Chapter 2
How Cities Can Enter the Ecological Age

Peter Head and Debra Lam

Abstract The aim of eco-cities is to build a viable future for humanity with a healthy planet where the Earth, water and air will continue to support our complex solar-powered ecosystems. Presently, our over-dependence on depletable resources is destabilising the planet's life-support systems. Three key issues that have exacerbated our problems are: (a) the continued growth of population; (b) the rapid growth of resource consumption associated with urbanization, especially in emerging economies; and (c) climate change. Against this background, this paper analyses current global knowledge and examine if and how we can reach a sustainable future. The authors believe that this is feasible if cities, driven by urbanization, population growth, and climate change, can lead the way. Working together globally and with the supporting policy framework in low, middle, and high income countries, and new eco-oriented business models, cities can reduce their carbon emissions, retain a limited ecological footprint, and improve their human development to enter the ecological age.

2.1 Introduction

In recent decades it has dawned on many of us that there can be no viable future for humanity without a healthy planet. Earth, water and air support the existence of an immensely complex living system, powered by the sun. We are part of this web of life. But within a few generations, we are using up most of the Earth's stored fossil fuel resources and their transfer from the Earth to the atmosphere is significantly altering its composition. Our globalising, resource over-dependent path is destabilising the planet's life-support systems. The total global resource consumption has gone up substantially, with nearly all of it from non-renewable sources. The direct impacts of this on human development, plus increase in population; rising

D. Lam (✉)
Arup (International Consultancy Services), London, UK
e-mail: debra.lam@arup.com

T.-C. Wong, B. Yuen (eds.), *Eco-city Planning*, DOI 10.1007/978-94-007-0383-4_2,

food and resource costs mean that traditional economic growth is rapidly becoming unsustainable and a global transition is underway to the ecological age of human civilization.

Three key issues that exacerbate our problems are: (i) the continued growth of population – it is predicted to reach 9 billion by 2050; (ii) the rapid growth of resource consumption associated with urbanization, especially in emerging economies; and (iii) climate change. The year 2008 marked the first time in history that half of the population lived in urban areas. The world urban population is expected to nearly double by 2050, increasing from 3.3 billion in 2007 to 6.4 billion in 2050 (United Nations 2008). As for climate change, even if we were to stabilize carbon emissions today, increases in temperature and the associated impacts will continue for many decades. And given the outcome of the Copenhagen Accord, pending expiration of the Kyoto Protocol and mixed national commitments, carbon emissions are not likely to stabilize soon.

The drivers for urbanization are strong, with the potential for better living standards, improved health, higher education, and greater gender equality. But this current model is unsustainable. Life in high income urban areas gives rise to a large proportion of CO_2 emissions and subsequent climate change impacts. It is also dependent on outside resources shipped in, and wastes shipped out. Seeing only the economic success of high income countries, low and middle income countries have followed the same fossil-fuel dependent route, and accelerated inefficient resource consumption. The rapid economic development of China, with over 800 million people living in cities by 2020 (People's Daily 2004) – 60% of its population – has alarmed many. There would be insufficient resources if every Chinese wanted to live the same high and inefficient standard as an American.

Urban centres and cities of the future need to be refashioned to enable people to live much more lightly on the planet with a huge reduction in greenhouse gas emissions and resilience to climate change impacts. Especially for low and middle income areas, there are opportunities to leapfrog the problems of the current high income world, making much more efficient use of their resources, following the new ecological age model.

2.2 Ecological Age Performance Measurements

This chapter carefully analyses current global knowledge in an attempt to see if and how we can reach a sustainable future. The conclusion is that we could move to a sustainable way of living within environmental limits over the next few decades, allowing for continued human development and population growth, whilst adapting to climate change impacts. Clear objectives are set out for 2050 Ecological Age, using three performance measurements:

- *CO_2 Reduction*: 50% average from 1990 levels by 2050
- *Ecological Footprint Decrease*: Within the Earth's biocapacity of 1.44 gha/person, based on a projected global population in 2050

- *UN Human Development Index Improvement:* Raise overall wellbeing in GDP/capita, life expectancy, and education.

