Our Planet's Urban Environments

PLANET GEOGRAPHY

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Stephen Codrington

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Gloria Kurnik: 4.71.

Preface

Our Planet's Urban Environments is one of seven monographs written to support the options for the International Baccalaureate Diploma Geography (IBDP) course. These seven monographs complement three larger books that span the entire content of the IBDP Geography Program. *Our Changing Planet* covers the SL and HL Core (Paper 2), *Our Connected Planet* covers the Higher Level Core Extension (Paper 3), and *Our Dynamic Planet* includes material on all seven options in the SL and HL themes (Paper 1).

As with all the books in the *Planet Geography* series, my aspiration is that every reader of this book will acquire knowledge and wisdom to become an effective steward of our planet, committed to ensuring its healthy survival and vibrant flourishing.

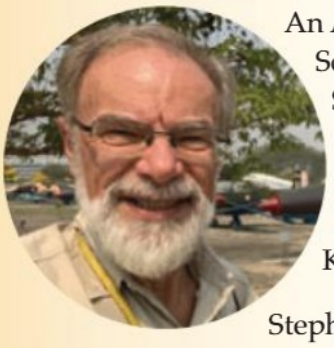
Any comments or suggestions to improve future editions of this book are always welcome. I hope you, the reader, will enjoy learning more about the geography of our fascinating planet as I have over the years.

Stephen Codrington.

The Author

Dr Stephen Codrington has a Ph.D. in Geography, and has taught the subject in several countries at both the high school and university level. He is the author or co-author of 69 books, mainly books that focus on his life-long passion for Geography.

Following his highly successful career as a teacher of Geography and Theory of Knowledge, including serving as the Head of five International Baccalaureate (IB) schools in four countries, he now works with school boards and leaders through Optimal School Governance, educates trainee teachers at Alphacrucis College, and is Chair of the Board at Djarragun College.



An Australian by birth, Stephen is a former President of both the Geographical Society of New South Wales and the Geography Teachers' Association of New South Wales (twice). He edited Geography Bulletin, the journal of the Geography Teachers' Association of New South Wales for seven years, and is now a Councillor and Treasurer of the Geographical Society of New South Wales. He has taught in schools in Australia, the United Kingdom, New Zealand, Hong Kong and the United States.

Stephen has been honoured with election as a Fellow of the Australian College of Education, the Royal Geographical Society (UK), and the Geographical Society of NSW. He was appointed to the role of IB Ambassador in 2014 and honoured with life membership of the Geographical Society of New South Wales in 2018. He is a former Chairman of HICES (Heads of Independent Co-educational Schools). Stephen's work has taken him to 161 countries, and he has been listed in Who's Who in Australia every year since 2003.

From 1996 to 2001 he served as Deputy Chief Examiner in IB Diploma Geography, setting and marking examination papers, assisting with curriculum development, and leading many teachers' workshops.

He maintains a personal website at www.stephencodrington.com that contains links to travel diaries and other items of geographical interest.

Chapter 1

The variety of urban environments

1.1 A settlement is regarded as functionally 'urban' when it provides secondary, tertiary or quaternary services . Despite its considerable size, Songo village in Mali has no commercial services such as a shop, hotel or hairdresser, so it is functionally classified as a rural settlement. Songo is thus a dormitory settlement, as it provides shelter for a farming community.

Characteristics of urban places

What does it mean to be urban?

Geographers distinguish two main types of settlement — urban and rural. A **rural settlement** is a dwelling or group of dwellings that simply provides housing for farm workers. In other words, no services are provided other than the **dormitory function** of providing accommodation for the residents. On the other hand, an **urban settlement** is an area of habitation that provides **services for payment** to the surrounding countryside. In other words, as soon as a rural settlement begins to have services such as shops or manufacturing, then it becomes urban.

In most nations it is usually statisticians (rather than geographers) who use the concept of 'urban settlement' to classify places. **Statisticians** prefer clear and precise definitions that are easy to work with, even if they are not completely accurate. Therefore, each nation in the world has developed its own **definition** of 'urban' based on the **population size** of the settlement. For example, in Australia, statisticians say that services will begin

Table 1.1

The minimum number of people needed to classify a settlement officially as 'urban' in selected countries.

COUNTRY	MINIMUM POPULATION OF A SETTLEMENT TO BE CONSIDERED 'URBAN'	OTHER CONDITIONS
Sweden	200	and less than 200 metres between houses
Albania	400	
South Africa	500	or 100 people if the population is white
Papua New Guinea	500	
Peru	600	must have 100 or more occupied buildings
Australia	1,000	must have at least 250 dwellings of which 100 are occupied
Czech Republic	2,000	and having more than 75 people per hectare, three or more rooms in at least 10% of the houses, piped water and sewerage in at least part of the town, at least two doctors and one pharmacy and less than 15% of people engaged in agriculture
France	2,000	and with less than 200 metres between houses
Israel	2,000	and a non-agricultural community
United States	2,500	
Austria	5,000	
Bangladesh	5,000	and has streets, tap water, sewerage and electric lights
Ghana	5,000	
India	5,000	and population density must be at least 390 people per square kilometre and at least 75% of adult males are employed in non-agricultural pursuits
Switzerland	10,000	
Malaysia	10,000	
Senegal	15,000	
Japan	30,000	and with 60% or more people (including dependants) engaged in manufacturing, trade or other urban types of business
Serbia	15,000 5,000 3,000 2,000	unconditional urban classification if at least 30% of people are not farmers if at least 70% of people are not farmers if at least 80% of people are not farmers
Bulgaria	-	a town can be classified as urban regardless of size

Source: United Nations Demographic Yearbook.

to appear in settlements when they have about 1,000 people. Therefore, they generalise and say that settlements with more than 1,000 people are 'urban' while those with fewer than 1,000 people are 'rural'. In India, the statisticians found that services do not usually appear until there are at least 5,000 people living in a settlement, so in India 'urban' settlements are defined as having 5,000

people or more. Table 1.1 shows some definitions of 'urban settlements' around the world.

The different definitions used for 'urban' around the world make **international comparisons** very difficult. For example, table 1.2 gives the proportion of people classified as 'urban' in a number of different countries around the world. However, when using the table it is important to remember that the definitions used in each country are different. Moreover, the accuracy of data collection in many nations may be very poor, especially in nations that lack the money to spend on data collection or where the culture of the people does not esteem accurate figures as Western societies tend to do. Therefore, the figures in table 1.2 should be seen only as approximations.

Urban terminology

Geographers use the term **settlement** to refer to all types of human habitation from a small thatched-roof hut or farm house to a huge city with millions of buildings. In everyday speech, people use the terms hamlet, village, town, city, metropolis and megalopolis to indicate increasing **size**, or **scale**, of settlements, and geographers use these same words, though usually with greater precision than the general public.

When statisticians categorise settlements as either urban or rural, they are using **population size** as the basis of their classification. On the other hand, when geographers classify settlements as urban if they provide services, they are using function as the basis. The **function** of an urban settlement is simply its reason or purpose for being. The function of Songo village shown in figure 1.1 is to provide accommodation for people who farm the surrounding area, which can also be described as a **dormitory** function. Other towns have different purposes, or functions, such as a mining town, a transport hub, a manufacturing centre, a fishing village or an administrative centre. Towns and cities that provide several functions are known as **multi-function centres**.

We commonly classify industries into four groups:

- **Primary industries** obtain products directly from the earth through agriculture, mining or forestry.
- **Secondary industries** convert raw materials provided by primary industries into products for consumers (or sometimes for other secondary industries) through manufacturing processes such as processing and fabricating.
- **Tertiary industries** provide services such as health, banking, accounting and restaurants.
- **Quaternary industries** provide advanced knowledge-based services such as information technology, information generation and sharing, research and development, education, consultancy and design.

1.2 The town of Mopti in Mali provides several urban services, such as the hairdresser and clothing store shown here. Mopti is therefore a functionally urban centre.

Urban occupations are those in the secondary, tertiary and quaternary sectors. Any settlement in which the majority of the workforce pursue urban occupations can be classified functionally as an **urban place**.

Hierarchy of settlements

Geographers sometimes also refer to urban places as **central places** because they are usually located centrally within a surrounding rural area that is served by the settlement's urban functions. The relationship between a central place and its surrounding area, known as the **hinterland**, is bi-directional (two-way) — residents of the hinterland travel into the central place to obtain goods and services, and goods and services travel from the central place out into the hinterland.

People's willingness to travel is affected by **distance-decay**, in which willingness to travel diminishes as distance increases. The distance that people are prepared to travel to obtain a particular good or services is known as the **range** of that good

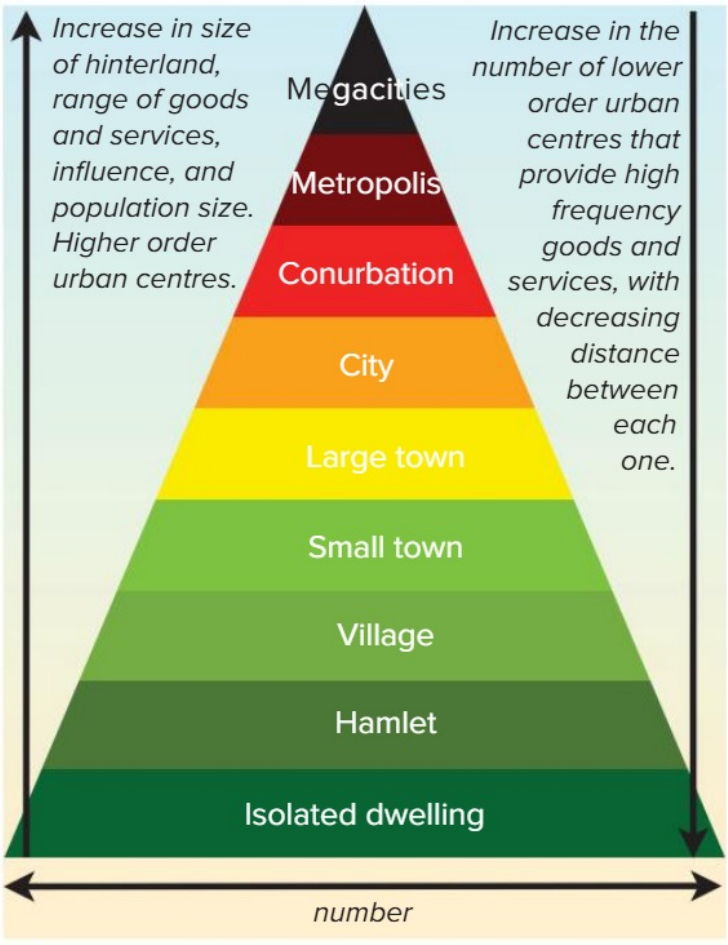
Table 1.2 — Urban population statistics for selected countries and regions.

	Urban population as a percentage of total				Average annual population change 2000 to 2005 (%)		Percentage of total population in cities with at least 750,000 people		
	1960	1980	2000	2020	Urban	Rural	1965	1995	2015
Africa	**21**	**27**	**38**	**49**	**4.0**	**1.6**	**7**	**11**	**n.a.**
Algeria	38	43	59	70	3.2	0.5	9	13	15
Burundi	2	4	9	17	5.9	2.1	0	0	0
Kenya	9	16	33	48	5.0	1.2	4	7	10
Libya	27	69	88	91	3.5	0.8	24	46	80
South Africa	47	48	50	59	2.7	1.5	23	30	34
Tanzania	5	15	28	42	5.2	1.7	2	9	14
Zambia	23	40	45	55	3.3	1.8	4	16	22
Asia	**22**	**27**	**38**	**50**	**2.8**	**0.3**	**10**	**13**	**n.a.**
China	18	20	34	49	2.9	-0.6	10	12	17
India	19	23	28	39	2.9	0.9	7	11	14
Indonesia	16	22	40	55	3.4	-0.3	7	9	12
Japan	67	76	79	83	0.4	-0.8	26	39	41
Myanmar	21	24	28	40	3.4	0.9	5	9	11
Nepal	3	7	12	21	5.2	2.0	0	0	0
Singapore	100	100	100	100	1.0	0.0	100	100	100
Thailand	13	17	22	33	2.5	0.2	8	11	15
North and Central America	**67**	**74**	**77**	**82**	**1.0**	**-0.3**	**36**	**39**	**n.a.**
Canada	73	76	77	81	0.9	0.2	29	41	42
Cuba	58	68	78	84	0.8	-1.4	20	20	21
Haiti	18	24	35	48	3.6	0.8	8	21	29
Mexico	55	66	74	79	1.7	0.6	25	33	32
United States	72	74	77	82	1.0	-0.4	39	42	42
South America	**56**	**68**	**80**	**85**	**1.8**	**-0.7**	**26**	**37**	**n.a.**
Argentina	76	83	89	92	1.4	-0.9	40	43	42
Bolivia	40	45	65	75	3.2	0.0	11	28	35
Brazil	50	66	81	87	1.7	-1.4	25	34	35
Peru	52	65	73	79	2.1	0.2	19	28	29
Uruguay	81	85	91	94	0.7	-1.4	43	42	41
Europe	**64**	**69**	**75**	**80**	**0.3**	**-1.2**	**23**	**24**	**n.a.**
Albania	31	34	39	51	1.9	-0.1	0	0	0
Belgium	93	95	97	98	0.2	-2.1	11	11	11
Estonia	62	70	74	80	-0.3	-1.8	0	0	0
France	67	73	76	81	0.5	-0.8	22	22	22
Germany	78	83	88	91	0.2	-1.5	42	44	45
Romania	38	49	58	68	0.6	-1.4	8	9	10
Russia	63	70	78	83	0.1	-1.8	20	21	22
Spain	61	73	78	83	0.3	-1.1	16	19	20
United Kingdom	87	89	89	91	0.2	-0.6	28	27	26
Oceania	**69**	**71**	**70**	**72**	**1.3**	**1.3**	**39**	**41**	**n.a.**
Australia	83	86	85	87	1.1	0.8	56	58	55
Fiji	33	38	42	54	2.6	0.8	0	0	0
New Zealand	79	83	87	90	1.3	-0.4	20	26	27
Papua New Guinea	5	13	17	27	4.0	1.7	0	0	0
Solomon Islands	9	11	20	32	5.8	2.3	0	0	0
WORLD	**36**	**39**	**47**	**57**	**2.2**	**0.4**	**15**	**17**	**n.a.**

Source: United Nations Population Division. *Figures after 2000 are projections.*

or service. People will go to great trouble and travel long distances to obtain some commodities (such as furniture or a car), but they will expect others (such as basic food needs) to be readily available nearby. Goods and services that people expect locally therefore have a **short range**. Short range goods are usually purchased quite often, perhaps every day or every few days, and are thus **high frequency goods**, or **low-order goods**. On the other hand, **long range goods**, or **high-order goods**, have a **low frequency** as they are purchased infrequently, perhaps only every few years or so.

Short range goods need to be located close to people's residences, and are therefore found in small towns and villages. On the other hand, low frequency goods with a long range will only be found in larger towns and cities. The number of people needed to support a good or service to make it viable is known as its **threshold population**. The number of people required to support a short range high frequency good, such as a general food store, is relatively small, so we can say its threshold population is low. Conversely, the number of people needed to support a long range low frequency good, such as a furniture store, is relatively large, so its threshold population is high.



1.3 The hierarchy of urban settlements, showing the inverse relationship between the number of settlements of a given size and their influence.

1.4 Weimar is a small town in Texas, USA, that provides basic (low order, high frequency) services for the surrounding farming community. People who need higher order, medium frequency goods and services must travel further afield, perhaps to the large town of La Grange (29 kilometres away). When low frequency goods and services are required, Weimar residents must travel even further, either to San Antonio (a large city 179 kilometres to the west) or Houston (an even larger city 142 kilometres to the east).

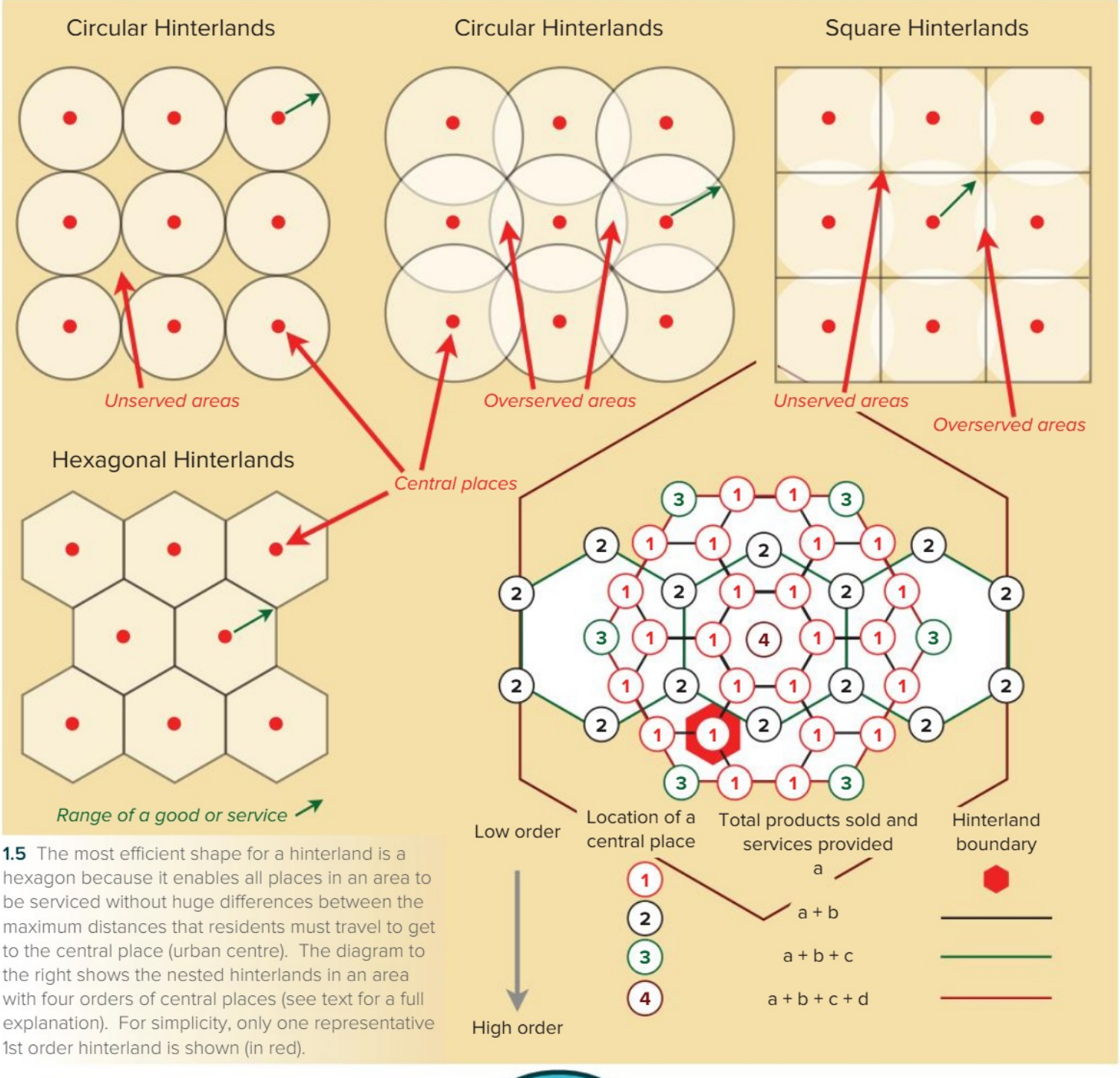
The ranges and threshold populations of various goods and services will **vary** from place to place according to factors such as the income levels of the populations, tastes, ages, sex structures, types of employment, and so on. Nonetheless, the size and spacing of urban settlements in any given area will form a **hierarchy** that reflects the ranges and threshold populations of the goods and services that people demand within the area. In any area, there will be a large number of small urban centres, a smaller number of larger centres, and so on until we reach a very small number of the largest settlements.

Small urban centres, which are very numerous, will each have a small hinterland, reflecting the short range, high frequency and low threshold populations of the goods and services they provide. On the other hand, the **largest urban centre** will have a large hinterland, reflecting the long range, low frequency and high threshold populations of the goods and services it provides.

We can summarise the **size and spacing** of urban centres using the following four principles:

- The larger the settlements are in size, the fewer in **number** they will be. In other words, there are many small villages, but few large cities.
- The larger the settlements are in size, the greater the **distance** between them. In other words, villages are usually found close together, while cities are spaced much further apart.
- As a settlement increases in size, the **range** and number of its **functions** will increase.
- As a settlement increases in size, the number of **higher-order services** will also increase. In other words, a greater degree of **specialisation** occurs in the services of larger towns and cities.

