Chapter 3

The Broad Environmental Footprint of Asian Cities

Despite improvements in some areas, Asian cities have large environmental footprints that endanger both their economic base and the global environment.

Improving the quality of urban life is imperative

The urbanization of Asia is occurring at a pace and on a scale never seen before. Living standards have increased dramatically for many, but for many others there is poverty, exclusion, and environmental squalor. For both economic and political reasons, governments must work to maximize the efficiency and sustainability of their cities. Cities should become better places for everyone to live, with more green spaces and less air and water pollution. The global environment must be protected by encouraging lower emissions of greenhouse gas (GHG). Sustainable but affordable city development should be the goal. The thinking about cities and their roles will need to change. The emphasis for too long has been on economic growth. But it is the quality of life that will increasingly determine the success of cities in Asia. This calls for new capacities in city management. Most Asian cities lack the resources for environmental management, including the management of sustainable urban transport.

Our resource devouring cities ...

Cities occupy only 2% of the world's land, but consume 75% of its resources. They generate a similar percentage of the earth's wastes.[50] Rapid urban growth has wrought massive environmental problems that are also felt, sometimes even more painfully, in smaller cities with less capacity to cope. As they consume resources, all cities generate waste, including air pollution, GHGs, solid waste, and toxic effluents. They also make unsustainable demands on soil and water supplies for their food production, and on forests for the timber and paper they use. London needs 125 times its own area to provide the resources it consumes,[51] and if urban areas in the developing world grow in the same way and consume at the same levels, their environmental impact will be catastrophic.

[50] Girardet, Herbert. 1996. Giant footprints. *Our Planet*, 8(1):21–23.
[51] Pearce, Fred. 2006. Eco-cities Special: Ecopolis Now. *New Scientist*. June.

... and their equally voracious residents

A sustainable footprint for each person in a world that shared all its resources equally would be about 1.8 hectares (ha) per inhabitant. The average ecological footprint in rural People's Republic of China (PRC) today is 1.6, but in Shanghai it is already 7.0 and in a typical United States (US) city, 9.7. Yet, it would not help much even if the world's entire population were to return to the countryside. Modern high-consumption living standards mean there is little difference between the ecological footprints of rural and urban areas. Moreover, to reduce poverty, urban areas need to grow.

A key challenge, therefore, is to maintain living standards while reducing environmental damage from urban-based production, consumption, and waste generation. Although consumption today is high, technology is available to substantially reduce the demand for fossil fuels without adversely affecting the quality of life.

Seeking social, economic, and environmental solutions

Our air, water, coastal areas, and forests can be considered "local public goods." They should be available to all. Degradation of these assets reduces a city's competitiveness. More and more people are demanding clean air, clean water, and a pristine environment, and those cities that cannot provide these basic attractions will lose their competitive edge. This may already be happening. In Hong Kong, China, for example, recruitment agencies find it increasingly difficult to encourage professionals to work and stay in the city because of its deteriorating air quality.

Clearly, the scope for improving sustainability lies with directing the economic growth of developing cities along

a more sustainable path and changing the way in which developed cities work to reduce their ecological footprint. In the developing world, the focus must be on mitigating existing negative economic, social, and environmental conditions—and ensuring that negative environmental impacts do not increase with economic development as they have in the developed world.[52]

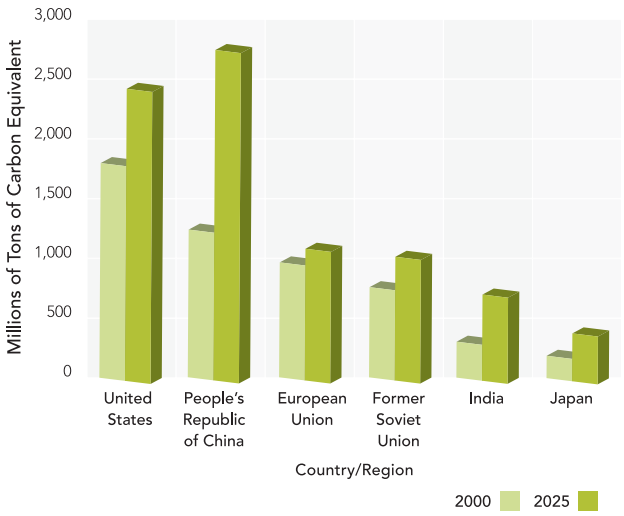
The aim should be to provide sustainable urban infrastructure and services efficiently and effectively, with equality of access to a minimum standard within a framework of economic pricing.

Measures to reduce the causes and impact of global warming and climate change will also be needed. At present, however, major investments in clean air or reducing water pollution are not forthcoming from the private sector since there are no appropriate pricing methodologies.[53] Governments, therefore, need to play a central role in promoting environmentally friendly development and encouraging energy efficiency. This objective must be a central tenant of national urban strategy.

Uncurbed pollution promises disaster worldwide

Economic growth has traditionally been associated with increases in both energy consumption and mobility. Both have environmental implications. They increase the emission of air pollutants. Cities are the major source of the GHGs[54] that contributes to global warming and climate change. Activities in cities, or generated by them, produce close to 80% of all carbon dioxide (CO_2) and other GHGs. Almost 80% of carbon emissions from burning fossil fuels and cement manufacturing and 76% of industrial wood used worldwide are from urban areas. Land use also impacts global climate change. Urban expansion, including the destruction of forests and vegetation, has a strong effect, not only on GHG emissions, but also on the changes in local and regional climate. By 2025, the PRC will be the largest emitter of GHGs, surpassing the US. Unless there is direct action to control activities leading to GHGs, emissions will increase in every country in the world, particularly in India, the nations of the former Soviet Union (FSU), the European Union (EU), and the US.

Emissions of Greenhouse Gases, 2000 and 2025



Source: World Resources Institute. 2005.

Climate change confronts humanity with a potential disaster. Science increasingly confirms this and one recent economic report demanded urgent action[55] to head off the huge risks. Over the next 10–20 years, there must be a shift away from

Flooding in Bangladesh and Impact on Dhaka

If sea level rises about one meter because of climate change, one of the poorest nations in the world is projected to lose 17.5% of its land area. Thousands of people would likely be displaced—including many in the capital—and the country's agricultural system would be badly affected. Coastal flooding would threaten animals, plants, and freshwater supplies. The serious danger to lives and livelihoods posed by storm surges when cyclones hit Bangladesh would only get worse.

Source: National Academy of Sciences, US.

[52] www.footprintnetwork.org/

[53] World Bank. 1994. *World Development Report 1994: Infrastructure for Development*. Washington, DC.

[54] Greenhouse gases (GHGs) include carbon dioxide (CO_2), methane, (NO_x), and some gases from industrial processes.

[55] Stern, Nicholas. 2006. *The Economics of Climate Change – The Stern Review*. Cambridge, UK: Cambridge University Press.

current dependence on fossil fuels. Energy must be used more efficiently, energy use reduced, and deforestation stopped. The consumption of polluting goods and services must decline. This has major implications for urban development since road and air transports are currently locked into fuels that create GHGs, and both are destined for major expansion in Asia and worldwide. Rising sea levels are a particular outcome of global warming and, according to the Intergovernmental Panel on Climate Change (IPCC), the current level is expected to increase worldwide from 8 to 88 centimeters during the 21st century. Many of Asia's largest cities are located on or close to the shore and would be affected.

Vulnerable cities include Bangkok, Chennai, Dhaka, Jakarta, and Tianjin (PRC). Global warming also means weather that is more violent. This has a heavy impact on those living in poor quality housing and in informal settlements often found in areas prone to natural disasters.

The fog over the solution to pollution

The ambient air concentration of particulate matter in most Asian cities now exceeds World Health Organization's (WHO) health and safety norms—often by dramatic margins.[56] But the trends differ. In some cities, industry-related pollutants are decreasing while transport-related pollution is growing rapidly in others. This is true in Japan, in North Asian cities like Beijing and Shanghai, and in Southeast Asian cities that include Ho Chi Minh City, Jakarta, and Manila.[57] In many large cities, however, industry is steadily relocating to the periphery or beyond city limits, with the net effect being improved air quality in city centers. Pollution moves to the suburbs. In addition, the relatively faster growth of the urban service sector in Asia will further reduce industry-related pollution or at least slow its rate of increase. One study reports evidence of consistent growth in the tertiary sector in 22 East Asian cities.[58]

Asian attempts to control air pollution have involved both demand- and supply-side approaches, including the burning of clean coal in the industrial sector, increasing the use of natural gas, developing mass public transport, and introducing regulations, fees, and targeted subsidies. The results have not been encouraging so far, with failures especially apparent in efforts to reduce demand. Overall institutional weaknesses, capacity constraints, inadequate

financing for infrastructure, and poor financial incentives for appropriate investment have all contributed to the lack of success. Meanwhile, the problems are becoming worse, particularly in cities with high energy demands, like those in the rapidly growing industrial centers of India, and the PRC many of which have resorted to increased use of coal, resulting in higher sulphur dioxide (SO_2) emissions.

Engendering responsibility: use the carrot or the stick?

Progressive thinking on how to encourage sustainable development is moving away from taxing businesses and people to charging those who pollute the environment. The aim is make consumers understand environmental costs. Other options include prohibition, regulation, and market mechanisms. Fuel duty in the United Kingdom (UK) provides one example where high taxes have failed to reduce emissions significantly, mainly because consumers are not given the incentives or alternatives that would convince them to leave their cars at home. Polluters-pay approaches to combating air pollution—where permits to pollute are issued, paid for, and are tradable—offer a possible alternative to prescriptive, static regulation but they require legislation at the national level and consistent enforcement locally.

Pollution can cross national boundaries and have transboundary impacts. Particulates from the PRC have been found in the US after crossing the Pacific. The effects of air pollution can be particularly widespread and impair the environments of cities that have kept their own houses in

[56] ADB. 2003. Manila.

[57] Institute for Global Environmental Strategies (IGES). 2004.

[58] Dhakal, Shobhakar, and Shinji, Kaneko. 2002. Urban Energy Use in Asian Megacities: Is Tokyo a Desirable Model? *Proceedings of the Workshop of IGES/APN Megacity Project on Policy Integration of Energy Related Issues in Asian Cities*, pp. 173–185.

The Stern Review

The Stern Review was tasked with taking the existing science on climate change and quantifying the economic costs and benefits of a business-as-usual (trend) scenario, compared with alternative proactive scenarios. The Review indicates that climate change is profoundly important and difficult to deal with. It concludes that action must be based on a very long-term strategy, whose benefits will be received substantially by future generations.

- What we do now can have only a limited effect on the climate over the next 40 or 50 years. On the other hand, what we do over the next 10 or 20 years can have a profound effect on the climate in the second half of this century and the next. Our actions over the coming few decades could create risks of major disruption to economic and social activity later in this century and the next, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be impossible to reverse these changes.

Global warming arises because of the build up in greenhouse gases (GHGs). But the rate of emissions is accelerating, and the level of GHGs could increase by 25% by 2035. Current trends are for a 2–3°C temperature rise within the next 50 years.

Modeling suggests a 50% risk of a temperature rise of +5°C by the end of this century.

- This would take humans into unknown territory. Such changes would transform the physical geography of the world… and must have powerful implications for the human geography—where people live and how they live their lives.

Nevertheless, the Review's record has a positive conclusion: Much of the risk can be reduced through a strong mitigation policy. With strong, deliberate policy choices, it is possible to "decarbonize" both developed and developing economies on the scale required for carbon stabilization, while maintaining economic growth in both.