"Between 2000 and 2005, emissions grew four times faster than in the preceding 10 years, according to researchers at the Global Carbon Project, a consortium of international researchers. Global growth rates were 0.8% from 1990 to 1999. From 2000 to 2005, they reached 3.2%" (New Scientist 2006). We need to decrease our carbon emissions or risk greater and more frequent impacts of heat waves, drought, typhoons, etc. However, decreased carbon emissions are not enough to transition towards an Ecological Age. We need to ensure that we continue to grow and develop, but within our resource constraints and improve our living standards.

Ecological footprint was developed by William Rees and Mathis Wacknernagel, and is a resource measurement tool similar to a life-cycle analysis. It attempts to account and compare human's demand for ecological resources, and the planet's ability to supply that demand and regenerate. Its methodology involves calculating "the area of productive land and sea needed to provide a given quantity of energy, food and materials for a defined population in a given land mass, and the area of land required to absorb the emissions" (Global Footprint Network 2005) – in other words, nature's ability to provide for our lifestyle consumption, or biocapacity. In 1998 WWF started publishing a biennial Planet Report, which in 2006 showed that we are now living in severe ecological overshoot. Worldwide, the report says that we are consuming 25% more resources than the planet can replace and are drawing down the stock of natural capital that supports our lives (World Wildlife Fund 2006).

The UN Human Development Index measures overall well-being in three basic dimensions of human development: a long life, formal education, and average per capita income of GDP (UNDP Human Development Report 2007–2008). It has been used by the United Nations since 1990 as an indicator of human well-being beyond sheer economic growth. Together these three objectives serve as our guide in entering an Ecological Age and future ecological age cities. Each indicator alone has weaknesses, but together, they provide a holistic assessment of where cities should strive for. The three keep us in balance with nature while continuing to promote our growth and development. Happiness will not be attained with material accumulation, but rather in a change in our living conditions and thinking.

2.2.1 Different City Conditions

Recognizing the different performance levels in each city– along with local conditions and policies – we aim to set recommendations that are relevant to each context while promoting an overall transition towards an Ecological Age. Existing urban centres are simplified into three basic models (Table 2.1).

The first type- emerging economy- focuses on the expansion or creation of urban areas, while the final two look into retrofitting existing areas. The emerging economy's goal is to avoid an increase in ecological footprint as it continues to grow

Table 2.1 City models

Urban centre models	Main characteristics	Ecological footprint (gha/capita)	Human development index	Example locations
Emerging economy	Dense living, growing population	1–2	0.4–0.8	Africa, Latin America, Eastern Europe, China, India
European	High density, low car use	4–8	> 0.8	Western Europe, Japan, Korea, Singapore
USA	Sprawl, high car use	8–15	> 0.8	North America, Australia

Source: Collated by authors from various sources

and improve its human development index. The European and USA models aim to decrease their ecological footprint while maintaining a high human development index.

Low and middle income cities need to develop in a way that improves quality of life and creates jobs and opportunities within the new global economy where resource efficiency underpins development. The planning, design and investment model will be a new one following the long term lessons from cities. For these low and middle income economies this approach can be thought of as a way of leapfrogging from the Agricultural Age to the Ecological Age.

At the same time high-income countries need to rebase their paradigms around city living, rural food production, water management, energy supply and manufacturing to take advantage of the ecological age economy. They need to avoid the ravages of inflation and political risks of shortages of basic needs that result from a continued focus in industrial production. This will require investment to transform existing cities along the lines of the London Climate Change Action Plan and various One Planet Living studies by WWF. We call this retrofitting and envisage this will be carried out at a regional scale of communities of at least 50,000–100,000 people.

2.2.2 Climate Change Resilience

At the same time, cities are retrofitting or developing anew, they will be facing greater and more frequent climate change impacts. There are an increasing number of natural disasters caused by climate change. The growing populations – particularly in coastal areas have increasing exposure to cyclones, droughts and floods – are affecting food production and prices and higher summer temperatures

are creating dangerous conditions for the elderly and infirm. This is caused by the higher intensity of storms. Fires are also becoming more frequent.