As shown in figure 1.5, the reason that hinterlands tend to be hexagonal relates to **packing theory**, or the study of the way that geometric shapes fit together to cover an area. If towns (central places) had circular hinterlands, which is the shape that gives the shortest average and maximum journey distances, there must either be some unserved or over-served areas because circles can't cover an entire area, or else they overlap. Square hinterlands would completely service the area, but the average and maximum journey distances would increase significantly. **Hexagonal hinterlands** are the most efficient shape to service an area completely without increasing journey distances excessively.



1.5 The most efficient shape for a hinterland is a hexagon because it enables all places in an area to be serviced without huge differences between the maximum distances that residents must travel to get to the central place (urban centre). The diagram to the right shows the nested hinterlands in an area with four orders of central places (see text for a full explanation). For simplicity, only one representative 1st order hinterland is shown (in red).

QUESTION BANK 1A

1. *Would hinterlands shaped like equilateral triangles completely cover an area?*
2. *Why would hinterlands shaped like equilateral triangles be unsatisfactory?*

Although landforms such as mountain barriers, rivers and coastlines can distort the pattern, urban centres will tend to be arranged in a network of **hexagonal, nested hinterlands** that reflect the range of the goods and services they provide. Figure 1.5 shows a model of the **idealised arrangement** of urban centres with hexagonal hinterlands. In that model, 1st order central places are the smallest urban centres, 2nd order towns are larger and offer more services to a larger area, 3rd order centres are still larger, and so on.

In reasonably flat areas where human settlements have existed for a long time, such as southern Germany and the North China Plain, the pattern of settlements resembles the model shown in figure 1.5 quite closely. In such situations, there is a **constant ratio** between the number of settlements in each order of the hierarchy.

In the model shown in figure 1.5, for example, there are six 1st order towns around each 2nd order town, six 2nd order towns around each 3rd order town, and so on. Because these towns lie on the boundaries of hinterlands rather than in isolation, towns 'share' the settlements around them with other central places. Therefore, in the model shown in figure 1.5, the ratio between the number of towns at each level of the hierarchy is 3:1. In other words, if the largest town in an area was a 4th order settlement, the number of urban centres at each level of the hierarchy would be:

4th order = 1
3rd order = 3
2nd order = 9
1st order = 27

In areas that were first settled after long-distance transport by rail or horse became commonplace, such as the central United States and much of Australia, the size and spacing of settlements is different. In such places, urban centres tend to be further apart because locations were determined by travelling time on a horse (for example) rather than travel on foot. These areas tend to have a large gap

1.6 The farming area south of Ringsted, a town of 22,000 people in Denmark visible in the right background, shows a pattern of size and spacing between settlements that reflects a hierarchical pattern.

in size between the largest city and the rest of the urban hierarchy because at the time the settlements were becoming established, travelling long distances to the largest city (usually the national or state capital city) was possible. If the largest city is more than five times the size of the second largest city, it is disproportionally large for its urban hierarchy and is said to be a **primate city**. An urban hierarchy dominated by a primate city is said to have a situation of **primacy**.

Primate cities

Many of the large cities in countries where fixed settlements only began to develop from the 1600s onwards are **primate cities**. This means that they completely dominate the urban networks of which they form a part. Primate cities are usually the political, economic, social and cultural focus of their country. Table 1.3 shows some cities which are primate.

Primate cities tend to emerge under certain circumstances. In developing countries, **foreign investors** tend to place their money in the largest city because that is where the **best infrastructure**, supporting services and government assistance are normally found. **Educational** and **research facilities** are also usually found in the largest city, meaning that there is more likely to be a pool of skilled labour there. **Transport routes**, which are often poorly developed in developing nations, usually focus on the primate city, encouraging growth in that city at the expense of smaller centres.

Table 1.3
Some examples of primate and near-primate cities.

Country	Largest (primate) city	Population ('000)	2nd largest city	Population ('000)
Argentina	Buenos Aires	12,024	Cordoba	1,368
Chile	Santiago	5,467	Valparaiso	360
Congo	Kinshasa	5,054	Lubumbashi	965
Indonesia	Jakarta	11,018	Bandung	3,409
Iran	Tehran	6,979	Mashhad	1,990
Iraq	Baghdad	4,865	Mosul	1,131
Mexico	Mexico City	18,066	Guadalajara	3,697
Myanmar	Yangon	4,393	Mandalay	770
Nepal	Kathmandu	359	Bhaktapur	65
North Korea	Pyongyang	3,124	Nampo	1,022
Paraguay	Asuncion	1,262	Concepcion	40
Peru	Lima	7,443	Arequipa	784
Tanzania	Dar-es-Salaam	1,434	Mwanza	201
Thailand	Bangkok	7,372	Chiang Mai	302
Uganda	Kampala	1,213	Jinja and Njeru	112
Uzbekistan	Tashkent	2,148	Samarkand	640

The global megacity

The world's largest cities are known as **megacities**, and they can be regarded as being at the peak of the global urban hierarchy.

Since the year 2006, over **half the world's population** has been living in urban areas. In 2015, more than 560 cities had populations of over one million people, compared with 83 in 1950 and 280 in 2000. This rapid urban transformation continues today, with much of it occurring in **developing countries** that are least able to cope with the pressures of urban growth.

The location of the world's great cities has changed enormously over the centuries. In 1800, seven of the world's largest cities were in Asia, the remaining three being in Europe. By 1900, nine were in Europe or North America, but by 2000 this figure had fallen to just two, both being in North America. Today, the **fastest urban growth** is occurring in the world's low income countries.

Cities with more than 10 million people are commonly referred to as megacities because of their **large size**. There are almost 30 megacities in the world today. In descending order of population size, the **largest 20 megacities** are Tokyo (Japan), Delhi (India), Shanghai (China), Mexico City (Mexico), São Paulo (Brazil), Mumbai (India), Osaka (Japan), Beijing (China), New York (USA), Cairo (Egypt), Dhaka (Bangladesh), Karachi (Pakistan), Buenos Aires (Argentina), Kolkata (India), Istanbul (Turkey), Chongqing (China), Rio de Janeiro (Brazil), Manila (Philippines), Lagos (Nigeria), and Los Angeles (USA).

All of the world's megacities are in **developing countries** except for seven – Tokyo, New York, Osaka, Moscow, Los Angeles, London and Paris. These seven cities also have the slowest rates of growth of the megacities. This is to be expected, as the countries where these cities are found (Japan,

1.7 Many megacities have substantial areas of shanty housing, reflecting unplanned growth by rural-urban migration. These shanties, known as 'favelas', are in Rio de Janeiro, Brazil.

1.8 Shelters erected for accommodation by rural-urban migrants on roadside vacant land, Kolkata, India.

1.9 Cairo, capital city of Egypt and one of the world's megacities, has many modern buildings, especially near the centre of the city that focuses on the Nile River.

1.10 Another view of the megacity of Cairo, Egypt. This view of the poorer, more traditional Mansheya Nasir area is only about 10 kilometres drive from the area shown in figure 1.9.

USA, France and the United Kingdom) are already highly urbanised.

Only a small part of the **rapid growth** of the megacities in developing countries comes from natural increase. Most of the growth is **unplanned**, arising from the process of **rural-urban migration**, in which people (mostly young, single, adventurous males or dispossessed farmers) move to the cities in search of work. The cities **attract migrants** because **job prospects** are perceived to be good, **services** are seen to be much better than in the countryside and fanciful **reports** often circulate in rural areas about the wealth to be made in the cities.

For most rural-urban migrants, the **reality** turns out to be quite different from the **perception**. Few rural-urban migrants find that their experience in farming or village life qualifies them for obtaining a job in the city, and many become shanty-dwellers or live on the pavements. The presence of **shanty settlements** is one of the characteristics of most megacities in the developing world.

With the rapid economic growth of many developing countries, the megacities in these countries are becoming **dichotomous** — in other words, developing a dual character. While some parts of the megacities are modern and mimic cities anywhere in the world, other zones may well be poorly developed, unhygienic, unplanned and dangerous for people who do not live within the zone.

QUESTION BANK 1B

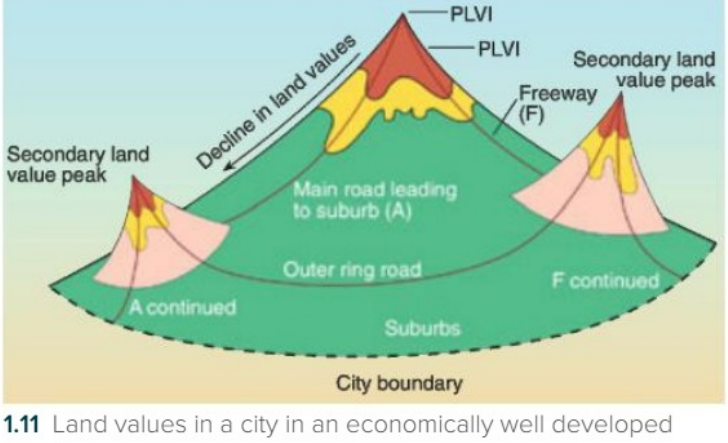
1. *What is the difference between a rural settlement and an urban settlement?*
2. *Explain why it is very difficult to make international comparisons of the size of urban populations.*
3. *Using the information in table 1.2:*
   a. *List the continents/regions shown in descending order of urban population as a percentage of total population in 2000.*
   b. *Devise a classification of 'high', 'medium' and 'low' urbanisation and allocate the nations listed into the three categories you have defined.*
   c. *Describe the pattern of places where the most rapid urbanisation occurred between 1960 and 2000.*
   d. *Describe the expected changes in world urbanisation to the year 2020.*
4. *What is meant by the term 'urban occupations'?*
5. *Explain the relationship between the range of a good or service and its threshold population.*
6. *Describe the relationship between the number of settlements of a given size and their influence in the hierarchy of settlements.*
7. *Why are hexagonal hinterlands efficient?*
8. *What does the term 'primate city' mean? Give one example from each of Asia, Africa and South America.*
9. *Why do primate cities develop?*
10. *What is meant by the term 'megacity'?*
11. *Where are most megacities located? Explain why this is so.*
12. *Is the growth of megacities planned or spontaneous? What processes contribute to the growth of megacities?*
13. *Why can we say that megacities are often 'dichotomous'?*

The pattern of urban economic activities and residential areas

Urban land uses in high income countries

The term **land use** refers to the ways that land is used. In urban areas, common land uses include **economic activities** such as manufacturing and retailing, and **non-commercial** zones such as residential areas and parklands. When we look at the way various land uses are arranged in a given city, we often see patterns and shapes emerging. The term **urban morphology** is used to refer to the shape and appearance of urban land uses. The urban morphology of a city is the result of the **urban dynamics**, or processes, operating there.

In cities where **economic forces** are the main influence on land uses, which is most cities in North America, Europe, Australasia and some parts of Asia, the pattern of land uses reflects **land values**. In such cities, land values will vary enormously from one part of the city to another. The parts of the city with the **highest land values** will be those near the centre as these have the greatest **accessibility** for the people who live in the city. Therefore, businesses that are located there can expect to attract extra business because of the highly accessible location. The point with the highest land values is called the **Peak Land Value Intersection**, or PLVI. The PLVI is always located in the **Central Business District** (CBD). The land values at the PLVI can be very high in large cities, and in American cities the values can exceed $5 million per hectare.

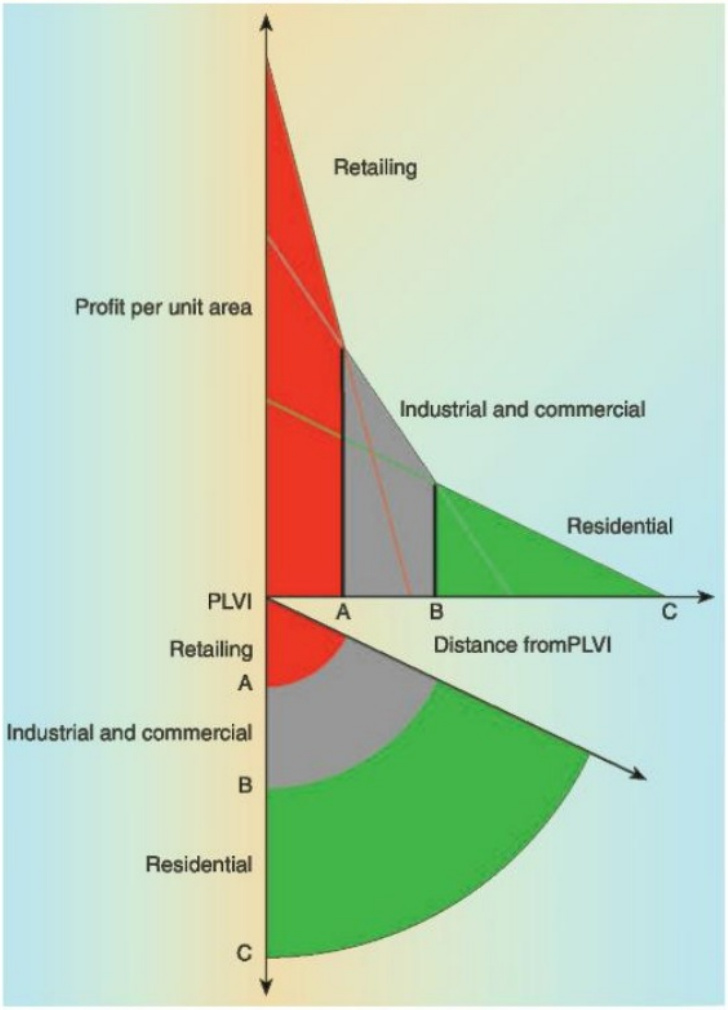


1.11 Land values in a city in an economically well developed country.

1.12 Building heights decrease from the PLVI, reflecting the decrease in land values in Sydney, Australia. A graph showing building heights in this area would closely mirror the land values.

Land prices usually fall away quite sharply from the PLVI. This is the principle of **distance-decay**. As distance from the PLVI increases, land prices decrease, and reflecting this, building heights also decrease. Only a few types of **very profitable businesses** that would benefit by being at the PLVI can afford to pay the high land prices demanded there. Typically, **large retail shops** have the most to gain from a highly central location, and these tend to be the highest bidders for the scarce land right at the PLVI. As accessibility declines with distance away from the PLVI, the price that businesses are willing to pay for land also declines. **Commercial enterprises** such as financial companies, solicitors and corporate offices require high accessibility, but they cannot usually afford to pay the high prices that large retail shops can pay. Therefore, these types of businesses are situated further away from the PLVI, towards the edge of the CBD.

Figure 1.13 illustrates the pattern that emerges, and is called the **bid-rent theory**. Retailers can afford the highest rents, but they are not prepared to pay high prices if they are not in a highly accessible location. Therefore, the slope of the rent curve for retail shops is very steep. The rent curve for industrial and commercial enterprises does not rise as high as that for retail shops, but it falls away a little more gently because accessibility is not quite as crucial for them. Similar forces operate for other land uses such as multiple family dwellings (flats and apartments), single family dwellings (free standing houses) and, finally, agriculture.



1.13 The bid-rent theory.

Agriculture is the least competitive land use, and so it is found beyond the urban limits.

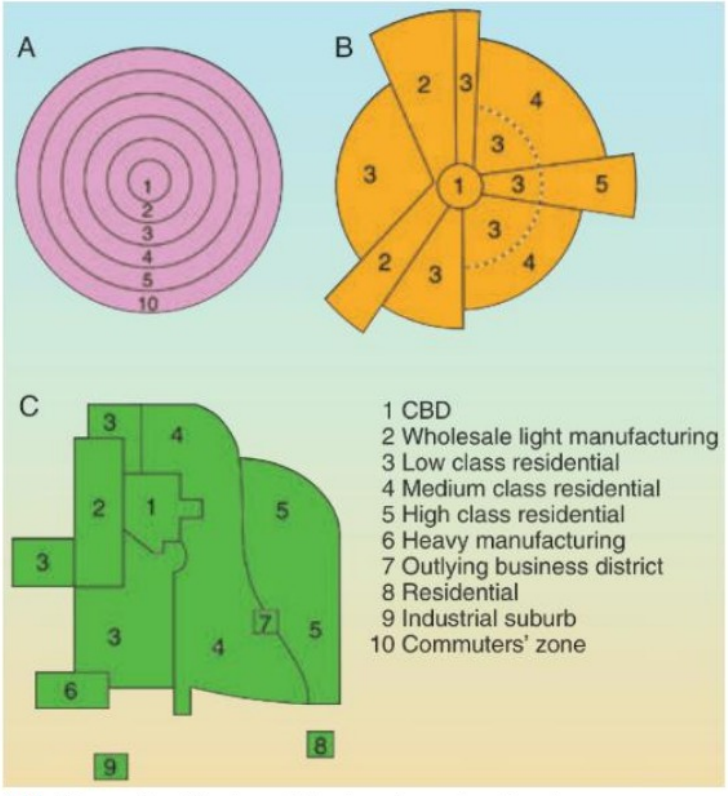
It is assumed that land developers will try to **maximise their profits**. In large cities, the high demand for space in the centre of the city (near the PLVI) drives up the land price (or rent) so much that **high-rise** developments become financially viable despite the very high costs of this type of construction. This trend has occurred to a spectacular extent in many US cities, resulting in the construction of skyscrapers (especially tall, tower-like buildings that are usually used for office or commercial purposes.

Because land developers try to maximise their profits, the land use whose curve is highest in figure 1.13 will be the land use found in that area. Thus, retailing will be found closest to the PLVI, as will the tallest buildings. As we move away from the PLVI in figure 1.13, we come in turn to an industrial and commercial area, and then residential areas of decreasing density — an area of flats and apartments, a zone of single family dwellings and finally to the farming areas which surround the city.

1.14 Not all skyscrapers are the result of high land values near the PLVI of a city centre. Prestige projects like the Burj Khalifa illustrate this point. Built in suburban Dubai, UAE, the Burj Khalifa is the world's tallest building with a height of 830 metres.

1.15 Chicago was one of the first American cities where high land values in the city centre led to the construction of skyscrapers. This continues today, resulting in a mix of old and new skyscrapers in Chicago's CBD.

If we assume that the land on which the city is built is fairly uniform, then this pattern will be found in every direction as we move away from the PLVI. In 1925, the American geographer Ernest Burgess carried out fieldwork in Chicago and concluded that this does in fact happen in reality. He developed a model of urban areas which concluded that land uses are arranged around the CBD in **concentric circles**, with the most profitable land uses being found closest to the city centre.



1.16 Three simplified models showing urban land uses:
A: the concentric zone model (after Burgess)
B: the sector model (after Hoyt)
C: the multiple nuclei model (after Harris and Ullman)

Although **Burgess' concentric zone model** highlighted some important urban dynamics, it had several **shortcomings**. It was clearly an **over-simplification**, as it took no account of landforms (land prices are higher where there is a view), transport routes (which attract industry) or changes that can occur over time. The model suggested that there were sharp boundaries between land use zones, whereas in reality these fade and merge into one another. Furthermore, it was only applicable to cities in industrialised nations, as land uses in developing countries were not influenced as strongly by economic forces. That is why Burgess concluded that poorer people tend to live in inner city areas whereas developing world cities tend to have poorer people living on the outskirts, usually in shanty settlements.

To overcome some of these difficulties, Homer Hoyt (another American geographer) suggested that land uses in cities are arranged in **sectors** rather than in concentric circles. **Hoyt** could not accept that all the land upon which a city is built is uniform, and his model took landforms and transport routes into account. He suggested that wealthier people tend to live on higher land while manufacturing industry will be aligned along transport routes such as roads, railways and rivers. In this way, he argued, land uses will be arranged in sectors that radiate out from the CBD.

However, two other American geographers, Chauncy Harris and Edward Ullman, argued that even this was too simplistic. They said that land uses are not arranged around just one CBD, but that large cities have several business centres (which they called **nuclei**) such as shopping centres and areas of office development. These centres emerge as the city grows because the one central CBD is no longer accessible to residents who live towards the edge, or periphery, of the city.