- Stabilization—at whatever level—requires that annual emissions be brought down to the level that balances the earth's natural capacity to remove GHGs from the atmosphere. The longer emissions remain above this level, the higher the final stabilization level.
- The current evidence suggests aiming for stabilization somewhere within the range 450–550 ppm CO_2e. Preliminary work suggests that if the target were within this range the social cost of carbon would be in the region $25–30 per ton of CO_2—around one third of the level if the world stays with business as usual scenario. Stabilization at 450 ppm CO_2e is already almost out of reach, given that we are likely to reach this level within 10 years and that there are real difficulties of making sharp reductions required with current and foreseeable technologies. Costs rise significantly as mitigation measures become more ambitious or sudden. Efforts to reduce emissions rapidly are likely to be very costly.
- An important corollary is that there is a high price of delay. Delay in taking action… would make it necessary to accept both more climate change and eventually, higher mitigation costs.
- Policies to cut GHGs include: reduce the demand for emissions-intensive goods and services; increase efficiency, which can save money and emissions; take action on nonenergy emissions, such as avoiding deforestation; and switching to low-carbon technologies for power, heat, and transport. The main policy components are carbon pricing that is considered essential, policies to promote low-carbon and high-efficiency technological innovation, and actions to remove behavioral barriers to change. Adaptation policy "is crucial for dealing with the unavoidable impacts of climate change, but it has been underemphasized in many countries. Adaptation is the only response available for the impacts that will occur over the next several decades before mitigation measures can have an effect. Adaptation efforts in developing countries must be accelerated and supported, including through IDA …. The poorest developing countries will be the earliest and hardest hit by climate change, even though they have contributed little to causing the problem.

"It is still possible to avoid the worst impacts of climate change; but it requires strong and urgent collective action. Delay would be costly and dangerous." *The Stern Review* explicitly states that the forecasts are "heroic" and very uncertain. Their value is in providing a sense of possible scale and strategic risks. Their recommendation is, in effect, that governments should invest today to insure against a possibly catastrophic future.

CO_2e = carbon dioxide equivalent, IDA = international development assistance, ppm = parts per million.

Source: Stern, Nicholas. 2006. *The Economics of Climate Change—The Stern Review.* Cambridge, UK: Cambridge University Press.

order, as Hong Kong, China and Singapore have discovered. This phenomenon will pose a growing threat if Asian consumption patterns do not change.

Pollution and poverty: twin challenges to health

Poor environmental conditions are directly responsible for about 25% of all preventable ill health in the world today. Two thirds of those affected are children.[59] They fall ill because of a lack of essential environmental resources—chief among them, sufficient clean water, food, shelter, fuel, and air. People are also made sick when exposed to hazards in the environment. Many diseases are linked to environmental problems like polluted drinking water, foul air, poor waste disposal, and the presence of mosquitoes and other carriers of disease. Changes in the way people live and work can also cause a sudden increase in old diseases and the emergence of new ones. Overcrowding and industrialization affect the health of millions in the developing world. The emergence of 30 new diseases in the past 20 years, including human immunodeficiency virus (HIV), Ebola, and hemorrhagic illnesses, has become a growing public health issue. Tobacco use now kills over 11,000 people a day worldwide.

Poverty in°uences people's health because it largely determines an individual's environmental risks, as well as the person's ability to access resources to deal with those risks. Many in the poorest countries live in conditions that imperil their health through steady exposure to biological pathogens in their immediate environment. More than 500 million people in Asian cities lack adequate shelter or acceptable housing. Safe water is unavailable to 700 million in these cities, and 2 billion of their people have no access to adequate sanitation. All these basic needs are essential for good health.

Asia's sprawling slum settlements suffer severe environmental and health problems. Garbage collection is often nonexistent and drainage tends to be poor, creating ideal conditions for insects and other disease vectors. Overcrowding increases the risk that disease will spread. Our cities' poorest people, who are often excluded from the benefits of emerging prosperity, may also face a disproportionate share of health risks related to economic growth. Urban slums may be located near major roads, factories, or dumpsites, exposing residents to higher levels of air pollution or to the risks of industrial accidents.

[59] World Health Organization (WHO). 2005. *New WHO Data Review Cost of Air Pollution to Human Health*. Virginia, US: EIN Publishing Inc.

Billion dollar bills for bad air

The economic, health, and other costs of environmental degradation are already high. The cost of air and water pollution in Jakarta probably exceeds $1 billion a year, while in Bangkok it is more than $2 billion. Costs in Asia's other large cities are comparable. They are rising as safety thresholds for a large number of pollutants and poisons are exceeded in increasingly large geographic areas.[60] According to *Science* magazine, exposure to air pollution affects "death rates, hospitalizations and medical visits, complications of asthma and bronchitis, days of work lost, restricted-activity days, and a variety of measures of lung damage."

A WHO study of Austrias France, and Switzerland found that their health costs because of traffic pollution amounted to approximately 1.7 % of gross domestic product (GDP), dramatically more than the cost of treating injuries from traffic accidents.[61] The rapid growth in vehicle ownership makes ozone more of a risk in highly motorized cities. More information is becoming available on the economic impact of air pollution and it is now widely believed that it can amount in negative terms to some 2–4% of GDP.

In Canada, the province of Ontario estimates that air pollution costs its 12 million residents at least $1 billion annually in hospital admissions, emergency room visits, and worker absenteeism.[62] And the World Bank reports that in the PRC—home to some of the most polluted air in the world—the deaths and illnesses of urban residents because of air pollution cost an estimated 5% of GDP. [63]

[60] Brandon, Carter, and Ramesh Ramankutty. 1994. As Asian Urbanizes, Pollution Problems Grow Even More Urgent. *International Herald Tribune*. 4 January.

[61] CNN. 2000. Traffic Pollution Kills Thousands Every Year. September.

[62] Ontario Medical Association. 2000. *Illness Costs of Air Pollution in Ontario*. Toronto, Canada.

[63] Sheram, Katherine, and Tatyana P. Soubbotina. 2000. *Urbanization and Urban Air Pollution, Beyond Economic Growth*. Washington, DC: World Bank.

Polluting cities make nasty neighbors

Air pollution in Asian cities is not only a health hazard for the local residents but also impacts upon areas far from the source. Air pollutants can travel over long distances, often more than 1,000 kilometers (km). Recent studies show the complex interlinkages of air pollution, haze, smog, ozone, and global warming. A good example of air pollutants raveling great distances is the transboundary movement of lead particles in the air emitted by industries and motor vehicles where leaded fuels are still used. Scientists have established that the levels of lead in the air in Greenland increased steadily until the 1970s when unleaded petrol and environmental regulations were introduced to limit the emissions of heavy metals by industries.[64]

Growth of Vehicle Ownership in Selected Asian Cities

City/Country	Type of vehicle	Period	% growth per annum	Doubles every ? years
Manila	Private		12	6
Malaysia	Car	1985–1995	8	9
Bangkok			33	3
Seoul			20	4
PRC	Light duty vehicles	1990–1997	20	4
India			8	9
Nepal			14	5
Pakistan			6	12
India	Car	1992–2004	12	6
	Motorcycle		22	4
	Scooter/ moped		(2)	n.a.
	All vehicles		11	7

( ) = negative value, n.a. = not available, PRC = People's Republic of China.
Source: ADB. 2001. Urban Transport Policy Paper. Manila; and ADB. 2006. Climate Change Mitigation in the Transport Sector Conference.

[64] Kante, Bakary. 2004. Local Capacities for Global Agendas; Impact of Cities on the Global Environment. Presentation in the Second World Urban Forum Dialogue on Urban Sustainability, 15 September. United Nations Environment Programme (UNEP).

There is major concern in Asia over the problems of cross-boundary pollution, including the haze that regularly affects Malaysia and Singapore because of forest burning in Indonesia. The haze of industrialization mars all city environments at various times of the year; much of this comes from other cities and industrial areas that are often in another country. Water pollution also travels. A recent example is the discharge of hazardous waste and chemicals into northern PRC rivers that °ow into the Russian Federation. Cross-border coordination and concerted action are clearly needed.

Facing Up to City Responsibilities

Cities are key participants in implementing the Montreal Protocol and the Vienna Convention—multilateral environmental agreements signed by national governments to reduce the emissions of substances that destroy the ozone layer, especially chloro°uorocarbons (CFCs) used in refrigerators and cooling equipment. Although cities were not directly involved in developing these international agreements, national government plans developed to implement their commitments had to include actions to be taken at the local level. In Europe, for example, local governments were asked to set up systems to collect old refrigerators separately from other wastes. It is likely that there will be similar pressure on Asian cities in the near future.

Motor vehicles: Shapers and stranglers

Rapid urbanization, frequent urban sprawl, and growing vehicle ownership and use have led to worsening congestion, with its attendant impacts of pollution, environmental degradation, and declining quality of city life. The consumption of oil-based fuels has increased rapidly, together with the generation of GHGs. The stabilization of urbanization, the private vehicle °eet, congestion, pollution, energy consumption, and emissions of GHGs—let alone their reduction—appears out of reach. Yet decision makers are increasingly advocating their reduction. This situation is unacceptable and a way forward must be found. The solution is to promote development with green, high-density urban areas that are integrated with effective public transport.

The rapid increase in vehicle ownership has strongly in°uenced urban form. It has led to the construction of elevated highways and resulted in urban sprawl and neglected city centers. Relatively low population densities

have hampered the development of cost-effective, high-quality mass transit systems.

Motorization has come at the expense of nonmotorized transport (NMT), such as walking and cycling. This, in turn, has contributed to the loss of public space and the human form of the city. Without restraints on the use of motor vehicles and energy, continued urbanization will make Asian cities even larger emitters of GHGs in the next 20 years.

Mode Share of Urban Transport in Selected Developing Cities

City	Mode share (%)		
	Non-motorized transport	Public transport	Private motorized vehicles
Ahmedabad (2002)	60	30	10
Bangalore (2002)	56	37	7
Bangkok (1999)	60	30	10
Beijing (1999)	71	24	6
Chengdu (2003)	74	10	16
Chennai (2002)	47	43	10
Delhi (2002)	39	42	19
Dhaka (1996)	65	25	10
Guangzhou (2004)	73	19	8
Ha Noi (1995)	54	4	42
Hong Kong, China (1999)	17	74	9
Hyderabad (2002)	45	36	19
Jakarta (1999)	22	36	41
Kolkata (2002)	16	79	5
Kuala Lumpur (1999)	17	26	58
Manila (1999)	18	54	28
Mumbai (2002)	21	60	19
Seoul (1999)	20	60	21
Shanghai (2002)	58	29	13
Singapore (1999)	22	56	22
Tianjin (2004)	87	10	3
Tokyo (1999)	22	49	28

Sources: World Business Council for Sustainable Development (WBCSD). 2001. *Mobility 2001: Mobility at the end of the twentieth century and its sustainability.* Geneva: WBCSD; and Vasconcellos, E. 2001. *Urban Transport, Environmentand Equity: The Case for Developing Countries.* London: Earthscan.

Cars at the crossroads?

There is growing awareness that the rapid increase in the number of vehicles cannot continue. There is not enough road space to accommodate all the vehicles that Asians can afford to buy and use on their daily commute, and neither can enough new road space be built. Over the last 10 years, many Asian cities have focused on the construction of rail-based urban mass transit systems in the form of subways or light-rail systems. But many city authorities have concluded that they can neither build these systems fast enough nor afford to construct and maintain them. More cities are now considering bus rapid transit (BRT) systems as a more cost-effective alternative that can reach much larger groups of the population. For example, Jakarta will have seven BRT corridors by the end of 2007 and 10 by end of 2008. This rapid expansion would not be possible with rail-based solutions. Associated with BRT growth has been a new interest in NMT. In the PRC, the vice-minister for construction has gone on record on several occasions to plead with cities to maintain cycle paths or to reconstruct them. Seoul has removed over 7 km of elevated highway in the city center and restored its river while building a BRT system and promoting NMT solutions.

