# GREENING CITIES

## A REPORT ON TRENDS IN URBAN SUSTAINABILITY 2013

Institute of Customer Experience

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“By mid-century, we’re going to have about eight billion – perhaps more – people living in cities or within a day’s travel of one. We will be an overwhelmingly urban species.”
– **Futurist, Alex Steffen**

## INTRODUCTION

The future is densely populated. Thus, the future is overwhelmingly urban. Does this mean the future belongs to inevitable concrete, crowds, and pollution? Fortunately, futurists, architects, urban planners, and designers are collaborating with industry, governments, and the public to build new cities that promise to be sustainable and green.

Green cities do the following **as much as possible**:

- Reduce ecological footprint
- Reduce air, soil and water pollution
- Reduce dependence on fossil fuels and heavy metals
- Use green energy (i.e., sun, wind, rain, and waste converted to energy)
- Preserve nature
- Ensure that people’s needs are being met given all of the above

# INTRODUCTION

Our report on Greening Cities covers trends related to this new kind of urbanization.

The **first** section covers inspiration from cities from around the world that have set an example of either experimenting with sustainable architecture or innovating with retrofitting urban spaces. We'll look at a vertical forest, a zero-carbon city and an unusual waste-to-energy plant. In the **second** section, we present the changing meaning of cityscapes – roads, flyovers, and other spaces found commonly around all cities. These cityscapes have already started being thought of in a new light and are undergoing urban retrofitting. The **third** section is trends in city buildings. We have found that there is much more to a green building than just growing plants on its rooftop. Green buildings are opportunities to restore nature to its original state while ensuring that people are accommodated as well. Finally, in the **fourth** section, we present trends in urban transport. New ideas include increasing the density of the city to reduce long commutes, improving the city's "walkability" as well as using renewable energy options for transport.

We welcome you to journey with us through the trends we found for greening cities from all over the world.

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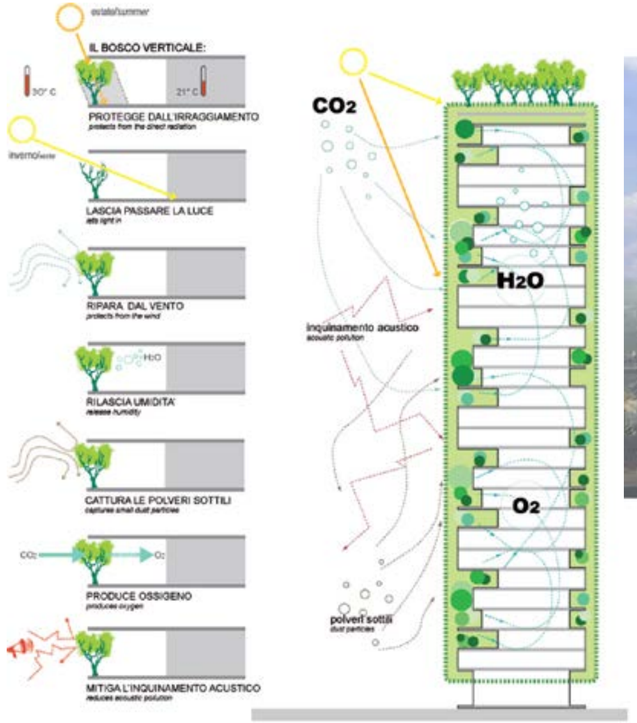
“The best time to plant a tree is 20 years ago. The next best time is now.” – **Chinese proverb**

## 1.1 VERTICAL FOREST

We might have come across greenery being applied vertically in the form of green walls. Here's an example of a more ambitious kind of greening of buildings. The innovative concept of the vertical forest in a sky scraper seemed like it might remain at the concept stage and never be realized. However, the towers designed by Stefano Boeri, Gianandrea Barreca and Giovanni La Varra are now being built in Milan, Italy. The intriguing concept is specially suited to Milan, which happens to be one of the most polluted cities in Europe. The trees planted in the sky scraper are meant to absorb CO2, suspended particulate matter, and radiation as well as release oxygen and humidity, keeping a natural balance in the densely populated city.

The structure which comprises of two towers, known as Bosco Verticale (Vertical Forest), is now nearing completion. "The two towers measure 260 feet and 367 feet tall respectively, and together they have the capacity to hold 480 big and medium size trees, 250 small size trees, 11,000 ground-cover plants and 5,000 shrubs (that's the equivalent of 2.5 acres of forest." Recycled water from the buildings will be used to water the trees; thus, the vertical forest will help save energy and increase the quality of life of the residents.



