Green Skyscrapers
What is being built, and why?

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Introduction

A global movement of green skyscrapers is upon us. Architects, engineers, developers, and clients – with the additional influence of governmental guidelines – are pioneering this shift towards eco-towers. These towers are shaping the future of tall buildings, and utilizing green technologies on an entirely new scale. This greater scale might mean greater positive effects, but can a skyscraper be considered “green” at all? In some ways green skyscraper might even be an oxymoron.

Skyscrapers in general mean more materials, more money, more time, and more risk. The vastness of these buildings goes against many of the minimalist environmental ideas of late. Nonetheless, if building up is a necessity, these skyscrapers certainly are respectable and awe-inspiring.

We will look at several examples of these so-called “green skyscrapers” in various regions of the world, in order to find common themes and trends behind the technology and the motivations behind the buildings. We will look most closely at the United States, China, Europe, and the Middle East. Understandably, this is not a fully comprehensive and global look, but the case studies provide angles though which to examine the movement.

Project Objectives

- Get a broad view of the green skyscrapers being built around the world
- Observe trends in the technology and other practices, in a local and a global context
- Analyze and critique the motivations for building these skyscrapers
- Forecast the future of skyscrapers

Case study: New York, NY

Manhattan can be considered the greenest place in America, if measured by energy use per inhabitant. If New York City were a state, it would be 12th in population and last in energy consumption. The first green skyscrapers in the United States were built in New York City. The city contains the country’s most expensive real estate, and yet these costly projects are still pursued. The skyscrapers are generally high-profile corporate buildings. These buildings offer a model for an urban future with these “intelligent machines” that contribute to a cleaner city and global environment.

In terms of governmental guidelines in the US, a LEED rating is considered a marketing asset. Corporations tend to look at LEED, or any publically-recognized example of “green washing”, as a source for brownie points. Many of their green projects are motivated by improving a company’s image.
LEED offers incentives, sets goals, and gives distinctions, but doesn’t set any minimum building standards. The Battery Park City Authority’s green guidelines (created in 2000) are an example of localized minimum standards. In Battery Park, both residential and commercial/institutional buildings are required to meet environmental guidelines. In Ground Zero redevelopment as well, there is a focus on environmentally-friendly building.

Manhattan offers a great example of the movements toward green skyscrapers within the United States. We will specifically look at the Hearst Tower and the Bank of America Tower.

*Example: The Hearst Tower*

The Hearst Tower on 57th and 8th, near Columbus Circle in Manhattan, was the first “green” high-rise in Manhattan. Rated LEED Gold, it set the standard for new skyscrapers being erected. The architect was Norman Foster, who is known for designing the Gherkin egg-shaped building in London, and for his work in environmentally-friendly design (his name will come up several times later). The “diagrid” triangular framing pattern provides superior stability with less material than a typical steel frame. In the atrium, escalators run diagonally through a 3-story waterfall built with thousands of glass panels. The water comes from rainwater, and cools and humidifies the lobby air. Communal spaces called “sky gardens” offer a respite from work, in naturally lit and ventilated comfortable areas. When workers leave their offices to work in these gardens, sensors turn off their office lights. The last item of interest is the smart elevator system, which retains memory and optimizes paths based on previous data, headcounts, and floor requests.
Example: The Bank of America Tower

The Bank of America Tower is currently under construction on the edge of Bryant Park. It is already the 2nd-tallest building in Manhattan after the Empire State Building, and with its LEED Platinum certification expected (the first time for a skyscraper), it can be considered the greenest skyscraper yet in the entire country. The building is interesting because it will act as a giant air filter for Midtown Manhattan, with its two-way air filtering system. It also has an onsite cogeneration plant that produces two-thirds of the building’s energy requirement. One feature of this plant is its use of ice batteries, meaning it creates ice in the cool temperatures of the evening, then releases the coolness during the day as the ice melts. Additionally, the tower has an extensive gray-water and water-saving system, including waterless urinals that save 3 million gallons of water per year. Finally, the structure accommodates surrounding pedestrian and transit circulation in a way that greatly compliments the culture and bustle of Manhattan.

Green Skyscrapers in the local context of New York (USA)

There are a few recurring themes in the up rise of these New York high rises. As mentioned earlier, the building and financing of these structures are led by corporations. In these two cases in particular, the structures are the high-profile headquarters of their respective companies. We can see the emphasis on LEED certification, and the use of more glamorous or technologically-savvy aspects, which are primarily meant to add positively to the public’s perception of the towers.

Case Study: Guangzhou, China

In China, it seems more that the architects are driving the green push. However, the corporations still come into play, particularly when it comes to impressing foreigners. The Olympic Games in Beijing and the upcoming Asian Games (which will take place in Guangzhou in 2010) have influenced corporations to build faster to be in time to show off.