Many of the cities most at risk from the impacts of climate change are low and middle income nations that have contributed very little to greenhouse gases. These cities are not the best equipped with the skills and resources to combat climate change impacts or to prevent its occurrence. The number of deaths in certain countries is decreasing thanks to early warning systems that trigger mass evacuations to shelters, but the social and economic impacts are terrible. Overall the impacts are already becoming very serious.

Adaptation must be a priority and should go hand in hand with mitigation. Costs can be reduced by combining infrastructure investments to serve both purposes. For example, we can plan urban areas to take advantage of natural cooling through green roofs and parks, combining lower greenhouse gas emissions and hence lower heat stress for residents. Emergency preparation plans can be part of the city's sustainable development programme and supported by a communications systems for up-to-date, accurate information for the residents.

2.2.3 Sustainable Urban Design and Transport

Competition for land in most urban areas is driving up the land part of house prices. This means that rising land value can be used to underpin investments in improved efficiency. Inequalities are widening however, especially between homeowners and renters. For most, the ambitions of those moving to urban centres globally are not being realised. As the former Executive Director of UN Habitat, Anna Tibaijuka, notes, "People move to the cities not because they *will* be better off but because they *expect* to be better off" (BBC News 2006). These members of the population find it hard to find the economic opportunities they envisioned. Their dire financial situation and lack of affordable housing, exacerbated by rising fuel and food costs, is leading to homelessness and slum housing. The slum population is forecast to reach 1.4 billion by 2020, with Africa most affected.[1]

The approach to city living needs to change radically to a much more efficient use of land if we are to live within the carrying capacity of the planet. Ecological footprint is changed fundamentally by the level of urban density, food and goods selection, energy supply efficiency, fuel choice, and transport. Food and goods are consumer choices while urban density, supply efficiency, and fuel choice are largely planning decisions. Good urban design and planning is therefore a key to a successful change of direction and clarity of legal structure for land use planning is critical.

One of the largest differentiators in the ecological footprint of cities is the relationship between urban density and transport energy use. An average urban dweller in the United States consumes about 24 times more energy annually in private transport than a Chinese urban resident (Kenworthy 2003). There is a sweet spot of urban density of 75 persons/hectare in which transport energy use is reduced through the economic provision of public transport and there is still ample room for urban parks

and gardens (Newman and Kenworthy 2006). Higher urban density combined with good public transport and a switch to use of fuel efficient and renewable energy powered vehicles can decrease transport-related energy use and improve liveability.

Opening up the city roads to walking, biking improves air quality, reduces traffic congestion, and enhances community and healthy living. Real time information can support greater public transport use and scheduling. Intercity connections can rely on high speed rail, waterways, and green logistics services from freight hubs for goods delivery. Better transport options also improve other infrastructure. A simple example is that the use of quiet electric vehicles and pedestrianised streets can mean the facades of buildings can be lighter in weight with the need for less noise attenuation, therefore consuming fewer resources; or that choosing more sustainable building material results in lower CO_2 emissions. Improved air quality from non-polluting vehicles can facilitate natural ventilation of buildings, saving energy costs and improving residents' health.

Increasing biodiversity with green roofs, urban parks and tree planting along streets will reduce the heat island effect and give benefits of improved health through lowering heat stress and improving mental health (Mind 2007). The link between biodiversity and health can be illustrated by Singapore's visionary approach to biodiversity management in parks. Dragonfly habitats are being introduced to try to help control mosquitoes and the problem of dengue fever in the city. Melbourne also uses species planting to create an eco-system in which mosquitoes do not proliferate.

There is a virtuous cycle between the biodiversity of a city, and therefore living in harmony with nature, and the energy consumption and quality of life. There is strong evidence that access to green space increases demand for developments and opens the door for funding through land value uplift. It will also benefit the natural systems that maintain life. Trees and vegetation also help with water-management, slow down water run-off and improve air quality. There is also a need to restore rural and aquatic bio-diversity outside urban areas. Future urban centres can be transformed to reflect places where we live in harmony with nature in all its forms.

