URBAN SUSTAINABILITY AT THE BUILDING AND SITE SCALE

1 Commerzbank Headquarters, Frankfurt, Germany

Designed by Norman Foster architects, this commercial office building is the tallest building in Germany and the world's first ecological skyscraper. This 53-story, nearly 300-meter-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 height of the structure.

A major design element is a series of sky gardens. The building incorporates these gardens every four floors, with a larger garden open to the elements on the 43rd floor. Nine gardens in all are provided, each with trees and vegetation, serving both as places for employees to visit and relax, and as 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 during 60 percent of the year (operable windows in all offices and on all floors), extensive daylighting, sensors that automatically adjust artificial lighting inside, and low-emissity windows (windows coated to allow in short

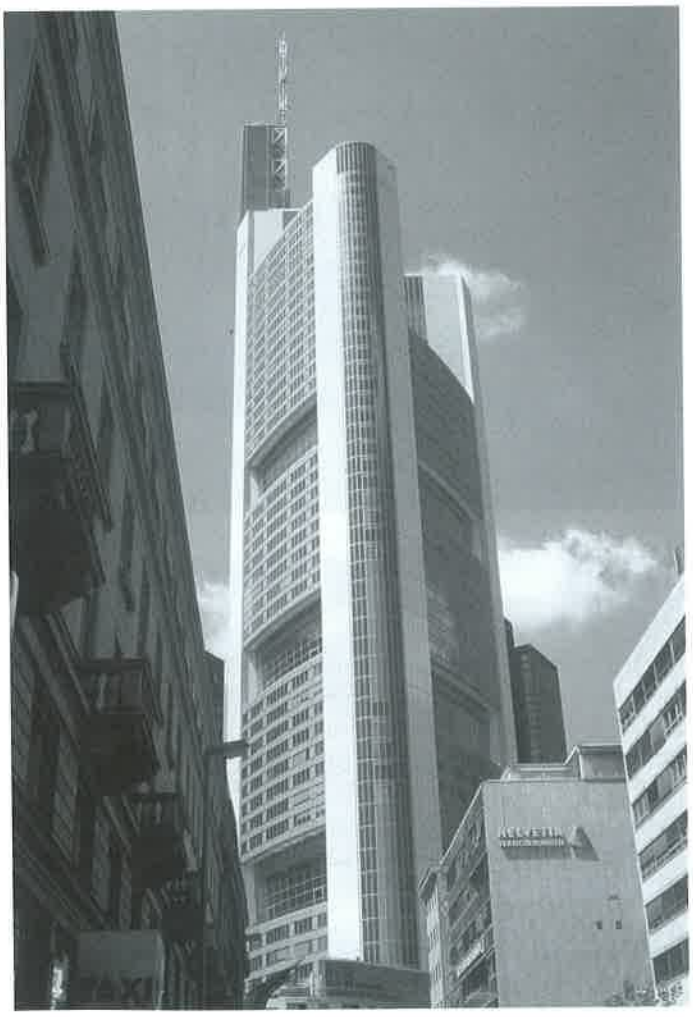

Figure 1 Commerzbank, Frankfurt, Germany (Norman Foster & Partners).

Source: Photograph by Timothy Beatley.

Figure 2 Sky garden in the Commerzbank.

Source: Norman Foster & Partners.

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 was designed to use 30 percent less energy than a conventional office building but is actually using 50 percent less. Beginning in 2008 it has used only electricity from renewable sources.

For more information, see: www.fosterandpartners.com and www.commerzbank.com/en/hauptnavigation/konzern/commerzbank_im__berblick/hochhaus_1/zahlen_fakten.html.

2 Menara Mesiniaga Bio-Climatic Skyscraper, Kuala Lumpur, Malaysia

Designed by architect Ken Yeang, the IBM headquarters building in Kuala Lumpur, Malaysia represents an important example of what Yeang calls "bio-climatic" skyscrapers. Such buildings are designed from

Figure 3 Menara Mesiniaga, a bio-climatic skyscraper designed by architect Ken Yeang.

Source: Photograph by K.L. Ng from ArchNet.

Figure 4 Menara Mesiniaga, garden terraces.