Bosco Verticale, Milan

Source: http://www.stefanoboeriarchitetti.net/

## 1.2 A ZERO-CARBON ZERO-WASTE CITY

Countries of the Middle-East that have enjoyed the riches of oil are now starting to come to terms with the definitive depletion of their oil resources. And while they are at it, they are preparing for a new reality – a future that relies on renewable energy. Check out Masdar city in Abu Dhabi, UAE, designed by British architecture firm Foster + Partners, which is creating a lot of buzz in the sustainable constructions world. It is the world's first experiment in a zero-carbon and zero-waste city. Masdar promises a great quality of life to its residents and is a completely sustainable city.

All the waste generated is planned to be recycled and reused within the city. The biggest solar power plant in the world is also planned as part of Masdar's 22 billion dollar ambitious plan. Interestingly, the marriage of solar power with the hot desert is perfectly suited to the city that requires high-energy consuming air conditioning at the hottest time of the day. Finally, no cars are allowed in Masdar city; only electric pods that come under the category of "personal rapid transit" will be used to get from one place to another. Time will tell if cities like Masdar belong only to a small elite group or will one day become affordable to all.

Masdar City in Abu Dhabi Is an experimental city - the world's first zero emissions, car-free city

Source: http://pollutionfree.wordpress.com/2009/12/21/masdar-city-zero-carbon-zero-waste//

## 1.3 WASTE-TO-ENERGY PLANT AND SKI SLOPE

The last, but not least by any means, piece of inspiration we found is a fascinating waste-to-energy plant called Amagerforbraending in Copenhagen, Denmark, designed by the Bjarke Ingels Group (BIG). The vision of the designers is to create a ski slope for varying skill levels on the roof of the plant that will produce a one-of-a-kind structure. The future isn't all about creating sustainable architecture from scratch but retrofitting what exists with sustainable options and Amagerforbraending is a great example of innovative retrofitting.

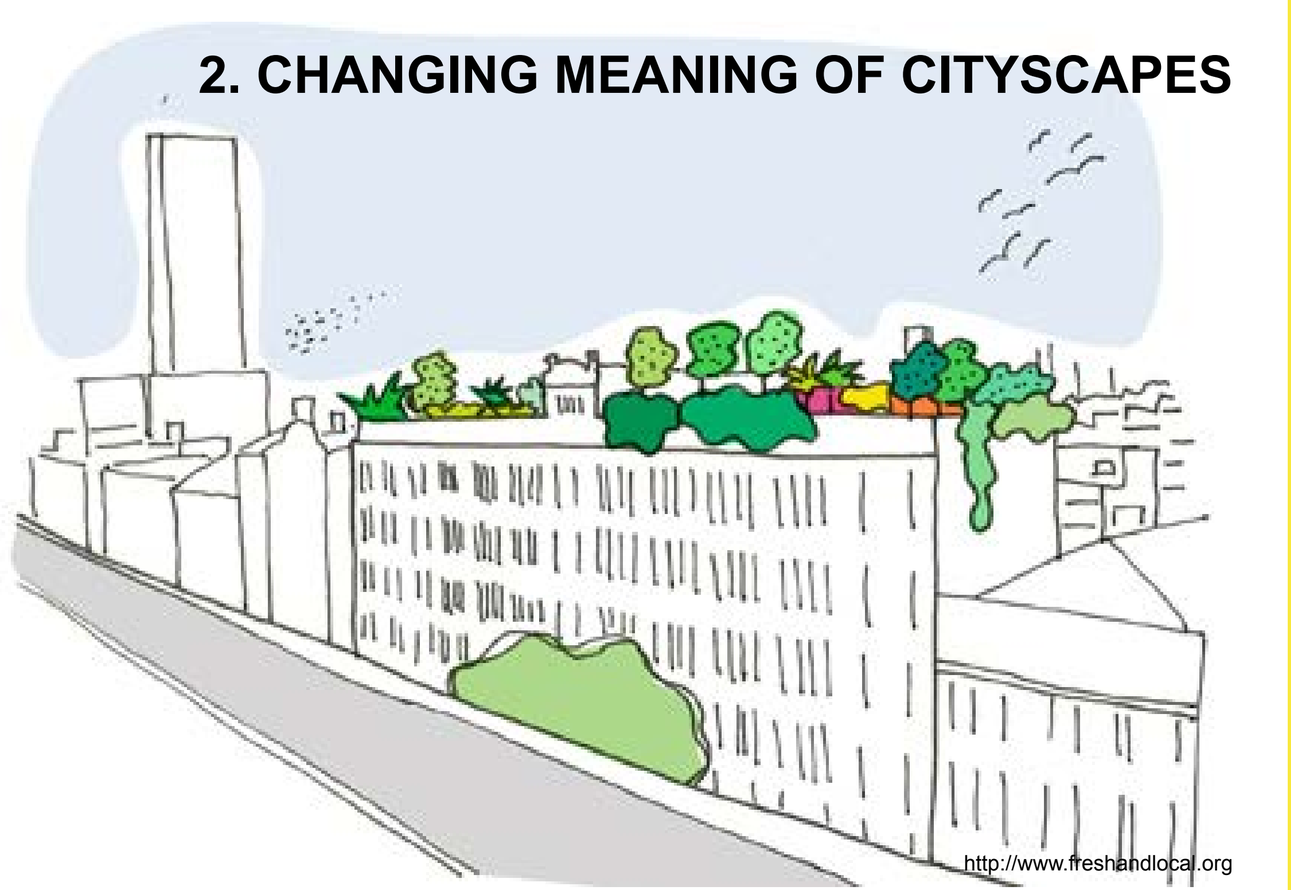
In terms of the function of such plants in Copenhagen, about 39% of the waste material collected in the city is incinerated and converted into heat and power, which is used in several households. For example, in 2004, the energy generated from these plants was sufficient to power 70,000 households.