2.2.4 Urban Agriculture

Food security and self-sufficiency have become a problem in many areas due to decreasing supply from agriculture, livestock, and aquaculture, and increased consumption and higher demands of energy-intensive goods. Food demand globally is expected to rise by 70–90% by 2050 due to population growth and higher standards of living (Varma 2008). Productive agricultural land area is generally decreasing in part because of urbanization, pollution and climate change impacts. Deterioration of soil quality and overgrazing are reducing food productivity on the shrinking land area, requiring ever increasing use of chemical fertilisers and yet more non-renewable energy consumption and associated carbon emissions. Water resources are also becoming depleted. Three-quarters of the world's fish stocks are fully exploited, overexploited or depleted. It is forecast that most fish stocks will collapse

by 2050 (UNEP GEO-4 2007). Tropical forests, important to ecosystems preservation and efficient stores of carbon are being destroyed to make way for food and bio-fuel production.

The 850 plus million hungry people will continue to grow, while others will be forced to change their spending and give up other necessary goods or services, such as healthcare and education (Varma 2008). Josette Sheeran, Executive Director of the United Nations' World Food Programme (WFP), notes with alarm:

> For the middle classes, it means cutting out medical care. For those on $2 a day, it means cutting out meat and taking the children out of school. For those on $1 a day, it means cutting out meat and vegetables and eating only cereals. And for those on 50 cents a day, it means total disaster (The Economist 2008a).

Food is becoming a larger part of one's budget. "The average Afghan household now spends about 45% of its income on food, up from 11% in 2006" (Ban 2008). As a result, people buy less and cheaper foods. But cheaper foods, such as processed or packaged goods are usually less nutritious and require more energy.[2] The rising middle class faces a different situation with food. As living standards rise we are consuming more resource intensive foods. For example, moving from cereals to meat results in 2.5–3.5 times more land required for food production (UNEP GEO-4 2007). This is most acutely seen in China as its increased living standards have resulted in a 2.5 times increase in meat consumption in less than 30 years.

We actually produce enough food now to feed every child, woman and man and could feed up to 12 billion people. But in reality, while 850 million people (mostly women and children) remain chronically hungry there are 1.1 billion people who are obese or overweight (Economist 2008b). Our food supply is unequally distributed.

Diet, food production efficiency and distribution are key elements of resource efficiency and these are issues that can be tackled. For example, it is likely that we will need to turn to new low energy processes of building and balancing soil fertility and this can be assisted by closing the resource loops between urban living and rural food production. Research is being carried out into food production in buildings in which artificial light is used together with hydroponics culture and nutrient recycling from city waste streams to grow green vegetables and fruit. This takes advantage of new LED lighting technologies and plant science and recognises that plants only need a proportion of the white light spectrum to grow healthily. It is likely that by 2050 a proportion of food can be grown commercially by supermarkets within their existing facilities in towns and cities and sold directly to customers with low ecological footprint as long as a supply of renewable energy is available. Control of nutrient supply to plants grown in this way will also enable the mineral balance in the food chain to be improved.

Urban co-operative gardens and urban agriculture can be an important contributor to food supply in cities. Storing and transporting food from the rural areas not only widens the rural-urban divide but also creates a dependency relationship on cities. Green walls and roofs can produce agriculture, improve air and water

quality and engage the community. There is also substantial opportunity is the growing of food in urban areas using hydroponics and nutrients recovered from the waste stream and the recycling of carbon from energy consumption in urban areas back to the productive land. This could also free up land for new forests to create other additional carbon absorption capacity and to improve biodiversity.