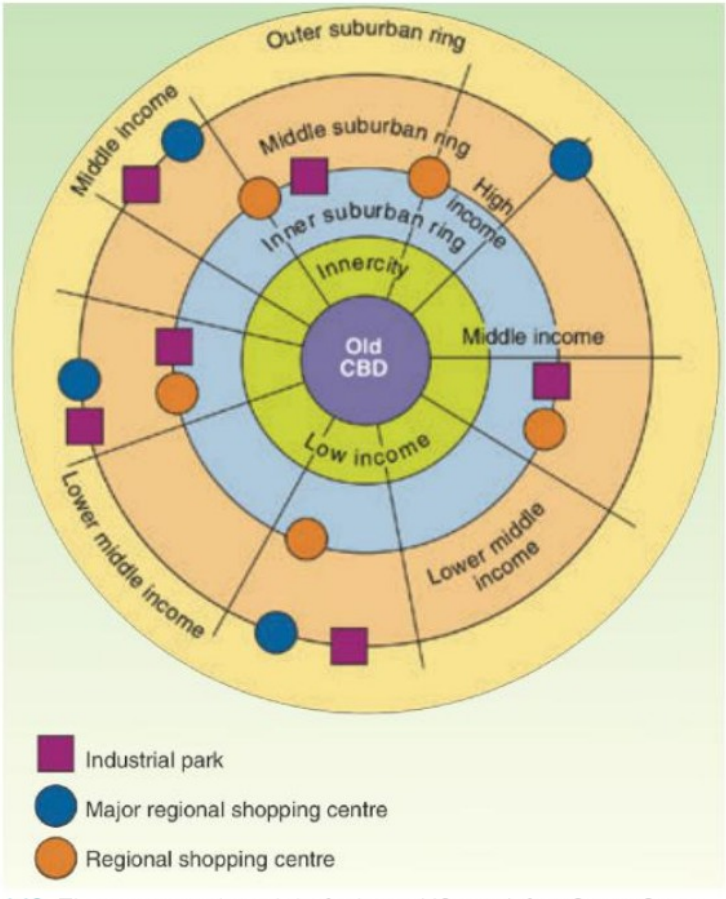
1.17 The taller buildings in the foreground of this oblique aerial view of Sydney (Australia) show Parramatta, an important nucleus serving Sydney's western suburbs.

Therefore, **Harris and Ullman** argued that land uses tend to be arranged in cells or patches throughout the city depending on the availability and the quality of the land. Some activities, such as shops and factories, will **cluster** together for their mutual advantage. Other land uses that are incompatible, such as high-class residential land and heavy industry, will not locate near each other. Certain types of land use that need large areas of land, such as manufacturing industry, will locate towards the edge of the city where cheap land is available. Other land uses which need high levels

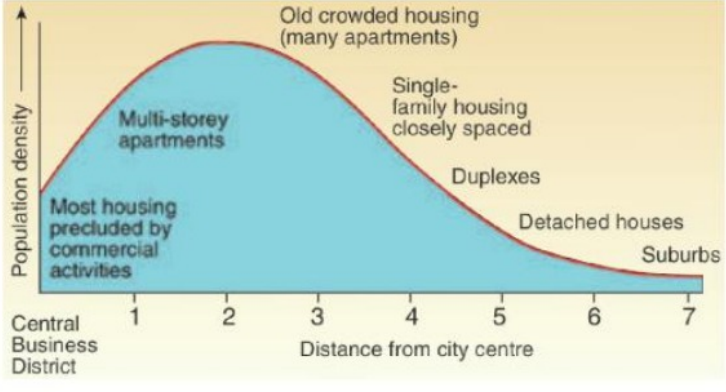
of accessibility, such as offices, tend to be located close to the CBD. Higher-class residential areas will tend to be located on elevated land where land prices are higher.

In reality, most cities in industrialised countries show a land use pattern that is a **combination** of all three models. Getis, Getis and Fellmann suggest a model of a **US city** that is applicable also to cities in Australia, Canada, New Zealand and elsewhere that combines the three earlier theoretical models.

The bidding process for land in the CBD has the effect of causing a **population density hollow** in the middle of the city (figure 1.19). Apart from a few very costly apartment houses, the residential land use is usually **out-bid** by retailing and office space in the CBD. Where residential areas are located close to the CBD, they tend to be high-density flats and apartments, as only these types of housing will provide the land owners with the necessary profit on the highly priced land in these areas. Thus, residential density (and building heights) decline with increasing distance from the outskirts of the CBD, two more examples of distance-decay.



1.18 The integrated model of a large US city (after Getis, Getis and Fellmann).



1.19 The general population density curve for a large city in an economically more developed country.

1.20 The CBD and inner zones of Miami, Florida, USA, reflect the Getis, Getis and Fellmann model of land uses in large US cities.

The forces that shape the land use patterns of cities are primarily determined by economic forces. Modifications to these patterns can arise when **government planners** mandate that land will be used for purposes that differ from the results of market forces.

QUESTION BANK 1C

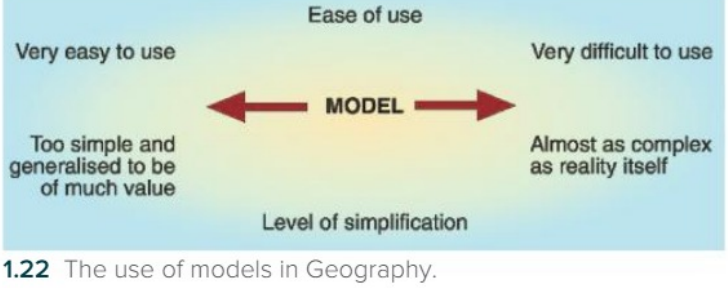
1. *Describe the processes that lead to sorting of land uses in cities.*
2. *What is the PLVI? Suggest where the PLVI is in the urban centre where you live.*
3. *What is meant by the term 'distance-decay'? Give two examples of how distance-decay can be seen in a city.*
4. *Explain how the bid-rent theory predicts that the land use zones in a city will be arranged in concentric circles around the city centre.*
5. *Make a point form list of the main features of the urban models produced by (a) Burgess, (b) Hoyt, and (c) Harris and Ullman.*
6. *Why is there a population density hollow towards the centre of most cities in economically more developed countries?*

Urban land uses in low income countries

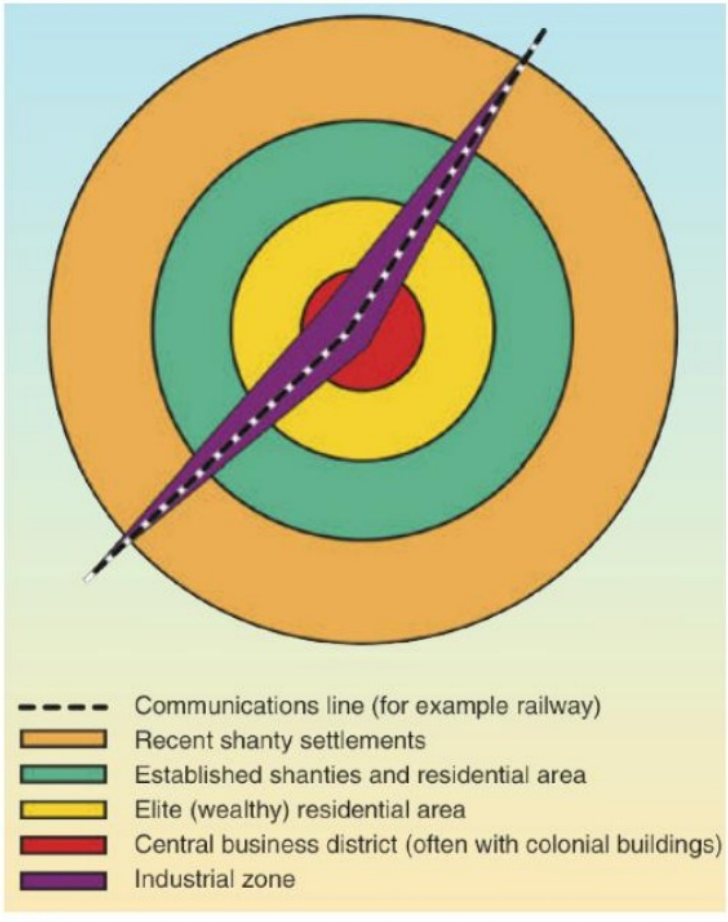
The processes that lead to land use patterns in high-income countries also operate in most low-income countries and developing countries. However, **additional forces** also have significant impacts, weakening the relative influence of economic forces. Although circumstances differ from country to country, some of the forces that tend to be stronger in low-income countries include ethnicity, political affiliations, corruption, loose government regulations and spontaneous use of land by squatters and rural-urban migrants.

1.21 Shanty settlements beside the railway line in Soweto, a township on the outer edge of Johannesburg, South Africa.

Cities in poorer countries usually develop incrementally and without formal planning, growing outwards by adding **shanty settlements** on the outskirts of the city. As time passes, these shanty settlements evolve into permanent buildings and a new 'ring' of shanties develops further out, causing the city to expand horizontally. In this way, cities in poorer countries tend to develop with the wealthy élite living close to the city centre, with people becoming progressively poorer towards the outskirts. Bands of **manufacturing** industry are generally situated along major lines of communication such as roads and railways.

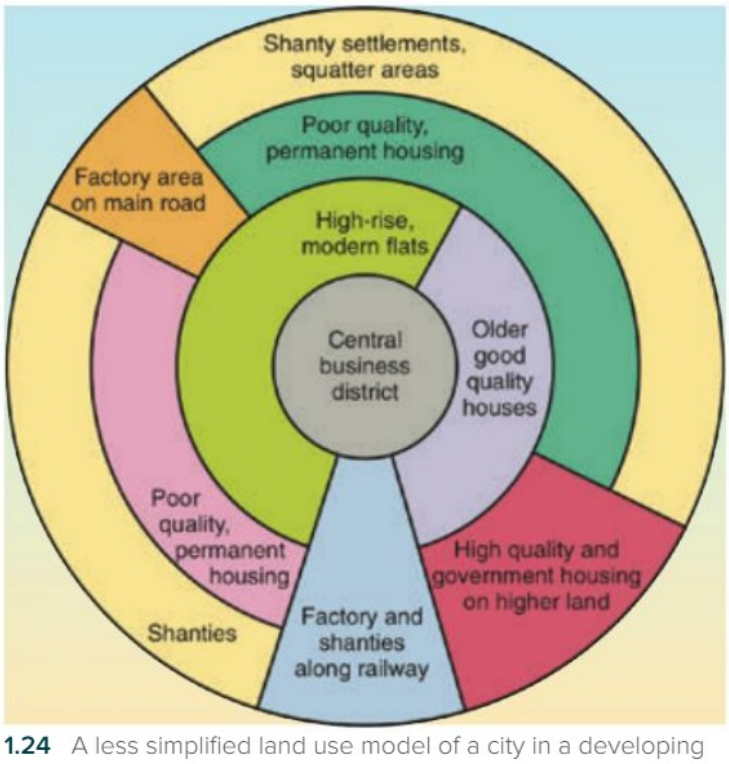


1.22 The use of models in Geography.



1.23 Simplified land use pattern in cities in developing countries of Asia, Africa and South America.

Any **model** such as figure 1.23 is a vast **simplification** of reality. As figure 1.22 suggests, the simplest models are the easiest to use but they are not very useful for predicting reality. The simplest models are most useful for highlighting



1.24 A less simplified land use model of a city in a developing country in Asia, Africa or South America.

broad patterns and processes. On the other hand, as we make models more **realistic**, they become more complex and more difficult to use. To be effective and useful, therefore, a good model will fall between the extremes shown in figure 1.22.

With this in mind, we can make the model of the developing world city shown in figure 1.23 somewhat more realistic without making it too complex. One such more complex model of a developing world city is shown in figure 1.24.

In the real world, of course, cities are even more complex than the pattern shown in figure 1.24. Models are only simplifications of reality, designed to highlight the processes that are operating. Developing world cities almost never have a clear, simple pattern of land uses.

People tend to segregate according to **ethnic group** as well as wealth. A city in South-east Asia may have separate areas for Chinese, Indian, Malay and European residents. Furthermore, land uses in developing world cities are seldom arranged horizontally, but they are more common arranged vertically in buildings known as **three-tier developments**. The buildings typically have a shop on the ground floor, with a warehouse or factory making goods in the middle level and the residence of the family operating the business on the top floor.

One of the features of cities in developing countries is that there are often huge **gaps in wealth** within the population. Many of the wealthiest – and the poorest – people in the world live in the developing nations. Social unrest based on differences in wealth is rare, and people tend to accept the differences in wealth, at least outwardly. In countries with a strong Confucianist, Hindu or Buddhist tradition, people traditionally accept their

1.25 Ethnic groups often cluster together in the same districts of cities in developing countries. This view shows Chinatown in Santo Domingo, capital city of the Dominican Republic.

1.26 An example of three-tier development in Jeddah, Saudi Arabia.

1.27 A poor residential area in Caracas, Venezuela. Like many cities in developing countries, land use patterns in Caracas show wide gaps in wealth between the rich and poor.

1.28 This wealthy area in Caracas is just a few kilometres away from the area shown in figure 1.27.

position in society as 'fate', the consequence of deeds or misdeeds in past lives. By accepting their position in society and working within it, Hindus and Buddhists who accept reincarnation believe that they can earn merit that will improve their positions in the next life. In contrast, societies which have embraced Christianity or Islam or a Communist ideology are less likely to accept wealth and position in society as 'fate'. More **social unrest** tends to occur in such societies as people work more actively to change their society.

1.29 Political graffiti on the wall of a building in Belfast, Northern Ireland, shows evidence of continuing social unrest. The sign honours the life of Óglach Charlie Hughes, a local fighter in the cause of trying to end British rule in Northern Ireland. Killed by gunfire in March 1971, many people now regard him as a martyr.

The **differences in wealth** are reflected in the urban morphology of cities in developing countries. It is very common to find cities in developing nations having a Central Business District (CBD) that has modern high-rise buildings of the type that might be found in almost any large city in the industrialised world. However, nearby there will often be poor quality, overcrowded housing. It is common to find housing for wealthy residents situated very close to residential areas for the poor. Such differences occur over very short distances.

Another consequence of the increasing wealth in many developing world cities is that new industries are created for which there was never previously a large demand. These **new industries** create wealth for a new emerging group of entrepreneurs that become the 'middle class' of these countries. The emerging middle class tends to have high disposable incomes that are spent on things like fast food, cars and electronic consumer goods.

1.30 Like many cities in developing countries, La Paz, Bolivia, has a CBD with modern, high-rise buildings, surrounded by poor quality, overcrowded housing.

1.31 These men operate businesses on the pavement typing letters for illiterate residents of Kolkata, India, who need to correspond with official government organisations. This is an example of a basic emerging service industry.

The one characteristic that is common to most cities in developing countries is that they are **changing rapidly**. Often, there is a deliberate **policy** of encouraging growth in urban areas. For example, China has set aside several cities and made them targets for government and foreign investment funds. These cities include Shenzhen, Zhuhai, Xiamen and the Pudong and Hongqiao districts of Shanghai. These areas have special tax concessions, streamlined regulations and labour laws that are designed to attract **foreign investment** funds. Other countries have introduced similar zones. However, with or without these special investment zones, the economies of most of the developing nations are expanding, and the **first benefits** of this expansion tend to be seen in the cities rather than the countryside. Consequently, the CBDs of many

1.32 The Pudong district of Shanghai, China, has special regulations to encourage foreign investment. As recently as the mid-1980s, this area was all farmland.

cities in developing countries are at least as modern as any city in North America, Europe or Australia.

QUESTION BANK 1D

1. *Which is the more useful model of a developing world city in your opinion, the one shown in figure 1.23 or the one shown in figure 1.24? Give reasons for your answer.*
2. *What is three-tier development?*
3. *Explain why there seem to be huge gaps between the rich and the poor in the cities of developing countries.*
4. *It is suggested in the text that 'the one characteristic that is common to most cities in developing countries is that they are changing rapidly'. Using specific examples, explain why you agree or disagree with this statement.*

CASE STUDY
Factors affecting the pattern of economic and residential land uses in Yangon, Myanmar

Yangon (which used to known as Rangoon) is the largest city in Myanmar (formerly Burma). With a population of about five million people, Yangon was Myanmar's capital city until 2006 when a new, specially built, inland city named Naypyidaw was named the capital city.

Like many cities in developing countries, Yangon's **land use pattern** results from a combination of economic, social and cultural forces. Also like most cities in developing countries, **rapid change** is a characteristic of Yangon.

1.33 The location of Yangon.

Yangon began as a small fishing village called Dagon. However, Dagon was quite different from other villages because it had a Buddhist pagoda (stupa) that has great religious significance. Construction of the pagoda, known as the **Shwe Dagon Pagoda**, began in about 500 BC, although it has been extended since that time. Now a symbol of both Yangon and Myanmar, the Shwe Dagon Pagoda comprises a 98 metre high solid central spire coated in a one centimetre thick layer of solid

1.34 The 2,500 year old Shwe Dagon Pagoda is a symbol not only of Yangon, but of the nation of Myanmar.

1.35 The Sule Pagoda marks the centre of the grid pattern of streets surveyed by the British for Yangon during colonial times.

gold, topped with 5,451 diamonds and 1,383 other precious stones. The central spire is surrounded by about 70 pavilions, temples and halls.

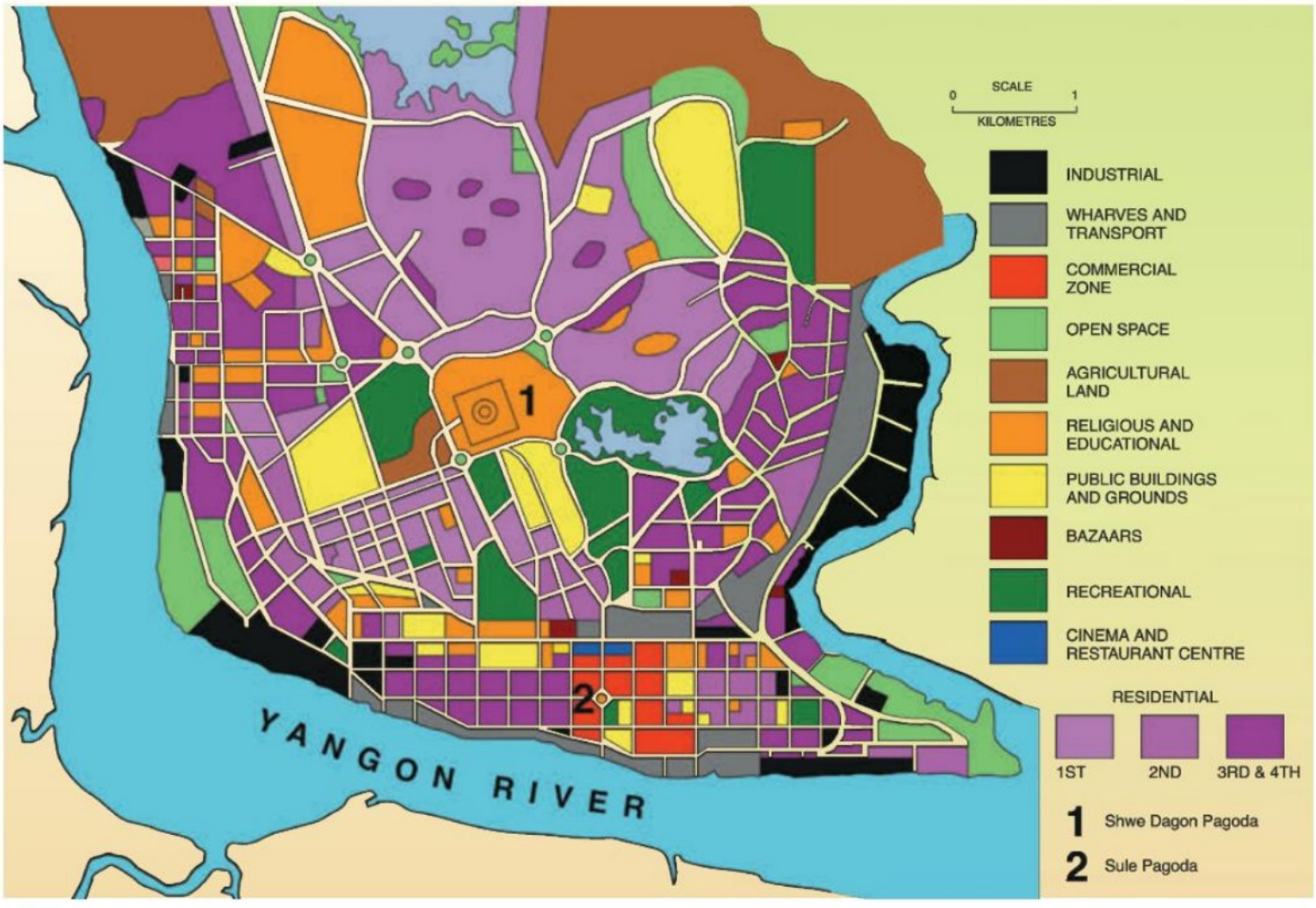
From the mid-1800s, the British occupied Burma (as it was known at the time) and made Rangoon the capital city. As the city had been destroyed during the fighting over political control, the British used the opportunity to re-plan the layout of those parts of the city near the river where they lived and worked. They decided to remodel the city according to a European-style **grid layout** with streets running at right angles, north-south and east-west.