The Amagerforbraending plant is an example of what Ingels describes as "hedonistic sustainability" that will continue to perform its function as a plant and be a recreational attraction for skiers. As combustion converts waste into energy, the plant releases a 30 meter smoke ring every time it releases one tonne of $CO_2$. So it's easy to calculate $CO_2$ emissions, just by counting the rings puffing out of the plant!

Visualization of the waste-to-power plant with a ski slope, Copenhagen, Denmark

Source: http://www.arcspace.com/features/big/waste-to-energy-plant/

## 2. CHANGING MEANING OF CITYSCAPES



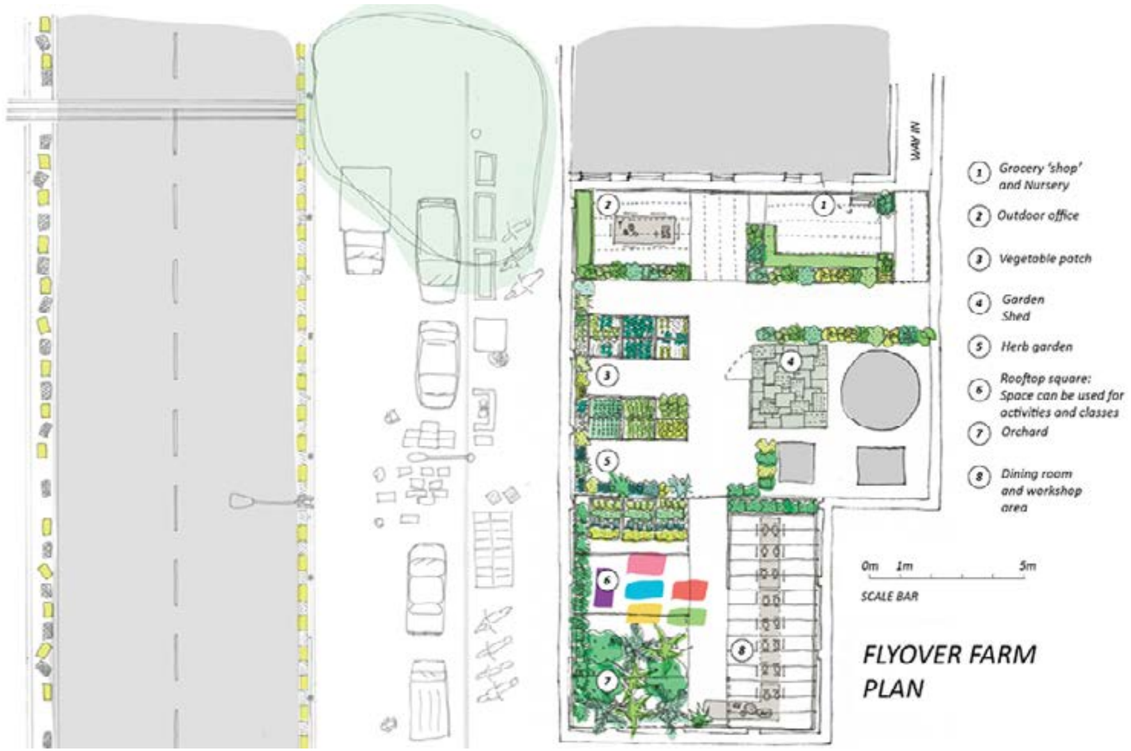

"The ultimate goal of farming is not the growing of crops, but the cultivation and perfection of human beings." – **Masanobu Fukuoka, The One-Straw Revolution**

## 2.1 URBAN AGRICULTURE

There is now a growing opportunity for city dwellers to feed the soul of the planet through its urban arteries by adopting this trend of urban farming. This can be motivated by a need for food security, to supplement income and eventually create a social paradigm for sustainability. One such example is the The Flyover Farm in Mumbai.