2.2.5 Total Water Resource Management

Freshwater resources are fundamental to agriculture, food production and human development. The UN Environmental Programme reports that "if present trends continue, 1.8 billion people will be living in countries or regions with absolute water scarcity by 2025, and two thirds of the world population could be subject to water stress (UNEP GEO-4 2007)." This is caused primarily by over-abstraction, inefficient/inequitable use, man made pollution and damage to the eco-system by deforestation. There is also an overconsumption by the agricultural sector and draw-down of most aquifers, largely from inefficient water pricing (Timmins 2004).

There are major opportunities to use recycled water. This can be from urban development to give efficient irrigation of surrounding farmland and to collect and store water run-off in cities and use it as grey water for secondary uses. These lead to a reduction in the demand for potable water and the associated energy needed for treatment. It can also help mitigate climate change impacts of increased storm rainfall intensity on flooding.

Likewise wastewater can be separated, and treated for reuse, and for conversion to energy. All the technology that would allow us to do this is on the market and is not excessively expensive, especially if the urban economies of scale are taken into consideration.

2.2.6 Energy Efficiency and Renewable Energy

If current trends continue the world's primary energy demand will more than double by 2030; almost half of that will be accounted for by energy demand in India and China alone (International Energy Agency 2007). Currently two thirds of potential energy is wasted through inefficiency in generation, distribution, supply and usage (The Economist 2008c). Demand for all fuels is predicted to rise.

Coal consumption is rising faster than oil and gas with global demand forecast to jump 73% between 2005 and 2030 (International Energy Agency 2007). Coal powered stations are being built all over the world despite the threat of emissions caps because coal is now the cheapest most plentiful fossil fuel we have left and could last beyond oil and gas. Current resource estimates assume consumption at present rates- not increasing consumption, but official coal reserve estimates may not be as high as believed so there may not be the 150 years of reserves some have estimated (Strahan 2008).

Oil prices have increased fourfold in 7 years (The Economist 2007). The cost of traditional production has changed little but deeper wells and a transition to more

inaccessible sources is having an impact. Most of the increase in prices is down to the classic economic model of supply unable to meet demand. The inelasticity of oil demand means that the price must get high before demand is "killed". The second report of the UK Industry Taskforce on Peak Oil and Energy Security finds that oil shortages, insecurity of supply and price volatility will destabilise economic, political and social activity potentially by 2015 (Industry Taskforce on Peak Oil and Energy Security 2008). An increase in oil prices not only affects our energy costs, but trickles through to the costs of other goods and services. Particularly on necessities, those who are less able to afford it will feel the largest impact.

Improving the energy efficiency is one of the cheapest and easiest ways to conserve energy sources. Behaviour changes, and smart energy monitoring in buildings and homes can reduce the need for excess energy. Work has shown that improvements such as insulation, efficient water heating and use of energy efficient appliances and lighting can reap rapid cost benefits to most householders. Cities can also look towards combined heat and power and local heat and power grids to supply their energy. They can take advantage of the waste to energy links and use secondary biomass for energy and products, including biofuel for transport.

For low and middle income countries, the rapid uptake of the use of microfinance to install photovoltaic panels, local energy from waste facilities and solar powered irrigation pumps shows that, at current oil prices, the use of local renewable sources of energy is much more attractive for human development in remote inaccessible areas than expensive centralised power supply. This could also extend into transport once economic electric vehicles are available, and can already be seen in the use of electric bicycles.

Energy from renewable energy sources such as solar, wind, tidal stream and wave power are greatly underutilized. We already see that development will move forward with a greater consumption of renewable resources (with non-renewables gradually being priced or regulated out as they become more scarce) and will be underpinned by greater efficiency, lower environmental pollution and an emphasis on improving the effectiveness of human development through the transition. For example we now see the increasing sales of energy efficient and renewable resource products and services. Renewable energy is the primary job creator in Germany with 100,000 new jobs expected by 2020, largely as a result of government policy (The Climate Group 2007). In Japan, new building energy codes for residential and commercial buildings will save US$5.3 billion in energy costs and 34 million tonnes of CO_2 annually (The Climate Group 2007).

