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**Urban Sustainability**

# CITIES, PEOPLE, PLANET

**Herbert Girardet**

The main issue I want to address is the complex relationship between cities, people and our planet at the start of the new millennium. As urban areas become our primary habitat - three quarters of the human population are expected to become city dwellers by around 2050 - it is of key importance to establish whether a sustainable relationship can be established between cities and the planet. [1]

The urgency of this task is only too evident: the size of modern cities in terms of numbers of citizens and physical scale is unprecedented: *in 1800* there was only one city of a million people, London. At that time the largest 100 cities in the world had 20 million inhabitants, with each city usually extending to just a few thousand hectares. *In 1990* the world's 100 largest cities accommodated 540 million people and 220 million people lived in the 20 largest cities, mega-cities of over 10 million people, some extending to hundreds of thousands of hectares. In addition, there were 35 cities of over 5 million and hundreds of over one million people. [2]

Urban sprawl is a major concern for environmentalists. It is typical of cities of increasing affluence in which people often prefer the spaciousness of suburbs to denser city centres. Metropolitan New York's population, for instance, has grown only 5 per cent in the last 25 years, yet its surface area has grown by 61 per cent, consuming much forest and farmland in the process. In the USA and Europe, sprawl today is above all else caused by the routine use of the motor car.

Los Angeles is famous for the way it sprawls along its vastly complex freeway system. 90 per cent of its population drive to work by car and many live in detached houses surrounded by large patches of land. A city of 11 million people, it covers an area three times larger than London which has a population of 7 million. London itself, where semi-detached houses are the norm in the suburbs, is several times larger than Hong Kong which has 6 million inhabitants and where most people live in high rise blocks. Not surprisingly, Hong Kong uses space far more efficiently than either LA or London.

Currently the fastest urban growth in the world is under way in China and this is taking place mainly on the country's precious farmland. With some 10 per cent economic growth per year, China is doubling the number of its cities, from just over 600 to over 1200 by 2010. Some 300 million people are expected to be moving to cities, converting from peasant farming to urban-industrial lifestyles.

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[1] Worldwatch Institute, State of the World, 2000, Washington, 2000

[2] Extracted from David Satterthwaite, An Urbanising World, the second global report on human settlements, Oxford University Press, 1996

Large-scale urbanisation is a profoundly resource-demanding process - to build as well as to run cities. As people in countries like China switch from peasant farming to urban lifestyles, their per capita use of fossil fuels, metals, timber, meat and manufactured products increases dramatically, typically by some 50 per cent.

Modern cities are the largest structures ever created by humanity. Vast agglomerations like Tokyo, with over 25 million people, or Sao Paulo, with some 18 million inhabitants, impossible to imagine before the age of coal, oil, steel, industrial mass production and global trade are now being taken for granted. These vast horizontal and vertical urban structures are all dependent on a continuous supply of energy - for internal and external transportation systems and, of course, for erecting the steel, concrete and glass structures that could not exist without lifts ceaselessly going up and down. The mega-cities of today depend on mega-infrastructures and for their energy, water and food supply.

At the start of the new millennium, cities and their resource use dominate life on earth, increasingly affecting the integrity of the global environment. In the last 100 years, human numbers have grown fourfold, whilst both the world economy and urban populations and have gone up about 15 fold. [3] Today, half of us are city dwellers, whilst the other, the rural half, increasingly depend on urban markets for their economic survival. Due to worldwide urbanisation, closely linked to economic and population growth, resource use is continuing to increase. At the turn of the century, humanity, just one of millions of species, already uses around 50 per cent of nature's entire annual production. How much higher could this figure rise? What will be left of the natural world if demands continue to grow?

An urbanising, industrialising humanity is rapidly changing the very way in which the 'the web of life' itself functions. Until recently, life on earth consisted of the *geographically scattered interaction* of a myriad of living species, to which local human cultures were intimately connected. Now we are moving to a new reality - an *assembly of urban centres* and their resource demands is coming to dominate all life on earth for the benefit of just one species. Humanity increasingly funnels resources from all over the biosphere into cities: they currently take up just two per cent of the world's land surface, yet they use over 75 per cent of its resources and discharge similar proportions of waste. [4]

Cities are also centres of communication and new electronic systems have dramatically enhanced that role. Information technologies have given cities a global reach as never before, and particularly in further extending the financial power of urban institutions. The daily money-go-round from Tokyo to London and on to New York and Los Angeles is the most striking example of this. '... the new economy is organised around global networks of capital, management, and information, whose access to technological know-how is at the roots of productivity and competitiveness.' [5] But will this power ever be exercised with a sense of responsibility appropriate to an *urban age*? If this is the global network society, who controls its ever-growing power?