The Flyover Farm aims to build a demonstration, research and community urban farm in the heart of Mumbai. The farm is located on the roof of a low income, mixed-use building on the busiest street in Mumbai. Here one can grow organic produce, compost kitchen waste, sell through a rooftop grocery, host workshops and even train other urban farmers. Similar trends are emerging through other initiatives in Mumbai, 'Urban Leaves' is one such endeavor which promotes 'sustainable lifestyles in the midst of concrete jungles'. The Bombay Port Trust has also embraced these trends and uses produce from its 'Kitchen Farm'.

In the not so distant future, let's imagine the veggies in your salad, one for every floor of your new high rise apartment, each one grown by your neighbors – the local farmers of tomorrow. It's possible.




Flyover farm plan, Mumbai

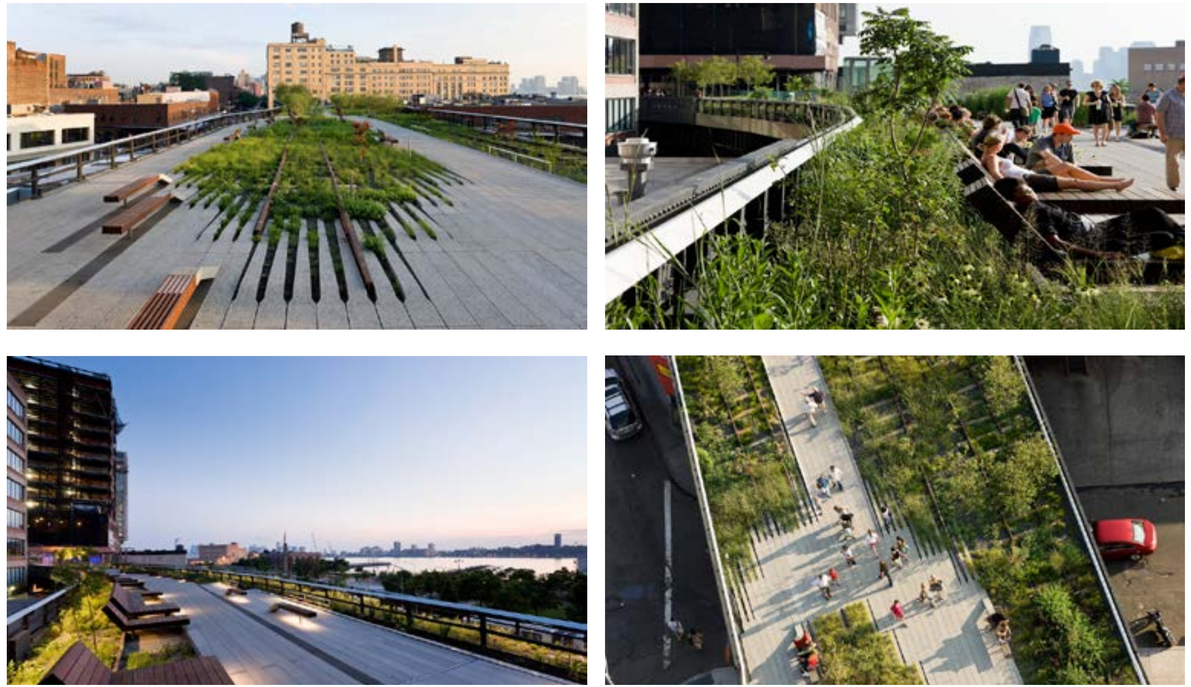
Source: http://www.freshandlocal.org

## 2.2 ABANDONED RAILWAY PARK

The High Line is a green structure that revisits a piece of industrial infrastructure as a public green space. The High Line is a public park built on an historic freight rail line elevated above the streets on Manhattan's West Side. This rail line was a freight rail line, in operation from 1934 to 1980 which carried meat, agricultural goods and mail. The High Line landscape functions essentially like a green roof; It's porous pathways contain open joints, so water can drain between planks and adjacent planting beds, cutting down on the amount of storm-water then runs off the site into the sewer system.