A grid was surveyed **centred** on the Sule Pagoda, and this point still marks the administrative and commercial centre of Yangon today. A **port** and **industrial zone** was established nearby along the northern bank of the Yangon River. Although some roads were built to other towns in Myanmar, the main means of transport was by boat. Even today, Yangon's river frontage is largely taken up with wharves, warehouses and trading houses. Because the area to the south-east of the Sule Pagoda comprised low-lying, reclaimed land, it was designated as **parkland**, and remains so today.

Meanwhile, at the northern edge of the city, the British military saw the hill where the Shwe Dagon Pagoda was built as having strategic value. Therefore, they made the **Shwe Dagon Pagoda** their military headquarters. This caused great offence to most Buddhists, as it is the custom to show respect by removing one's shoes before entering the precincts of a pagoda; the British

1.36 The Yangon River is lined with warehouses and port facilities, reflecting the land uses that were designated by the British during the colonial era.

1.37 Maha Bandoola Park is an open expanse of parkland south-east of the Sule Pagoda that occupies the space of a former swamp. It was made parkland as part of the British colonial authorities' land use planning. The building in the background is the High Court Building, also a remnant of British colonial land use planning.



1.38 Urban morphology of Yangon in the late 1930s. Because there has been so little new construction since that time in this part of Yangon, the map is still essentially accurate today.

soldiers were certainly not willing to walk around their own base bare-footed!

Notwithstanding all this, a substantial and elegant city arose as construction continued. Population grew rapidly, reaching 92,000 by 1872, 141,000 by 1881, 177,000 by 1891, 221,000 by 1901 293,000 by 1911, 342,000 by 1921 and 400,000 by 1931. By 1930, half of Yangon's population was Indian, mainly labourers brought in by the British.

The pattern of **urban land uses** in Yangon in the late 1930s is shown in figure 1.38. The commercial core was found in a compact area around the Sule Pagoda, while banks and trading companies were found along Strand Road, the main street that ran along the northern side of the Yangon River. A large area of movie theatres was found to the north of the Sule Pagoda near the railway station.

West of the central core area was the main retailing area. The large Scott Market, a huge complex of covered alleyways and stalls was found there, together with the Chinese markets, street stalls,

1.39 The area around Scott Market is still one of Yangon's main bazaar areas, attracting extensive street markets on the surrounding pavements.

bazaars and small shops. Further to the west, approaching the Yangon River, an area of manufacturing industry was found, comprising food factories, saw mills, metal workers and rice mills. In general, the most elegant buildings, such as the High Court and the City Hall, were found near the Sule Pagoda.

Residential areas at the time fell into three types, as shown in figure 1.38. These three types of residential area were often separated from each other by open spaces. **Type 1** residential areas, which were of the highest quality, tended to be found on the ridges where some cooling breezes could be felt. Many of these areas were occupied by the British, although large areas to the north and east of the Shwe Dagon Pagoda were occupied by higher ranking government workers and business families. At the other extreme, **type 3 and 4** residential areas, which can also be termed 'slums', tended to be found on the low lying areas of flood-prone land on the eastern side of the city near Pazundaung Creek. The poorest areas were inhabited by Indian workers, and they had the highest death and infant mortality rates in Yangon.

To the north of the Shwe Dagon Pagoda, the outer suburbs resembled over-sized traditional villages in that they were sprawling areas with dirt roads and small timber houses with thatched roofs. Beyond these outer suburbs lay the countryside of rice fields and smaller, more isolated villages.

On 4th January 1948 Myanmar was granted its independence from British rule. The country entered a long period of **isolation** and civil unrest, during which almost no new construction was undertaken in Yangon, effectively freezing the land use pattern established by the British. Yangon took on the appearance of a decaying, poorly maintained, 'living museum' of British colonial architecture.

The Yangon River was the reason for the selection of Yangon's site, and it continues to influence the city. Yangon has grown to the north away from the site of first settlement near the river. Expansion to the west, south and east has been restricted by the river and its tributaries. Thus, there is a clear **transition** as one travels towards the north away from the river of rising elevation, less well planned street layouts and more recent development.

1.40 Typical colonial-era buildings in central Yangon.

The intention of the British to build a European city in an Asian environment is seen very clearly in the centre of Yangon. Although centred on the indigenous Sule Pagoda, the architecture of this area is almost entirely British. Other reflections of the **colonial origins** include the grid layout of the streets, the English street names such as Merchant Street, Strand Road and Mission Road, and the large open recreational areas in the city centre. Among the buildings found in this city core are Yangon City Hall and National Library, several embassies (especially in Strand Road), the Office of Ministers, Office of the Workers' Council, General Post Office, Yangon General Hospital, St Paul's School, the National Museum, the Central Railway Station and the High Court Building.

1.41 The streets of downtown Yangon form a colonial-era grid pattern, and most are still lined with buildings constructed during the period of British rule.

Like most cities in developing countries that had colonial origins, Yangon's core is heavily influenced by **port activities**. Currently, Yangon handles most of Myanmar's legal foreign trade. Therefore, the city's river frontage is lined with some 6.5 kilometres of **wharves** with accompanying commercial activities such as **warehouses** and **factories**. Most of Yangon's manufacturing involves light processing of the raw materials brought in from the surrounding countryside.

1.42 Strand Road in downtown Yangon lines the Yangon River with buildings accommodating services that support the shipping trade. Poorly maintained colonial-era buildings remain the most common type of structure in this area.

Consequently, the main **manufacturing industries** include textiles, jute, medicines, timber milling, rice milling and building materials manufacture. Many minor industries have been established in an effort to make Yangon self-sufficient in as many goods as possible to control the outflow of foreign currency.

The **residential areas** of most Asian cities are divided into **ethnic districts**, and Yangon is no exception. Yangon has a small **Chinese** quarter towards the western end of the commercial core, and an area of **Indian** housing in shanties along Pazundaung Creek to the east of the core. Otherwise, the city is almost uniformly indigenous in character. The **former European areas** are now occupied by wealthier locals, such as government and military officials. These areas have large houses that are on hillsides facing the river to benefit from breezes in the hot, tropical climate.

1.43 The Guanyin Gumiao Temple marks the focus of Yangon's main ethnic Chinese quarter.

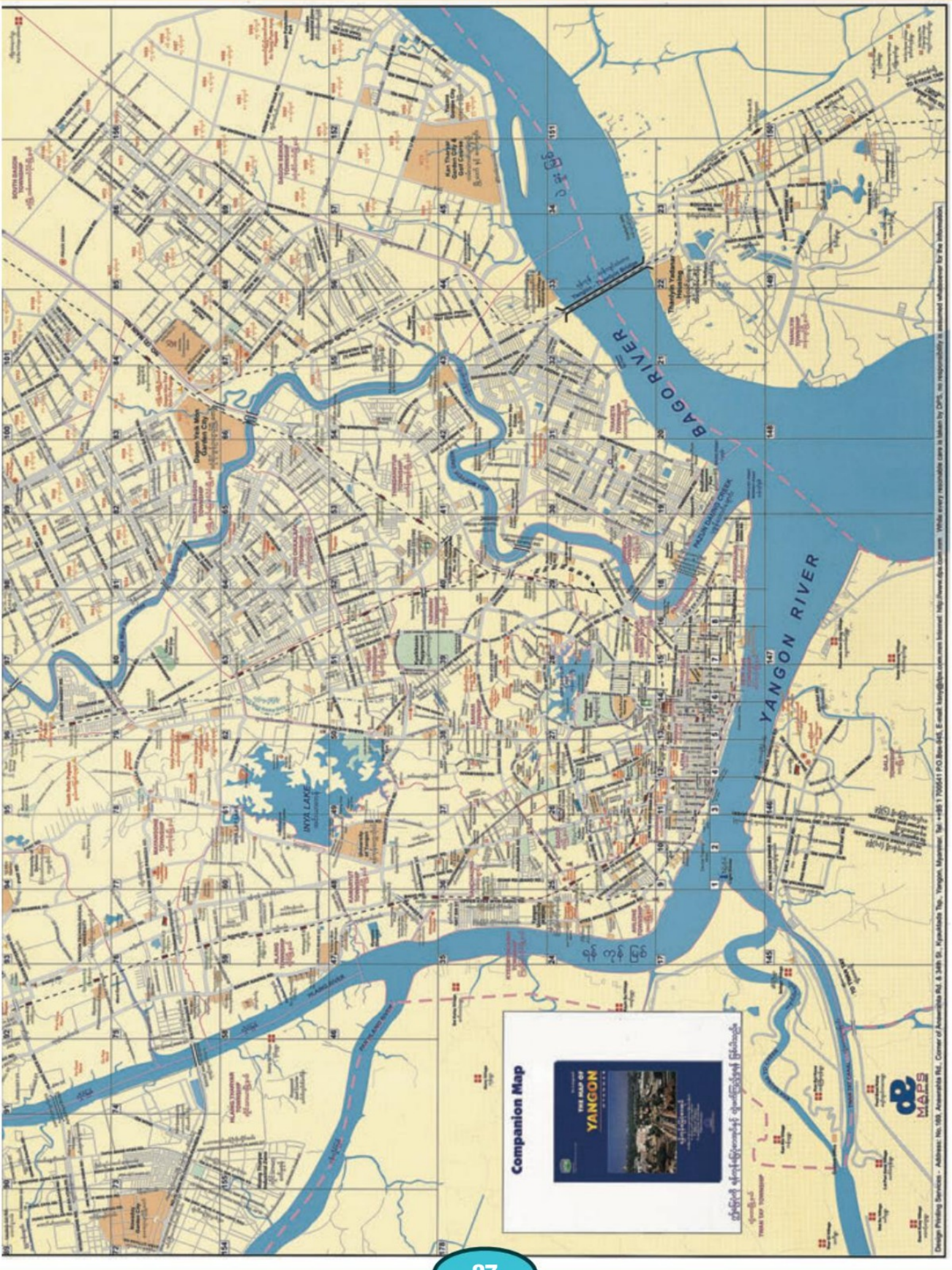
Like many of the buildings in the commercial core of the city, little maintenance has been done on the old colonial-era houses since independence, and they present a somewhat crumbling, decaying appearance. In Yangon, these **wealthier housing** areas are **dispersed** in pockets throughout the city wherever there is some higher land, although they are concentrated towards the city core. In recent years, poorer residents have tended to occupy old crumbling colonial buildings, whereas the middle class tends to occupy newer housing blocks in the suburbs.

1.44 Many of Yangon's old colonial mansions are now occupied by wealthier residents.

1.45 Many old colonial buildings in and near downtown Yangon are now occupied by poorer residents.

In general, the **quality** of the residential areas **deteriorates** as one moves further away from the commercial core of Yangon. Much of the residential accommodation in central Yangon comprises converted colonial buildings. Away from the city centre in **suburban Yangon**, accommodation is mostly in small houses with shops at the front or

1.46 Street map of Yangon. Source: Design Printing Services


BAGO RIVER
YANGON RIVER
INYA LAKE
Companion Map
THE MAP OF
YANGON
MAPS

1.47 Typical houses in Dala, an outer suburb of Yangon.

more recently built traditional 'village' houses. Dwellings are often single roomed with a minimum of furniture and lighting. Settlement becomes **sparser** towards the northern edge of Yangon because there is less pressure on the land. The buildings on the outskirts are typically two or three roomed shacks of somewhat flimsy construction.

On the outskirts of Yangon some **shanty** housing is found. These are areas of temporary housing built on pockets of vacant land by squatters who have migrated to Yangon from rural areas. **Rural-urban migration** does not appear to have been as significant a force in the growth of Yangon as it has been in the growth of other Asian cities such as Jakarta, Dhaka, Kolkata or Bangkok. **Push factors** encouraging migration into Yangon include the lack of amenities in rural villages, natural disasters such as droughts and floods, civil wars in the hill areas near Myanmar's borders, and slow but increasing farm mechanisation. **Pull factors** that encourage people to leave their rural areas and migrate to Yangon include the higher standards of living in the city and the prospect of employment.

In most Asian cities, it is very difficult to construct maps of urban morphology showing the urban land use zones. There are several reasons for this. First, the **economic forces** that operate through the land-rent mechanism are often absent or weaker in Asian cities than in western cities. In Asian cities, tradition, ethnic groupings and politics are usually more influential than simple commercial forces. Second, many economic activities occur in the **streets** rather than in buildings. For example, many of Yangon's markets are on the footpaths, and they relocate to different positions at various times of the day.

Third, a distinctive type of architecture has become increasingly common in Asian cities during the past few decades. Much of the recent construction has been building **three-tiered buildings** with retail activities at the street level, residential facilities on the upper level and light manufacturing on the middle floor. Where such buildings occur, land use zones should probably be plotted vertically rather than horizontally as on a land use map.

Because there has been so little construction in Yangon since 1948, this three-tiered pattern of architecture has hardly emerged in Yangon. Many of the old colonial buildings in the city centre have been modified inside to accommodate more and more families, and in so doing a three-tiered pattern has often emerged with the buildings. Nonetheless, with so little new construction of three-tiered buildings, Yangon has an unusually **clear pattern** of land use zones for an Asian city, and the pattern is a clear reflection of the pattern that existed during colonial times.

1.48 Three-tiered land use in an old colonial building in Yangon.

In addition to the commercial, administrative, industrial, port and residential areas described above, Yangon has a number of zones set aside for **special purposes**. One such zone is the area set aside for the huge Shwe Dagon Pagoda complex that was described earlier. Other examples are the large areas of **recreational land** and parks surrounding Yangon's two lakes, Inya Lake in the north and the smaller Royal Lake to the south. These are both artificial lakes that were expanded in the 1800s to provide a water supply for Yangon. Open space is also found around the University of Yangon to the north-west of the city, at Yangon racecourse to the north-east and in many other

1.49 New high rise housing in U Wisara Ward, the area between the CBD and the Shwe Dagon Pagoda (seen in the background).

smaller areas within Yangon. Indeed, much of suburban Yangon has a park-like atmosphere with many tall trees hiding the buildings.

Yangon's street pattern shows **three major phases** of development (figure 1.46). First, the **grid pattern** in the Central Business District beside the river at the southern end of the city reflects the city's colonial origins. British influence was concentrated in the port and administrative areas, and so these zones were surveyed according to the practices then current in Europe – a grid layout aligned with the cardinal points of the compass. To the north of this 'grid' area, extending up the southern side of Inya Lake, is a zone where the growth was largely unplanned and uncoordinated. In this area, a **deranged street pattern** emerged with roads following the traditional pathways and ridges. Finally, recent expansion to the west, north and east of Inya Lake shows increased evidence of town planning by government authorities, who have tried to plan urban development using a loose system of a l**arge scale grid** layout.

QUESTION BANK 1E

1. *In about two pages, describe and account for Yangon's urban morphology in the late 1930s, as shown in figure 1.38.*
2. *Explain why there was so little new construction in Yangon between the 1950s and the mid-1990s.*
3. *Compare the pattern of Yangon's urban land uses today with its pattern in the late 1930s. Give reasons for the changes (and lack of changes) under these headings: (a) physical factors and limitations, (b) urban planning, (c) ethnicity, (d) economic forces such as land values.*
4. *Compare the importance of rural-urban migration in Yangon with other Asian cities. What have been the reasons for and consequences of Yangon's different pattern?*
5. *Use the map in figure 1.46 to construct a sketch map showing Yangon's pattern of main roads and water areas today. Label the areas of the three main types of street pattern which reflect Yangon's growth.*

Poverty, deprivation and informal activity in urban areas

There are **gaps** between rich and poor populations in all cities at every level of economic development. The size of these gaps, and the ways these gaps are expressed in urban patterns, vary widely from city to city.

Shanty housing

One of the features of most cities in developing countries is that they have large areas of **shanty housing**. This comprises **self-help housing** made from scrounged materials such as corrugated iron, packing cases, cloth and disused plastic sheeting.

1.50 Part of a shanty settlement in Bamako, Mali.

Shanty settlements are known by various names in different countries, including *bustees* in India, *bidonvilles* in West Africa, *ishish* in the Middle East and *favelas* in Latin America. The Worldwatch Institute estimates that between 70% and 95% of all new housing in developing nations consists of shanty settlements. About 60% of the urban population in Africa live in shanty settlements, and the equivalent figures for Asia and South America are between 20% and 30%.

1.51 Shanty housing in Soweto, Johannesburg, South Africa.

Often, shanty settlements are occupied by **squatters**, a term for people who neither own nor have legal title to the land on which they are living. Squatters will build on land that has been left vacant, such as the strips along the sides of railway lines, or the edges of parklands or steeply sloping land that is unsuitable for building. In many cities in low income countries, this can lead to the paradoxical sight of shanty settlements being situated almost next door to expensive real estate such as luxury housing or prestigious corporate office blocks. Shanties can be found in all parts of developing world cities, but they are most commonly located on the **outskirts** of the cities where the most 'free' land is available. Many governments are embarrassed to have shanty settlements and use the police or the army to demolish them from time to time.

Other governments are a little more enlightened and realise that shanty housing is a **self-help** way of addressing the **housing shortage**, and that a housing shortage cannot be solved using a bulldozer. Some administrations even connect shanty housing to basic services such as electricity. Where this happens, the highly dangerous temptation to steal electricity by connecting wires to the power lines with bulldog clips is reduced.

1.52 Shanty housing on vacant land beside the railway tracks in Kolkata, India.

1.53 Shanty housing facing the beach at Mamba Point in Monrovia, Liberia. These shanties back on to some of Monrovia's most prestigious housing in United Nations Drive.

1.54 Singapore and Hong Kong no longer have shanty housing, but before the large-scale construction of high-rise housing blocks, they were quite widespread. This view of Braemar Hill in 1993 shows one of Hong Kong's last extensive shanty settlements.

Some governments that have enough resources have been highly successful in building public housing to rehouse the shanty dwellers. The extensive programs to construct high rise housing blocks in Singapore and Hong Kong began as strategies to rehouse shanty dwellers.

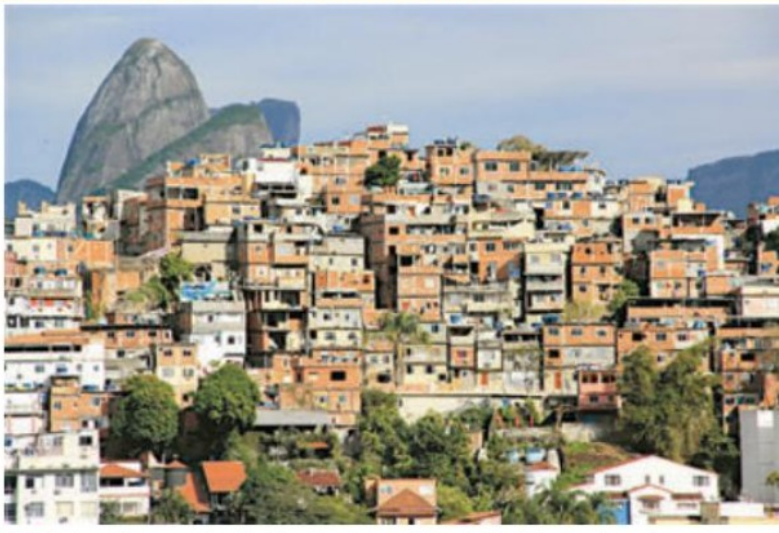
The replacement of shanty housing is a major issue in many developing countries. Not all countries

1.55 Poor housing occupied by a fishing community in Accra, Ghana. The large building on the hill is Fort James, a military installation and prison built by the British during colonial times.

have the resources available that Singapore and Hong Kong had to build large housing estates. Other **strategies** include **providing materials** for people to build better quality self-help housing, providing people with **loans** or **grants** to improve their shanties or having the **government pay** to improve the quality of shanty areas.