There is much more solar energy available in the desert regions of the world than we are currently generating from fossil fuels. According to the 2006 United Nations Environment Report, an area of 640,000 km^2 could provide the world with all of its electricity needs (the Sahara is more than 9 million km^2 in size) (United Nations Environment Report 2006). But climate change could also turn valuable deserts and their solar resource uninhabitable with unbearable rising temperatures and water scarcity. We have to be willing to build the infrastructure to transfer the desert power into our urban areas. This is one of the greatest opportunities for new technology to help solve our problems.

Emerging technologies will also be important to future energy supply. This will be an important component to research institutes and academia, translating that knowledge first into demonstration projects, and gradually into wider use and decrease costs. Carbon capture and storage, plus new coal gasification technologies offer the opportunity to reduce emissions from coal power stations. The costs are high, however, because of the need to liquefy and store the carbon dioxide gas. Other new technologies are in sight for creating short carbon cycles in urban areas by absorbing carbon dioxide at local power stations into different algae forms and using the algae and by-products as a local fuel with the carbon being returned to the land.

2.3 Smart Responsive Simplicity

All of these systems are connected and form virtuous cycles that integrate the environmental, economic and social performance of different components of built environment so that change in the design of one can lead to benefits in another.

The stacking of problems has led to a complexity of infrastructure with high maintenance costs. A clear vision is now emerging that the way forward is one of smart responsive simplicity rather than rigid complexity. For example, in a new compact mixed use development, people can easily go to work, school, shops and leisure facilities by walking, cycling or by public transport; the residents save money and travel creates less pollution from car exhausts. This leads to better health, lower social care costs and creates a more desirable place to live in and a higher return for the developer. Local utility systems for energy, water and waste management should be integrated to allow cooperation, shared land use and shared resources. Retrofitting of new sustainable systems need to follow this model too. Typical examples are energy from waste anaerobic digestion plants for both municipal waste and sludge from sewage treatment viable, particularly when they interconnect new and existing rail routes.

Recent surveys in many countries have shown that people are prepared to live differently and willing to make lifestyle changes (BBC News 2007). Diversity of cultures, ages and family groups in local accommodation can greatly assist human development through mutual support systems which are “bartered” within communities. All of these point to high quality urban design for compact mixed use which includes access to education, leisure and parks as well as work to help human development.

2.3.1 Policy Framework

When countries are not able to provide basic necessities like food for their people, social disruption results. We have seen this in many African countries and increasingly in other low- and middle-income countries. “Food riots have been reported from Kolkata to Namibia, Zimbabwe, Morocco, Uzbekistan, Austria,

Hungary and Mexico" (Varma 2008). Similarly, disputes and frustrations have erupted over land, water, and energy. For cities to effectively provide reliable, consistent and cheap services to their citizens, we need to have strong policies and an economic model that promotes resource efficiency, sustainable development and climate change resilience.

First, policies which drive towards the sustainable or optimal scale need to address the limiting of scale and the fact that previously free natural resources and services have to be declared scarce economic goods. Once they are scarce they become valuable assets and the question of who owns them arises and therefore the issue of distribution must be addressed, for example:

- Energy feed-in legislation.
- Polluter pays taxes introduced progressively, with proceeds used to drive public sector investments which help the private sector.
- Tradable permits with quotas set so that the marginal social and business costs are equal to the societal benefits.

Second, as sustainability is the criterion for scale, justice is the criterion for distribution to ensure that there is fairness across society and globally, for example:

- National and regional land use plans.
- Land value taxation to redistribute value to the community.
- Bartering of human development benefits against environmental clean up benefits.
- "Contract and Convergence" for carbon and "Shrink and Share" for ecological footprint.

Thirdly, policy needs to ensure that allocation of resources is as efficient and cost effective as possible, for example:

- National resource efficiency targets and circular economy laws to incentivize symbiotic manufacture.
- National policy to manage the rebound effect of improved resource efficiency.