The China Green Building Council outlines basic energy efficiency rules for building, and offers a 5-star labeling system as a market-based incentive.
**Example: The Pearl River Tower**

This tower is being built in Guangzhou, which is in the Guangdong Province in southern China. This skyscraper is known for its net-zero-energy goal, meaning that it will conserve and generate enough power to meet its energy demands. The most interesting and unique aspect is the building’s structure that pushes rapid wind into the wind turbines in the two openings, thus producing energy and alleviating some structural forces.

**Green Skyscrapers in the local context of Guangzhou (China)**

Similarly to in the States, companies in China are driven by image. The Pearl River Tower architects themselves point this out:

In addition to its superior performance, the tower also represents the pinnacle of quality for a world-class headquarters facility. The client desired a building that would represent and enhance their position as a global leader and an active participant in the sustainable design movement. Pearl River Tower represents a true symbol of progress for the 21st century: a self-sustaining, environmentally intelligent building that is a stunning new icon for the future of the region.

Eleven skyscrapers are in the works to be built in Guangzhou over the next few years. There are questions about whether these buildings will be filled, as Guangzhou is a major manufacturing city, and manufacturers are looking more to be close to the factories than to be located in a fancy upper floor. Locals are hoping that the development of other higher-end industries will bring the profile, tenants, and money needed in Guangzhou.
Case Study: Bahrain and Dubai, UAE

The Middle Eastern skyline has provided the world with a plethora of innovations and paradigms for green design. After remaining an architectural non-factor in recent decades, the Middle East has grown exponential in the past few years. Jonathan Last notes in the Philadelphia Inquirer that, "Today, none of the skyscrapers in the Middle East crack the world's top 10 in terms of height. But when the current building boom is over, the Middle East will be home to five of the 10 tallest buildings in the world and 12 of the tallest 30." But behind the skyscraping wall created by these buildings, there hides a much less green force to these buildings. Who funds the construction and development of these skyscrapers? The answer lies in another part of the world: American citizens and their gas-guzzling tendencies. The pricey residences in the Burj al-Taqa are selling for $3,500 per square foot, and it is American money being shipped overseas that has enabled these prices. Last reminds us that oil now hovers around the cost of about $140 per barrel compared to $29/barrel in 2001. "In real dollars, oil producers are pocketing an extra $105 per barrel on top of the price they were getting in 2001. That's an extra $2.1 billion dollars per day that Americans are shipping overseas." So while the Middle East boasts their sustainable missions, one must heavily scrutinize the deeper value of these buildings and look at the comprehensive picture to determine their actual benefits.

Example: The Burj al-Taqa

The Burj al-Taqa was modeled after ancient Persian architectural features. With its massive stature, this green skyscraper has a cylindrical shape that is designed to expose as little surface area to the sun as it can. This is made possible by a new façade built from a new generation of vacuum glazing that comes on the market in 2008. A protective solar shield reaches from the ground to the roof and covers 60 percent of the building. It protects the side most affected from the sun’s glaring rays, making sure that none of the rooms are exposed to direct sunlight. The remaining 40 percent has diffused light that is tempered by a mineral coating on the windows. This whole set up is designed to shield the building from outside heat, keeping the temperatures inside at a low, comfortable temperature. "Such a building has to work like a thermos flask," says DS-Plan's energy manager Peter Mösle. "It has to have a cooling effect in the summer and retain heat in the winter." This building also has a natural air conditioning system. Lateral openings in the towers suck in cool air like a chimney. The heavier cool air sinks downward, displacing the lighter air; therefore creating a temperature that is
ideal for the working environment. Architects plan for fresh air to be pumped into the interior of the building by means of a duct system at the same time. Seawater will also be used to pre-cool the air. There will be three large cooling units in the cellar of the skyscraper, also lowering the inside temperature. Finally, this skyscraper will not need to utilize any sources of outside energy. There will be a 60-meter turbine on the tower roof and two photovoltaic facilities that will produce the electricity to meet the needs of the building. Additional energy will be provided by an island of solar panels that drift in the sea within viewing distance of the tower.

**Example: The Lighthouse Tower**

![The Lighthouse Tower](image)

Designed by the Atkins Group and standing at an astonishing 400 meters with 66 floors, The Lighthouse Tower is an extremely tall, commercial skyscraper located in Dubai, UAE. The building is designed to produce the smallest carbon footprint possible. It is structured as two separate towers connected by a bridge at level 10, this structure will also be home to numerous sky gardens. The green skyscraper will house three large 225 kW wind turbines, which are 29 meters in diameter, located on the south facing side of the structure. In addition to the wind turbines, there will also be 4,000 solar panels to generate additional energy needed to accompany the skyscrapers daily operations. The tower hopes to reduce its overall energy consumption by 65% and its water consumption by 40% when compared to an equivalent building of the same magnitude.