[3] Worldwatch Institute, State of the World 1999, Washington, 1999
[4] Herbert Girardet, Creating Sustainable Cities, Green Books, Dartington, 1999
[5] Manuel Castells, the Network Society, Blackwells, Oxford, 1996

To develop a sustainable relationship between people and planet in the years to come is one of humanity's greatest challenges for the new millennium. We need to conceptualise how -

- the world's urbanisation trends can be brought to a halt;
- cities can maintain an equitable relationship with rural areas;
- urban structures and systems can be designed to function sustainably;
- urban communication systems can benefit sustainable development.

If sustainability is the primary frame of reference for planning urban *spaces, structures and processes* - how will we do things differently in the future?

Much of the process of large-scale urbanisation started in the UK. London's rapid growth, from one million in 1800 to eight million in 1930 was an unprecedented phenomenon. Before that time there had only ever been a hand-full off cities with populations of up to a million people - Ancient Rome, Constantinople, Shajahanabad (Old Delhi), Edo (Tokyo's predecessor) and Old Peking. Each of these were capital cities, and national centres of culture, crafts and industry. They traded food and timber supplies by land, river and sea, relying on renewable energy like fuel wood, muscle and wind power. Only the relatively recent introduction of fossil fuel based technologies made much larger cities of several million people with a global reach possible.

Never in history had there been a city of more than one million people not running on coal, oil or gas. London's astonishing growth was powered by fossil fuel technologies pioneered in the industrial revolution - coking coal used for smelting of iron; steam power and its use in production, transport and then electricity generation. Together, these made possible the unprecedented processes of urbanisation that are still unfolding even today.

Fossil fuel combustion technology and the use of coke in steel production were revolutionary developments because, until then, metal ores had been smelted in small quantities, using limited available quantities of charcoal. Legions of miners and industrial workers, many displaced from farms, manned the new production centres. In the early 19$^{th}$ century, when the use of coke became widespread, it made available large quantities of steel for the first time. This caused a revolution in mining, industrial production, building construction, transport and warfare. The unprecedented access to the Earth's stores of resources, and the vast range of new industrial products made in Europe and America, brought about a new prosperity for many, but also profoundly changed the way we inhabit this planet.

By the 1850s, London, by then the largest city ever, numbering some 4 million people, had an increasingly global reach. In his book 'The Coal Question', John Jeavons wrote: "The plains of North America and Russia are our cornfields; Chicago and Odessa our granaries; Canada and the Baltic are our timber forests; Australasia contains our sheep farms; and in Argentina and on the western prairies of North America are our herds of oxen; Peru send her silver, and the gold og Southa Africa and Australian flows to London; the Hindus and the Chinese grow tea for us. And our coffee, sugar and spice plantations are all in the Indies. Spain and France are our vineyards and in the Mediterranean are our fruit gardens, and our cotton grounds, which for so long have occupied the Southern United States, are now being extended everywhere in the warm regions of the Earth."

Economic globalisation, much talked about in the early 21st century, actually made its debut in the mid-19th century. The prolific use of imported resources caused its own local problems. London had to learn to deal with the effects of its extravagant use of resources. It faced three major types of pollution: smog from a million of coal fires, soil and water contamination from industrial activity, and the accumulation of ever growing quantities of human excreta. The latter was particularly acute: seepage of sewage into the groundwater table and its discharge into its rivers caused cholera and typhoid outbreaks, as well as intolerable environmental conditions. 1858 was the year of the 'big stink' - the Thames was so polluted with sewage that the appalling smells halted the debates in the House of Parliament for days on end. Something had to be done: how could London deal with the sewage of so many people?

Various schemes were discussed. One was a circular recycling system, designed like the spokes of a wheel, where the sewage would be flushed to the edge of the city, to be collected and turned into fertiliser for the fields surrounding London. Justus Liebig, then the world's most famous chemist, was called in from Germany to advise the UK government, and he favoured such a scheme. Whilst most people were concerned about the stench in the Thames and the health dangers of sewage contaminating drinking water supplies, Liebig was preoccupied with the loss of plant nutrients from farmland feeding London, as urban sewage was flushed into the sea. Having studied the environmental history of ancient Rome, he argued that it had imported the fertility of North African fields for 200 years as it shipped some 500,000 tonnes of grain to Rome every year. The excreta of a million Romans was then flushed through the *cloaca maxima* into the Mediterranean. In a letter to prime minister Sir Robert Peel he wrote:

"The cause of the exhaustion of the soil, is sought in the customs and habits of the towns people, i.e., in the construction of water closets, which do not admit of a collection and preservation of the liquid and solid excrement. They do not return in Britain to the fields, but are carried by the rivers into the sea. The equilibrium in the fertility of the soil is destroyed by this incessant removal of phosphates and can only be restored by an equivalent supply. ... If it was possible to bring back to the fields of Scotland and England all those phosphates which have been carried to the sea in the last 50 years, the crops would increase to double the quantity of former years. "

Liebig asked himself the question: if many of Europe's cities were to grow like London, and their sewage was not returned to the land, their food demands would rapidly deplete the fertility of farmland feeding them. When London decided to build two massive pipelines and to flush the sewage into the Thames estuary rather than recycle it, Liebig responded by starting work on developing artificial fertilisers. In his view this was the only way for keeping farmland feeding cities productive. These decisions, taken in the 19th century, still have a profound effect around the world, even today. Most of the world's cities have built sewage *disposal* rather than *recycling* systems and the farmland feeding cities is being kept productive artificially by the use of chemical fertilisers. But the consequences are there for all to see: today rivers and coastal waters everywhere carry the twin burden of urban sewage and industrial pollutants, as well as the fertiliser and pesticide run-off from farmland feeding cities. But *out of sight* has always been *out of mind*.

On British farms in the 19th century, guano from Chile and Peru became the primary source of fertiliser until artificial fertilisers, containing phosphates, nitrates and potash, had been fully developed. Meanwhile the abolition of the corn laws in Britain meant that food, and particularly grain, was increasingly imported from places like Canada and the USA rather than grown at home. When refrigerated ships became available, even meat was imported long-distance, from places like New Zealand. A globalising system for feeding cities got under way.

In a world of cities it is crucial to take a new look at the way urban systems function, where their resources come from, and where their wastes end up - in the atmosphere, in rubbish dumps or, indeed, in the rivers and coastal waters. It is essential to find ways to minimise urban impacts on forests, farmland, aquatic environments as well as the atmosphere. How can we reduce the urban intake of vast quantities of natural resources and the huge output of waste materials? Plausible methods for creating a sustainable relationship between cities and the global environment are urgently required.

Take the water supply to a city such as London. It used to be pumped up from ample supplies in the groundwater table underneath London itself, but 150 years or so of economic activity there resulted in accumulations of heavy metals or chemicals from gas works and factories in the soil. This made the use of groundwater for drinking purposes increasingly problematic. London is lucky in having another water supply close at hand in the form of the river Thames. However, other cities are not so lucky. Urbanisation in dry locations around the world has meant drawing vast quantities of water from large dams constructed in distant rivers. Los Angeles pipes water in from the Colorado and other rivers hundreds of miles away. In China and India, where urbanisation is occurring at breakneck speed, vast dams are under construction to meet the water (and electricity) needs of rapidly growing cities. Local rural populations are often deprived of water as thirsty, as distant cities grow. Similar stories can be told from many parts of the world.

Demand for energy defines modern cities more than any other factor. Yet, most city people have a very limited understanding of the origin of their energy supplies. Our ancestors had the daily task of assuring firewood supplies, but we get electric or gas appliances with the simply flick of a switch. We are hardly aware of the power station, refinery or gas field that our homes are plugged into. Few of us reflect on the environmental impacts of our daily energy use, unless we choke on exhaust fumes on a busy *local* street. But we rarely confront the fact that there is a *global* price to pay: that most of the increase in carbon dioxide in the atmosphere is attributable to combustion within or on behalf of our cities. Ironically some of the primary effects of global warming, rising sea levels, will take a heavy toll on cities: a large proportion are located on low ground close to sea shores.

Global urban food supplies are another case in point. Most of us are used to harvesting at the super market and we expect food to be served up packaged and branded for enhanced recognition. Yet we are hardly aware of the origins of that food and the impact of food production on the fertility of farmland or the energy required to produce, process and transport it to our homes. An ever-increasing proportion of the fruit and vegetables we eat are flown in by jumbo jet. There are major costs to be considered that are not included in the price. By the time a fruit such as mango, flown in to London from East Africa, arrives on the kitchen table in London, it will have consumed up to 600 times as much energy as it actually contains

in calorific value. Many other foods we eat will have require ten to several hundred times as much energy as the food itself actually contains. Yet the environmental cost of the food we eat is simply not reflected in the price we pay in the supermarket.