The planting process is site-specific and encourages local sourcing. It sources materials within a 100-mile radius; the current park landscape was created to reflect the original micro-climates on the High Line. The planting design is inspired by the self-seeded landscape that grew on the out-of-use elevated rail tracks during the 25 years after trains stopped running. Many of the species that originally grew on the High Line's rail bed are incorporated into the park's landscape.

The High Line is a fascinating story of remodeling a historic location in New York into a beacon of sustainability which will eventually lead to what is called 'The World's Longest Green Roof'.



The Highline abandoned railway park

Source: http://www.thehighline.org/

## 2.3 URBAN ECO-ART

There is something rather poetic about an environment which offers itself as a canvas to an artist to forewarn its denizens about future peril. “Environmental Art” and “Sustainability Arts” have been gaining focus since the late 60s. Now, urban landscapes not only provide artists a medium but also a reason to create a green future.

In Los Angeles, Urban Air is turning prominent billboards in the city into living, suspended bamboo gardens. These once commercial billboards are now an “advertisement” for a green future. Initially created as an artwork by Stephen Glassman at a studio in Los Angeles, it was identified by Summit Media, a billboard company, who later donated their billboards to lay the foundation for the first Urban Air prototype.

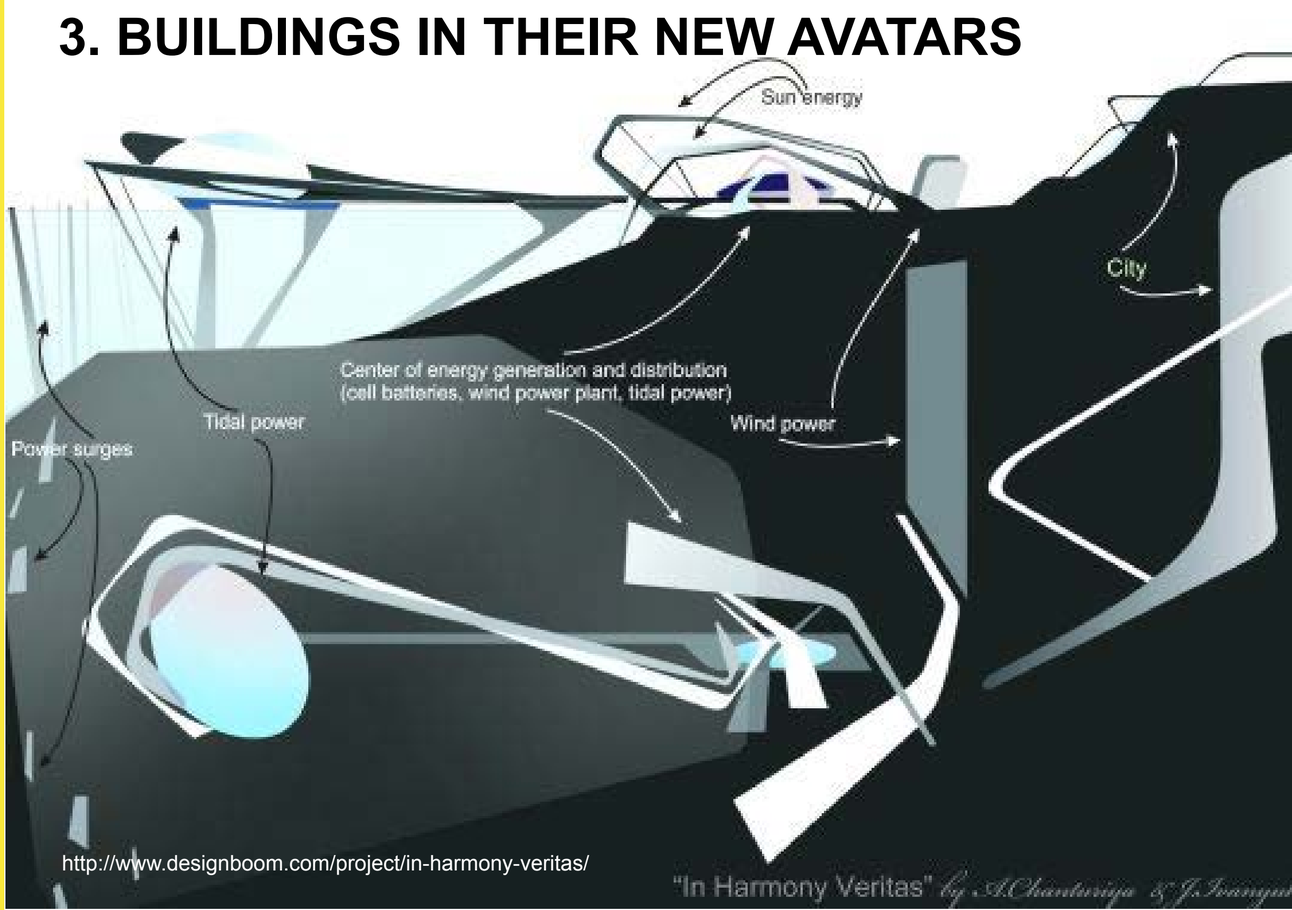
Examples like this illustrate the rare synergy created between artists, engineers and the Environment. This synergy has the potential to educate and transform the ecological conscience of our public through Urban Eco-Art, which in turn can support sustainability advocacy and action.