**Bahrain World Trade Center Towers**

![Bahrain World Trade Center Towers](image)

The Bahrain World Trade Center is a 240 m high twin tower complex located in Manama, Bahrain’s capital. Comprised of 50 floors, this skyscraper is the second tallest building in Bahrain. Despite being the second tallest in Manama, the Bahrain World Trade Center is first skyscraper in the world to integrate wind turbines into its design. Three different bridges, all of which house a 29-meter turbine, connect two separate towers. These towers face north to capture the winds from the Persian Gulf. The building assumes a sail shape so as to maximize the amount of wind funneled through the towers. The “S” shape flow is ideal because it ensures that any wind coming within a 45 degree angle to either side will create a wind stream that is perpendicular to the turbines. These turbines are intended to provide 11% to 15% of the towers total power consumption.
Case Study: Europe

Our project examines two “green” skyscrapers in the European context. One, the Commerzbank tower in Frankfurt, Germany, completed at the beginning Europe’s green skyscraper movement, represents the goals of local participation and a planned, calculated need for change. On the other end of the spectrum, Moscow’s Russia Tower resulted from dynamic, market driven innovation and design.

Example: Commerzbank Tower

Visionary British architect Norman Foster teamed with a bi-partisan committee from the Frankfurt government in efforts to provide the city with an ecologically sustainable alternative to the standard “boxy” skyscrapers prevalent throughout the world. Starting construction in 1994 and finishing in 1997, the 56 story building (while this is a modest height by most international standards it was the tallest building in Europe at the time of its completion and remained so until 2005) brought different landscapes into the urban work environment through its use of “winter gardens” placed strategically throughout the building. These gardens combined elements of sustainable design (natural lighting at all times of day, natural ventilation, etc.) with aspects of environmental justice (brining urban dwellers closer to nature – why should those in rural and suburban areas be the only ones to enjoy the bounty of our world?). Below are some of the key design features offered by the tower:

- Central Atrium
  - Runs from ground floor to top story
  - Allows for strategic placement of “winter gardens”
- Winter Gardens
  - Placed on 9 different levels on alternating sides
  - Provides natural light to all areas of the building at all times of day
  - Allows for ventilation throughout the atrium
  - Provide atypical working space in the urban environment
Insulation buffer-zone

Example: Russia Tower

Also designed by the luminary architecture firm of Foster & Partners is Moscow’s Russia Tower. Started in 2007 and planned for completion in 2012 (though the recent credit crisis has left the developers with a shortage of funds and forced them to temporarily suspend construction), the tower will be the largest in Europe and eighth-largest free-standing structure in the world. Rather than a collaboration between public officials and private entrepreneurs, the Russia Tower bears more resemblance to the oil-funded projects now commonplace in the Middle East. Compared to the aforementioned modest dimensions of the Commerzbank Tower, the Russia Tower certainly possesses more in the way of “sex appeal,” if a building can have such a thing. By constructing one of the largest buildings in the world, the Tower will gain notoriety not simply as a green skyscraper, but as a destination for tourists and wealthy real-estate connoisseurs – this raises questions about the motives for construction, were they truly motivated by environmental interest, or were they created in the search for a different shade of “green?”

Features:

• “Green Spine”
  – Three tapered sides provide maximum support with minimum materials
  – Achieves more efficient use of space
    • Mixed Use – modules at the top are divided into smaller areas and designed for residential use
    • Offices tend to waste more energy in terms of heating and cooling costs
    • Offices create heat from the bottom up in the winter
  – Natural ventilation systems running through the core of the building

Green skyscrapers in the local context of the European Union


While the Directive does not directly apply to the Russia Tower (Russia is not a member state of the European Union), it has affected the design and construction of buildings in Europe since its inception in 2002. The directive contains four key elements regarding the construction and retrofitting of major buildings in Europe:

• a common methodology for calculating the integrated energy performance of buildings;
• minimum standards on the energy performance of new buildings and existing buildings that are subject to major renovation;
• systems for the energy certification of new and existing buildings and, for public buildings, prominent display of this certification and other relevant information. Certificates must be less than five years old;
• regular inspection of boilers and central air-conditioning systems in buildings and in addition an assessment of heating installations in which the boilers are more than 15 years old.