We can argue that we no longer live in a *civilisation*. We live in a *mobilisation* - of people, resources and products. Most of the world's transport routes start and end in cities. Their transport dependent consumption patterns define human global environmental impacts more than any other single factor. Are more and more motorways and airports really needed? Can we make our urban systems less dependent on these transport routes? Should ever more global trade be curtailed for the sake of sustainable development?

A few years ago I spent some weeks estimating the *ecological footprint* of London. The footprint concept originates from the work of Canadian ecologist William Rees. He focussed on the three categories: the areas required to *feed* a city; to supply its *timber and paper* needs; and the surface area that would be needed to *reabsorb its CO2* output by areas of growing vegetation. If you put these three areas together, London has an ecological footprint the size of the United Kingdom - about 125 times larger than London itself - yet London only has 12% of the UK's population. [6] In reality, of course, London's footprint is scattered all over the world.

William Rees and his co-researchers suggested that if other countries adopted the consumption patterns we take for granted in urbanised Europe and in North America, we would need three planets rather than the one we actually live on. [7] So, for the rest of the world to copy western lifestyles - requiring something like 3 hectares per person - rather than the 1.5 hectares of productive land actually available per head of the world's population - would be an unrealistic proposition. As the world industrialises and urbanises, a growing mismatch emerges between human demand patterns and the capacity of the planet to supply. So, we need to find ways to reorganise our urban, economic and technical systems. This requires major changes in tax and subsidy regimes, in the technical use of resources as well as in the administration of our cities.

I got interested in urban sustainability above all else because I was interested in forests. I came to realise that forests all around the world are disappearing into cities, or are being replaced by cropland for produce animal fodder, or indeed cattle ranches, to supply urban meat demands. And together with the destruction of forests, great damage is also done to the forest cultures that are a most ancient part of our cultural inheritance.

Despite many of us seeing TV programmes about the vast, deliberate forest fires set in rainforest areas like the Amazon, Malaysia and Indonesia, we don't often make the connection to our daily urban lives. Yet, as cities grow and increase their demands, forests recede, and with them their plant, animal and human populations. All too often these forests are not replanted. In any case, virgin rainforests and their unique assembly of species cannot be replaced once they are burned or cut down. Temperate timber forests in places like Sweden, Canada or Siberia *are* being replanted, but their original biodiversity is greatly depleted.

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[7] William Rees and Mathis Wackernagel, Our Ecological Footprint, New Society Publishers, Gabriola Island, BC, 1992

In Mata Grosso on the southern edge of the Amazon, major impacts on savannah and forest are now occurring. Forests there are being cleared on a vast scale to create farmland for producing and exporting soybeans to Rotterdam, Tokyo, and increasingly Shanghai or Beijing, to meet the growing demand for meat that results from increased affluence. Feedlot cattle, pigs and chicken in Asia and Europe are increasingly fed on soybeans from Brazil's rainforest areas. Wherever disposable income grows, meat consumption also rises. So, we are seeing the ever-larger *ecological footprints of* our cities across the world. Trading systems based on ever more sophisticated transport and communication technologies make it possible for these global links to be established.

The impact of cities is not solely terrestrial. The earth's atmosphere has become the sink for their waste gases, with dire consequences. Since the beginning of the industrial revolution C02 in the atmosphere has increased by some 30 per cent. Global climate change is becoming an irrefutable reality, and related to it the ever-growing incidence of storms, floods and irregular weather patterns. All in all, the environmental impacts generated by global urbanisation need to be met with a wide range of creative responses.

Is world-wide urbanisation inevitably a road to global environmental destruction? Or can we transform cities into much less environmentally demanding and damaging places than they are today? Is it possible to redesign urban systems to assure a sustainable relationship between urbanised people and the planet?

Given the vast environmental impacts of urbanisation today, cities would be well advised to remodel their functioning by mimicking natural ecosystems. These are generally systems of permanence, whereas currently man-made systems such as cities are characterised by high levels of entropy. Natural systems like forests or coral reefs function quite differently. All their waste materials are beneficially reabsorbed into their living fabric, contributing to the long-term viability of the whole system. If we want sustainable cities in the future, we'd better study carefully how natural eco-systems seem to be able to exist indefinitely, powered only by sunlight.

In recent years I had the opportunity to study the metabolism of London, quantifying the resources that go into this city and the wastes that come out the other end. The metabolism of cities like London, now a city of seven million people, is basically linear - resources are taken from somewhere, and the biosphere is used as a sink for their wastes. Every year 14 million tonnes of non-biodegradable solid waste are dumped in holes in the ground, such as Mucking in Essex, which will take thousands of years to break down.