However, **problems** can arise from these strategies. All these measures cost **money**, which is always in short supply in countries with impoverished or weak economies. People are often **reluctant to move** away from locations near the city centre, even if it does mean an improvement in the quality of their housing. Moving people can often destroy the **spirit of community** that binds people together, and job training may still be needed to make people employable. Finally, when shanty areas are improved they may be seen as being so attractive that even more people come to settle there, leading to problems of **overcrowding** and **congestion**.

1.56 Poor housing occupied by rural-urban migrants in Iquique, Chile.



1.57 Favelas overlook Copacabana Beach in Rio de Janeiro, Brazil.

Urban sprawl and movement

Cities in both high-income and low-income countries have experienced **urban sprawl** on a huge scale to accommodate their **population growth**. The speed with which cities in developing countries are growing today is unprecedented in world history, and far more rapid than the growth of cities in the industrialised world a century ago.

This rapid population growth means that urban sprawl is also continuing to expand the land area occupied by cities. For example, the area of **Bangkok**, Thailand, expanded from 67 square kilometres in 1953 to 426 square kilometres in 1990, to 800 square kilometres in 2009 and 1,600 square kilometres today. In 1959, it was possible to walk across the entire city of Bangkok from north to south in three hours; today it is not possible to drive across Bangkok in three hours at most times of the day. The Bangkok Metropolitan Region now covers an area of more than 7,500 km².

1.58 Vertical and horizonal expansion in Bangkok, Thailand.

1.59 Mexico City is one of the world's largest cities, and it has sprawled over an area of 1,500 square kilometres to accommodate its influx of rural-urban migrants.

1.60 An oblique aerial view of part of Mexico City, showing its extensive urban sprawl.

Continuing urban sprawl causes several **problems** that impact on the lives of the residents. First, urban sprawl **takes over farmland** that was previously used to grow crops or raise livestock. It is estimated, for example, that each year urban expansion takes up 200,000 hectares of arable land in China alone. This urban expansion in turn has three important impacts. First, many farmers become **dispossessed** of their land, and must either move outwards to new farming areas which are often less productive (which is why they were not already being farmed) or move to the city in search of non-farming work for which they have no experience or qualifications. Second, it means that food must be **transported** over longer distances from the countryside to feed the rapidly growing population in the city, raising the costs of food to urban dwellers. Finally, the additional **burning of fuel** adds to greenhouse gases that could in turn

1.61 Urban sprawl and expansion of manufacturing take over farmland used for rice cultivation on the periphery of Bangkok, Thailand.

lead to global warming and climatic change. Between 15% and 20% of the six billion tonnes of carbon dioxide produced by human activities annually comes from transport. This is significant as carbon dioxide is a major greenhouse gas.

Urban sprawl has an even more direct impact on urban dwellers in the form of **movement** and **transport difficulties**. An expanding city means that more people will have their homes and places of work separated by long distances. In most cases, the people who are forced to live in areas with the **least accessible transport connections** are the **poorer residents**, and this applies in both low-income and high-income countries.

Living towards the outer edge (**periphery**) of a city experiencing urban sprawl means that people must commute long distances on roads that are often highly congested. At a superficial level, traffic congestion is a nuisance for commuters, but in

1.62 Traffic congestion and air pollution in Cairo, Egypt.

1.63 A major source of traffic congestion in Kampala, Uganda, is the fleet of privately owned minibuses that provide transport for poorer residents who cannot afford their own private motor vehicles.

reality the problems are much worse than this. **Traffic congestion** represents a waste of scarce petrol resources as cars' engines run without moving as well as a waste of time that could otherwise be used productively in work or recreationally.

In most cities in developing countries, **private car ownership** is rare compared with cities in more industrialised economies. This means that most people, and especially poorer residents, are more dependent on **public transport** such as buses, trams and trains. These services are often inadequate for the numbers of people needing to use them. Prices are low to make the transport affordable, but this means few funds are available to maintain and upgrade the vehicles. The low prices also attract more people to use the transport, leading to overcrowding and discomfort while travelling.

1.64 Crowded trains in Kolkata, India, bring commuters from the suburbs into the city centre.

1.65 Traffic congestion in Bangkok, Thailand.

Urban services deprivation

Government administrations of cities in developing countries face great difficulties in providing the **services** that residents might like or expect. Much of the problem arises because **tax revenues** collected by governments are insufficient to provide services such as street maintenance and garbage collection, and this in turn leads to problems such as poor roads and infrastructure, and a build up of rubbish in the streets. In cities where funds are scarce, it is usually poorer residents who experience **services deprivation**.

1.66 Under-investment in public infrastructure can cause problems, such as the rough and broken pavement seen here in Niamey, capital city of Niger.

In many cities in low income countries where rubbish collection services are provided, large communities of people live at or on the garbage tips and make a living from recycling the rubbish that is dumped there. For example, Dump Hill (also known as Stung Meanchey) is Phnom Penh's

largest garbage tip. Thousands of poor people live at the tip and make their living from it, including many children who remain uneducated because they never attend schools. Many of the residents of Dump Hill are chronically sick because of the unhealthy conditions of living and working in garbage, and many suffer poisoning from the toxic fumes of burning plastic.

1.67 Poor residents of Phnom Penh, Cambodia, sift through garbage at the city's major rubbish tip, Dump Hill, as a way to make money recycling waste. Most live in small shelters erected on the tip, making it both their place of work and place of residence.

Table 1.4 gives a summary of some of the urban services that reflect **poverty** and **deprivation** in some of the world's largest cities. Representative cities at all levels of development are included so that comparisons can be made. The table shows, for example, that large areas of many cities have houses without **running water** or **adequate sanitation**. People who live in such houses often have no alternative but to use nearby rivers for washing clothes and for personal washing as well as for garbage and sewage disposal. It is understandable that people who do not have access to clean running water in their homes experience problems of diseases such as gastrointestinal upsets and diarrhoea.

Unemployment, underemployment and informal employment

The **population structure** of cities in developing countries differs from cities in industrialised nations. Developing world cities tend to have a high proportion of the population aged between 15 and 30 years of age. Many of these young people have **migrated** into the city from rural areas in search of work, and they lack skills that would equip them for many urban jobs. This creates enormous pressure on the job markets of cities in developing countries, and **unemployment** rates of up to 30% and 40% are common in many cities.

The response of people to this challenge varies. Many young people **create** their own work, such as setting up small street stalls and re-selling goods that do not cost very much to buy wholesale. Sometimes the goods sold are food obtained cheaply from farmers, while at other times small goods bought in shops are sold at a profit.

Other job seekers manage to obtain jobs that are below their capabilities, which means they are **underemployed**. Another variation on underemployment occurs where more people are hired to do a job than is really efficient or necessary. This occurs quite commonly when job applicants know the employer who would not have otherwise given them a job. This practice is common in developing countries where labour is relatively cheap compared with machinery, which is scarce and expensive. This contrasts with the cost structure of economically more developed economies where labour is relatively expensive, making it economically more rational to justify replacing people with machines.

1.68 Underemployment (overstaffing) on a building site in Dhaka, Bangladesh.

The cities in developing countries also have many people working in the informal sector of the economy. The **informal sector**, which is also known as the 'black economy', includes those activities that are outside the legal and tax structures of a country. It includes **begging** and

Table 1.4

Poverty and deprivation in selected large cities

	Area	Population Size ('000)			Indicators of poverty and deprivation					
	sq km	1980	1990	2015	% h'hold income spent on food	People per room	% houses with tap water	% houses with electricity	Phones per 1000 people	Cars ('000)
Argentina										
Buenos Aires	2,590	9,918	10,648	12,390	40	1.3	80	91	14	1000
Bangladesh										
Dhaka	311	3,290	6,578	7,310	63	2.4	60	85	2	n.a.
Brazil										
Rio de Janeiro	1,580	8,789	10,948	11,160	26	0.8	86	98	8	n.a.
São Paulo	2,590	12,101	18,119	19,140	50	0.8	100	100	16	4000
China										
Beijing	2,616	9,029	10,867	12,770	52	1.2	88	90	2	308
Shanghai	2,396	11,739	13,447	14,460	55	2.0	95	95	4	148
Egypt										
Cairo	1,269	6,852	8,633	16,750	47	1.5	91	98	4	939
India										
Delhi	1,425	5,559	8,171	18,000	40	3.1	50	81	5	1660
Mumbai	777	8,067	12,223	19,530	57	4.2	92	78	5	588
Kolkata	984	9,030	10,741	15,010	60	3.0	51	63	2	500
Indonesia										
Jakarta	2,720	5,985	9,206	21,800	45	3.4	75	94	3	1380
Japan										
Osaka	2,720	9,990	10,482	17,270	18	0.6	96	100	42	n.a.
Tokyo	7,835	21,854	25,013	34,400	18	0.9	100	100	44	4400
Mexico										
Mexico City	2,137	13,888	15,085	18,430	41	1.9	92	97	6	2500
Nigeria										
Lagos	971	4,385	7,742	8,860	58	5.8	47	53	1	n.a.
Pakistan										
Karachi	881	5,023	7,943	9,380	43	3.3	66	84	2	650
Philippines										
Manila	1,425	5,966	8,882	19,550	38	3.0	89	93	9	510
South Korea										
Seoul	1,943	8,283	8,979	20,010	34	2.0	100	100	11	2660
United States										
Los Angeles	5,812	9,523	11,456	14,730	12	0.5	91	98	35	8000
New York	11,264	15,601	16,056	20,090	16	0.5	99	100	56	1780

Sources: United Nations, *World Resources.*

prostitution, which is a major industry in many cities of the world, and it is especially significant in Bangkok and Manila.

1.69 For people with disabilities in countries where social services are meagre on non-existent, begging may be the only way to survive. This beggar is in La Paz, Bolivia.

1.70 A young man in Lima, Peru, is trying to generate his own informal employment by juggling at red traffic lights in the hope of getting money from sympathetic and generous drivers.

1.71 A rural-urban migrant in Rio de Janeiro, Brazil, looks for wealthy beach goers at Copacabana Beach who will pay him to serenade them with his guitar.

QUESTION BANK 1F

1. *Explain why shanty settlements are a feature of many cities in developing countries.*
2. *Some governments tolerate shanty settlements whereas others oppose them. Which policy is better in your opinion? Give reasons for your answer.*
3. *For nations that do not have the financial resources to re-house shanty dwellers as Singapore and Hong Kong did, what can be done to improve the quality of life for shanty dwellers?*
4. *What problems does urban sprawl cause for poorer residents of cities in (a) low income countries, and (b) high income countries?*
5. *What transport difficulties do residents of cities in developing countries face that are not normally faced by residents of economically developed countries?*
6. *Why is there usually a shortage of housing in the cities of developing countries?*
7. *Why are the urban services in developing countries cities often inadequate?*
8. *Using the information in table 1.4:*
   a. *List the cities in descending order of their population sizes in 2015.*
   b. *Compare the indicators of poverty and deprivation in two cities, one from a low income (or developing) country and one from a high income (or industrialised) country.*
   c. *Suggest reasons for the differences you noted in your last question.*
9. *Conduct a survey among the students in your class to collect data on the five sets of statistics listed under the heading 'Indicators of poverty and deprivation' in table 1.4. Compare the results of your class with the statistics for the major world cities.*
10. *Explain why unemployment is a problem in many cities.*
11. *Define 'underemployment', and give some examples of underemployment.*
12. *What is meant by the term 'informal employment'? Explain the relationship between informal employment and poverty/deprivation.*
13. *Explain how the incidences of poverty, deprivation and informal employment vary at different levels of economic development.*

CASE STUDY
Begging in Karachi, Pakistan

It is not known how many people around the world work as beggars, a key type of **informal activity** in many countries. Large numbers of beggars are found in almost every developing country, and also in many economically developed countries. Although begging occurs in some countries as part of the traditional structure of society, begging is usually seen as a social evil caused by **poverty**, **unemployment** and **inflation**. This study looks at one example of the begging industry – Karachi, the former capital city of Pakistan and its largest city.

Karachi is the **former capital** city of Pakistan and the country's **largest city**. It has an official population size of more than nine million people, but when **rural-urban migrants** from the countryside are included, the real figure thought to exceed ten million. Karachi is the **financial capital** of Pakistan, and is known as 'Mini-Pakistan' because it is seen as a prelude to all of Pakistan's future problems. Many of Karachi's people came to the city as rural-urban migrants, lacking the skills needed to find **employment** in a large city.

Most of Karachi's **50,000 beggars** fir this pattern, having come to the city as rural-urban migrants. Many began to beg simply to **survive**, although others have taken on begging as a **profession**. Many of those who have taken up begging as a profession did so because their university degrees did not lead them into formal employment or because they were frustrated that their paid employment did not earn them high enough wages. Many Pakistani beggars beg because their fathers and mothers did so, and it is the only way of earning an income that they know.

Pakistan is overwhelmingly a Muslim (Islamic) nation. **Islam** teaches that giving donations to the poor will reward the donor in heaven. Islam teaches that if someone directs others to a good deed, they themselves share a part of the reward of that good deed. Thus, many Muslims in Karachi like to donate as much money as they can afford in order to gain rewards in the afterlife.

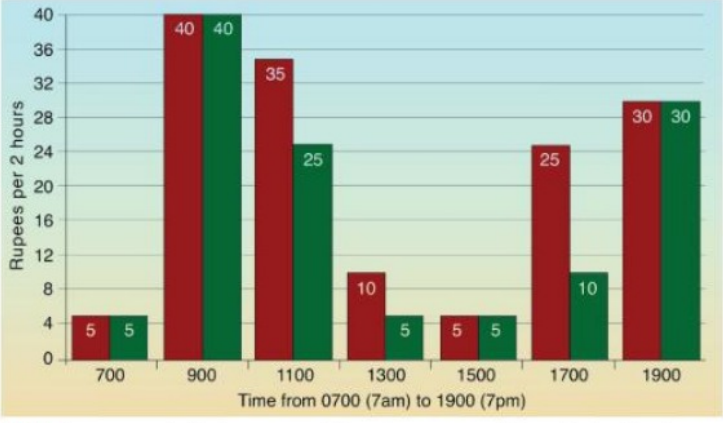
More economically advanced Muslim countries such as Saudi Arabia, Qatar and the United Arab Emirates have a lack of poor people needing to receive donations. Therefore, during the Muslim holy month of **Ramadan** and during other religious festivals, beggars from Pakistan fly to these countries to receive donations. In this way, it must be said that beggars in Pakistan have taken some significant steps to **combat their poverty** in the face of local unemployment and inflation.

Begging at the Civic Centre intersection

Karachi has more than 100 areas where groups of **professional beggars** are found. The beggars tend to situate themselves in high-traffic areas. One important area for begging is the **Karachi Civic Centre Intersection**, which marks the point where four roads leading to important industrial, commercial and residential areas in Karachi meet. The beggars at this intersection belong to one *kunbaa* (family), and the intersection is their *elaaqaa* (territory). The beggars give *batta* (bribes) to the traffic police to ensure that they do not interfere with the begging, and to make sure that beggars from another *kunbaa* do not begin begging at the same intersection. One beggar who was interviewed for this study commented that "Rich people pass by here and 'shower' money!".

1.72 Several beggars can be seen standing beside cars asking for donations at the Civic Centre Intersection. This part of the intersection is known by the beggars who work there as a low and middle income begging area.

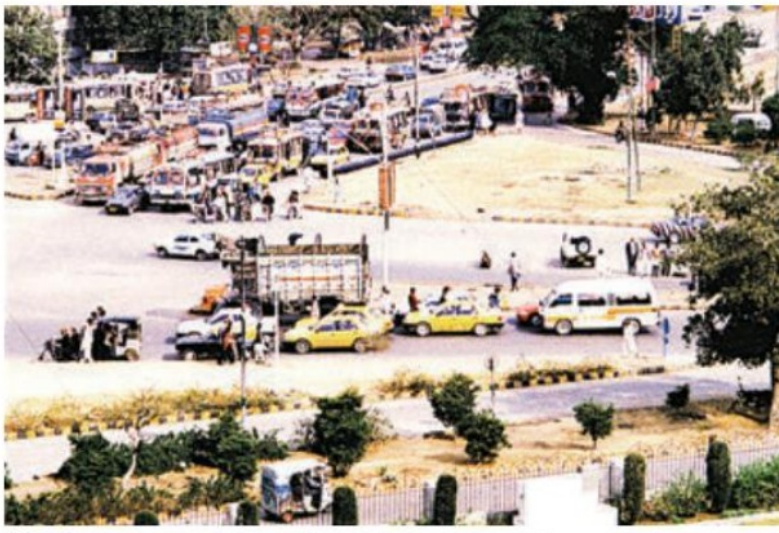
In general, beggars who have the **greatest deformities** or who look thinnest are allowed to locate at the best locations. On one corner of the Civic Centre Intersection, for example, a lame man begs with his wife who holds her new-born baby up to the car drivers stopped at the red traffic lights, crying out "My baby is dying of hunger". Rafeeq confessed that this was 'acting', but acknowledged that this was very effective in bringing donations.



1.73 Average daily income of two beggars at the Civic Centre Intersection in Karachi, Pakistan. The red bars show income for a lame beggar with a wife and young baby who has a prime location. Most donors are labourers and middle class workers. Average daily collection (except holidays) is 150 to 200 rupees (US$1.50 to US$2.00), of which the constable from the traffic police receives a percentage. The green bars show income for a beggar on a corner where many wealthy drivers pass by. Although this beggar is also lame, his average daily collection is less because richer people in Karachi tend to be less superstitious than labourers and middle class people.

The **peak hours** for begging coincide with the peak hours of traffic movement (figure 1.73). At the Civic Centre Intersection, these peak hours are 9am to 11am, and 6pm to 7pm. During these hours, the beggars work quite hard, approaching every car that stops at the red light to request a donation, hurrying back to their places on the footpath when the lights turn green. The beggars typically spend about 12 hours per day begging at the intersection, returning to their homes in the evenings. The holy month of **Ramadan** is the time when incomes are highest, and some beggars bring their relatives from rural villages to beg with them in Karachi at that time.

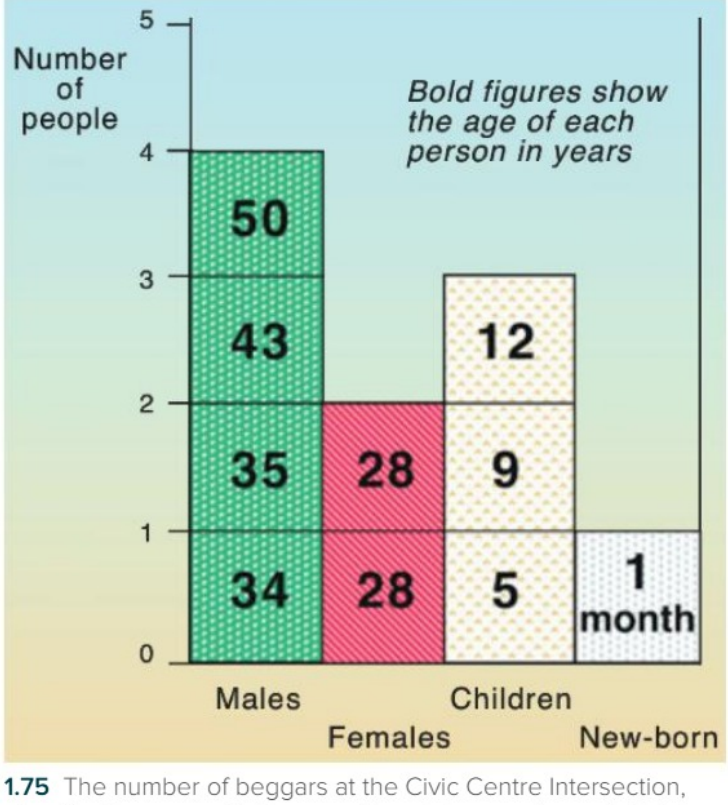
On a typical working day, ten people beg at the Civic Centre Intersection (if a new-born baby is included). The **ages** of these beggars are shown in figure 1.75. Of the ten, seven have been begging all their lives, one for 12 years, one for 10 years and one child for a month.