These contingencies are important because rather than affecting design on a strictly voluntary basis like the LEED program in North America, they strictly scrutinize buildings for their energy use, forcing architects and planners to carefully examine their methods when incorporating green features. Rather than adding features that do not necessarily fit in the larger local context to achieve a higher LEED certification (a process sometimes referred to as “point-mongoring”), developers focus simply on achieving the most efficient use of energy. These ideas of practicality run through all green design in Europe today.

Mixed-Use

Skycrapers in Europe have incorporated mixed-use policies into their plans for use. Mixed-use is important because it accomplishes two important tasks, one of which is to enable the most efficient use of building space. An oft-encountered problem with skyscrapers is eliminating vacancies – there is no way to accomplish green design with large plots of idle space. Rather than limiting use for commercial purposes, planners are allowing individuals to purchase smaller spaces for residential use - these residential buyers can then fill in the holes left after the commercial space has been allocated. Allowing residential use also enables developers to shore up funds for the discouragingly high initial costs associated with large-scale green projects. Downsides remain, however, as purchasing a luxury suite in a building like the Russia Tower is an option only available to the very wealthy.
Conclusions

Europe has provided the rest of the world a paradigm for green living throughout many facets of the built environment. Europe has many positive examples of balancing social needs with economic incentives through green space, biking initiatives and justice programs. Green skyscrapers have been no different. As we have demonstrated, European cities have continued this balance through regulation and market driven development.

Motivations: Analysis and Criticism

There are a few categories of pioneers in this eco-tower movement. The motivation to build high and green comes from all sides in different ways. There are several motivations that are common in several continents, but there are also some notable differences, particularly between the United States and Europe.

- **Architects as pioneers**
  Norman Foster is an example of an architect who has designed several of the high-profile green towers.

- **Real estate firms as pioneers**
  The Durst Organization did 4 Times Square and 1 Bryant Park (two well-known greener skyscrapers), and is known as the world leader in the development of technologically advanced and environmentally responsible commercial property.

- **Corporations as pioneers**
  There is a lot of emphasis in this movement on company image, in this race to be the “greenest”. As Thom Mayne, an LA architect points out, “In Europe the guidelines tend to have to do with broader organizational ideas. Energy consumption, the organization of the workplace, urbanism – they’re all seen as interlinked. Here [in the U.S.], the whole focus is on how to get these points… it’s very narrow.”

- **Government standards and incentives**
  The difference between motivations for building in Europe and motivations for building in the United States highlights one of the most glaring contrasts between cultures. While the European Union regulates on a broad scale – the 27 member states are subject to the energy-use standards of the EU – regulation in the US is done on a much smaller local level. The Battery Park City Authority, for instance, imposes standards for development in their small area in New York City. Certainly the United States favors a market-driven strategy to dictate the actions of developers and corporations, so in order to achieve European-style success, programs like the Battery Park City Authority need to grow in size and number to achieve this success. In North America, these local regulations need to become the norm, necessitating change by forcing less-willing areas to get on board or get left behind.
Criticisms

In many ways, these green skyscrapers are a popular trend. There is currently a competition between countries with expanding economies for the international status and business that these towers may represent.

But while the skyscrapers are snatching up awards, how much good are they actually doing? These “monstrosities” are popping up everywhere, and everyone is trying to outdo each other with height and “greenness”. The buzz is created, but point may be lost. For one thing, a single efficient skyscraper among several wasteful ones doesn’t solve our problems, and we may be reaching for easy solution to difficult problem. For another, building green is becoming a minimum, and a necessary part of the pitch from developers. People aren’t doing it to actually make change, but rather because they feel they need to and want to build up their image.

LEED is another huge issue, which we can’t fully cover here. But LEED is making people money, which is never the best plan for an organization of its type. It is getting the attention drawn to green buildings, but not adjusting accordingly as the movement continues and technology develops. The standards are no longer as relevant, yet people are making money and corporations are getting their gold (or platinum) stars.

The last point is around money. It’s great to be green, but money is also green! Meaning, these projects are extremely expensive. Thus, the population that can afford these spaces is limited, and no one is even sure if the new skyscrapers will be filled. Additionally, skyscrapers may need to be the future of housing our population, but such expensive structures seem less feasible when rich corporations are less involved. This means that these high-end projects may start affecting urban growth and development.

Conclusions

Green building comprises only a tiny component to reducing the carbon footprint of our civilization. In order to truly make an impact, the motivation from these entrepreneurs, policy-makers and intellectuals needs to trickle down to the remaining public. Developers can build green skyscrapers to their hearts’ contents, but unless the inhabitants of these skyscrapers act with sustainability in mind, their efforts will be futile. Buildings are great, but ultimately it will be the people who decide the ecological future of our planet.
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