Whilst many cities today have a *linear* metabolism, nature's own ecosystems have an essentially *circular* metabolism. Every output by an individual organism is also an input that renews the whole living environment of which it is a part: the web of life hangs together in a chain of *mutual benefit*. To become sustainable, cities have to develop a similar circular metabolism, using and re-using resources as efficiently as possible and minimising materials use and waste discharges into the natural environment.

The concept of the city as a dynamic and ever-evolving *super-organism* helps us formulate strategies for a sustainable urban future. New communication systems and computer modelling can help us *reinvent* the city. In this context individuals and communities should have an important role in decision making. Sustainability implies cybernetic feedback systems that help us to continually adjust our relationships to each other and to the outside world.

Change will occur at different levels and scales of impact, ranging from individual action, community interaction and government policy. *Thinking* comprehensively about our cities is an important starting point in the process of remodelling them. To rethink the city, we must first accept its complexity, and the myriad of interrelationships that define it. The real challenge however is to *act* differently. As we start working towards evolving a more beneficial interaction with natural systems, a profound impact on their appearance and working will occur. It is quite apparent now that there can be no sustainable development without sustainable *urban* development. In a world of cities, suitable policies for transforming the way cities work are a key issue. This is recognised both in key UN documents such as Agenda 21, drawn up at the Rio Earth UN Summit in 1992, and the in the Habitat Agenda, signed by the world's nations at the UN City Summit in Istanbul in 1996.

It could be argued that it makes environmental sense for people to congregate in cities. They have the potential for great resource efficiency through closed-loop economies, diversity and mutuality. Economic well being need not automatically mean growth in the consumption of resources. Sustainable development requires new technical and organisational solutions to ensure the efficient use of resources, minimising pollution and waste. It is increasingly apparent that this can also have great social and economic benefits: new renewable energy systems, for instance, can supplant fossil fuel supplies from outside cities, creating many new local jobs.

So what is a sustainable city? I use the following definition:

'***A 'sustainable city' enables all its citizens to meet their own needs and to enhance their well-being without damaging the natural world or endangering the living conditions of other people, now or in the future.'***

To implement sustainable urban development, circular and highly productive systems need to be put in place, making efficient use of resources as well as the land surfaces. Among other things this means reduced distances between resources supply and demand: sustainability requires us to reintroduce the concept of *proximity* in order to help increase the efficiency of urban consumption patterns - even if this flies in the face of the gospel of competitive advantage. For instance, could at least some of the food we consume in our cities come from urban regions?

The growth of urban agriculture is a significant trend in cities all over the world, rich and poor. In Havana, Cuba, for instance, as a result of the collapse of the Soviet Union and the loss of sugar sales to Russia, an economic emergency arose. The city authorities in Havana dealt with it very creatively. Using compost made from bagasse, a waste product of the sugar cane industry, they created so called 'organoponicos', a cultivation system based on raised beds extending right within the city itself. Havana is a spacious city and people there could utilise tens of thousands

of acres to grow a wide range of vegetables and fruit. The new gardens permeate the city and the gardeners market their produce from their own co-operative shops.

Shanghai, too, used to be permeated with vegetable gardens but its rapid growth has reduced the farmland available within the city. 'Intra-urban' agriculture has been replaced by 'peri-urban' agriculture in recent years: urban farming is being transferred to the edge of the city. Shanghai's city authorities administer a total of 600,000 ha of land, half of which is built-up areas whilst the other half is farmland used for supplying a large proportion of the city's food needs. Similar systems operate in many other Chinese cities. This is a very cost effective and energy efficient urban food system that the Chinese authorities have no intention of giving up. In Shanghai alone it employs 270,000 people out of a total population of 13 million.

Urban agriculture is not just a phenomenon of developing countries either. In the Bronx, in New York, vegetable gardens are thriving in the poorer communities and the same applies to other cities across the USA. Peri-urban agriculture is expanding fast. In the last decade over 4000 new farmers markets have been created in American cities, mainly supplied by peri-urban growers, as more and more consumers are attracted to eating food bought from local farmers they actually know.

Across the world there are many initiatives underway to localise supplies and to create circular and resource efficient urban systems. Recycling of steel and aluminium, for instance, reduces some of the need for mining virgin ores. The same is true for paper. In the US in recent years pulp mills tend to be built near cities, rather than near forests, because cities can supply huge quantities of waste paper, reducing the need for using trees for making paper.