Cool image, but city living is hot, hot

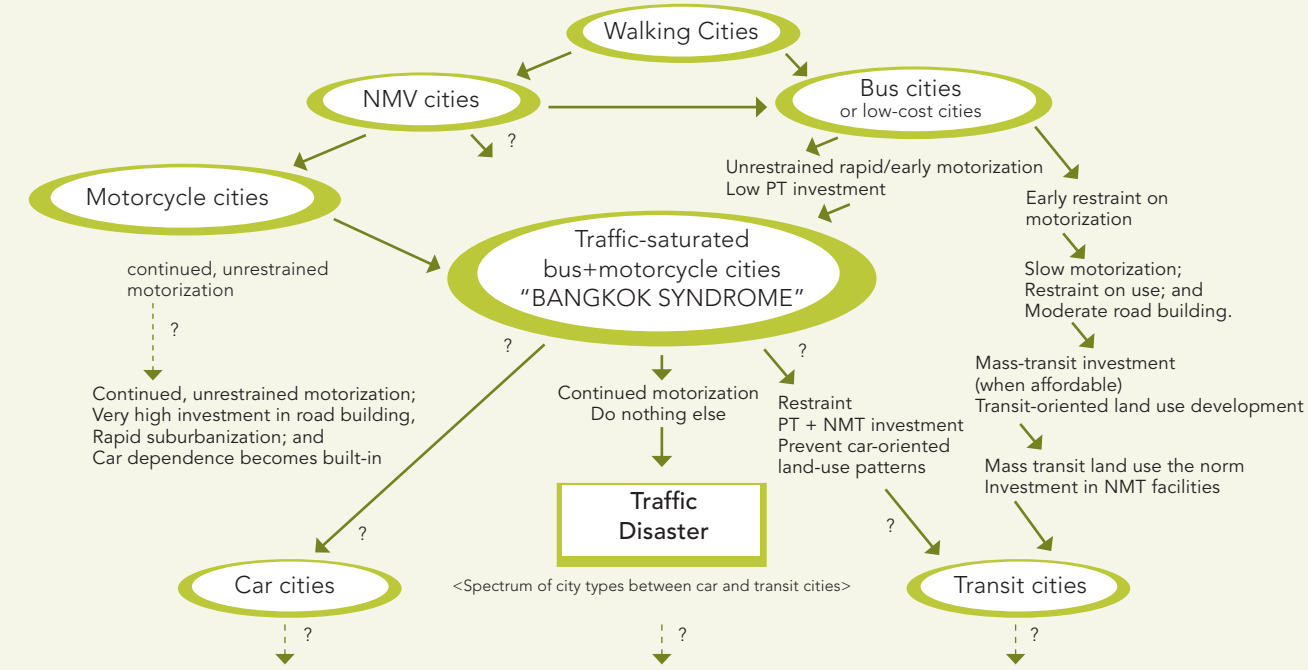
A wholesale rethinking of how cities are laid out is needed to reduce the use of private vehicles. How can new cities be planned in an energy-efficient way and how can existing cities be restructured to minimize the need for movement? One way would be to build cities with multiple centers where people live close to their work in high-rise blocks near public transport hubs, as in Singapore. Although living in high-rise blocks is, for some, at odds with living in harmony with nature, a study by Peter Newman and Jeff Kenworthy suggests this is not the case.[65] They found a strong inverse relationship between urban density and the amount of energy used by cars driving within city limits.

The energy use for transport is far higher in a sprawling city like Houston than in more compact, low-rise cities like London or Copenhagen. Increasing density does produce another problem, however; dense development heats the surrounding air. Stone, concrete, and asphalt absorb more and re°ect less solar energy than natural surfaces such as grass, water, and trees. Vehicles, air conditioning, and electrical appliances also give off heat, while tall buildings cut down winds that can disperse the heat. So cities are usually about 1°C warmer than the surrounding countryside during the day and can be up to 6°C warmer at night.

The denser the city is, the worse the effect. In hot climates, where many super-dense megacities of the world are found, air-conditioning is used to keep indoor temperature bearable. On a hot day in many of these cities, air-conditioning can consume more energy than any other single activity. To cut this

[65] Newman, Peter, and Jeff Kenworthy. 1999. *Sustainability and Cities: Overcoming Automobile Dependence.* Washington, DC: Island Press.

Transport Development Paths and City Typology

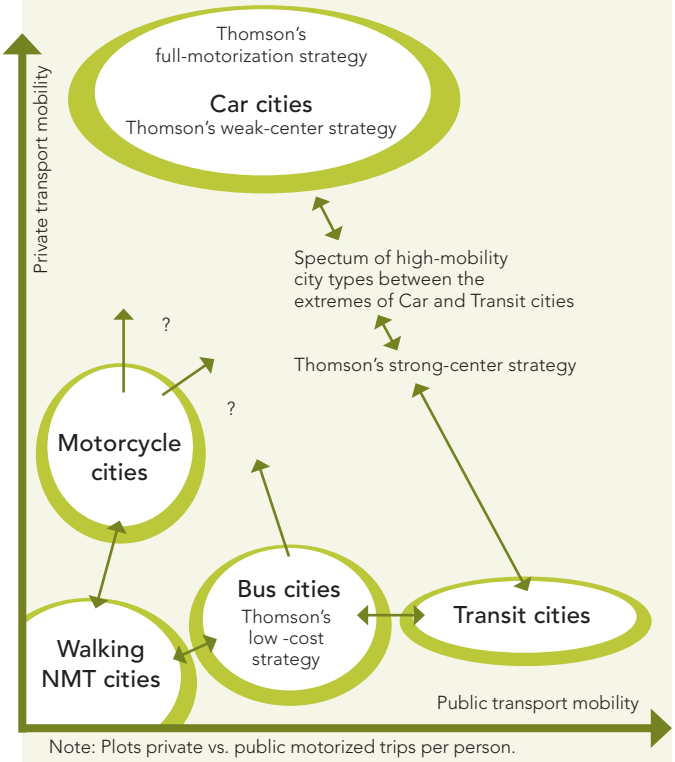


Note: Shows intended or potential transport development paths for developing cities.
NMT = nonmotorized transport, NMV = nonmotorized vehicle, PT = public transport.
Source: Barter, P.A. 1999. *An International Comparative Perspective on Urban Transport and Urban Form in Pacific Asia.* Institute of Sustainability and Technology Policy, Murdoch University, Perth.

huge use of energy, many cities are taking steps to counter the heat-island effect by redesigning buildings to reduce direct sunlight through windows, increase ventilation, cool the air with water fountains, and cut energy absorption by painting external walls white. Planting trees along the streets can help reduce the air temperature, too. In Miami, researchers found that summer electricity bills were around 10% lower in neighborhoods with more than 20% tree cover than in neighborhoods with none. Urban areas in the Netherlands have demonstrated that cities without extensive high-rise buildings can still be dense enough to make life without a car possible, and that they can retain the economies of scale needed for efficient infrastructure provision, public buildings transport, energy use, and recycling. In addition, they can offer people a wide variety of lifestyle choices. The key is to put both people and ecology first.

There is this broad consensus that urban transport policy is intimately linked with urban development outcomes. It affects a wide range of environmental, social, and economic issues at global, national, and local levels. These outcomes determine the sustainability of an urban area. Barter's typology of cities, and the concept of choices—cities always have choices—and of transport development paths is compelling and provides a strong framework and focus

City Typologies



Note: Plots private vs. public motorized trips per person.
NMT = nonmotorized transport.
Source: Barter, P.A. 1999. *An International Comparative Perspective on Urban Transport and Urban Form in Pacific Asia.* Institute of Sustainability and Technology Policy, Murdoch University, Perth.

for debate. There is strong consensus that, in principle, sustainability requires the development of compact or smart cities—"transit cities," in Barter's terms.

These cities have strong central business districts and other subcenters. There is a clear conclusion that early restraint and an improved bus system achieved by introducing competition, innovation, and priorities—possibly including BRT—are critical to the transition from a "bus city" to a "transit city." What is necessary is to anticipate and plan for urban expansion.

Urban areas need an increasing supply of natural resources and these are brought in from surrounding rural areas. This can have a positive impact since cities provide facilities, services, and jobs, and have been a driving force behind rural development. In some countries, such as Indonesia, much of the increase in rural incomes has come from nonfarm or urban employment. But the urban demands on rural areas also result in environmental pressure. Resources are depleted and pollution finds its way into the countryside. Growing cities can encroach on agricultural land and overtax natural waste sinks, such as rivers and air sheds. As urbanization increases, resources need to be sourced at longer distances from the cities, and rural areas will increasingly be drawn under the direct in° uence of cities. Managing the fringes of urban areas is also a major challenge.

Control the fringe, sustain the city

The scale of the urban fringe problem is large and growing. The urban population of East Asia is expected to increase by an average of 21 million every year between 2006 and 2030, with an annual increase of 17 million in the PRC, 1 million in Viet Nam, and 0.2 million in the Philippines. Most of this growth will be accommodated on the urban fringe. Yet neither markets nor governments provide the right incentives for sustainable development in these areas. The consequences of this failure are large and many, including the proliferation of unserviced informal settlements, development that leaves existing residents worse off, encroachment on environmental areas, and even more pollution. The circumstances vary sharply between countries. For example, the PRC's rapid growth, strong institutions, and proactive approach to urbanization are different from conditions in the Philippines, where there is a general lack of effective planning control or direction. In the latter case, development happens largely because of market forces and is particularly in° uenced by the development of major roads

and trunk water supply.[66] The issue is not so much a lack of understanding by governments, but their priorities and efforts. These determine outcomes.

The sustainable development of fringe areas is important for virtually all developing cities. The issues are complex in some respects, and so are the solutions. They concern the balance between market forces, government capacity to intervene effectively, and market failure, which is manifest in marginal settlements that are poorly serviced and in problems that can also affect middle-income households. The sustainable development of fringe areas requires a package of measures that includes land management, adequate infrastructure, environmental protection for sensitive areas, pollution reduction, and safeguards for the rights of existing occupiers. On the other hand, the requirements for transport intervention—given a general idea of where growth should occur—are usually obvious, in° uential in achieving desired growth patterns, and achievable.

First decision: Private or public transport?

Peter Hall[67] suggests that:

- Servicing land and the building of transport infrastructure are the two most important tools with which to guide the pattern of urban development, especially in developing Asian cities where direct urban planning controls are weak. In conditions of pervasive congestion, any new infrastructure tends to have a major in° uence on urban form. If the aim is to foster an urban form suited to public and nonmotorized transport, then their infrastructure must be used to guide development, and not just roads. Trying to first build roads and leaving the public transport until later will tend to shape the city around private vehicle

[66] World Bank. 2006. *East Asia and Pacific – Sustainable Development of the Urban Fringe*. E-mail Report by Halcrow. USA.

[67] Hall, Peter. 1983. *The World Cities*. World University Library. London: Weidenfeld and Nicholson.

use and make the tasks of installing public transport and changing travel behavior more difficult. In low-income cities, the public transport and NMT infrastructure need not be capital intensive. The important thing is that these modes receive priority in capital spending.