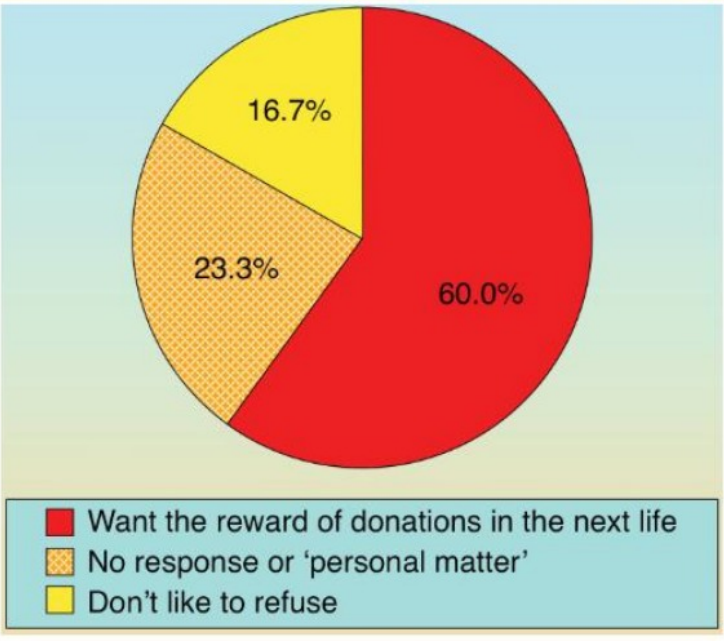
1.74 Begging at the Civic Centre Intersection. The area where the yellow taxis have stopped is the high income begging area. Since this photo was taken, an overpass has been constructed, causing some changes in the allocation of places to the beggars who operate at the intersection.

A survey of 30 people at the Civic Centre Intersection why they had chosen to give money to beggars. The responses are shown in figure 1.76.

Begging is an important means of acquiring income in many low income countries. This is especially so in countries like Pakistan where the government does not provide pensions and social security. Beggars who lack work skills suitable for urban living find that it is one of the few ways they can overcome inflation and poverty.



1.75 The number of beggars at the Civic Centre Intersection, classified by age, with the age of each beggar shown in bold figures.



1.76 Reasons people choose to give to beggars at the Civic Centre Intersection in Karachi, Pakistan.

QUESTION BANK 1G

1. *Why do people become 'professional' beggars in developing countries?*
2. *Why do people give money to beggars?*
3. *Why would beggars choose to beg at the Civic Centre Intersection?*
4. *Describe the organisation of the begging industry in Karachi.*
5. *Would it be desirable to eliminate begging? If so, how should it be done? If not, explain the reasons why begging should continue.*

CASE STUDY
Social stresses in London, UK

With a population of about seven million people, **London** is the third largest city in Europe (after Paris and Moscow). London is the capital city of the United Kingdom and a **major centre** of banking and international finance. It is a centre of political power, world trade and communications, tourism, entertainment, and sporting spectacles.

In many ways, London is a curious mix of **social extremes**. On one hand, London is the **wealthiest region** of Britain and one of the four wealthiest regions of Europe. On the other hand, there are large areas of **poverty** and **unemployment**, with three-quarters of a million people living below the poverty line of US$150 per week. In inner London, almost half the children live in households with no earner of regular income.

1.77 The affluent side of London — expensive cars are parked in Chester Terrace, an exclusive housing area in Regents Park.

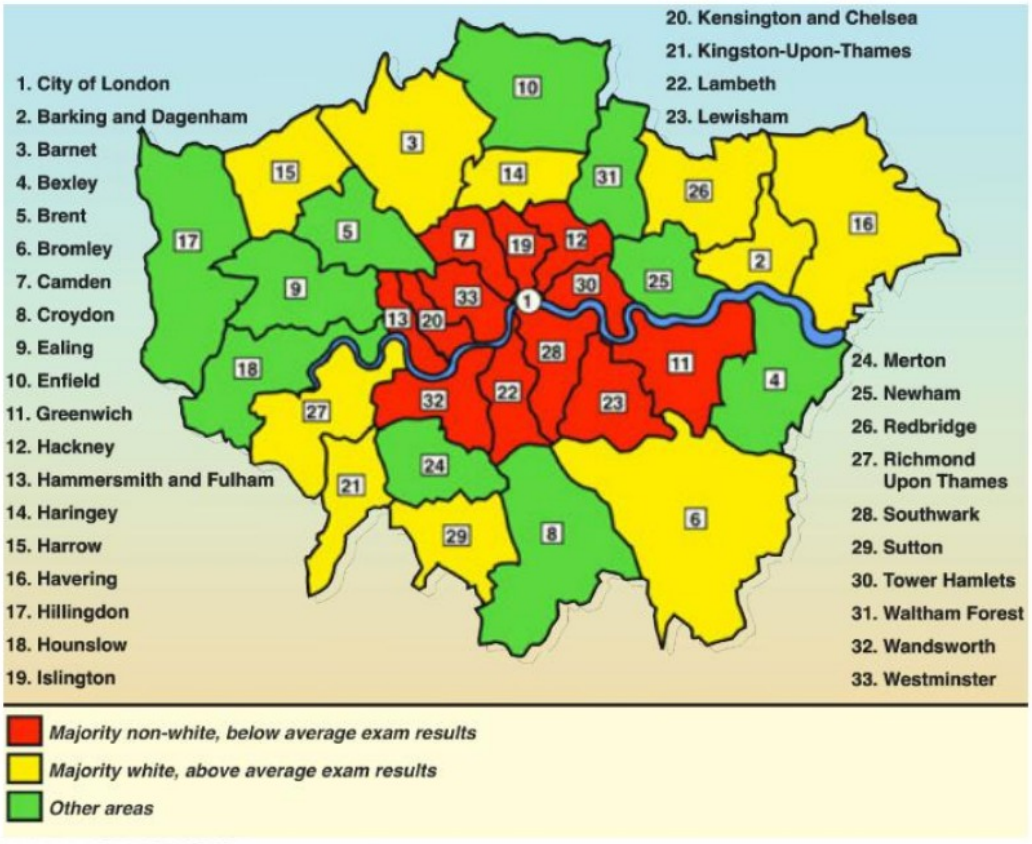
1.78 The poorer side of London — graffiti covered housing in the suburb of Hackney Wick.

London's **social structure** is similar to the rest of Britain except that it has proportionally more in both the richest and the poorest groups. The gap between the rich and the poor in London began to **widen** throughout the 1980s and 1990s, and the trend is continuing. Part of the reason for the widening gap is government policy, which has emphasised **private sector investment** and personal self-reliance in recent decades.

London's social structure today **reflects past patterns** to a large extent. In the 1800s, while traders were making large profits and Britain's overseas empire was bringing in great wealth, many Londoners suffered from disease, overcrowding and poverty. Moreover, thousands of people were dying each year from cholera,

smallpox and typhoid. These problems were most severe among the poor in the **East End**, but they were also felt to some degree throughout London.

Today, the reasons for London's social problems are different. However, the problems still tend to be worst in London's **inner areas**, as it is these parts of the city which have seen the most factory, shop and office **closures**. **Unemployment** in the inner areas of London is very high, and so **crime**, **vandalism** and **violence** have also become common. In these inner areas, rents and land prices are often high, and many residents have had to move elsewhere. The



1.81 The relationship between social structure and school performance in London. Schools with majority non-white populations are in London's poorest areas.

1.79 Urban dereliction in Hackney Wick.

1.80 Urban renewal — a new shopping mall at Stratford, built on disused industrial land near London's Olympic Stadium.

term **urban blight** is used to describe many of London's inner areas, where the factories, people and jobs that have disappeared from the area have been replaced with **vacant land** or **deserted** and **derelict buildings.**

Traditionally, people in London have placed great faith in the **education system** to narrow the **gap** between rich and poor. In London, many would argue today that the education system has widened the gap (figure 1.81). British education authorities publish annual tables of statistics comparing the performance of schools in external examinations. The tables highlight the **polarisation of opportunity** for London school students. In one year, it was reported that three London schools were among the top ten schools in England, while in the same year six London schools were among the bottom eight in the country.

The gap in London's schools is reflected in London's **workforce**. On one hand, London has a very well educated workforce, with 20% of the population having university degrees compared with the British national average of 13%. On the other hand, London has a larger percentage of its population without qualifications or skills than the

national average. Over 50% of young people in London have no employment qualification whatsoever. By 2016, one million people in London were receiving government **welfare payments**.

Like many social characteristics of London, **unemployment** is unevenly distributed. It is worst in the inner areas, and becomes less severe towards the edges. In part this is because many people with jobs have chosen to relocate their homes beyond the outer boundaries of London and commute to work each day. Today, about 750,000 people commute into and out of London on a daily basis for work. For London as a whole, 1 in 5 jobs is held by someone commuting, and for the financial centre, the proportion is 1 in 3.

The **distribution of wealth and poverty** in London is mirrored in the access people have to **housing** of different standards. In general, London's poorer suburbs are in inner areas, while wealthier people live on the outer fringes. London's poorest housing tends to be in the East End and Southwark, where there is a mix of old houses and high rise estates.

The **ownership of housing** in London reflects the social structure. There is a shortfall of some 600,000 dwellings in London. As a result, London over 30,000 squatters living in vacant houses they do not own or rent. On the other hand, many wealthy householders own two or more homes. Distribution of ownership shows that the proportion of the population owning their own home increases with distance from the centre of London (figure 1.86). This measure of the **distribution of wealth** mirrors other indices such as average incomes, housing prices and savings.

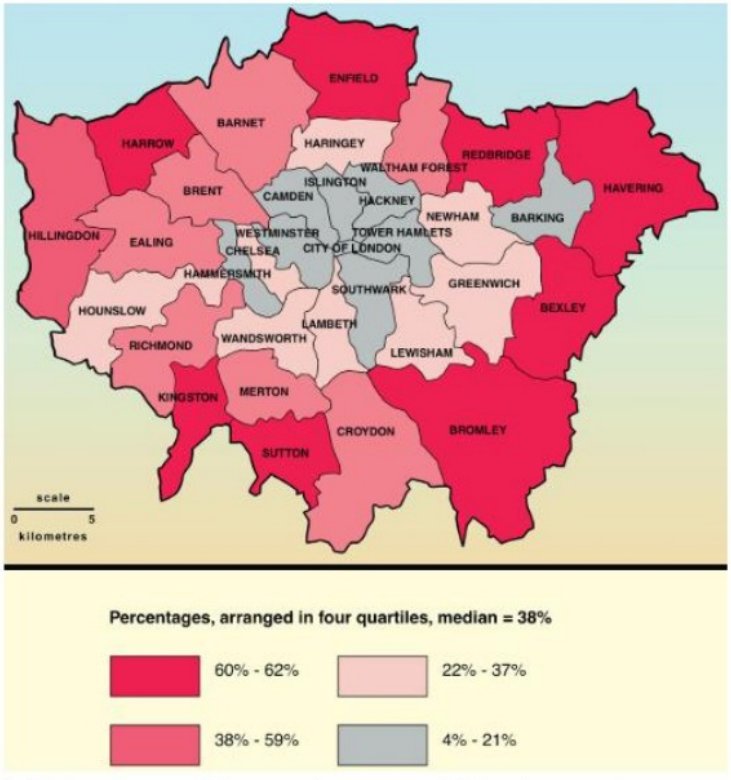
Many older London homes have **inadequate facilities**, and it is estimated that about 150,000 homes in London do not have their own bath or indoor toilet. The most poorly serviced homes, with no bath or toilet, poor heating and no insulation, are found in the poorer inner areas.

1.82 Outer suburban housing in London.

1.83 Inner city housing in London.

1.84 Part of Aylesbury housing estate in Southwark.

1.85 The residents of Heygate Estate in London's Elephant and Castle district were forcibly evicted to allow demolition.



1.86 Proportion of the population aged 65 and over who own their own home outright.

Overall, there are about 250,000 applications from families waiting for **low-cost council housing** in London. The waiting lists vary from area to area, however, reflecting the distribution of wealth. In the inner suburbs, there is an average of more than 100 applications per 1,000 resident families, whereas in London's wealthier middle and outer suburbs the figure is fewer than 35 applications per 1,000 resident families.

Many of those who are successful in obtaining low-cost council housing find themselves in **high-rise housing estates**. It has been found that people in high-rise housing estates are very **disadvantaged** compared with the general population. Residents in high-rise blocks have a higher likelihood of **suicide**, they are more likely than average to be **bashed** or **murdered**, and they suffer from frequent **thefts**.

Large numbers of people have no choice but to continue to live in high-rise estates in London. However, many of them **resent** having to do so, and they demonstrate this in various ways. Several tenants' groups have been organised to campaign for improvements in the quality of living in the estates. Many of these tenants' groups have suggested blowing up the high-rise estates and replacing them with low-rise dispersed housing, and in the early 2000s some high rise estates were forcibly vacated and marked for demolition.

1.87 Poorly maintained public areas in Heygate housing estate.

1.88 Graffiti covers many of the walls in Heygate Estate.

1.89 In an effort to improve security in some high rise housing estates, security doors and enclosed stairwells have been installed. This example shows Gloucester Grove Estate.

The estates have gained a savage reputation as centres of crime and violence, and as a result many of them have been declared **'no-go' areas** by many milk vendors, doctors and rubbish collectors. This further disadvantages the residents of the housing

blocks because they therefore may not have **access** to these services. It is quite common for upper-floor residents to throw their rubbish over their balconies or through their windows into the gardens below because they are so frustrated that no-one will come and collect it. Fires are also common in the estates because residents attempt to burn their rubbish in the corridors to dispose of it, or to set fire to their flat in the hope that they can move out into different housing.

There are other signs of **frustration** and **discontent** among the residents of the high-rise housing blocks. For example, large quantities of **litter** are found in corridors and in the grounds, there is widespread **vandalism** such as broken windows and smashed equipment, while piles of human excrement are often left on the floors of corridors or smeared on the walls. **Graffiti**, usually a sign of frustration, is found on most housing estates.

Some larger housing estates were designed to have **shopping centres** included on one floor of the high-rise blocks to provide access to everyday needs for the residents. However, because of the combination of deliberate **vandalism** and the **poverty** of the often-unemployed residents, most of these shops have fallen into **disuse** and **disrepair**. As a result, many housing estates have an entire floor with boarded up shop fronts which provide little more than a derelict place for young people to meet. Sadly, the only commercial activity on these floors now is drug selling and vice.

Not surprisingly, most of the residents feel **trapped** in the environment of the high rise housing estates because they cannot afford to move elsewhere. Although there is a major shortage of housing in London, many high-rise estates have **vacancy rates** as high as 35%. This high vacancy rate shows how unpopular the high rise estates are, even for low income earners without any other form of housing. It is not uncommon for **squatters** to move into vacant flats, which causes **resentment** among the tenants who are paying rents for their flats.

In spite of its problems, London continues to attract large numbers of **migrants** from other parts of Britain. Migrants are attracted by the job prospects, wealth, entertainment and education opportunities available in London. The typical migrant into London is a young, single, ambitious, well-educated person, whereas the typical migrant out

1.90 Evidence of multiculturalism in London — Muslim businesses cluster near a large mosque in Aldgate.

1.91 Walworth is one of London's districts with a large proportion of people whose origins can be traced to Africa and the Caribbean.

of London is a successful husband and wife team in their mid-forties or older (plus their children) in search of more open space in which to enjoy a more comfortable lifestyle.

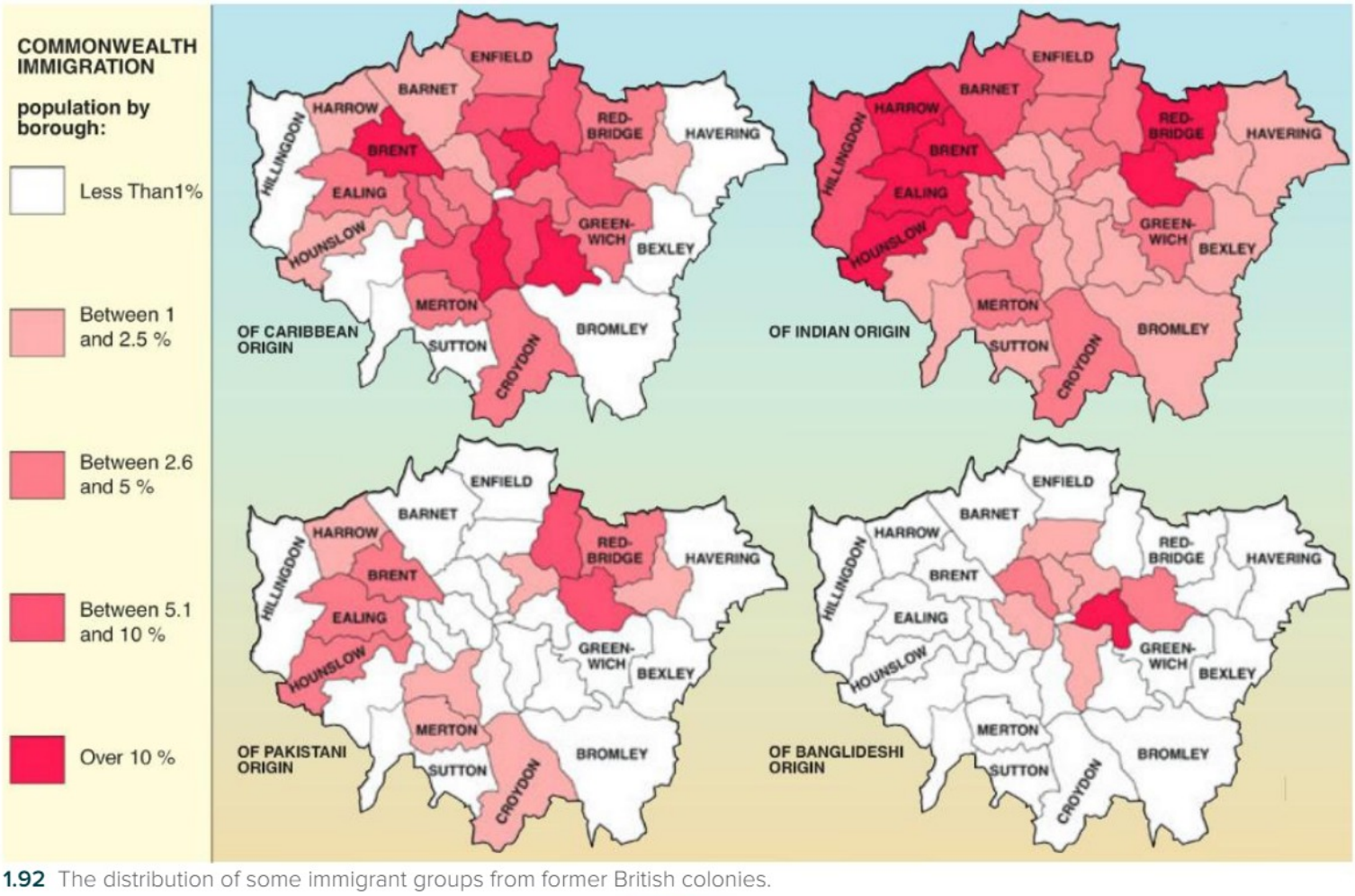
The **movement of people** into and out of London has created some further inequalities and unequal access to services, however. For example, urban planners have **zoned** areas for housing which are separated from areas of employment. This has been done to preserve the high quality of residential environments. However, the planning was done based on the transport costs for male heads of households. The planners are now criticised because they did not take into account the fact that over 40% of London's work force is now female. The separation of home and workplace is especially inconvenient for working women as most of them continue to do the household shopping and child raising in addition to their paid employment.

In addition to migrants from other parts of England, London also attracts migrants from other regions and countries. The influx of migrants gives London a distinctive **multi-cultural character**, but the diverse ethnic mix also mirrors patterns of advantage and disadvantage.

Since the late 1960s, increasing numbers of **immigrants** have settled in London. The largest groups have come from former colonies in Asia (such as Pakistan, Bangladesh and Sri Lanka), East Africa (such as Uganda and Kenya) and the Caribbean (especially Jamaica and Trinidad). Large numbers of refugees have been accepted from many of the world's trouble spots – Nigeria, Afghanistan, Iraq, Somalia, Syria, and so on. London absorbs 90% of Britain's **refugees**.

When immigrants from former colonies or trouble spots first arrive in London, they tend to be quite **poor** and therefore they are **unable to afford** good housing. As a result, many new immigrants tend to cluster together in groups, generally in London's poorer suburbs. The specific place where immigrants settle depends on where cheap housing is available at the time and where previous patterns of migration have seen people of the same nationality settle. As a general rule, new arrivals follow the settlement patterns of earlier migrants from the same country. Over time **community facilities** for that ethnic group develop in the area.