Many of these developments are market driven, yet they can be further accelerated by government policy. For instance, shifting taxes from labour to resources can help turn a wasteful 'disposal society' into one that practices reuse and recycling. In Britain in 1995, the 'landfill tax' was introduced, making it more expensive to dump waste in holes in the ground. As a result, the behaviour patterns of companies are changing, encouraging new recycling initiatives. Take UK road construction companies: until recently they took gravel extraction for road building for granted. Higher disposal costs because of the landfill tax made them think again. Now it is becoming economic when renewing roads to scrape up old road surfaces and recycle them: a much more sustainable use of hardcore.

At present in the UK only 8 per cent of household waste is recycled. Meanwhile the European Union insists on ever-higher recycling rates. Across continental Europe, 40 per cent is the norm and rising. In the US, too, 30 to 35 percent is now taken for granted. In Europe or the USA we are in the habit of using capital intensive methods for recycling waste. In third world cities even higher recycling rates are often achieved than in Europe or the US. Most waste materials end up being reused, recycled and remanufactured. Waste collectors are much in evidence, pushing their carts through the streets and using labour intensive methods for waste recycling.

Some third world cities have implemented innovative waste management policies. In the southern Brazilian city of Curitiba, the city authorities found it more cost effective and socially beneficial in the narrow streets of poorer districts to involve communities in waste collection and recycling than sending in heavy waste trucks. People in the

'favellas' collect and separate their own rubbish and deliver it to key collection points twice a week where it is exchanged for fresh vegetables, grown on city compost. Thus people participate not only in cleaning up their neighbourhoods, but also consume healthy food supplied free of charge by the city authorities. Overall, this system is more efficient than the use of heavy trucks to collect and dump waste in holes in the ground.

Alternative approaches to sewage treatments are also gaining ground around the world. Recently Wessex Water in Bristol decided to dry the city's entire sewage output, to pellet it and convert it into small granules, called Biogran. This is sold to farmers as soil conditioner and fertiliser. The former slag heaps in Merthyr Tydfil in South Wales, which were eyesores after the coal mines there were closed down, have been 'regreened' using Bristol's dried, pelleted sewage. Instead of dumping sewage in the sea, a circular system for reusing urban sewage has been implemented. This system is not without problems: it only captures some of the nitrates and phosphates contained in sewage, and the pellets can contain trace quantities of heavy metals. However, a useful start has been made in upgrading sewage technology.

A critical issue for the future is whether urban systems that have been created by the use of fossil fuels (and nuclear power) could run on renewable energy technology instead. Until the 1960s, cities such as London trucked in coal from outside the city to be burned in stoves and local power stations. The resulting smog caused major health problems. As a result of the Clean Air Act, passed in the early 60s, power stations were relocated hundreds of miles away from cities, discharging their smoke plumes from tall chimney stacks. This solved local air pollution problems in cities, but caused major acid rain problems downwind instead. It is also a very inefficient use of fossil fuels because only 30 per cent of the actual energy contained in the coal or the gas is actually converted into electricity. But today we have realistic alternatives.

Greater energy efficiency in supplying power to our cities and greater efficiency in urban energy consumption, together, are preconditions for improving urban energy performance. It is crucial to find ways to implement non-polluting energy alternatives within cities themselves. Can we create more sustainable, more local, renewable energy systems for our cities?

Many alternative options can be cited. At Smithfield Market, in London, a former cold store has been turned into a *combined heat and power* (CHP) *station* which now supplies electricity to the grid. It operates at 90 per cent efficiency with virtually no acid gases coming out of the high technology chimney, making much better, more efficient use of fossil fuels by producing electricity as well as hot and chilled water for local use. Such CHP systems are a rarity in the UK but they are common place in most cities in Scandinavia, greatly reducing per-capita energy consumption. Today the annual C02 output of a Stockholm citizen, at five tonnes per year, is half the figure for a Londoner.

An even more important new energy technology is photovoltaic (PV) cells. Until a few years ago they were only used in calculators or satellites. PV electricity is still four to five times more expensive than conventional, but the cost is expected to come rapidly in the next few years due to rapidly increasing demand and increasingly automated production of PV cells. Large-scale government support programmes in

Japan, Europe and America now give households and companies substantial financial incentives to install PV cells on the roofs and walls of buildings. As a result, a boom in the use of photovoltaics is now underway. Housing estates, sports stadiums and public buildings across are now being fitted with PV panels to help them become largely self-sufficient in electricity. According to research by PB Solar, even cloudy cities such as London could be largely self-sufficient in electricity from available surfaces covered in PV panels.