Almost all Asian cities experience that transport is important in guiding and structuring fringe area development. Major road construction stimulates the development of private sector land development—mainly for upmarket housing and industry. But without a complementary road network this results in ribbon development—of the kind that extends along the main radial roads 60 km out of Bangkok, for example. As traffic and congestion on the main radial road increases, private sector expressways may reinforce this trend. Conversely, where major roads are not built, development takes place at a much slower and less intense level, if at all. Where a road network is built, as opposed to a single main road, development of large land areas occurs and is more efficient than ribbon development.

Public transport is essential for those without a car, particularly low-income and low middle-income households living at distances from the city and depending for employment on long, affordable journeys to the city. They need a competitive, efficient bus or busway system that keeps fares down and journeys within acceptable time bounds. Public transport generally and busways in particular are even more effective when they are established when major roads are developed, rather than retrofitted. Expressways may support bus transit in providing rapid bus journeys. It is government's role to plan, license, procure, and regulate such services.

Time for change in infrastructure and service delivery

The issues surrounding sustainable infrastructure and service delivery show that the status quo is not solving the problems. Nor is there a clear pathway to resolving the competing pressures that characterize sustainable provision of urban services, which are declining in many urban areas along with the level of infrastructure. This has serious implications. Water, sanitation, and wastewater treatment and disposal are critical for sustainable development. Solid waste management also presents an increasingly complex problem and has significant impacts on both public health and GHG emissions.

Water supply and sanitation are inadequate for one in two Asians

Many people in Asian cities have no access to adequate water and sanitation services. ADB's Asia Water Watch 2015 indicates that 361 million people in the urban areas of Asia do not have access to adequate sanitation. Although the absolute number of people in the urban areas now served by some form of water supply has increased in recent years, the rate of coverage has dropped because of rapid urban population growth in the

Smart Growth and Sprawl

	Smart Growth	Sprawl
Emphasis	Accessibility—to goods, services, and activities	Mobility—physical movement, particularly by car
Density	Higher density, clustered activities	Lower density, dispersed activities
Growth pattern	Infill development	Urban periphery (greenfield) development
Land use mix	Mixed	Single use, segregated
Public services	Local, distributed, smaller, walking access	Regional, consolidated, larger, requiring car access
Transport	Multimodal transportation and land-use patterns that support walking, cycling, and public transportation	Car-oriented, poorly suited to walking, cycling, and public transportation
Connectivity	Highly connected roads, pavements, and paths allowing more direct travel by motorized and nonmotorized transport modes	Hierarchical road network with many unconnected roads and walkways, and barriers to nonmotorized transport
Street design	To accommodate a range of activities, with street calming	Designed to maximize vehicle throughput
Planning process	Planned and coordinated between jurisdictions and stakeholders	Either unplanned/little coordination, or planned (e.g., US)
Public space	Emphasis on streetscape, pedestrian areas, public parks, and public facilities	Emphasis on the private realm—of shopping malls, gated communities, private clubs

Source: ADB. 2007. Environment and Transport Background Paper, *Managing Asian Cities Study. Manila.*

Pacific, East and North East Asia, Republic of Korea, and has remained constant in Southeast Asia (see table below). But there is a high degree of variability in the coverage and availability of water supplies across major cities in Asia. In Pacific coastal cities of the PRC, and Republic of Korea the coverage is nearly 100% and water is available 24 hours a day. This contrasts sharply with Southeast and South Asian cities. The coverage in Jakarta is only 27% and availability is 18 hours a day, while in Chennai, coverage is 97%, but water is available only 4 hours a day. About half of Asia's people do not have adequate water supply and sanitation. In most cities, 90–100% of the population are within 1 km of a standpipe or public well, but these facilities are often shared by many. Official statistics often overstate the level of provision of water and sanitation. Coverage in Mumbai, for example, is cited as 100% although many low-income neighborhoods have long lines at water points and only irregular supplies of poor quality water.[68] Detailed figures of coverage of water supply and sanitation are shown in the table below. There have been some improvements in the proportion of those with household water connections in East, Southeast, and Central Asia. Sanitation coverage has shown modest gains or has remained static. Asian cities face major challenges to provide adequate water supply and sanitation facilities to low-income areas and informal settlements, which make up the bulk of unserviced areas.

Ensuring appropriate sanitation is essential to promote sustainability. Many of Asia's major cities do not have extensive waterborne sewer systems and rely heavily on septic tanks and latrines for waste disposal. Only about 40% of household sewage is treated prior to disposal and it often undergoes only primary treatment.[69] Most sewage is discharged untreated into urban drainage, river systems, or the ocean. In the PRC, for example, only 16% of wastewater is treated[70] while in Bandung the figure is 23%, in Penang, 20%, and in Karachi, 10%.[71] Other cities enjoy a high percentage of wastewater treatment, 83% in Bangalore, India, and 70% in Chiang Mai, Thailand, but the efficiency of the treatment plants is often very low. The challenge of improving treatment facilities to reduce pollution of water courses and avoid further environmental degradation will require massive investments in urban sewer systems.

Drinking Water and Sanitation Coverage in Urban Areas, Asia and Pacific, 1990 and 2002

Region	Water Supply						
	Percentage Coverage (%)				Unserved Population (Millions)		
	1990		2002				
	Total Access	Household Connections	Total Access	Household Connections	1990	2002	Increase, 1990 to 2002
East & Northeast Asia	99	85	94	92	1	40	39
North & Central Asia	96	86	98	90	5	2	(3)
Pacific	100	93	99	92	0	0	0
South & Southwest Asia	90	56	94	54	35	24	(11)
Southeast Asia	91	37	91	45	13	19	6
Total	95	70	94	73	54	85	31
Region	**Sanitation**						
	Percentage Coverage (%)				Unserved Population (Millions)		
	1990		2002				
	Total Access	Sewer Connections	Total Access	Sewer Connections	1990	2002	Increase, 1990 to 2002
East & Northeast Asia	71	28	73	43	128	163	35
North & Central Asia	92	83	90	84	12	12	0
Pacific	99	77	98	75	0	0	0
South & Southwest Asia	58	29	69	27	144	147	3
Southeast Asia	67	6	79	7	44	39	(5)
Total	70	33	75	37	328	361	33

( ) = negative value.
Source: ADB, United Nations Development Programme, World Health Organization, UN Economic and Social Commission for Asia and the Pacific Asia. 2005. *Water Watch 2015*. Manila.

[68] Bapat, Meera, and Indu Agarwal. 2003. Our needs, our priorities; women and men from the slums in Mumbai and Pune talk about their needs for water and sanitation. *Environment and Urbanization*, Vol. 15(2).

[69] ADB. 2001. *Cities Data Book*. Manila.

[70] Song, L. 1997. *Physical and Chemical Wastewater Treatment*. Hong Kong, China.

[71] UN-Habitat. 2003. *Overview of Urban Environmental Management in Asia*. Washington, DC.

Poor Quality Water is Costly to Society

The cost to society of poor quality water has generally been estimated with reference to the health effects and environmental costs of polluted water. This method computes the benefits of a good quality water supply as time savings, health, and other closely related benefits. The World Health Organization's (WHO) *Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level,* by Guy Hutton and Lawrence Haller (2004)[a] reviewed many urban and rural water supply and sanitation interventions and concluded that, in achieving the Millennium Development Goals (MDGs) for water supply and sanitation in developing regions, the return on a $1 investment would be on the order of $5–28. This return was achieved whether the interventions were for both water supply and sanitation, or for sanitation improvements for those already having improved water supply, or vice versa. The database used in this analysis was comprehensive, with analysis based on data generated from over 50 countries in all developing regions. Similar analysis carried out by Water Aid[b] refers to WHO estimates that 5.6 billion working days and 443 million school days would be gained by universal access to safe water and sanitation. While also concluding that the attribution of wider benefits of water supply and sanitation is not a straightforward matter, it estimates that for a range of water supply and sanitation investments, returns of between $2 and $52 are made for every $1 invested, the result only of the time savings and better health that such investments generate.

Other research confirms that the greatest measurable benefits from water supply and sanitation improvements are in employment time savings, largely because of reduced incidence of diarrheal diseases. Rijsberman[c] reports that more than 4 billion cases of diarrheal diseases are reported each year, with between 1 and 2 million deaths annually. Thus, the burden of disease associated with poor water supply, sanitation, and personal hygiene has been estimated at 82 million disability-adjusted-life-years (DALYs) annually. Taking a low valuation of $500 per day, the total economic cost amounts to $40 billion annually.[d] However, this figure is highly dependant on the valuation of the DALY.[e] Rijsberman also provides estimates of total investment and recurrent costs for water supply ($1.8 billion) and sanitation ($9.3 billion) to achieve the MDGs. These are estimated to generate benefits of $54 billion—a benefit/cost ratio of almost 5. Again, the major benefits are derived from time measurements—less time (and lives) lost from being sick, and less time spent caring for sick babies and infants. This implies a net present value (NPV) of $400 billion at a discount rate of 5%, but still leaves half of population unserved as of 2000 without safe water and sanitation access. Providing all with water supply and sanitation would generate an NPV estimated at $600 billion. Work in Delhi[f] indicates that a long chain of beneficial consequences is initiated by water supply improvements. These involved complex relationships between the time saved in obtaining water, the health benefits, and thus further time savings, and the impact on personal hygiene, food preparation, etc. The average cost to a household of illness caused by poor water quality and poor sanitation based on health expenses alone is estimated at 143 rupees (Rs) per month for poor families, or about 3.5 % of household income.

Sources and Notes:

[a] Hutton, Guys, and Laurence Halter. 2004. *Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level.* WHO, Geneva. Available: www.who.int/water_sanitation_health/wsh0404.pdf

[b] Redhouse, David, Paul Roberts, and Rehema Tuaki. 2006. Every One's a Winner? Economic Valuation of Water Projects; Water Aid.

[c] Rijsberman, Frank. 2004. The Water Challenge, Summary of Copenhagen Consensus Challenge Paper. Copenhagen Consensus.

[d] Based on the data available, this suggests about 1% of gross domestic product (GDP).

[e] At the other extreme, in the United States, a life is frequently valued at $3 million. If this is converted to a DALY valuation of $40,000, the global economic cost of poor water supply, sanitation, and hygiene becomes $3.2 trillion.

[f] Dasgupta, Purnamita. 2006. Valuing Health Damages from Water Pollution in Urban Delhi, India: A Health Production Function Approach. *Environment and Development Economics,* 9: 83–106.

Inefficiency and waste are key problems

The major barriers to achieving greater coverage and sustainability of water supply and treatment in Asia include serious capacity problems arising from extensive operational and management inefficiencies. Very low tariffs often act as inequitable subsidies and encourage users to waste water.[72] Asia also suffers from major under-investment in this infrastructure compared with other areas of the world.[73]

[72] McIntosh, Arthur C. 2003. *Asian Water Supplies: Reaching the Urban Poor.* Manila: ADB.

[73] WHO and United Nations Children's Fund (UNICEF). 2000. *Global Water Supply and Sanitation Assessment Report 2000.* The share of water supply and sanitation as a percentage of total infrastructure investment is lower in Asia than in other regions of the world; 3.6% in Asia compared to 5.3% in Africa and 9.3% in Latin America and the Caribbean.

Although city sewage systems have prevented the transmission of diseases, particularly in developed countries, the lack of sewage treatment in many Asian cities is severely damaging ecosystems and water resources. This not only affects the immediate environment and the availability of water resources, it allows the transmission of infectious diseases, which have a global economic impact that was recently estimated at $10 billion per year.