As well as settling near other people from the same country, immigrants also tend to take up **similar work** to previous arrivals in the same ethnic group. For example, many Spanish immigrants work in the hotel and hospitality industry, many Latin Americans clean offices and many West Africans manage car parks. Sometimes, the division of work can become quite specific, such as where many Nigerians are employed stacking shelves at '7-11' stores, whereas many Tamil Indians stack shelves in 'Europa' stores. At any one time, there are about 55,000 young Australians, New Zealanders and Canadians working in London – these are short term immigrants who typically work for a few months to earn enough money to go touring through Europe. Like other immigrant groups, the young Australians tend to live in the same area (Earl's Court) and work in the same industries (hotels, restaurants, and child care).



1.92 The distribution of some immigrant groups from former British colonies.

Because they cluster together in **urban villages** for reasons of comfort, support and economy, immigrant groups have been able to retain many aspects of their own cultures in London, including continuing to practice their own religion, establishing their own food stores, speaking in their original languages and arranging their own marriages. On the other hand, there have been instances of **hostility** towards immigrant groups in London, such as racist graffiti in buildings and trains and hostile personal behaviour.

1.93 Recent refugees often face challenges in finding work. These three refugees have created work in the informal economy by washing the windscreens of cars stopped at traffic lights in London in the hope of receiving a small payment.

Although British government policy strictly forbids **racism** and **discrimination** on the grounds of ethnicity, many immigrants complain about racial discrimination shown to them by London's housing authorities. It is claimed that **poorer quality housing** tends to be allocated to immigrants than to white people. It is also alleged that immigrants with coloured skin are more likely than whites to be allocated high-rise housing, rather than more desirable semi-detached or terrace housing.

Racial riots have broken out from time to time against Asian immigrants in parts of London. The best known race riots in London occurred in the suburb of Brixton. About 25% of the population of Brixton comprises immigrants of different racial background, which is why the suburb became the target of racist rioting. Some extreme political groups have argued that immigration and refugee intakes should be reduced or stopped, and these arguments formed part of the successful 'Brexit' campaign in 2016 for the United Kingdom to withdraw from the European Union.

On the other hand, most Londoners seem to appreciate the **positive contribution** which immigrant groups make to the city's economic and social life. One London citizen summed up thus:

"Here in a hundred (metre) stretch can be seen an Irish pub, Indian newsagents, food shop and restaurant, a Greek-Cypriot delicatessen, a halal butcher, a variety of West Indian businesses, a West African restaurant with a taxi service above, a Chinese take-away, a Lebanese flower shop, a Jewish-run ironmongers, an Italian restaurant and a Spanish-run off-licence (take-away liquor store). It is this rich mix of cultures rubbing alongside one another that characterises London and adds so much to its vitality."

Not all the immigrants into London are economically disadvantaged. London is also attracting increasing numbers of **millionaire immigrants** from various countries, but especially the Middle East and the former Soviet Union. Like other immigrant groups they tend to cluster together, but in these cases it is in areas of London's **top real estate** – Mayfair, Knightsbridge, Kensington and Belgravia. Housing in these areas has always been expensive, but the arrival of foreign millionaires has **raised prices** of real estate in these areas beyond the reach of even wealthy British people. The shopping streets north of Hyde Park and parts of Mayfair (east of Hyde Park) and Knightsbridge (south of Hyde Park) are now almost entirely owned by Arab immigrants from the Gulf.

QUESTION BANK 1H

1. *Outline the evidence to support the claim that "London is a curious mix of social extremes".*
2. *Why is London's social structure so polarised?*
3. *Describe and account for the spatial distribution of wealth and poverty in London.*
4. *Why is the East End of London so disadvantaged?*
5. *Describe the pattern shown in figure 1.81.*
6. *List the disadvantages faced by high-rise housing residents.*
7. *What realistic solutions would you propose to relieve the problems of people living in London's high rise housing?*
8. *What attracts migrants to London?*
9. *List the reasons that immigrant groups tend to settle near other people from the same ethnic group.*
10. *What is the relationship between the patterns shown in figures 1.81, 1.86 and 1.92?*
11. *Do you think London's wide ethnic mix is a positive or negative factor in influencing the city's culture of place? Give factual reasons and evidence to support your view.*

Chapter 2

Changing urban systems

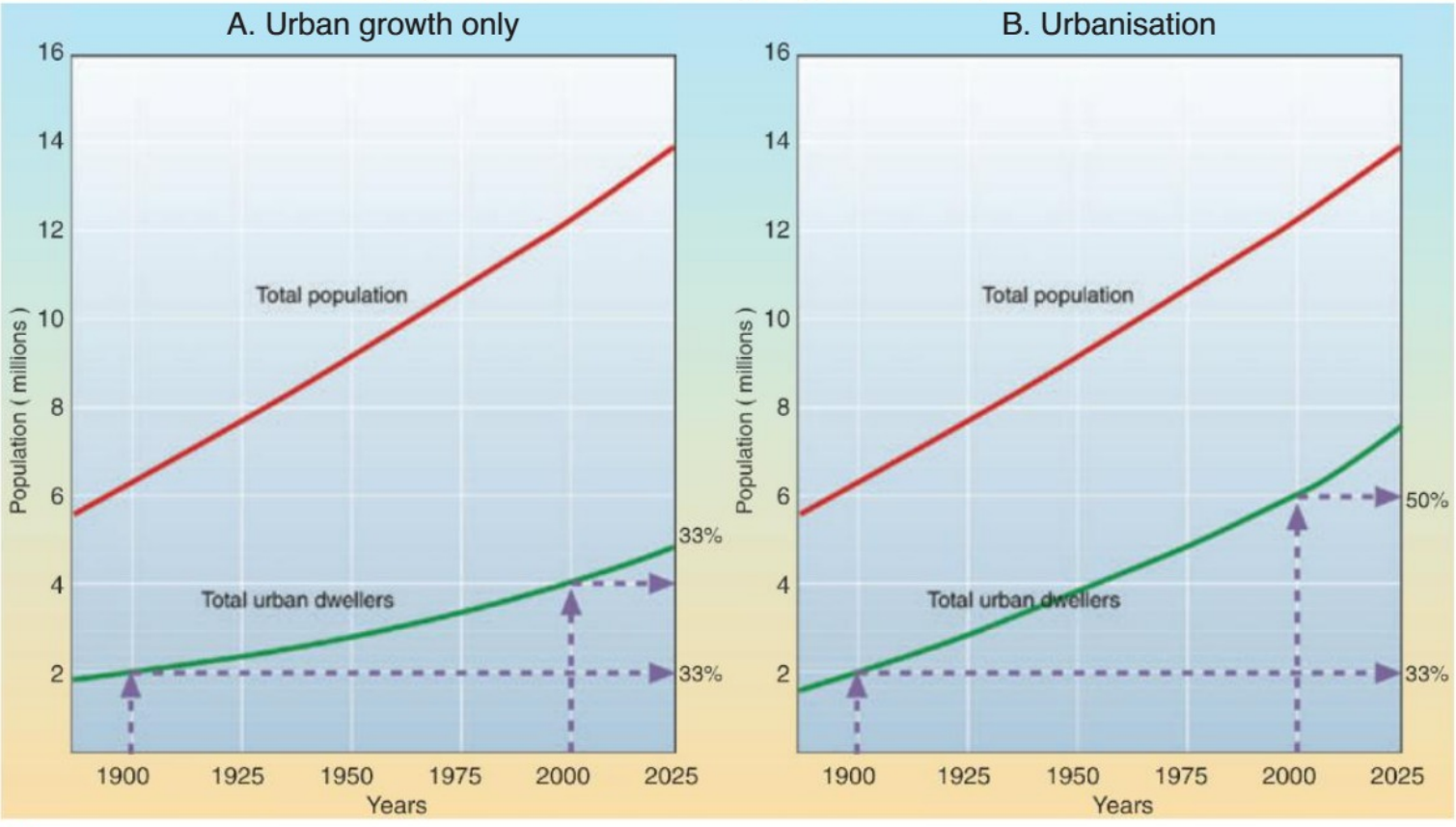
2.1 The fringes of the city of Quito, Ecuador, spread up the surrounding hillside as the city expands to accommodate an influx of migrants from rural areas — evidence of urbanisation as the percentage of urban residents in Ecuador increases.

Urbanisation

The world has never experienced urbanisation on the scale that it is occurring today. Urbanisation at this time has been described as one of the most dramatic demographic, economic and social changes occurring in the world. It is without doubt one of the major changes of global significance in the world today. The impact of urbanisation that is currently underway will continue for many decades at least. This makes understanding the causes and consequences of urbanisation an important issue for people today.

Urban growth and urbanisation

There is a significant difference between 'urban growth' and 'urbanisation', and unfortunately these two terms are often used in different ways in different books. **Urban growth** can be used correctly in two ways. First, it can mean the **increase in size of a particular urban place**. For example, if a city's population increases from 3.5 million to 3.6 million, we can say that urban growth has occurred. The second way that the term 'urban growth' can be used is to mean an **increase in the number of people living in urban centres**. For example, we could say that the urban population of



2.2 Urban growth and urbanisation.

a country increased from 7 million to 8 million people, and that therefore 'urban growth' had occurred.

The term **urbanisation** is quite different. Whereas urban growth refers to increase in the **number** of people living in urban areas, urbanisation refers to an increase in the **proportion** of people living in urban areas. The diagrams in figure 2.2 help to explain the difference. In **part A** of the figure, the national population in a hypothetical nation increases from 6 million people in 1900 to 12 million people in 2000. During the same period, urban population increases from 2 million people to 4 million people. In 1900, the urban population was 33% of the total population, and in 2000 the urban population was still 33% of the total. **Urban growth** had occurred but **urbanisation** had not occurred, as the proportion of people living in urban centres had not increased.

In **part B** of the figure on the other hand, the national population in our hypothetical nation still increases from 6 million people in 1900 to 12 million people in 2000. However, this time urban population increases from 2 million people to 6 million people during the same period. In 1900, the urban population was 33% of the total population,

2.3 Self-help housing added to the backs of existing housing in Monrovia, Liberia, is evidence of urban growth. However, it is not evidence of urbanisation; we would need to look at national statistics of changes in the percentage of people living in urban centres to draw conclusions about the process of urbanisation.

but by 2000 this had increased to 50% of the total. **Urban growth** has occurred once again and this time **urbanisation** has also occurred, as the proportion of people living in urban centres has increased.

The term '**urbanisation**' can also be used in a slightly different, but related, way. We have just described the **process** of urbanisation, but we can also refer to the **level** of urbanisation. The level of

urbanisation is the proportion of the population living in urban areas at a given time. In table 1.2 in the previous chapter, data is given headed 'Urban population as a percentage of total population'. This column could have also been headed 'Level of urbanisation'.

Centripetal population movements

As the processes of urban growth and urbanisation occur, three types of **population movements** take place. The first group of processes involves the **inward** (or **centripetal**) movement of people to urban areas, and these processes include rural-urban migration, gentrification, and reurbanisation (with urban renewal). The second group of processes is **outward** (or **centrifugal**) movements of people, and these include suburbanisation, counterurbanisation and urban sprawl. The third group of processes do not involve movements of people, but comprises the **natural changes** to patterns of population density within urban areas.

Low-income countries

As cities in developing countries have expanded in recent years, they have tended to **sprawl**. In other words, they have expanded horizontally over great distances. To take just one example, each year, Bangkok spreads out to cover an additional 32 square kilometres of former farmland. In 1900, only 10% of the world's population lived in cities — today the figure is more than 50%. Most of the current growth is occurring in the large cities of developing countries.

Much of the recent urbanisation in developing countries has happened because of rural-urban migration. **Rural-urban migration** is the movement of people from rural areas into urban areas. In the cities of some developing countries, well over half the population may not have been born in the city, but have moved there from rural areas. For example, in Port Moresby, the capital city of Papua New Guinea, 61% of the population were not born there. In Dhaka, the capital city of Bangladesh, 80% of the city's growth has come from rural-urban migration, with only 20% coming from natural increase. In the Tanzanian towns of Dar-es-salaam, Dodoma, Arusha and Zanzibar Town, the proportion of migrants (i.e. people born elsewhere) is 68%, 73%, 70% and 85% respectively.

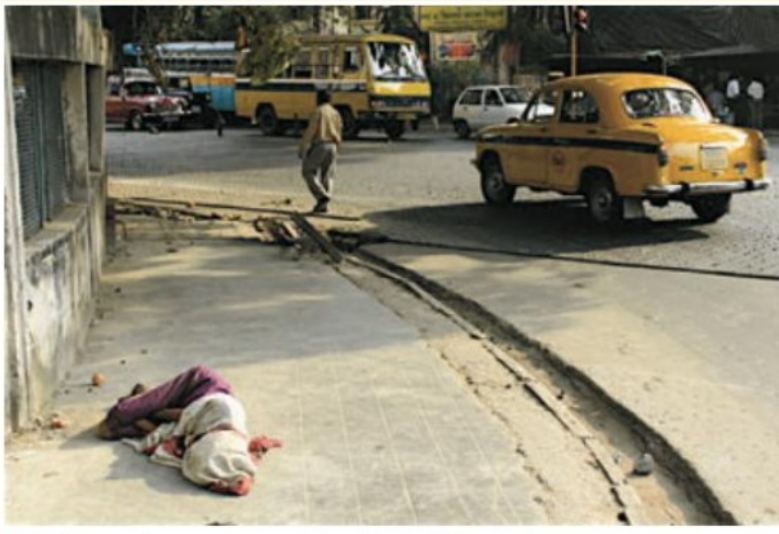
2.4 Nine Mile is a vast settlement on northern Port Moresby, Papua New Guinea, that houses thousands of rural-urban migrants from all parts of the country.

2.5 A shanty settlement in Dhaka, Bangladesh, populated by rural-urban migrants.

Moving from a rural village to a big city is a major decision that is not made lightly. The **decision** whether or not to move is usually made after long consideration and many factors are considered. The factors that encourage a person to move can be divided into push factors and pull factors. **Push factors** are forces that send a person away from an area. **Pull factors** are the forces that attract a person into a certain area. As well as the push and pull factors that encourage a person to move, there are also **restraining factors**, or **forces of inertia**. These are forces that encourage people to remain in the rural areas where they are living.

Migration from a village to a large city is seldom undertaken in one jump. Most rural-urban migration is done in a step-wise manner, called **chain migration**. The rural-urban migrant will usually move from a village to a nearby small town

2.6 These rural-urban migrants in south-eastern Mali are on their way to the country's capital, Bamako, in search of employment.

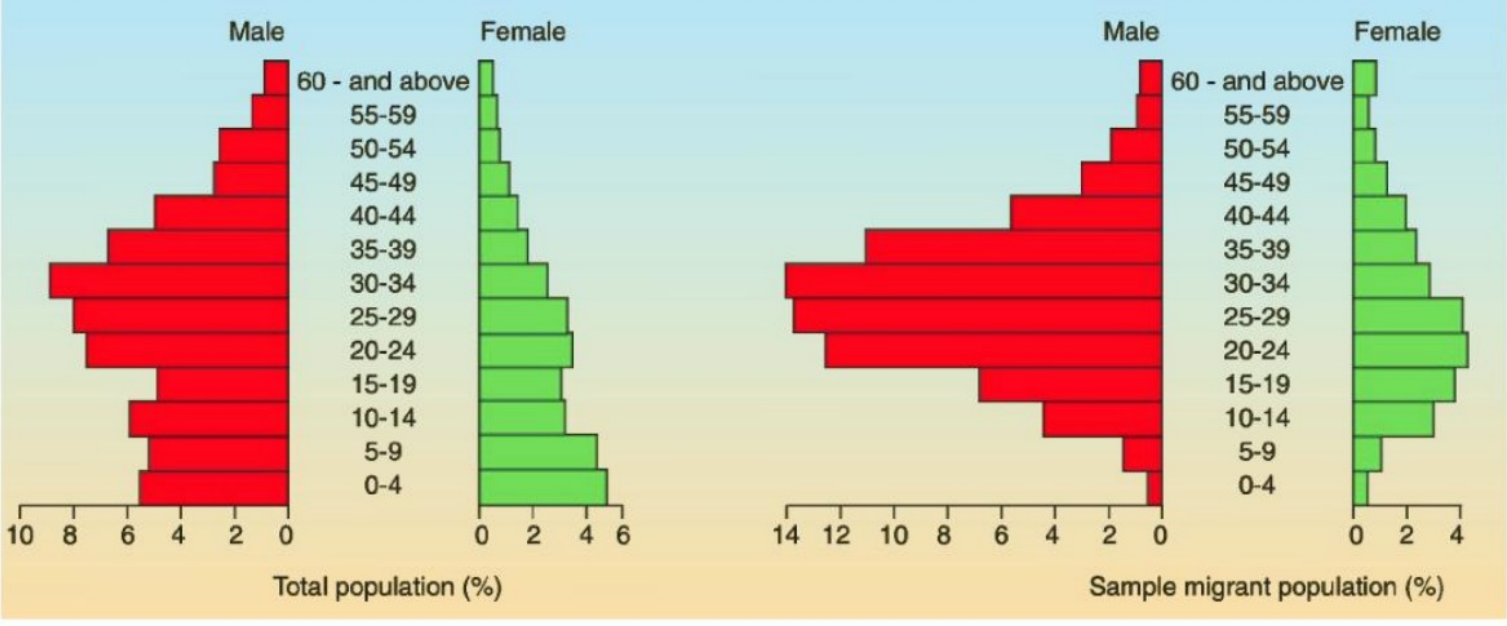


2.8 A homeless pavement dweller in Kolkata, India.

at first, then to a larger town and only then to a city. The typical rural-urban migrant is a young, single, somewhat adventurous male who comes to the city in search of wealth before returning to his home town or village. Some rural-urban migrants wind up staying in the city, especially if they find a marriage partner there. Others return to their rural area, either permanently or seasonally. Migrants who repeatedly return to their home areas and back to the city are said to engage in **circular migration**. Rural-urban migrants who stay in the city but have family left behind will usually send money back to their family on a regular basis.

Most rural-urban migrants who come to the city do so with very **few skills** that would be useful in an urban environment. Many are peasant farmers who have been forced off their land due to mechanisation or changes to patterns of land ownership. These people may be highly skilled at growing rice or raising animals, but they lack even such basic skills as literacy. Arriving with very little money, they often have difficulty in finding even basic housing and so must sleep on the **pavement** or construct **shanty** housing or **shelter**.

Rural-urban migration **distorts** the **population structures** of many cities in developing countries. Because the typical rural-urban migrant is a young single male, cities with high rates of rural-urban migration have a **skewed population pyramid**. Figure 2.7 shows the age-sex structure for a typical city in India that is influenced by a high rate of rural-urban migration. The population structures



2.7 Age-sex pyramids for the city of Kolkata, India. The left graph shows the city as a whole, and the right graph shows a sample of rural-urban migrants.

of the smaller towns and villages from which the rural-urban migrants have come will also be affected, but in the opposite direction. Whereas the large cities have an **excess of males** in the 20-45 year age range, small towns and villages will be deficient in such people, leaving an excess of females, children and the elderly. Fortunately, women do most of the farming work in many developing nations so food production is not affected by this imbalance. However, the excess of non-productive people (children and the elderly) can cause problems in many areas.

This trend has changed a little in recent years. It is still true that **few women migrate** to the cities independently of men because of the traditional roles they are expected to play in the villages and because of the limited job opportunities available to them in the cities. However, it is now becoming more common for men who have moved to cities to be followed by their wives after a few years.

The unskilled people who migrate to the cities often have **difficulty surviving**. Most developing nations do not have social security systems or pensions, and migrants who do not have family in the city must fend for themselves. Employment is usually difficult to find for people who possess only farming skills. In some nations, the women (and some men) resort to **prostitution** to make enough money, but this is really a last resort for the desperate. A number of people turn to crimes such as **theft** and **mugging** to obtain the money they need to survive.

Others resort to **begging**, often using children to do the begging on behalf of the adults, or a person with some disability such as blindness, missing limbs or injuries. In most cities in the developing world, begging is organised with bands of beggars each having their own territory that is protected for them by their leader. Some rural-urban migrants create their own work by doing things such as washing drivers' windscreens when they are stopped at traffic lights, performing with trained animals or shining people's shoes. These people are said to work in the **informal sector**.