Fuel cell technology has started another energy revolution. This higly efficient technology converts hydrogen straight into electricity without combustion, using an electro-chemical process. Fuel cell powered buses, trucks and cars are expected to be mass produced within a few years. One important advantage they have for cities is that they don't burn fuel when they are stationary in traffic jams or in front of traffic lights. Fuel cells can also be used for powering boats, buildings and whole urban districts. In various cities in Europe and America, fuel cell power stations are now coming on stream, making very efficient use of pure hydrogen, as well as natural gas or methanol.

It is clear that the energy systems powering our cities can be dramatically improved and their dependence on fossil fuels greatly reduced. London is a case in point. It currently consumes around 20 million tonnes of oil equivalent every year and discharges about 60 million tonnes of CO2. By the introduction of a combination of energy efficiency, combined heat and power and photovoltaic and fuel cell technology, that figure could be halved in the coming decades. There is also a huge job creation and business potential. Tens of thousands of new jobs would be created by *re-localising* the energy systems of a city such as London. But for sustainable urban energy systems.
to be created, it is vital for appropriate government and local authority policies to be implemented.

Integrated transport for cities is another case in point. This is often talked about, but good examples are to find. Here, again, the city of Curitiba in Brazil has taken significant policy initiatives. Growing rapidly to 1.6 million people in 30 years, the city set about organising a very efficient and highly integrated bus system to service the entire city, making it pleasant and fast to move around without the huge expense of constructing an underground system. Curitiba created a hierarchy of bus services - from ones only serving local neighbourhoods to fast, articulated buses that run across the city on dedicated routes. By replacing conventional bus stops with so-called loading tubes, bus travel is greatly speeded up: as people enter the tubes they pay the resident conductor and when the bus arrives, everyone can get on and off instantly.

But as important as creating integrated transport systems is the creation of local lifestyles that don't require motorised transport in the first place. In Holland and elsewhere on the European continent cycling is taken for granted in many cities, and lifestyles are organised around *short journeys* wherever possible. Pedestrianisation is another case in point and is being widely implemented. The muscle power that enables us to ride bikes or walk originates from food and drink. What a simple, practical way of powering sustainable urban transport.

Part of the problem of our cities at present is that that they are perceived by many people as inhospitable places that they want to get away, given half a chance. Many people dream of the green and pleasant land on the edge of the city and beyond, where they think they can get closer to nature and, maybe, get more peace of mind. This is a great challenge for urban planning. It is crucial that we learn to recreate cities into places that are sedentary, which are not centres of *mobilisation* but centres of *civilisation* again, of urban culture and of the urbane, creative interchange between people.

It is vitally important to find ways to turn our cities into truly hospitable, convivial places, with a wide range of community facilities, meeting places, piazzas, parks and neighbourhood gardens. We need to create conditions in which people can develop a pride of place, truly enjoying their daily urban lives. That also means improving the architecture of our cities, getting away from the repetitive right angles and straight lines that characterise so many recent buildings. We should create buildings with solar facades that are highly energy efficient; but they should also be beautiful, imaginative and even a bit eccentric. Many cities have some unusual recent buildings, such as Gaudi's creations in Barcelona, or Hundertwasser's buildings in Vienna, that have proved to be highly popular with locals and also with visitors. Modern cities greatly benefit from such non-standard building design, greatly enlivening the urban ambience.

There is enormous pent-up creativity present in all cities. Techniques such as neighbourhood forums, consensus building and action planning should be widely used to liberate this creativity because it invariably leads to improved social interaction. The active dialogue between city people about shared concerns strengthens democratic processes and widens people's horizons. This is crucial since I believe that there can be *no sustainability without participation.* We need to develop new *cultural feedback* mechanisms, enabling city people to learn about environmental conditions and impacts, or about new 'best practice' examples of sustainable development that may be relevant to their cities.

My thesis is that we can do much to change the way we design and run our cities. Many people are becoming increasingly aware that efforts to improve the living environment must focus on cities and urban lifestyles. Cities the world over cannot avoid participating in a globalising economy, but we can, nevertheless, help create urban systems that are highly resource efficient and less dependent on unsustainable global supplies. Eco-friendly, more self-reliant urban development is one of the greatest challenges of the twenty-first century. The tools for this are policy, technology and participation.

I am, of course, aware of the many other problems facing cities at the turn of the new millennium: deep social inequalities, grinding poverty and squatter camp living for millions, homelessness, unemployment and intra-urban water, air and soil pollution. These problems are particularly acute in the fast growing cities in developing countries. I have addressed these issues in some detail elsewhere. [8] Much efforts has gone into trying to address them through numerous initiatives at local, national and global level.

