liaoning is a small village of 42 homes that has come under great criticism: most of the homes are unoccupied by villagers.
- Nanjing: As of April 2008, an ecocity collaboration project is being proposed here.
- Rizhao, Shandong mandates solar water heaters for households, and has been designated the

Environmental Model City by China's SEPA.[26]:108

- Chengdu Tianfu District Great City is a planned city located just outside of Chengdu that is planned to be sustainable and has the goal of being a self-sustaining city that discourages the use of cars.[27]

Denmark

Two comprehensive studies were carried out for the whole of Denmark in 2010 (The IDA Climate Plan 2050) (http://vbn.aau.dk/en/publications/idas-klimaplan-2050%2881036e70-961c-11de-802f-000ea68e967b%29.html) and 2011 (The Danish Commission on Climate Change Policy) (http://vbn.aau.dk/en/publications/idas-klimaplan-2050%2881036e70-961c-11de-802f-000ea68e967b%29.html). The studies analysed the benefits and obstacles of running Denmark on 100% renewable energy from year 2050. There is also a larger, ambitious plan in action: Copenhagen 2025 Climate Plan

On a more local level, the industrial park in Kalundborg is often cited as a model for industrial ecology. However projects have been carried out in several Danish cities promoting 100% renewable energy. Examples are: Aalborg,[28] Ballerup[29] and Frederikshavn.[30] Aalborg University has launched a master education on sustainable cities (Sustainable Cities @ Aalborg University Copenhagen) (http://sustainablecities.aau.dk/). See also the Danish Wikipedia

Germany

No other country has built more eco-city projects than Germany. Freiburg im Breisgau is often referred to as a green city. It is one of the few cities with a Green mayor and is known for its strong solar energy industry. Vauban, Freiburg is a sustainable model district. All houses are built to a low energy consumption standard and the whole district is designed to be carfree. Another green district in Freiburg is Rieselfeld, where houses generate more energy than they consume. There are several other green sustainable city projects such as Kronsberg in Hannover and current developments around Munich, Hamburg and Frankfurt.

Hong Kong

The government portrays the proposed Hung Shui Kiu new town as an eco-city. The same happened with the urban development plan on the site of the former Kai Tak Airport.

India

Auroville (http://www.auroville.org/) was founded in 1968 with the intention of realizing human unity, and is now home to approximately 2,000 individuals from over 45 nations around the world. Its focus is its vibrant community culture and its expertise in renewable energy systems, habitat restoration, ecology skills, mindfulness practices, and holistic education.

Ireland

South Dublin County Council announced plans in late 2007 to develop Clonburris, a new suburb of Dublin to include up to 15,000 new homes, to be designed to achieve the highest of international standards.[31] The plans for Clonburris include countless green innovations such as high levels of energy efficiency, mandatory

renewable energy for heating and electricity, the use of recycled and sustainable building materials, a district heating system for distributing heat, the provision of allotments for growing food, and even the banning of tumble driers, with natural drying areas being provided instead.[32]

In 2012 a energy plan was carried out by the Danish Aalborg University for the municipalities of Limerick and Clare. The project was a short-term 2020 renewable energy strategy giving a 20% reduction in CO_2-emissions, while ensuring that short-term actions are beneficial to the long-term goal of 100% renewable energy.[33]

Kenya

Hacienda - Mombasa is the largest development of eco-friendly residential properties in East Africa; construction is currently ongoing, and it will eventually be one of Africa's first self-sustaining estates.

Korea

Songdo IBD is a planned city in Incheon which has incorporated a number of eco-friendly features. These include a central park, irrigated with seawater, a subway line, bicycle lanes, rainwater catchment systems, pneumatic waste collection system, ... Finally, 75% of the waste generated by the construction of the city will be recycled.

Gwanggyo City Centre is another planned sustainable city.[34]

New Zealand

The city of Waitakere, the Western part of the greater Auckland urban region, was New Zealand's first eco-city, working from the Greenprint, a guiding document that the City Council developed in the early 1990s.

Portugal

The organization Living PlanIT is currently constructing a city from scratch near Porto, Portugal. Buildings will be electronically connected to vehicles giving the user a very detailed sense personal eco-friendliness.

Sweden

Gothenburg, and especially Älvstaden (central city by the river Göta Älv) are good examples of sustainable city in Sweden. They have low environmental impact, contain passive houses, good recycling system for waste, etc.

Hammarby Sjöstad

Västra Hamnen or Bo01, Malmö

United Arab Emirates

- Masdar City, Abu Dhabi is a planned city under development that will rely entirely on solar energy

and other renewable energy sources, with a sustainable, zero-carbon, zero-waste ecology.

United Kingdom

- London Borough of Sutton is the first One Planet Region in the United Kingdom, with significant targets for reducing the ecological footprint of residents and creating the UK's greenest borough.[35]
- Middlesbrough is another One Planet Region in the United Kingdom.[36]
- St Davids the smallest city in the United Kingdom aims to be the first carbon neutral city in the world.[37]
- Leicester is the United Kingdom's first environment city[38]

United States

- Arcosanti, Arizona
- Treasure Island, San Francisco: is another project that aims to create a small eco city.
- Coyote Springs, Nevada is the largest planned city in the United States.
- Babcock Ranch Florida a proposed solar-powered city.
- Douglas Ranch, Buckeye Arizona
- Mesa del Sol in Albuquerque, New Mexico
- Sonoma Mountain Village (http://www.sonomamountainvillage.com/) in Rohnert Park, California*

See also

- Bicycle City
- Circles of Sustainability
- Transition town
- Sustainable design
- Ecodistrict
- Zero-carbon city
- Carfree city
- Urban design

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