2.3.2 Economic Model

Most detailed carbon emissions reduction studies like the Stern Review (see UK Chancellor of the Exchequer 2007) and a major report from McKinsey Company (2007) say that the transition costs are within our means and will not hurt economic growth. The McKinsey report says that the United States can reduce greenhouse gas emissions by one-third to a half by 2030 at manageable costs to the economy. In reality if the broader canvas of resource efficiency was adopted, as suggested here, then the economic drivers would be even clearer. Failure to act now means that the cost of climate change, especially its impacts will be much higher.

The economics of scale are bringing down the costs of low carbon technologies. Already in the United States, studies of energy efficient buildings designed and built to LEED standards have shown that initial increases in costs have disappeared as the numbers have increased and substantial energy performance improvements compared to non-LEED buildings (Turner and Frankel 2008). A combination of top down policy and individual action is needed to enable the direction of development to change. A major obstacle is the fact that culturally, we have convinced ourselves that human development cannot occur without resource consumption.

The financing solutions will require long-term infrastructure partnerships between public and private sectors and community groups and NGOs and we can expect to see these emerging at a regional level and to include mitigation and adaptation. Partnerships are necessary because often land ownership will be in both public and private sector hands. Pension funds have a significant interest in this area of investment. Risks of losses of value will be mitigated and so partnerships with insurance companies are also likely to be productive as will partnerships with mortgage lenders for the upgrading of homes and surrounding infrastructure to enable occupiers to see cost reductions quickly. Microfinance and micro-insurance schemes that deal with both adaptation and mitigation are emerging quickly and these can operate at a local community or regional scale in low and middle income countries to manage and share risks over the long term.

2.4 Conclusion

This is a first glimpse of a way forward and a credible vision of the future for ecological age cities, but it is only a modest start for a long journey. There is clear evidence that first movers in this transition are gaining benefit both at a regional economic level and at a business level. Cities, driven by urbanization, population growth, and climate change can lead the way towards an ecological age. Despite different local conditions, and various economic and environmental levels, the principles of urban design and resource management are universal. But they can also be localized to fit the context. Planning for new and retrofitting high, middle, and low income cities can transform the way we manage our water and waste; feed our community; supply our power; travel to places; and live each other and with nature. Together, with the supporting policy framework and new business model, cities can reduce their carbon emissions, retain a limited ecological footprint, and improve their human development to enter the ecological age.

Notes

1. UN Habitat characterizes slum housing as lack of durable housing material, insufficient living area, and lack of access to clean water, inadequate sanitation, and insecure tenure.
2. The cost of fresh vegetables and fruit (lower calorie foods) are rising fastest.

References

BBC News (2006, 16 June). Report reveals global slum crisis. http://news.bbc.co.uk/1/hi/world/5078654.stm#slums. Accessed 12 April 2010.

BBC News (2007, 9 November). Most people ready for green sacrifices. http://news.bbc.co.uk/1/hi/world/7075759.stm, and http://news.bbc.co.uk/1/shared/bsp/hi/pdfs/09_11_2007bbcpollclimate.pdf. Accessed 12 April 2010.

Ban, K.-M (2008, 12 March). The new face of hunger, Washington Post. http://www.washingtonpost.com/wp-dyn/content/article/2008/03/11/AR2008031102462.html?hpid=opinionsbox1. Accessed 12 April 2010.

GEO-4 (2007). United Nations Environmental Programme. http://www.unep.org/geo/geo4/media/ p 142. Accessed 12 April 2010.

Global Footprint Network (2005). Definition in multiple sources and reports. http://www.footprintnetwork.org/en/index.php/GFN/page/frequently_asked_questions/. Accessed 2005.

International Energy Agency (2007, 7 November). World energy outlook 2007 – China and India insights, http://www.iea.org/w/bookshop/add.aspx?id=319. Accessed 12 April 2010.

Kenworthy, J. R. (2003). Transport energy use and greenhouse gases in urban passenger transport systems: a study of 84 global cities. Presented to the international third conference of the Regional Government Network for Sustainable Development, Notre Dame University, Fremantle, Western Australia, during September 17–19, 2003. http://cst.uwinnipeg.ca/documents/Transport_Greenhouse.pdf. Accessed 20 April 2010.