Source: Photograph by K.L. Ng from ArchNet.

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 and also add to the building's visual distinctiveness. Perhaps most impressive 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 15-story building to earth and land.

Completed in 1992, this is perhaps Ken Yeang's best example of a completed Bio-Climatic skyscraper design. It was awarded the Aga Khan Award for Architecture in 1995. Other important examples include the UMNO Tower in Penang, the planned EDITT Tower in Singapore, and a design for a 40-story eco-tower as part of a comprehensive redevelopment scheme for the Elephant and Castle area of London.

For more information, see: Ken Yeang, *Bioclimatic Skyscrapers*, Revised Edition, (London: Ellipsis London Press Ltd, 2000); *The Green Skyscraper: The Basis for Designing Sustainable Intensive Buildings* (New York: Prestel, 2000) and *Reinventing the Skyscraper: A Vertical Theory of Urban Design* (London: John Wiley & Sons Ltd, 2002). See also http://www.akdn.org/architecture/project.asp?id=1356.

3 Adelaide Eco-Village (Christie Walk), Australia

The Southern Australian city of Adelaide features an ecologically designed 27-unit cohousing project known as Christie Walk, built in three phases over seven years. (Cohousing is a form of cooperative living in which residents have their own dwelling units but share a common house and other facilities, and usually eat many meals together.)

Green city ideas have a long history in Adelaide, under the advocacy of Paul Downton and the organization Urban Ecology Australia. This urban infill project relied on extensive community participation in its design and development. Community facilities include kitchen, dining, reading, and laundry rooms. Stormwater is retained onsite and used for toilet flushing and gardening purposes. Initial plans called for both graywater and sewage to be recycled onsite, but the tight site and lack of support from the utility prevented this initially.

The homes at Christie Walk are designed to be very energy-efficient, and include both active and passive solar. Units use 60 percent less energy than the average one-person all-electric household and 50 percent less energy than the average two-person household. The building designs take advantage of high thermal mass, extensive insulation, and a natural ventilation system. All buildings use solar hot water, and the community generates some of its own electricity with two types of photovoltaic cells. Stairwells act as ventilation flues. Vegetation and landscaping using native plants cool 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 straw bales in cottage walls and non-toxic paints and finishes. The outer shell of buildings 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 is produced for the neighborhood.

Siting this development on a T-shaped parcel in the heart of Adelaide reflects its sustainability values as well. Its urban location permits 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 11 parking spaces were required for the 27 units.