Keep water flowing around the clock

Issues of resource availability raise the question of whether a constant supply of water 24 hours a day and 7 days a week (24/7) is an achievable and sustainable goal. This is often the stated aim of system improvements but is it the most cost-efficient way forward when water scarcity exists? Existing networks are often complemented by rival systems or investments that have enabled customers to survive using intermittent and low-pressure supplies. The poor often rely on water vendors, for instance, while the more affluent construct storage reservoirs or install pumps to supply elevated reservoirs or to draw directly from the main source. Rather than striving to provide 24/7 water supply, which would require unaffordable investments, should we seek to optimize the use of existing investments within an improved system that would increase efficiency and bring down costs for the poor? The answer to this question will depend on the circumstances of a particular city, but the aim must be 24/7 supply. Intermittent supply damages networks, encourages contamination through infiltration, and makes metering useless.

Local Circumstances Contribute to Water Shortages

Case studies show that changing local circumstances can contribute to water shortages despite relatively plentiful supplies. In Beijing, groundwater levels are dropping as water withdrawals exceed aquifer recharge rates, and most groundwater is contaminated. Meanwhile, agriculture around the city has shifted toward higher-value, more water-consuming products, becoming a major water user and contributor to water pollution. Water stress requires a regional response through which agriculture, as well as industry, the power sector and residential and commercial areas, must become more efficient in using freshwater and reducing water pollution. In Andhra Pradesh, India, during the dry year of 2002, the groundwater supply to the city of Chitoor dried up completely. All of the city's water had to be trucked from a distance of 50 km. Because of the immense cost of this operation, the state government at one point considered evacuating all of the city's 70,000 people until the monsoon rains brought respite and recharged depleted aquifers.

Source: Vaux, Henry. 2004. *The Water Challenge—Opponent's Views.* Copenhagen Consensus.

Is water scarcity a legitimate concern?

There is debate over whether sufficient freshwater resources are available for all needs. Some argue that the problem is one of unequal distribution and that the poor lack the political and financial capital to ensure that water is made available to them. Others believe there is a scarcity that is demonstrated by groundwater depletion and rapidly drying rivers and lakes. Groundwater—responsible for one third of world supply—is used almost everywhere, and most critically, is exploited for most potable supplies in India. Literature on water stress generally assumes that water scarcity is at the root of problems.[74] But the countries facing greatest water stress are not necessarily those with the greatest inadequacies of water. Many large cities where provision is inadequate have little or no overall shortage of freshwater resources.

The greatest threat to groundwater as a usable resource is overuse that does not allow for regeneration. Water tables are falling virtually everywhere—a problem that is particularly serious in large areas of India and the PRC. The depletion issue is often addressed by deepening wells and building additional surface water storage and facilities for recharge and water harvesting. This is expensive, however, and it provides only a temporary respite without effective controls

[74] International Institute for Environment and Development. 2003. *Water and Sanitation: What will deliver the improvements required for urban areas? Environment and Urbanization Brief* (8). London: Russell Press.

over extraction and the reduction of resource use through recycling.[75]

Sewage: A looming deluge

Cities can devastate water bodies, rivers, lakes, and coastal areas. Approximately 60% of the world's population lives within 100 km of the coast, an area that accounts for only about 25% of the land mass. By 2025, the majority of Asia's largest settlements will be coastal megacities. Many coastal cities discharge their sewage, industrial effluent, and other wastes into rivers and oceans. Few Asian cities have adequate sewerage systems and the ones they have are often limited to economically advantaged areas. Only an estimated 35% of all wastewater in Asia is treated, and adequate treatment is rare. Worldwide, two thirds of the sewage from urban areas is pumped untreated into lakes, rivers, and coastal waters. If no action is taken, these discharges will grow along with populations, channeling ever greater amounts of untreated wastes that contain nitrogen and phosphate into the sea. This has created dead zones in some coastal areas—areas with too little oxygen in the water to sustain the original flora and fauna.

Construction along shores and rivers, deforestation—especially the cutting of mangrove forests—and erosion cause the run-off of fine sediments into the ocean, either directly or through rivers. Singapore is a case in point. Its land area has been increased by more than 10% in the past 35 years. Sediment is continually stirred up by massive shipping traffic. This damages coral reefs and contributes to the global depletion of fish stocks. More than 90% of the world's marine harvest comes from coastal waters and much of it is brought ashore in cities where the fish are being sold.

[75] Vaux, Henry Jr. 2004. *Opponent note on water and sanitation.* Copenhagen Consensus Project of the Environmental Assessment Institute. Denmark.

Wastewater: overlooked and understated

The coverage of effective and environmentally satisfactory wastewater management systems in Asian cities falls well below that for household water supply. Much of the needed investment in sanitation and wastewater management is frequently diverted to further investment in providing water supply because:

- Water supply provides a tangible benefit, and thus enjoys political support, whereas sanitation does not, if the waste is removed from under people's feet.
- The negative impacts of inadequate sanitation facilities and/or poor wastewater disposal are often felt at points removed from the source of waste, or are so dispersed as to impact on the environment in ways that are not immediately obvious.

The costs of environmentally sustainable wastewater collection treatment and disposal are high and the solutions are technically complex. Crucial to success is introducing the polluter-pays principle that requires the costs of pollution to be borne by the polluter. This is achieved through a charge levied by volume, which is the most effective method when dealing with domestic sewerage, and, for industry, through insisting on on-site treatment to levels comparable to domestic waste before discharge into the sewerage system. In most developed cities, conventional sewerage and sewage treatment provides an acceptable means for the collection, treatment, and disposal of domestic and industrial wastewater. These systems were developed as cities grew. In many Asian cities, conventional sewerage systems were never installed in a comprehensive way, and to build them retroactively is both expensive and disruptive. This high cost has led many water and wastewater authorities to seek alternatives. For instance, the wastewater disposal strategy of Manila Water Corporation—one of the two private concessionaires for water and sanitation services in Metro Manila—is still emerging.

The original targets for wastewater service coverage have had to be renegotiated. Its current strategy involves an incremental approach and a combination of sewerage and sewage treatment, installation of a package plant for high-density developments, a system of septic tank emptying, and septage treatment for others. Even with this approach, the target is that only 30% of the service area population will be covered by sewerage and sewage treatment by 2010.

Object Lessons: When Communities Act on Sewer Systems

Where communities can afford to take matters into their hands, a more decentralized approach can provide quicker and possibly more affordable solutions. In Alandur, a suburb of Chennai in India, the local community was not prepared to wait until the water utility extended the sewerage network to their suburb. So the community, with help from the local government and support by the private sector, acted on its own. Similar efforts to provide community-level solutions to sanitation and wastewater management problems have been made elsewhere. One of the best known is the Orangi pilot project in Karachi, which succeeded in mobilizing communities to construct their own secondary and tertiary sewerage networks. While this got the waste out from under the feet of the poor, problems were encountered in linking Orangi to the existing sewerage network. As a result, wastewater from Orangi is now disposed of through the storm drainage network while intercepting sewers within the same catchments run empty. In South America, some success has been experienced in developing condominial and shallow sewerage systems, which involve the use of both interceptor tanks for solids settlement and shallow and small bore-flexible sewerage. These systems have proven generally successful in periurban areas and small towns but it is unclear why they have not found favor in larger cities or in other parts of the world.

Where extensive sewerage systems and some form of sewage treatment do exist, opportunities for effluent reuse are often ignored or neglected. If the utilities operating these systems lack the resources or technical capacity to realize the potential for resource recovery or effluent reuse, the private sector can be involved to provide a solution that improves operational efficiency, reduces demand on other parts of the system, and generates an environmental benefit. An example is the private operation of the Sindh Industrial Trading Estate sewage treatment plant in Karachi.

Source: ADB. 2007. Infrastructure Background Paper. *Managing Asian Cities Study.* Manila.

Deficient drains and fears of future flooding

The maintenance of city drainage networks is frequently neglected and capital investment for improving storm and surface water drainage is often seriously inadequate. This has a heavy impact on the living conditions of city residents, especially in low-income areas.[76] Many of Asia's cities and towns are vulnerable to floods, particularly those in coastal regions. This growing danger is exacerbated by upstream deforestation, the filling in of retention basins, and the effects of climate change. Of the world's 15 largest cities, 13 are on coastal plains. Many other cities will also face a severe risk of flooding if sea levels rise by one meter. Parts of Bangkok and Manila, for example, are below sea level. To prevent inundation in future, many cities will need to invest in extensive costal protection and flood-control systems.

Solid waste: A region-wide municipal headache

A number of countries in Asia have recently introduced solid waste management (SWM) legislation that seeks to provide a policy framework for dealing with the increasingly difficult problems associated with the handling, disposal, and recycling of municipal solid waste. India faces a jurisdictional problem: SWM is a local government responsibility and higher levels of government have little capacity to penalize those who do not comply with regulations. The Philippines' Republic Act 9003 that deals with SWM and recycling is visionary but, to a large extent, it has not been implemented so far. Some Asian countries have had greater success with efforts to legislate on issues relating to waste disposal, particularly minimizing waste. In the developed world, the EU's packaging legislation, designed to reduce the amount of packaging that has to be disposed of by placing greater responsibility for its reuse or disposal on producers, has been successful in reducing the amount of waste in landfills. There are now EU-wide targets in other areas designed to dramatically reduce waste by increasing reuse, recycling, or recovery. The overall sustainability of moves to increase recycling is a complex issue, however. For instance, a recent report on the UK government's recycling targets pointed out that some recovery processes used more energy than they saved, thereby raising GHG emissions.

The SWM sector appears to offer more opportunities than other environmental services for developing countries to avoid mistakes made by developed countries. Most Asian cities already have a strong informal waste recycling industry that can be harnessed to put

[76] Parkinson, Jonathan. 2003. Drainage and Stormwater Management Strategies for Low Income Communities. *Environment and Urbanization*, Vol. 15(2).

them ahead of many in the developed world in terms of minimizing waste, including recycling, reuse, and recovery. There is an opportunity to avoid duplicating the fate that befell the "rag-and-bone men" or junk dealers of the West, who were the equivalent of the ragpickers in many Asian cities today. These people were forced out of business because of overly zealous public health regulations and the move toward "wheelie bins," which discouraged householders from sorting and segregating waste and increased the amount of potentially reusable solid waste going to landfills.

Population growth, rapid urbanization, and intensified economic activity have combined to increase the volume of waste in Asian cities. In the cities of Japan, Malaysia, and Republic of Korea, the quantity of waste generated exceeds 1 kilogram per person per day, similar to that in the most developed countries. In the large cities of the poorer, developing countries of Asia, the amount is roughly half.[77] The composition of solid waste differs too. In wealthier countries, the waste is highly inorganic and nonrecyclable. In the cities of developing regions, solid waste is generally organic and recyclable.

After collection, where?

About 75% of solid waste generated in urban areas is collected, according to estimates, but less than 60% finds its way to a disposal site. Most Asian towns and cities use open dumps and only about 10% ends up in properly engineered and managed landfill sites. For most cities, disposal remains a serious problem, with finding suitable sites, appropriate technology, and finance for a citywide facility among the leading difficulties. Often, there are also issues over the public acceptance of such disposal facilities once they are found.

[77] IGES. 2001.