Urban Air

Source: http://www.urbanair.is/
http://stephenglassmanstudio.net/index.php?/project/urban-air/

# 3. BUILDINGS IN THEIR NEW AVATARS

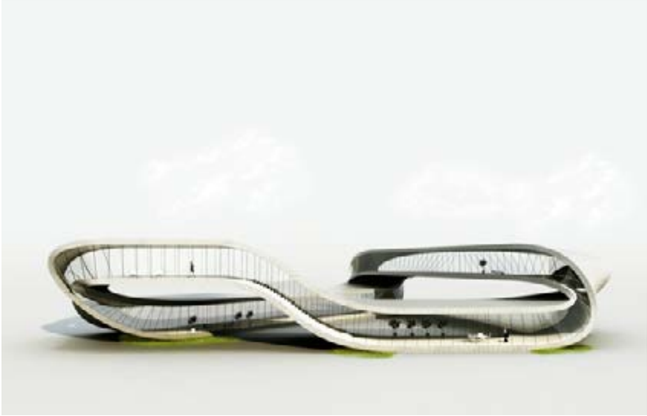
“We intend to communicate through artworks our understanding of the changing climate on a human scale, so that our individual lives can have meaning in what is a global problem”
– **David Buckland (Cape Farewell Project 2009)**



## 3.1 3D PRINTED BUILDINGS

Next time your architect hits the print button, he may not be printing the blue prints to your latest real estate acquisition but printing the actual building itself. Landscape House, designed by Janjaap Ruijssenaars of Amsterdam firm Universal Architecture, is planning to construct a Möbius strip-shaped house using the world's largest 3D printer. It will contain around 1,100 square metres of floorspace throughout the twisted structure. The 3D printing technique for this endeavor is being developed by D-Shape from Italy. An artificial rock consisting of ground rock, sand and binder are used to build up the wanted shape layer by layer. This will enable the printing of complex forms directly without making moulds. Another advantage is that one can use the ground from where one wants to build.

Its impact on sustainability also stems from the raw materials that can be used which can range from recycled plastic bottles and believe it or not potato flour. The same could become true for reusable metal. This would mean a new building could be printed from the recycling of an existing structure on-site. Essentially, the rebuilding of the city is transformed into a reprinting for itself from itself. As research in the technology grows, the future possibilities stretch to the moon; quite literally so to speak. A recent report from phys.org suggests the exploration of a feasible 3D printed life-sustaining base on the lunar surface.



3D printed building concept

Source: http://www.wired.co.uk/news/archive/2013-01/24/dutch-architect-3d-printed-house

3D printed lunar base building concept

Source: http://techcrunch.com/2013/01/31/forget-3d-printed-buildings-the-european-space-agency-is-exploring-3d-printed-moon-bases/

## 3.2 RENEWABLE ENERGY: THE SUN, WIND AND WATER

It is interesting to note that prior to the development of coal in the mid 19th century, nearly all energy used was renewable. There has been a strong emphasis for a while now on green building, with architects and builders using different means of renewable energy to achieve their target. The largest solar powered building was recently built in China and even in its design, with its sun dial shape, it underlined the urgency of seeking renewable energy sources to replace fossil fuels.

A few years ago, the Bahrain World Trade Center made an innovative attempt to have three giant 29m-diameter turbines provide power to the building. This essentially could set a trend in integration of wind-energy in larger buildings. In the near future one can potentially look at the integration of various renewable sources into a single building like the “In harmony Veritas” project which showcases a hi-tech future where buildings and cities can be small, ecological, structured and completely in harmony with nature.