[8] Herbert Girardet, The Gaia Atlas of Cities, New directions of sustainable urban living, Gaia Books, London, 1992 and 1996

In this paper I have focussed primarily on the issue of the environmental sustainability of cities, or the current lack of it, because this urgent issue is often overlooked in the debate about the future of cities. So I feel that in a world of cities much needs to be done to understand better that there cannot be *sustainable* development without *sustainable urban* development. This paper is intended as a contribution to the discussion on this key issue facing us in the 21st century.

**CV:**

Herbert Girardet, BSc., Econ., is an ecologist, writer and consultant. At the Rio Earth Summit, 1992, he received *a UN Global 500 Award For Outstanding Environmental Achievements.* He was a consultant to the UN City Summit, Istanbul, 1996. He is trustee of the Sustainable London Trust, chairman of the Schumacher Society, UK and visiting professor at Middlesex University. He recently became an honorary fellow of the Royal Institute of British Architects.

He is author and co-author of seven books - incl. *Earthrise*, 1992, and *The Gaia Atlas of Cities*, 1992 and 1996, *Making Cities Work*. In 1994 he produced *Metropolis,* a documentary on London's metabolism, for Channel 4. In 1999 he wrote *Creating Sustainable Cities,* and the ecological design text for the UK government's Urban Taskforce report. In 1999 he produced 28 three-minute films called *Deadline 2000*, on the environment & the new millennium, for Channel 4. He recently curated an exhibition, *London Living City,* on creating a sustainable London, for the RIBA. He has recently completed work as series editor on a six-part international TV series, *The People's Planet,* for CNN and NHK, Tokyo.

# THE METABOLISM OF GREATER LONDON, POPULATION 7,000,000

| 1) INPUTS | tonnes per year |
|---|---|
| Total tonnes of fuel, oil equivalent | 20,000,000 |
| Oxygen | 40,000,000 |
| Water | 1,002,000,000 |
| Food | 2,400,000 |
| Timber | 1,200,000 |
| Paper | 2,200,000 |
| Plastics | 2,100,000 |
| Glass | 360,000 |
| Cement | 1,940,000 |
| Bricks, blocks, sand and tarmac | 36,000,000 |
| Metals (total) | 1,200,000 |

| 2) WASTES | |
|---|---|
| CO2 | 60,000,000 |
| S02 | 400,000 |
| N0X | 280,000 |
| Wet, digested sewage sludge | 7,500,000 |
| Industrial and demolition wastes | 11,400,000 |
| Household, civic and commercial wastes | 3,900,000 |

***(compiled by H. Girardet, 1995 and 1996; sources available)***

# LONDON'S FOOTPRINT

## 7,000,000 people

## Surface area: 158,000 ha

**Area required for food production:**
**1.2 ha per person: 8,400,000 ha**

**Forest area required by London for wood products:**
**768,000 ha**

**Land area that would be required for carbon sequestration = fuel production:**
**1.5 ha per person: 10,500,000 ha**

## Total London footprint: 19,700,000 ha = 125 times London's surface area

## Britain's productive land: 21,000,000 ha

## Britain's surface area: 24,400,000 ha

***(compiled by Herbert Girardet, 1996)***

The worst city overall was Nairobi, which ranked dead last at 50, as well on on people factors, 45th on planet and 49th on profit. Cities in Asia showed the most divergence, with three in the top ten but fourâ€”Jakarta (46), Mumbai (47), Wuhan (48), New Delhi (49) and Mumbaiâ€”falling in the bottom ten. They were joined by three in the Middle Eastâ€”Doha (42, ranked 50th in environmental factors), Jeddah (44) and Riyadh (45)â€”plus Rio de Janeiro (41) and Moscow (43). Itâ€™s time to start planning the ultimate city break. ðŸŒ†.Â  I want emails from Lonely Planet with travel and product information, promotions, advertisements, third-party offers, and surveys. I can unsubscribe any time using the unsubscribe link at the end of all emails. Contact Lonely Planet here. Lonely Planet Privacy Policy. Thank you for subscribing. Destinations. Africa. When first published in 2004, Cities People Planet effectively anticipated current concerns about climate change, most significantly, outlining the central role of cities in contributing to energy consumption. Since the book's publication, the tsumani in Thailand, hurricanes, intemperate weather conditions worldwide and the increasing demand on natural resources have made the book's original urgent appeals seem more relevant than ever.