The Philippine Approach: Ecological Solid Waste Management Act of 2000

The Act adopts a systematic, comprehensive, and ecological solid waste management (SWM) program to ensure the protection of public health and the environment. It prescribes the use of environmentally sound methods that maximize the use of resources and encourage resource conservation and recovery. It sets guidelines and targets for solid waste avoidance and volume reduction through source reduction and waste-minimization measures, including composting, recycling, reuse, recovery, green charcoal process, and others, before collection. It also set targets and guidelines for treatment and disposal in appropriate and environmentally sound SWM facilities in accordance with ecologically sustainable development principles. The Act prescribes proper segregation, collection, transport, storage, treatment, and disposal of solid waste through the formulation and adoption of the best environmental practice in ecological waste management, excluding incineration. It promotes national research and development programs for improved solid waste–management and resource-conservation techniques, and a more effective institutional arrangement and indigenous and improved methods of waste reduction, collection, separation, and recovery. Greater private sector participation in SWM is encouraged, but primary enforcement and responsibility of SWM is with local governments, although the act establishes cooperative efforts among the national government, other local government units, nongovernment organizations, and the private sector. The approach aims to encourage cooperation and self-regulation among waste generators through the application of market-based instruments. Public participation in developing and implementing national and local integrated, comprehensive, ecological waste management programs is institutionalized. It further encourages the integration of ecological SWM and resource conservation and recovery into the academic curricula of formal and nonformal education to promote environmental awareness and action among the citizenry.

Source: Republic Act of the Philippines 9003, 2001.

Communities do not want them in their neighborhoods. Nevertheless, some cities are adopting the use of controlled dumps and partially engineered landfills, and composting and recycling are now receiving more attention.[78] Informal recycling is also important and between 5% and 25% of waste collected is recycled in this way,[79] although it generally involves manual sorting and the related health risks. Increasingly, it is undertaken with the help of the nongovernment sector. Many city collection systems that previously were inefficient now seem to be working much better, with many local governments contracting the services out. Because of its high cost and the fact that residual waste still needs disposal, incineration is usually not practiced, except for hospital wastes.

High cost, low support

In most cities, waste management suffers from weak institutional, regulatory, and financing capacities, and this is further exacerbated by poor communication as well as a lack of public participation.[80] Waste management services account for a high percentage of municipal budgets in many Asian cities. For some, expenditures on SWM can reach 40% of a municipality's operating budget, with 70–90% of this spending going to collection. Although recycling is promoted by some governments and private sector firms, these activities are usually limited and often not well supported by municipal authorities.

The challenge: To supply more than infrastructure

Providing adequate potable water and sanitation to growing urban populations is made more complex by the long history of imbalance of supplies and facilities between the rich and poor, and the underpricing of water, sanitation, and solid waste services, which have often been viewed as a social rather than an economic good. While the urgent need for improved water and sanitation services—particularly for the poor—remains a critical Millennium Development Goal, pressure on freshwater resources is increasing. This includes pollution from poor waste treatment and disposal practices. While adequate water supply, sanitation, and solid waste centers can be regarded as a fundamental right in modern urban society, providing them also requires complex administrative, management, financial, and regulatory structures that are heavily influenced by political considerations.

Cities provide opportunities to tackle water supply, sanitation, and waste management problems efficiently because of their economies of scale and density. The concentration of population and enterprises reduces both the capital and operating costs of the services. Geographically concentrated wastes are effectively dealt with more readily than dispersed wastes. Cities are wealthier than smaller centers of population and have a greater capacity to pay for these systems.

It is critical that cities regard water and wastewater treatment as an economic good, with a social element factored into the way the service is priced and is paid for by the urban poor. To achieve the transition from a social to an economic good, changes must be made to the institutional arrangements governing how water is supplied and wastewater is managed. These should focus on:

- promoting national water sector changes, emphasizing policy formulation and institutional reform;
- fostering the integrated management of water resources;
- improving and expanding the delivery of water and sanitation services;
- fostering the conservation of water and increasing system efficiencies;
- promoting regional cooperation and increasing the mutually beneficial use of shared water resources within and between countries;
- facilitating the exchange of water sector information and experience; and
- improving governance through promoting institutional reform, decentralization, and building capacity.

Basic elements for an efficient system

Although there is no one-size-fits-all solution for the sustainable development of infrastructure, there are some elements of water supply and sanitation provision that many consider are sine qua nons of a move toward more sustainable services. The first is for governments to change or modify their role from a service provider to a regulator. International experience has demonstrated that water supply and sanitation services are most efficient when delegated to autonomous and accountable service providers. These may be public, private, or cooperative agencies that provide water supply and, generally, sanitation services within a defined

[78] Enayetullah, Iftekhar, and Magsood Sinha. 1999. *Community-Based Decentralized Composting: Experience of Waste Concern*. Urban Management Program. Nairobi.

[79] Footnote 69.

[80] Ogawa, H. 1996. Sustainable Solid Waste Management in Developing Countries. Presentation in the 7th International Solid Waste Association (ISWA) International Conference and Exhibition. Yokohama, Japan; Zurbrugg, C. 2002. Solid Waste Management – Biological Treatment of Municipal Solid Waste. *SANDEC News* No. 5. Duebendorf. Switzerland.

Suburb Power: Public–Private Partnership in the Alandur Sewerage and Sewage Treatment Plant

Alandur is a 2,000-ha satellite town within the Chennai metropolitan area with a population of about 150,000. One quarter of its residents live in slums. It had no sewerage system and people used various forms of waterborne sanitation. Sewage and sullage flowed in open storm water drains and ended up as stagnant water in an area where the sludge from residential septic tanks was also dumped. This was hazardous to public health and contaminated ground water. The Alandur sewerage project was championed by the municipality in partnership with the community and the private sector. Its objectives were to:

- improve the standard of living of the residents of Alandur to a level matching that of the rest of Chennai;
- eradicate the mosquito menace and eliminate associated nuisance and health dangers;
- provide a basic facility to all the residents;
- avoid recurrent expenditures on septic tank cleaning; and
- prevent continuing groundwater contamination.

Infrastructure under the Alandur sewerage project included a conventional sewage treatment plant, pumping station, and a 120-km network of sewerage lines with a capacity of 24,000 cubic meters per day, which was sufficient to serve a population of 300,000. The pumping station was constructed on a build–operate–transfer (BOT) basis. The contractor was given a lease period of 14 years, including operation and maintenance responsibility for 5 years after construction on a fixed-fee basis. At the end of the lease period, the sewage treatment plant will be handed over to the municipality. The treated effluent is to be used for afforestation in open areas. A special feature of the project is its use of citizens' contributions. A one-time deposit of 5,000 rupees (Rs) was received from owners of residential properties, along with Rs10,000 from commercial and industrial establishments. To encourage people to contribute, publicity campaigns and discussions with community groups were organized. The project cost was Rs340 million, of which citizens' contributions amounted to Rs80 million. The balance was from other sources, including a loan from the Tamil Nadu Development Fund.

Source: ADB. 2007. Infrastructure Background Paper. *Managing Asian Cities Study.* Manila.

geographical area for an appropriate fee. In most instances, and particularly in larger cities, experience suggests that private sector or "strictly corporatized" initiatives are more likely to introduce market-oriented behavior which, subject to good regulation, will generate performance and efficiency improvements and improve service sustainability. However, in many smaller cities—particularly when technical and management capacities are weak and cost recovery is poor—innovative solutions involving public–private partnerships (PPPs) need to be developed.

Finding ways to improve affordability

In developing PPP arrangements, governments must balance the need to invest in the system with the consumers' ability and willingness to pay. Where affordability and/or macroeconomic stability are a concern, a stepwise approach should be considered. Many donor agencies and governments have begun to experiment with the concept of management contracting as a first step in the PPP continuum. Management contracts provide governments with an opportunity to bring private sector expertise to bear in improving utility management, the quality of system data, and initial efficiency. These can be valuable tools in preparing a water utility for a deeper level of private sector involvement in future.

PPP arrangements remain highly controversial and so there is need for a strategic approach to stakeholder consultation and communication. When employed properly, strategic communications can build stakeholder support and provide governments with valuable feedback on service quality, investment needs, and affordability. To be effective, communication and stakeholder consultation must begin at the earliest stages of formulation before key decisions are made and while stakeholders feel that their input will be meaningful.

Lessons learned from privatization

A 2004 World Bank report[81] that draws lessons from experience since 1984 with the reform and privatization of infrastructure utilities concludes that substantial benefits can be expected from the policy, although it has been oversold and misunderstood in the past:

- Infrastructure delivery, when undertaken by state-owned companies, was often inefficient. Under pricing was common and this meant that utility agencies were unable to finance the expansion of infrastructure.

[81] Kessides, Ioannis N. 2004. *Reforming Infrastructure: Privatization, Regulation and Competition.* Washington, DC: World Bank.

- There is no universal reform model. Results depend on the sector and will differ, for example, between telecommunications and water and sanitation. The approach will also depend on the country and the social environment involved. Telecommunications offers the most compelling case for privatization, while transport networks, electricity, and water supply are more problematic.
- Effective regulation is the most critical condition for reform, protecting the interests of both private investors and consumers. This is the only way to attract private funds toward infrastructure and to get social support for the reforms.
- It is essential that the regulatory authority has the correct information on the distributional impact of a reform. Often, this information is lacking.
- Privatization should follow restructuring and the introduction of competition. There is no point in privatizing monopolies. Privatizing for privatization's sake is not an objective per se, and privatization will work only within a competitive structure.

Starting with major consumers, the cities

Energy and energy services are critical for sustainable development. The ecological footprint method of assessing environmental sustainability shows that roughly half of global ecological demand is attributable to CO_2 from fossil fuels, and 55% is attributable to total energy use. Today, issues of energy security, the depletion of nonrenewable resources, and rising international energy prices provide a context that supports opportunities for more sustainable energy production and consumption. However, such patterns are highly structural, potentially volatile, and heavily influenced by political considerations.

Cities offer specific advantages in addressing energy-related problems. There is scope for more sustainable energy practices because a number of energy-related environmental problems are concentrated in the cities of developing countries. Urban consumers use energy more intensively than their rural counterparts, and energy use in cities casts an environmental shadow over surrounding areas.[82]

[82] Leitmann, Josef. 1991. Energy-environment linkages in the urban sector. *World Bank Discussion Paper.* Washington, DC: World Bank.

[83] ADB. 2006. *Special Evaluation Study on ADB's Energy Policy-Position Paper.* Manila; Friends of the Earth, United States. 2005. *Power Failure: How the World Bank is Failing to Adequately Finance Renewable Energy for Development.* Washington, DC: Friends of the Earth.

Bumps on the road to energy market reform

A recent ADB study[83] of energy policy highlights some key lessons. Lending policy since 2000 has emphasized the development of independently regulated and privatized energy markets that were expected to lead to more efficient use of energy, lower costs, and greater private investment. But energy market reform has been slower than expected because of the renegotiation of power purchase agreements by several countries, a lack of investor confidence, political influence to keep tariffs below cost levels, and unacceptably high system losses. The evaluation points out several other problems: difficulties in building regulatory expertise and independence, insufficiently deep and liquid markets for trading electricity contracts, a major withdrawal of independent power producers from the Asian market, and declines in funding for generation projects in the public sector and for transmission and distribution investments. The type and destination of lending have reflected a growing concern with environmental effects, with a particular focus on renewable energy emerging.

Determining energy policy according to demand and supply

The primary focus of energy policy has been on supply-side interventions such as providing cleaner, renewable energy sources. But urban areas determine demand for energy with their pricing regimes, their transport systems, their need to heat and cool buildings, and their manufacturing. An emphasis

on consumption overproduction is embodied in the Global Environment Facility's (GEF) strategic priorities. Given that environmental impacts and efficiency losses occur on both the supply and demand sides, urban development policy needs to better integrate demand- and supply-side interventions to ensure that efficiency and environmental damage is addressed at the points of production, transformation, and transmission and distribution, as well as consumption.