These buildings of the future can be designed akin to an organism which becomes part of the environment it is a part of and uses its power for betterment of the ecosystem.

Largest wind energy integrated building, Bahrain Trade Centre

Source: http://www.treehugger.com/renewable-energy/worlds-first-building-integrated-wind-turbines.html

Largest solar energy powered building

Source: http://inhabitat.com/worlds-largest-solar-energy-office-building-opens-in-china/

# 4. NEW MOBILITY IN CITIES

‘Walkability’ is defined as “… the extent to which walking is readily available to the consumer as a safe, connected, accessible and pleasant activity.” – **Making London a Walkable city: the Walking Plan for London (2004)**

## 4.1 URBAN DENSITY

Urban density as part of a city's planning is used as a measure to curtail urban sprawl. Urban sprawl implies relative low-density housing in the open lands. This, along with people living at the peripheries commuting to the city center for work, causes the overall ecological footprint to increase.

Sustainability experts now suggest that cities should be designed in order to make transport as efficient as possible. If cities are planned such that commuters live in dense areas close to their workplaces, then the parts of the city that are not lived in can be used to preserve the natural environment, which is essential for a sustainable city. Hyde Park in London and Central Park in New York are based on this theme of allocating a separate and significant part of the city to nature.

There are several benefits of increasing living density: (Designing High-density Cities for Social and Environmental Sustainability - By Edward Ng)

- Living closer together builds community interaction and protects vulnerable institutions, such as young families.
- High-density settlements require less transportation, which will have positive effects on health and the environment.
- The overall carbon footprint of living will drop in the case of high-density living.
- Finally, in rural areas, smaller indigenous shops, bus services, etc. would not decline in the case of high-density living.

Central Park, New York

Source: http://www.visitingdc.com/new-york/central-park-picture.asp

Hyde Park, London

Source: http://asummerinlondon.co.uk/london-holidays-hyde-park-surroundings/

## 4.2 WALKABILTY OF CITIES

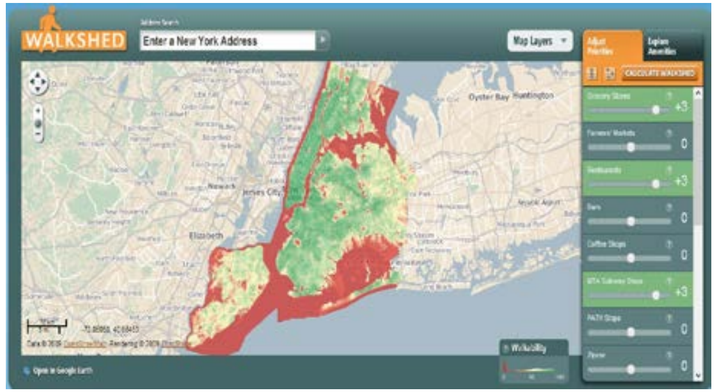
On its transport maps, London's TFL (Transport for London) includes walking as a valid transport option, along with bus, train, boat, etc. Walking as a means of transport is promoted in several cities and a common measure of a city's sustainability is its walkability.

Walking provides an opportunity for exercise and has health benefits and it also reduces carbon footprint. An indirect benefit of walking is that it increases people's interactions in their neighborhood, making the community a safer place to be in. Cities like Philadelphia are constantly striving to improve their walkability and mapping walkable routes that are helpful for pedestrians. Google Maps provides a walking route feature with an estimate of the time taken to travel from one point to another by foot.

There are several apps available that also provide pedestrian routes, which harness the power of crowdsourcing and have the pedestrians tag and rate walkability of streets. According to Walkonomics, for example, pedestrians use the app to rate eight characteristics that make up the quality of streets – 1) road safety, 2) easy to cross, 3) pavements/sidewalks, 4) hilliness, 5) navigation, 6) fear of crime, 7) smart and beautiful and 8) fun and relaxing.

The Walkonomics ap

Source: http://walkonomics.com/blog/wp-content/uploads/2012/10/Walkonomics_Android_App_3_Screens.png




Walkability area of Philadephia, USA

Source: http://walkshed.org/philly

## 4.3 BICYCLE-FRIENDLY

About 30% of the people in Copenhagen, Denmark and 60% of the people in Lund, Sweden ride their bikes to work or school. It is no wonder that there is an increasing demand for dedicated cycle lanes in these cities, not shared with other means of transport. Brian Hansen, the head of Copenhagen's traffic planning section, claims that a typical cycle journey is about 5 km; however, their aim in introducing a bicycle superhighway was to increase the length of the bike tracks to make cycling a transport option that is up there with cars, buses, etc. In April 2012, Copenhagen opened the first of its 26 planned bicycle superhighways. It is estimated that once the bicycle superhighway is operational, about 15,000 more people will switch from driving to bicycling.