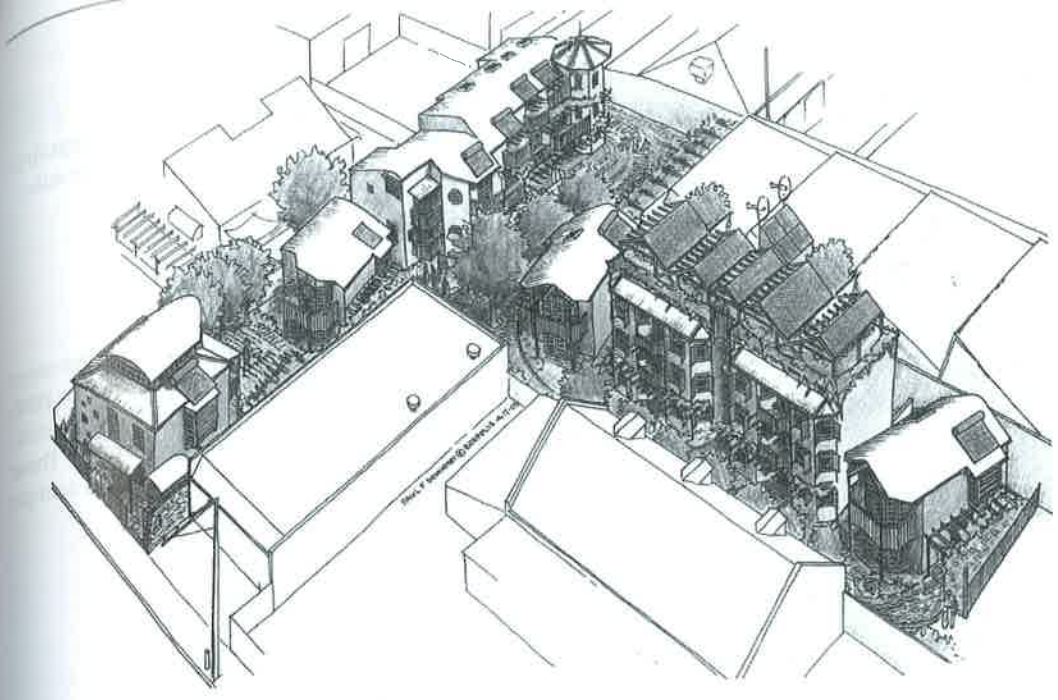

Figure 5 Artist's rendering of Christie Walk, Adelaide, Australia.

Source: Courtesy of Paul Downton, Urban Ecology Australia.

Figure 6 Christie Walk, Adelaide.

Source: Photograph by Paul Downton.

For more information, seen http://www.urbanecology.org.au/eco-cities/christie-walk/, http://www.aila.org.au/SustainableCanberra/009-christie/default.htm, http://www.yourhome.gov.au/technical/fs92.html, and http://www.yourhome.gov.au/technical/fs101.html. Suburban Adelaide is also home to the Aldinga Arts Eco Village, with more than 100 units, a small farm, and onsite sewage treatment. More information about this project is at http://www.aaev.net/about/index.html.

4 Condé Nast Building (4 Times Square), New York

Nicknamed the "green giant," the Condé Naste building, also known as 4 Times Square, is the first major office structure in New York City designed and built around sustainability principles. Completed in 1999, the building is 48 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

Figure 7 Condé Nast building, 4 Times Square, New York.

Source: Photograph by Timothy Beatley.

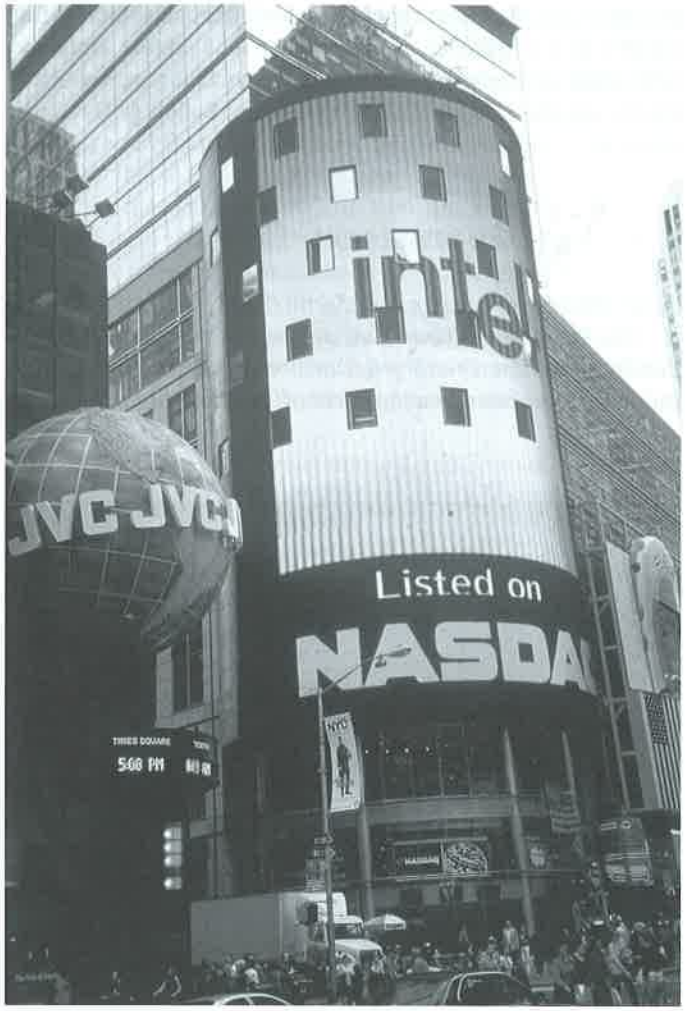

Figure 8 Condé Nast building, neon frontage on Times Square, with sign powered by photovoltaic production.