A sustainable energy policy involves action on three fronts—efficiency (saving), diversification (alternatives), and pollution and emissions control. Six of the seven strategic priorities (SPs) of the GEF's climate change program, for instance, relate to the characteristics indicated in the table below. (The seventh is piloting an operational approach to adaptation.) And all relate to urban management either directly or indirectly. Initiatives to tackle emissions and pollution range from comprehensive power sector development programs to household-level interventions that reduce indoor air pollution from the burning of biomass fuel. Long-term, large-scale investment by the World Bank in Brazil has had a widely acknowledged impact in reducing emissions in São Paolo while expanding gas distribution at the same time. Success rested on leveraging cross-border projects, institutionalizing credible and effective environmental regulation, and timely and in-depth environmental assessment procedures.

At the household level, projects to encourage a switch from biomass fuels to liquefied petroleum gas (LPG) in Sudan have succeeded. They were built on strong women's groups with demonstrated saving and financial capacity, and on a livelihoods approach that integrated pollution objectives with microenterprise activities.

In many Asian cities, significant improvements in air quality, particularly in suspended particulate matter, SO_x, and NO_x, have been achieved through the replacement of two-stroke and diesel engines for public transport with compressed natural gas (CNG). In cities such as Delhi and Kathmandu, this has made a significant difference to urban air quality. A different approach to reducing emissions has been used in the city of Puerto Princesa in the Philippines with the support of the United States Agency for International Development (USAID).

For environment sustainability

Urban ecologies to reduce waste

Manufacturing and construction activities generate a lot of waste—as much as four times produced by households, according to estimates. One way to overcome this problem is to mimic nature, where waste produced by one organism is

Global Environment Facility's Climate Change Strategic Priorities

Efficiency	SP1: Transformation of markets for high-volume, low-GHG products and processes to catalyze both demand and supply sides with relatively small resource input, resulting in a significant and lasting market penetration or transformation
Efficiency & diversification	SP2: Increased access to local sources of financing for renewable energy and energy efficiency to provide capital for investment in (near-) commercial energy-efficient equipment, energy conservation, or renewable energy technologies for modern energy services
Diversification	SP4: Productive uses of renewable energy to provide income generation and other essential social services
Pollution/emissions	SP5: Global market aggregation and national innovation for emerging technologies to support the reduction of cost in the end of emerging clean-energy technologies SP6: Modal shifts in urban transport and clean vehicle/fuel to emphasize public transit (such as bus rapid transit), nonmotorized transport (such as bicycles and pedestrian areas), and nontechnology measures (such as traffic demand management and economic incentives)
Efficiency, diversification, & pollution/emissions	SP3: Power sector policy frameworks supportive of renewable energy and energy efficiency to incorporate clean energy into energy policy frameworks

GHG = greenhouse gas, SP = strategic priority.
Source: Global Environment Facility (GEF). 2007. Cities Development Institute for Asia. *The Challenges: The broad environment footprint of Asian cities.* November. Available: www.cdia.asia./node/138

Vertical Farming: Perhaps Cities Can Even Produce their Own Food

In January 2006, about 38% of the world's land was being used for agriculture. Farming has radically altered the natural landscape and ecosystems. Rapid population growth requires more land for food, but this land is no longer available. Alternative approaches to producing food are needed to avoid further encroachment on the remaining functional ecosystems. The replacement of traditional farming by urban food production centers, or vertical farms, would enable the gradual repair of the world's ecosystems as farmland was returned to natural vegetation. In temperate and tropical zones, the regrowth of hardwood forests would absorb carbon dioxide (CO_2) and contribute toward reversing global climate change.

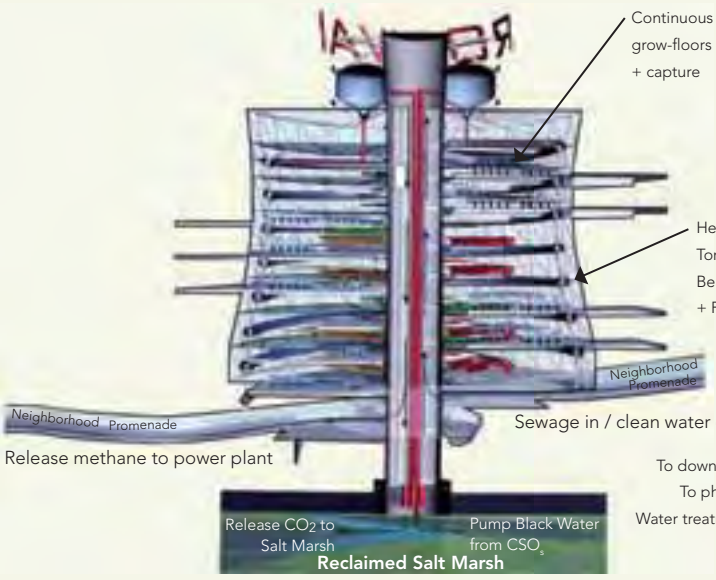
Vertical farming involves growing food within towns and cities inside environmentally controlled multistory buildings that recycle organic, human, and animal waste and wastewater. Indoor farming is not new but existing operations need to increase substantially in both output and range of products. The concept offers urban renewal, sustainable year-round production of food, and employment. But government-supported economic incentives are needed so that the private sector, universities, and local develop the concept. The vertical farm must be efficient, cheap to construct, safe to operate, and independent of public subsidies and outside support.

Dickson Despommier. Available: www.verticalfarm.com

Farming in the Z-Axis: The Vertical Farm

6th Street Basin, Gowanus Canal, Brooklyn

- Healthy transportation alternatives
- Crops distributed locally and regionally
- Existing buildings reactivated
- Public education
- Electricity generation
- Job creation



To power station
To parking
To prospect park

To downtown
To phase I
Water treatment

+ Public signage
+ Structural mast & holding tanks
+ Blackwater biogas reactor
+ Compostable plant production
+ Edible corp. production: 24 hour/365 day Hydroponic growing
+ Decorative plant production
+ Public interchange platform
0 Greenmarket/ public access to salt marsh
- Pumping station/ underground parking

CO_2 = carbon dioxide, CSO = c_____s_____o_____.

Source: Despommier, Dickson. *The Vertical Farm, Reducing the Impact of Agriculture on Ecosystem, Functions, and Services.* Columbia University, New York. Available: www.verticalfarm.com

often reabsorbed by another as part of symbiosis.[84] Industrial symbiosis offers the same kind of solution, whereby the waste or by-product of one enterprise becomes the resource or input of another.

Denmark provides an example (see box on the next page) where 20 projects have been developed through the exchange of residual products. This has a number of advantages:

- Recycling of by-products. The by-product of one company becomes an important resource for another company.
- Reduced consumption of resources, including water, coal, oil, gypsum, fertilizer, etc.
- Reduced environmental strain, through lower CO_2 and SO_2 emissions, lower discharges of wastewater, and less pollution of watercourses.
- Improved utilization of energy resources. Waste gases are used in the energy production.

The project was financed by its core partners and all projects are environmentally and financially sustainable.

The Kalundborg experience produced several lessons:

- An industrial symbiosis can only work if industries with the right composition exist or are relocated in one area. One company's residual products must take the place of another's raw material. Diversity within the local industrial structure is important.
- The physical distance between individual companies must be as small as possible since the transport of residual products over large distances is seldom profitable. Geographical distance is the most important parameter when energy is exchanged between companies. Other by-products can be transported to advantage over larger distances.
- The basis is openness, communication, and mutual trust between the partners. The Kalundborg companies are located in a small community that has helped establish an enabling environment for open, intimate working relations.
- Energy-efficient buildings, built form, renewable energy sources, standards, and climate-responsive design, together with open space and green areas, are also important to ensure a sustainable neighborhood.

[84] Symbiosis means coexistence between diverse organisms in which each may benefit from the other. Industrial symbiosis can be applied about the industrial cooperation between a number of companies and local government, all of which exploit each other's residual or by-products.

Bionic buildings: Taking a lead from spiders and termites

Many architects feel that the world is on the cusp of change. Buildings will emulate nature and become more energy efficient. City landscapes are likely to transform as new materials and designs enable buildings to become more colorful, stronger, and suitable to an era where sustainability comes to the fore. Such changes in the color and texture of buildings would radically alter the look and structure of a city.

Nature provides many examples of energy efficiency, structural strength, and an ability to maintain cleanliness. Much can be done to promote energy-efficient buildings through design that emulates nature. Energy efficiency can be improved if the walls and facades of buildings emulate skin. Natural ventilation can be encouraged by providing double layers of building materials with a cavity in between. Buildings can be designed with intelligent skins that contain sensors to control blinds in response to sunlight patterns throughout the day. Self-cleaning windows, following the model of the lotus leaf where water simply runs off, would greatly reduce maintenance costs for most buildings.[85] Less resources will be needed to construct buildings in the future. Lighter and stronger structures frames can be designed by adapting the structure of trees and even spider webs. The largely columnar-grid structures with pillars and beams now used for most buildings would consume far less material if they were designed to make use of cross-braced tubes (twisted columns) based on the cellular structure of trees. Strong, lightweight structures engineered along the lines of the web of a spider have been built economically using a minimum amount of material to cover a large area. The Munich Olympic Stadium constructed in the 1960s is an example.[86]

The style of today's building interiors needs to change. The current approach to office layout is to pack workers in and hope that they work hard. This encourages neither innovation nor productivity. The better, more livable the building, the happier and more productive people are. Simple things like windows that open, plants and gardens, and communal open space make for a happier workplace. The layout and lighting of buildings also play a role in encouraging or discouraging antisocial behavior. The cost of making buildings more livable is minimal compared with the benefits. With increasing energy costs, buildings need new efficient heating and cooling systems. One method