City transport authorities across the world have introduced city bikes for rent, for example, the Vélib in Paris, Barclay's Cycle Hire in London. The cycle superhighways in London are not dedicated to cycles alone; they are lanes that are shared with other means of transport. Further, e-bikes, or electric bikes are becoming common in Germany – there are already about one million such bikes in Germany. These bikes can take cyclists far at 40-45 kilometers per hour, which help them cover greater distances.

A trendy electric bike, GoCycle

Source: http://www.likecool.com/Gocycle_Electric_bike--Bike--Gear.html

Pedaling to work on a bicycle superhighway in Copenhagen, Denmark

Source: http://www.nytimes.com/2012/07/18/world/europe/in-denmark-pedaling-to-work-on-a-superhighway.html?page-wanted=all

## 4.4 END OF FUEL-DEPENDENCE

The final frontier for a sustainable city is the end of fuel dependence for transportation. Increasingly, the podcar, or PRT (personal rapid transit), is starting to be adopted in many cities around the world. London's Heathrow airport started the first PRT system in the world, called ULTra. These driverless pods carry 3 to 6 passengers and act as a shuttle to get passengers from one point to another. The way PRT works is extremely convenient for passengers. Every 5 seconds these compact podcars appear for passengers to get in. This means that passengers have little or no waiting. Importantly, the podcar has no stops and works like a taxi taking passengers from point A to B.

Some examples of where PRT is being adopted include an Italian firm Pininfarina Extra, which is designing a PRT system for the South Korean transportation company Vectus and an already operational system in Uppsala, Sweden. Of course, Masdar city, which is a zero-carbon city, will also use PRT as its primary means of public transport. PRT is a sustainable transport system because it consumes very little energy and produces few emissions – about 20% of the CO2 a normal vehicle would produce. However, it is very expensive to build the system, which costs 6 to 10 million dollars per mile.

| Benefit | Transit | Car | PRT |
|---|---|---|---|
| New technology | Good | Good | OK |
| Trip Time | Bad | OK | OK |
| Cost per passenger | OK | OK | Good |
| On-demand 24/7 | Bad | Good | Good |
| Transfers | Bad | Good | Good |
| Seated travel | OK | Good | Good |
| Private | Bad | Good | Good |
| Non-stop | Bad | OK | Good |
| Vehicle waits for passenger | Bad | Good | Good |
| ADA compliant | OK | Bad | Good |
| Safe and secure | OK | OK | Good |
| User friendly | OK | OK | Good |
| Snow & ice | OK | Bad | OK |
| Minimal walking | Bad | Good | OK |
| Environmentally friendly | OK | Bad | Good |
| Energy efficient | OK | OK | Good |
| Visually appealing | OK | OK | OK |
| Operates inside buildings | Bad | Bad | OK |

Legend: Bad OK Good

A comparison chart showing the benefits of PRT

Source: http://prtconsulting.com/benefitsf.html

Pod taking people to Heathrow airport, London

Source: http://www.engadget.com/2009/08/18/heathrow-taxi-pods-become-a-glorious-driverless-reality/

# CONCLUSION

Based on the sustainability trends in this report on Greening Cities, we can make the following predictions for the coming decades:

- The stark contrast between cities and rural spaces will give way to a **blurring of boundaries** between rural and urban.
- The **developing world will catch up** with the developed world and create its own stunning examples of sustainable cities.
- We will accept the fact that **oil is finite** and create more zero-carbon cities from scratch as done by oil-rich areas of the Middle East.
- Sustainability will not be seen as a problem; rather, **sustainable hedonism** will become possible, where radically reimaging urban spaces could even be luxurious.
- Instead of abandoned spaces in cities being perceived as dubious, they will be seen as opportunities in **urban retrofitting**.
- Our use of non-renewable energy will gradually end as we embrace **renewable energies** such as solar power to sustain cities.
- **3D printing in architecture** will revolutionize architecture as we know it, using recycled materials for building, even life-sustaining structures on the moon.
- Long-distance and high-CO2-emitting commutes in cities will be replaced with **short-distance commutes** with preference for walking and bicycling.

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**Authors:** Kalika Sharma and Mathivanan Rajendran

**Copyeditor:** Rasika Wadodkar

**Special thanks to:** Apala Lahiri Chavan and Ananya Roy


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