Source: Photograph by Timothy Beatley.

and retain heat and provide extensive daylight to the building, natural gas absorption chiller/heaters, added insulation, thin film photovoltaic panels (on the south and east façades of 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 uses 40 percent less energy than the New York State code minimum. 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 have 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 the US Department of Energy Buildings Database entry at http://eere.buildinggreen.com/overview.cfm?projectid=32.

5 Pearl River Tower, Guangzhou, China

Proclaimed by its designer, Skidmore, Owings and Merrill (SOM) to be "the world's most energy-efficient supertall office tower," the Pearl River Tower has raised the bar for sustainable skyscraper designs following its completion in 2011. The 71-story, 2.3 million square foot tower is located in the Chinese City of Guangzhou and is the corporate headquarters of the Guandong Tobacco Company.

Figure 9 Pearl River Tower.

Source: SOM.

The building incorporates more than 30 different energy strategies and technologies and produces a large portion of the energy it needs. The most dramatic energy feature of the building are its four vertical-axis wind turbines, integrated into the interior of the structure. Wind is directed into four visually dramatic openings in the building, accelerating significantly over the curved funnels guiding the air. The building is oriented to take advantage of the prevailing winds from the south most of the year (and from north for two months of the year). As it flows over the building's surfaces, wind is estimated to accelerate some 2.5 to 3 times the ambient speed, in turn dramatically increasing the power that will be produced from the turbines (as power generation is the cube of wind velocity). It has been estimated that each of the internal turbines will produce some 15 times the power of a conventional stand-alone wind turbine.

The unique curving form of the building helps to guide wind into the turbines from the street below as well as from the upper portions of the structure above. The curvature of these wind funnels leading to the building's turbines also creates a visually dramatic result, making the energy-production dimension very apparent and visible.

But while the vertical-axis turbines are the most unusual and dramatic energy feature of the building, there are many other features. Many of the design features that will result in a low-energy building have to do mostly with saving energy, including use of chilled beams and radiant cooling, extensive daylighting, a double-layer curtain wall system, and use of a geothermal heat sink (routing the building's hot water to be cooled underground).

Energy needs are also reduced through natural day-lighting, solar hot water heating, integration of photovoltaic cells into the building façades, and careful ventilation of excess heat. Together these techniques reduce the building's energy demand by some 65 percent and do much to help it reach its low-energy goal. Production of energy then occurs through the innovative vertical-axis wind turbines and also through the façade-integrated photovoltaics, producing electricity directly from the sun. The extra costs associated with the building's energy features are estimated to pay for themselves in five years through substantially reduced operating costs.

For more information, see https://www.som.com/project/pearl-river-tower or http://www.josre.org/wp-content/uploads/2012/09/Pearl-River-Case-Study-China.pdf.

6 Via Verde, New York

Is it possible to build densely in cities but also ensure access to nature? A terrific new development in the South Bronx, in New York City, is showing the way.

There was a time not that long along when the Bronx was literally burning. It was a place where, in the 1970s and 1980s, high foreclosure rates and tax delinquencies left the city owning much of the land. Much has changed since then, and increasingly the Bronx is a testing ground for ideas that merge poverty reduction and affordability with what is green and sustainable.

Via Verde (Spanish simply for the "Green Way") is one such inspiring example, a very unique affordable housing project that opened its doors to new residents in 2012. It all began with a city-sponsored design competition, and with the winning design co-developed by Phipps Houses and Jonathan Rose Companies. A key aspect of Via Verde is that it doesn't look at all like an affordable housing project. There is use of a varied set of materials, including prefabricated panels of cement board, metal and wood laminate. It is a visually interesting exterior. The large windows and distinctive sun shades are also contrary to the usual look of housing for low- and moderate-income families.

Situated on a relatively skinny lot, running from north to south, the design response is creative indeed – 222 units in total, stepping up from three-story townhouses on the south end to a 20-story residential tower on the north, and maximizing sunlight as a result.

When it is fully occupied, more than 400 residents will live in Via Verde. And they will have an unusual green living environment. Perhaps most distinctive about this project is multi-layered green