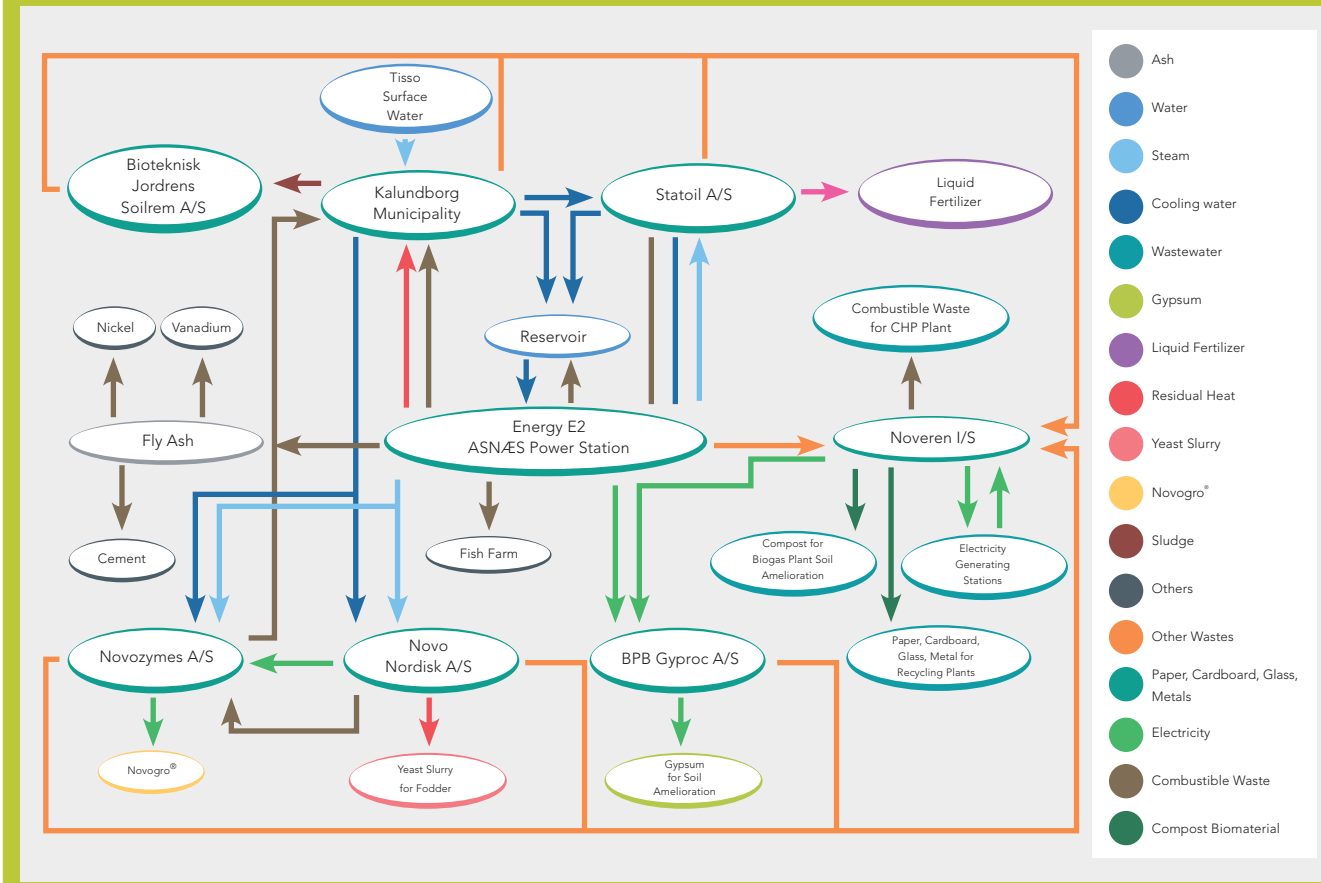
[85] British Broadcasting Corporation. 2005. Bionic Buildings. 9 February.
[86] Footnote 85.

Kalundborg Industrial Symbiosis

The evolution of industrial symbiosis in Kalundborg, Denmark, has been spontaneous but slow. The web of material and energy exchanges among companies within the small coastal industrial zone 75 miles west of Copenhagen has been developing for more than 30 years. The original motivation, in 1975, was to reduce costs by seeking income-producing uses for waste products. Gradually, the managers and town residents realized they were generating environmental benefits. The Kalundborg system comprises eight major partners:

- Energy E2, Asnæs Power Station.
- Plasterboard factory BPB Gyproc A/S.
- Pharmaceutical plant Novo Nordisk A/S.
- Enzyme producer Novozymes A/S.
- Oil refinery Statoil A/S.
- Bioteknisk Jordrens Soilrem A/S.
- Waste company Noveren I/S.
- City of Kalundborg, which supplies district heating to the 20,000 residents, hot water to the homes and industries.

Acting on their own, these partners have developed a series of bilateral exchanges that also include a number of other companies. There was no initial planning for the overall network; it evolved as a collection of one-to-one deals that made economic sense for each pair of participants. The symbiosis began when Gyproc located its facility in Kalundborg to take advantage of the fuel gas available from Statoil.



Source: Industrial symbiosis website. Available: www.symbiosis.dk

is modeled on the way termites keep their mounds cool in the desert. Air is drawn over an underground water reservoir into the building and passes out through a chimney. This uses a natural resource (air) to regulate temperature.[87] The ultimate aim is to lower operating costs of a building and conserve energy.

Applying the results of the rigorous, scientific study of nature to the construction of bionic buildings leads to new and better design and construction. With a little encouragement from local authorities, buildings can become far more energy efficient and pleasant places to live and work.

Designing a house—think energy saving

Energy saving housing technologies have been tested in a number of locations in South Africa with a focus on passive design. Some have found traditional methods like the use of mud bricks to be thermally efficient although generally constrained by low acceptability. While some technologies, such as solar-powered water heaters, might appear suited to tropical locations, affordability remains a critical problem. Several projects for energy-efficient housing have been implemented in the context of the country's reconstruction and development program.[88]

Some of these tests of potential low-cost urban housing methods have not systematically or comprehensively evaluated energy savings. The passive design technologies have focused on orientation that minimizes heat gains and losses, insulated ceilings, wall cavity insulation, innovative window sizing and shading, use of mud bricks for improved thermal performance, shared walls, and ãuorescent lighting.

Spreading the emission control message

Australia[89] faces a major challenge and has been active in promoting relatively small-scale diversification projects in its mission to abate GHG emissions. The initiative is built on partnerships between industry and governments, with a focus on power distributors. High-profile institutional and corporate clients, including Australia's Parliament House and Westpac Banking Corporation, showcase state-of-the-art technologies. Other projects demonstrate the effectiveness of regionally focused solutions like the country's mini-hydroelectric system, supported by the provision of technical expertise and consultancy services.

Farming within cities

Wikipedia, the online encyclopedia, offers an excellent definition of urban or periurban agriculture as the practice of farming, including crops, livestock, fisheries, and forestry activities, within or surrounding the boundaries of cities. It may use private residential land—privately owned plots, balconies, walls, or building roofs—public roadside land, or river banks. Urban agriculture is practiced for income-earning or food-producing activities. It contributes to food security and food safety by increasing the amount of food available to people living in cities, and by allowing fresh vegetables, fruits, and other products to be made available to urban consumers. Because it promotes energy- and resource-saving local food production, urban and periurban agriculture is a sustainable practice.

That makes it important for the urban environment. The current industrial agriculture system is accountable for the high-energy costs for the transportation of foodstuff. According to San Diego's Community Forest Advisory Board, a group that is promoting urban agriculture in the city, 95% of the food produced within the US is exported, while 95% of the food eaten in the US is imported. The energy used to transport food would be greatly decreased if urban

[87] The wind towers of the 100-year-old houses in old Dubai are clear examples of building design that should be considered today.

[88] Klunne, Wim Jonker. 2002. *Energy efficient housing in South Africa: Overview of current state of affairs.*

[89] Australia has one of the fastest-growing per capita greenhouse gas (GHG) emissions in the world. Over the past few years, while its GDP per capita has grown from about $15,000ã$25,000 per annum (at 1995 PPP), its emissions per capita has grown from 200 to 300 gigajoules per annum. Over similar periods and with similar GDP growth rates, Japan's emissions have gone from 140 to about 180 gigajoules, and the UK from 160 to 170 gigajoules.

agriculture could provide US cities with locally grown food. Cities could significantly reduce their ecological footprint.

Urban agriculture is too wide a subject to be fully explored in this book. Activities have included small plot-intensive cultivation, "greening" of roofs, and aquaculture, to name but a few. There are debates about the efficiency of the process. These issues and more can be canvassed on the many web sites dealing with the topic.

What is needed and how to provide it

National and city governments can no longer hope that reactive management will solve the problems of transport, infrastructure, and utilities, and of air and water pollution. The reactive approach has largely failed—a failure clearly illustrated in almost all Asian cities by the widespread transport crisis, the lack of wastewater treatment, and worsening air pollution. The issues have local, national, and global dimensions and are now too important to ignore. The pervasive interconnection between the wide range of policy questions this raises poses the major challenge to effective city management and to providing needed infrastructure.

The solution to inadequate urban services—the "what to do"—is not to be found in the provision of infrastructure hardware alone. There needs to be an increased focus on the required outcomes in terms of more sustainable, cost-effective, and appropriate services, and the actions required to achieve such outcomes. The "what" must be driven by, and provided within, a framework of sustainable development that addresses these issues of interconnectedness.

Fact: sustainable growth and environmental health are compatible

At the outset, city administrations need to believe in sustainable growth and reject the notion that they must choose between protecting the environment and promoting prosperity. There is a direct connection between environmental protection and wealth creation. The most attractive cities in the world generally have the highest environmental regulations. Cities in countries that have fallen behind economically often cut environmental regulations, as Central Asia and Eastern Europe did in the early years after the fall of the FSU. But this has changed dramatically now as these same cities try to attract higher value-added industry. Cities have the ability to achieve economic growth and a sustainable environment at the same time. Indeed, one supports the other. Delhi, for instance, has pioneered the

use of CNG as a fuel source for all public transport vehicles and its air quality has improved significantly without any impact on growth. Energy efficiency leads to lower costs for business; new market opportunities arise as consumers demand more environment-friendly products. The world market for environmental services has been estimated at $515 billion and it is growing rapidly. British Petroleum has shown that promoting energy efficiency within a business can add to the bottom line—over $650 million to date—while over the past 5 years, Dupont has reduced its global energy consumption by 7%, reduced its emissions by 70%, and saved some $2 billion.[90]

At the city level, much can be achieved through the adoption of market mechanisms. Markets are essential because, through prices, they enable consumers to decide rationally. By enabling markets, desired outcomes can be achieved efficiently with minimal cost of regulation. Polluter-pays concepts and emission trading are examples. A cohesive strategy is needed, one that is shared by all. Success is achieved when the strategy involves financial incentives and disincentives that adopt market principles. Political consensus is also necessary because achieving sustainable development is a long-term process. The impact of decisions made today will last beyond the life of any one mayor or city administration.

Solving a region's environmental troubles . . .

Some progress has been made. Many cities in Asia have increased their air quality management capabilities. This is often limited to primary cities, however, with the exception of the PRC and Thailand that increasingly are installing

[90] Cameron, David. 2006. Meeting the Challenge of Climate Change. Speech in Oslo, Norway.

capacities in secondary urban centers. Most Asian countries now have road maps in place that will result in cleaner tailpipes and an overall reduction in emissions from road transport for most pollutants. But similar reductions are not yet foreseen for GHG emissions. This mixed bag is evident across all pollution sources. And it is not enough.

Environmental problems need to be tackled at three levels:

- Global and international concerns such as climate change, GHG effects, and energy prices. These cover: air quality issues like the cross-border haze that is driven by city demand; water quality and quantity, as in the Singapore–Malaysia water issue; water pollution across boundaries that causes fish stock depletion; and greenhouse effects.
- National concerns, such as economic competitiveness, conversion of farmland, and protection of natural areas.
- Local concerns that affect the quality of life, including congestion, pollution, accidents, and health.

Appropriate incentives for action and frameworks that enable such actions need to be in place at each level. Much depends upon city form and car use.

Global, National, and Local Concerns

Global Concerns
Climate change—GHG effects

Energy prices/security
Terrorism

National concerns
Financial liabilities

Economic competitiveness
Farmland conversion
Protection of natural areas

Local concerns
Civilized quality of life
Congestion, pollution, accidents
Poverty alleviation

Source: ADB. 2007. Transport Background Paper, *Managing Asian Cities Study.* Manila.

. . . and action at city level too

Legislation is largely in place to improve city environments but it is rarely enforced consistently and, effectively. Planning for the future form of a city, including its spatial growth, is largely nonexistent. Among other things, this leads to poor management of movement and severe problems on the urban fringe. Incentives are not in place for people and business to use energy more efficiently. Some governments in the West make notional gestures toward the use of economic instruments but most are more revenue-driven than genuine efforts to employ taxation to encourage a reduction of energy use. And as cities begin to swim in seas of waste, there exist no clear incentives to build the required environmental infrastructure.

The core problems are a lack of international incentives for action to preserve global public goods, and a lack of capacity in, and funding for, management entities at the local level. Many problems clearly stem from a lack of political will. But the rise in pollution and sea levels puts trillions in economic output and hundreds of millions of people at risk. Action must be taken now. The cost of more delay will be too great.