Mckinsey & Company (2007, December). Reducing greenhouse gas emissions: how much at what costs? US Greenhouse Gas Abatement Mapping Initiative Executive Report. http://www.mckinsey.com/clientservice/ccsi/pdf/US_ghg_final_report.pdf. Accessed 20 April 2010.

Mind Organisation (2007, May). Ecotherapy: the green agenda for mental Health. http://www.mind.org.uk/mindweek2007/report/. Accessed 22 April 2010.

New Scientist (2006). http://www.newscientist.com/article/dn10507-carbon-emissions-rising-faster-than-ever.html

Newman, P. & Kenworthy, J. (2006). Urban design to reduce automobile dependence. *Opolis: An International Journal of Suburban and Metropolitan Studies*, 2(1): 3. http://repositories.cdlib.org/cssd/opolis/vol2/iss1/art3. Accessed 03 March 2010.

Peak Oil Group (2008). Industry taskforce on peak oil & energy security. http://peakoiltaskforce.net/. Accessed 20 April 2010.

Peoples' Daily Online (2004). China's urban population to reach 800 to 900 million by 2020. http://english.people.com.cn/200409/16/eng20040916_157275.html, and http://www.newscientist.com/article/dn10507-carbon-emissions-rising-faster-than-ever.html. Accessed 12 April 2010.

Strahan, D. (2008, 19 January). Coal: bleak outlooks for the black stuff. New Scientist. http://environment.newscientist.com/data/images/archive/2639/26391802.jpg. Accessed 20 April 2010.

The Climate Group Report (2007, August). In the black: the growth of the low carbon economy – summary report. http://theclimategroup.org/assets/resources/TCG_ITB_SR_FINAL_COPY.pdf. Accessed 20 April 2010.

The Economist (2007, 15 November). Shock treatment. http://www.economist.com/finance/displaystory.cfm?story_id=10130655. Accessed 12 April 2010.

The Economist (2008a, 17 April). The new face of hunger. http://www.economist.com/world/international/displaystory.cfm?story_id=11049284. Accessed 12 April 2010.

The Economist (2008b, 10 May). The elusive negawatt. http://www.economist.com/displaystory.cfm?story_id=11326549. Accessed 20 April 2010.

The Economist (2008c, 3 November). An expensive dinner. http://www.economist.com/world/international/displaystory.cfm?story_id=10085859. Accessed 12 April 2010.

Timmins, C. (2004). Environmental resource economics. Volume 26, Number 1, sourced from, http://www.springerlink.com/content/rp22580246p40t34. Accessed 12 April 2010.

Turner, C. & Frankel, M. (2008, 4 March). Energy performance of LEED for new construction buildings, US Green Building Council. http://www.usgbc.org/ShowFile.aspx?DocumentID=3930. Accessed 20 April 2010.

UK Chancellor of the Exchequer (2007). Stern review: the economics of climate change. http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm. Accessed 12 April 2010.

United Nations Development Programme (2007–2008). Human development report, http://hdr.undp.org/en/media/hdr_20072008_en_complete.pdf. Accessed 20 April 2010.

United Nations Environment Report (2006). The environmental effects assessment panel report for 2006. http://www.unep.ch/ozone/Assessment_Panels/EEAP/eeap-report2006.pdf. Accessed 20 April 2010.

United Nations (2008). World urbanization prospects: the 2007 revision, UN publication, 26 February 2008. http://www.un.org/esa/population/publications/wup2007/2007WUP_Highlights_web.pdf. Accessed 20 April 2010.

Varma, S. (2008, 13 March). Hunger is set to grow as global food stocks fall. The Times of India. http://timesofindia.indiatimes.com/Hunger_is_set_to_grow_as_global_food_stocks_fall/articleshow/2859771.cms. Accessed 12 April 2010.

World Wildlife Fund (2006). Living planet report. http://assets.panda.org/downloads/living_planet_report.pdf. Accessed 12 April 2010.