2.9 A roadside sign in Lusaka, Zambia, warns of the consequences of giving money to children who are begging.

QUESTION BANK 2A

1. *What is the difference between urban growth and urbanisation?*
2. *Quoting some specific statistics, explain how important rural-urban migration is in developing countries today.*
3. *What is the difference between 'pull factors', 'push factors' and 'restraining factors'? Give two examples of each.*
4. *What is the difference between 'chain migration' and 'circular migration'? Why does each occur?*
5. *Why do many rural-urban migrants have trouble finding employment in the city?*
6. *How does rural-urban migration affect the population structure in (a) cities in developing countries, and (b) rural areas of developing countries?*
7. *How do unemployed rural-urban migrants survive in the city?*

High-income countries

Cities in more economically developed countries are sometimes known as **post-industrial cities**. These cities are experiencing much **slower growth** than cities in developing countries, and in some cases they are experiencing a **decline** in population. Therefore, the urban dynamics of developed world cities are quite different from cities in developing world cities.

One of the greatest impacts that older cities have had to cope with is the introduction of the **motor vehicle**. The streets of most European cities were planned when the main means of transport were walking and horses. The **narrow streets** and **twisting patterns** of these streets cause problems of **congestion** and **parking** for the large numbers of motor vehicles now found in developed world cities. The large numbers of motor vehicles cause other problems also. One of the worst of these is **air pollution**, which in turn causes respiratory

2.10 Narrow, cobble-stoned streets in the city centre of Riga, Latvia, are not really suitable for motor vehicles, which are therefore restricted from parts of the historic city centre. This in turn encourages movement by walking and by bicycle.

problems for residents and can hasten the weathering of old stone buildings. Unlike many developing countries, most developed world governments have imposed strict emission controls on motor vehicles in an effort to address these problems.

Because the population growth rates of developed world cities have slowed or declined, the inner city areas of many cities are **decaying**. This urban decay is a reflection of the **lack of demand** for inner city land, and it shows as vacant blocks of land, derelict buildings or graffiti in public places. When inner city land is left vacant for long periods of time, it becomes an unproductive resource that is not supplying employment, income or tax revenue.

According to the **bid-rent theory** that was explained in the previous chapter, inner city land should be in high demand and command high prices. Urban decay represents a **lack of demand** for inner city land, perhaps because inner city traffic congestion has made the area unattractive for industry or commerce, perhaps because the buildings require expensive upgrading, or perhaps because outer areas with more space, cheaper land and good communications have become more attractive.

Governments and citizens' groups in developed world cities often embark on projects to **rejuvenate** inner city areas which are experiencing urban decay. One common low-cost strategy is to convert streets that are lined with shops into **pedestrian plazas**. This strategy is often opposed at first by shop keepers who are worried that their business

2.11 Vacant land, derelict buildings and graffiti in inner Berlin indicate urban decay in an area of low demand for land.

will decline. However, business turnover invariably increases as people find that shopping in a car-free environment is much more enjoyable.

2.12 Most high rise urban development in Saudi Arabia's capital city, Riyadh, has occurred since 2000. This explains the concentration of skyscrapers and car parks in a planned narrow strip of land between two major roads, surrounded by sprawling residential areas that house more than 7 million people.

2.13 This street in Baku, Azerbaijan, has been converted into a pedestrian plaza.

2.14 Gentification, shown by restored historic buildings and resurfaced pathways in Minsk, Belarus.

2.15 Butler's Wharf was originally built as a warehouse on the banks of the Thames River in London. It has now been gentrified by being converted into luxury flats and restaurants.

Gentrification occurs when middle class residents or property developers move into run down inner city areas with the intention of renovating the old buildings. The old inner city areas are **attractive** for developers because they are fairly **inexpensive** due to their run-down condition, but they are highly **accessible** to services and employment in the CBD.

As a result of gentrification, old buildings are usually **restored** in keeping with their original character, **raising their value** considerably and repaying the people who carried out the renovations. As a consequence of the increase in value of properties in gentrified areas, **poorer residents** are usually forced to move away, as they can no longer afford the increased land and property (rental) prices. They are usually replaced by **young professional people**, transforming the demographics of the area.

Another approach is for governments to carry out a program of **urban renewal** in run-down inner city areas. This involves extensive clearance of old buildings, replacing everything with new, purpose-built constructions. One of the most spectacular examples of urban renewal has been the **London Docklands**. In Sydney, Australia, a large area occupied by a largely disused railway goods handling yard at **Darling Harbour** was completely redeveloped by the New South Wales state government. Although the redevelopment has failed to attract as much private sector investment as the London Docklands, the project has been successful in attracting tourists and business folk to the convention centre, exhibition halls, shops and other attractions.

Other examples of large-scale urban renewal include **Potsdamer Platz** in Berlin (Germany), Cardiff Bay redevelopment in Cardiff (Wales) and **La Défense** in Paris (France). La Défense was a run-down area west of the main CBD of Paris. It was redeveloped in the 1980s and 1990s into a major office and administrative centre with futuristic architecture on a grand scale. **Cardiff Bay** redevelopment covers an area of 1,100 hectares, which is 20% of the area of the City of Cardiff, and involves large-scale construction of factories, housing and offices in an area of urban decay near the old Cardiff docks. A one kilometre coastal barrage was built to control the tides of Cardiff Bay so that it is always covered by water to make the

2.16 Potsdamer Platz in Berlin (Germany) used to be an area of vacant derelict land that was "no man's land" on either side of the Berlin Wall that divided communist East Berlin from capitalist West Berlin between 1961 and 1989. After the demolition of the Wall in 1990-91, the area was redeveloped to create open public areas with office blocks for major international companies.

area more attractive – the natural range between high and low tides at Cardiff Bay is 12 metres. Construction of the barrage also created an additional 13 kilometres of waterfront land suitable for development. The total cost of the Cardiff Bay urban renewal scheme was about US$3 billion.

In **Washington DC** (USA), Christian churches and other charitable organisations have seen the availability of cheap derelict land as an opportunity to be grasped. They have bought large areas of cheap land, demolished the old buildings, and used the land to build low cost housing for poor residents of the city, especially people from minority ethnic groups.

2.17 Urban renewal in Amsterdam has included development of an extensive red light district based on the sex industry.

Urban renewal can be smaller in scale than this and still transform an area of urban decay. In **Amsterdam**, the largest city in the Netherlands, the inner city area was experiencing urban decay in the 1960s. The area experienced urban renewal through the development of an entirely new industry – sex shops and brothels – during the 1960s and afterwards. Today, central Amsterdam is an economically vibrant area with a buoyant tourism industry. A similar pattern of urban renewal occurred on the south bank of the Yarra River in **Melbourne** during the 1990s, although this was based on gambling rather than sex. The entire riverbank area was cleared to make way for a casino, with associated hotels, restaurants and shopping centres.

QUESTION BANK 2B

1. *Why do many cities in the developed world have inner city decay?*
2. *Describe some successful programs which have relieved the problem of inner city decay.*
3. *Explain the economic forces which cause 'urban decay' to lead into 'gentrification'.*
4. *Urban renewal occurs in many cities. Quoting specific examples, explain why such projects might be controversial.*

Centrifugal population movements

Suburbanisation refers to the overall movement and resettlement of people from inner city locations to vast new areas of housing further from the CBD. To some extent, suburbanisation (where residents move outwards) is a **balancing process** to gentrification (where residents move inwards), although it has occurred at a much larger scale.

Suburbanisation began to happen on a large scale in wealthier countries after the end of World War II in 1945. For the first time, ordinary families could afford their own **motor vehicles**, and these gave people a new freedom to live away from their place of work. Up until that time, workers had been dependent on **public transport** to get to and from work, and so they had to live close to bus routes or railway stations. Private motor vehicles meant people could live much further away from their work, shops and schools. Consequently, vast new areas around the cities were opened up for the first time for suburban development.

In the United States, this led to **urban sprawl** on a large scale. The government made low interest loans available to families to build their own

2.18 In US cities such as Dallas, Texas, extensive suburban areas are heavily dependent on private motor cars.

2.19 A new suburban area in Houston, Texas, USA. The curved streets and hierarchical street patterns reflect sound principles of modern urban planning.

2.20 Large houses and curved streets characterise modern suburban development in the USA. This example shows a suburban area in Seattle, Washington state.

homes, and special grants were given to soldiers returning from the war. There was a large backlog of demand for housing because of the effects of the Great Depression between 1929 and 1941. Between 1950 and 1970, the main trends in American cities were the **urbanisation** of the population, and within cities, the **suburbanisation** of the residents. The early suburbs tended to be medium density areas, often built on a grid pattern of streets. However, in recent decades, there has been a trend towards **larger houses** on bigger blocks of land in the suburbs. Modern principles of town planning such as **curving** the streets, building a **hierarchical network** of streets to minimise traffic flow and planting lots of **trees** in residential areas are now commonly practised.

Accompanying the movement of people to the suburbs, **manufacturing industries** (and thus jobs) also moved away from crowded inner city locations to the edges of the cities where larger amounts of cheaper land were available. These industries were followed by retail outlets, eager to maintain easy accessibility to a sprawling population. In American and Australian cities, the vast majority of shopping activity now takes places away from the CBD. The construction of **freeways** has accelerated the process of suburbanisation. Increasingly, major shopping areas are being located at expressway intersections and along the approach roads to expressways, with large car parks being provided for shoppers to park their cars.

2.21 Like many other US cities, large areas of Los Angeles, California, are devoted to cars, including freeways and large car parks.

Where manufacturing industries and people relocate away from an urban centre, **decentralisation** is said to occur. In Australia, this occurred as industries and people relocated outwards from state capitals to centres such as Albury-Wodonga, Bathurst-Orange and Gosford-Wyong. In fact, decentralisation can also occur within an urban area. For example, if an industry wishes to escape the pollution, congestion and high land prices of an inner urban area, and relocates to the suburbs or beyond, then decentralisation is said to occur.

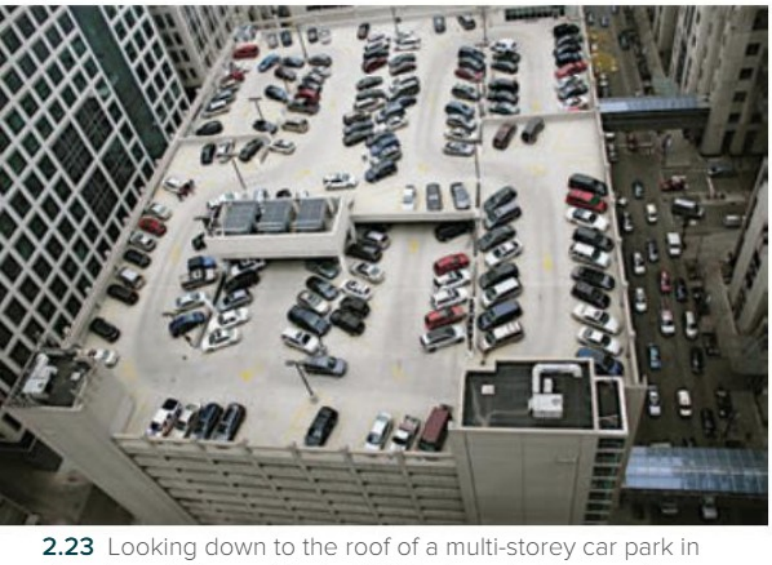
Suburbanisation reduces the **population density** of urban areas, making it difficult to provide viable public transport. Therefore, in most countries, suburbanisation has only been possible because of the widespread use of **private motor vehicles**. During earlier times when people depended on walking for transport, the growth of urban areas was severely limited by the distance people could

walk to and from work. However, the huge growth in the number of cars in most high income countries from 1950s onwards removed the constraint on urban sprawl. In the United States and elsewhere, extensive networks of expressways developed. Although these expressways were designed to speed up people's movement, they attracted such increased numbers of vehicles that movement on many routes actually became slower.

The increased use of private motor vehicles also occurred in Europe, though to a lesser degree than in the United States. Although many European cities had well-developed systems of public transport, use of private motor vehicles increased substantially from the 1960s onwards. The increased use of cars had a significant impact on the **land use** in many cities, as areas have had to be devoted to providing **parking areas** for the cars. This led many cities in high income countries to restrict the amount of parking space available in the hope that making parking difficult would encourage more people to use public transport, and also to restrict the movement of cars into the city centre. Most European cities also charge for parking space, either in parking stations or using parking meters. Despite these efforts, traffic congestion is a major problem in many cities.

Counter-urbanisation is also sometimes called **deurbanisation** or **reurbanisation**. This does not mean, as the term might imply, that the proportion of people in urban areas is declining, but means that smaller and medium sized towns are **growing at a faster rate** than the large cities. Counter-urbanisation is said to occur when there is a

2.22 The M25 orbital motorway is a 188 kilometre road that encircles London, UK, to facilitate the movement of suburban residents. However, heavy congestion often leads to very slow journeys.



2.23 Looking down to the roof of a multi-storey car park in downtown Chicago, Illinois, USA that was built to provide parking for commuters from the suburbs.

2.24 Electronic road pricing (ERP) is used in many cities (including Singapore, shown here) to regulate the number of cars in the CBD. The toll charged varies according to the type of vehicle and the time of day.

2.25 This tollway in Houston, USA, adjusts the toll according to the congestion and time of day. "HOV 2+ free" means high occupancy vehicles (2 or more people) can travel toll free.

marked decline in the number of people living in large metropolitan areas, or a slowing in the growth of large metropolitan areas. This is accompanied by the growth of smaller urban centres at the expense of the larger ones.

Counter-urbanisation is a strong trend in some parts of Western Europe. For example, London's size has been shrinking slowly for many decades as people moved into smaller towns that were considered more desirable. To some extent, counter-urbanisation is the opposite of rural-urban migration as it is a movement of people away from the largest cities.

In general, suburbanisation and counter-urbanisation have affected **different income groups** in different ways. In the United States, younger, wealthier and better-educated upwardly mobile residents who can afford cars have tended to move away from inner city areas into newer areas. An extension of this is the process of **exurbanisation**, which occurs when affluent people move from the city to rural areas. However, when they do so, they continue to maintain an urban way of life, either through long **distance commuting** or **technology**.

On the other hand, poorer, older and less advantaged people, especially from **minority ethnic groups**, cannot afford to move and they get left behind. American cities have become increasingly segregated by income and ethnicity as a result of this process. This creates problems because entire neighbourhoods are coming to consist of poor people from minority groups who have little ability to pay taxes for government services such as education, health, police and fire protection which are needed. Many people in these inner city areas are forced to sleep on park benches, in doorways of public buildings, in underground railway stations or near the warm, street-level exhaust vents from the underground trains.

2.26 Homeless people sleep on the pavement in Curitiba, Brazil.

2.27 As a result of counter-urbanisation, downtown Detroit, Michigan, USA, has become a depopulated area of urban blight.

2.28 This inner area of La Paz, Bolivia, has become an area of urban blight as a result of suburbanisation.

As a result of suburbanisation and counter-urbanisation, the inner city areas of many North American and some European cities have become very run down, and **urban decay** sets in. This is a particular problem in old industrialised areas of the United States, where people have moved away from cities as factories have closed, and in northern England, as people have migrated to cities in the south. The tax base of the cities declines, and so local government authorities have less money to maintain the city and provide services. This encourages still more people to move away. Buildings have been abandoned, graffiti and vandalism have become endemic and the areas

become afflicted with **urban blight**. Once this happens, land prices plummet and the area becomes ready for **redevelopment**.

QUESTION BANK 2C

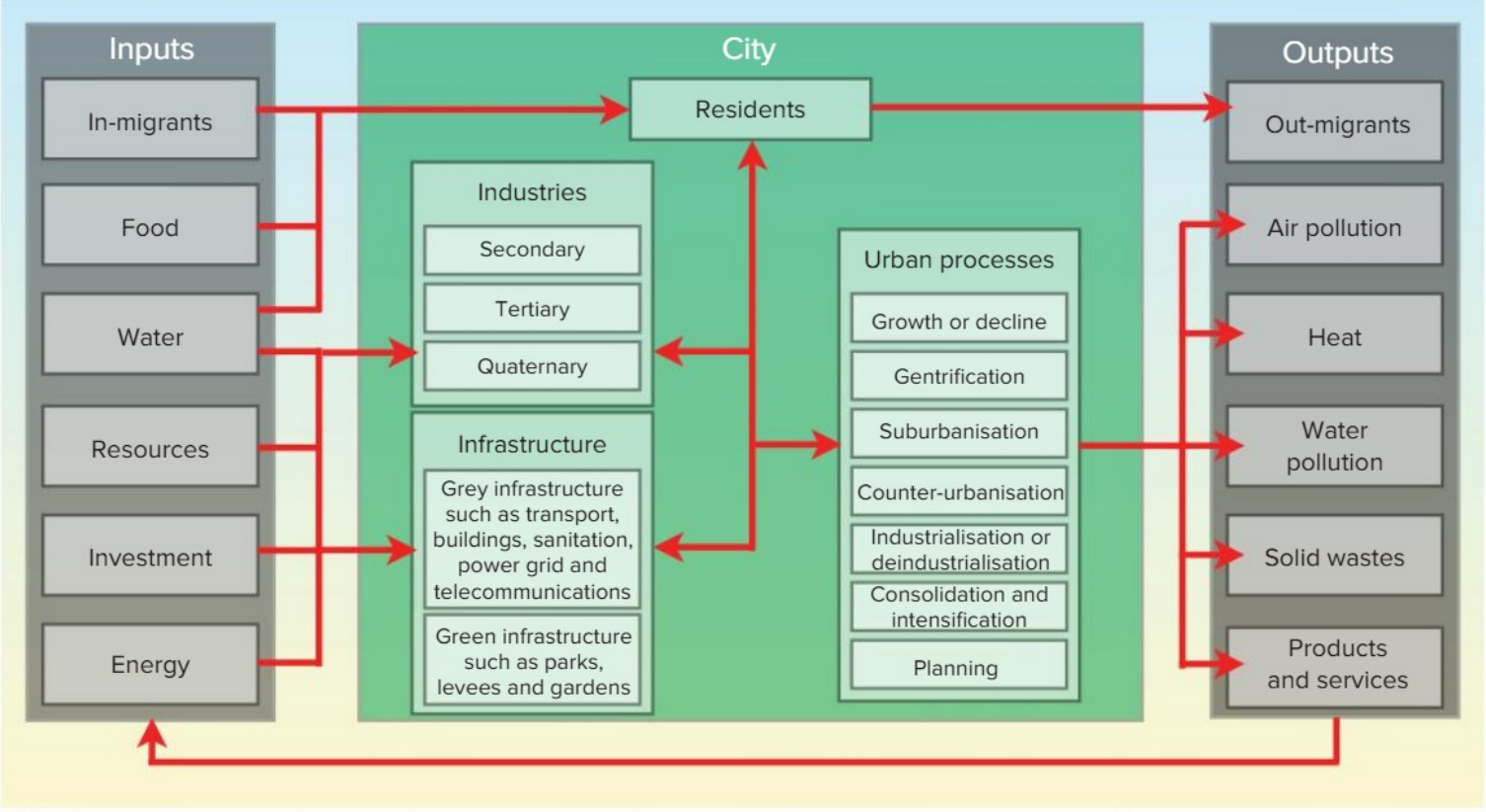
1. *What is 'suburbanisation'? How important has this process been?*
2. *Why has urban sprawl affected many cities in the United States between 1945 and the present time?*
3. *What is decentralisation? Give some examples of decentralisation.*
4. *What have been the effects of motor vehicles on the development of urban areas in recent decades?*
5. *What is 'counter-urbanisation', and how does it differ from suburbanisation? Where is counter-urbanisation seen most strongly?*

Urban system growth

Any urban centre can be thought of as a **system**. Towns and cities receive **inputs** from both the physical and human environments. Important inputs from the physical environment include water, land and solar energy. Significant inputs from the human environment include food, resources such as knowledge and raw materials for industry, human-generated energy such as electricity and fuels, and investment. An especially important human input for many cities is people, such as in-migrants who move to the city from elsewhere for work.

Once these inputs reach an urban area they undergo a series of complex **processes**, most of which are planned or intended, but some of which are not. Many of the inputs are processed through **urban industries** — secondary (manufacturing), tertiary (services) and quaternary (knowledge-based functions). Other inputs are used in building urban **infrastructure**, which means the basic physical and organisational structures that are needed for the city to function.

There are two types of urban infrastructure, sometimes referred to as grey infrastructure and green infrastructure. **Grey infrastructure** determines a city's layout, or urban morphology. Examples of grey infrastructure are buildings (such as homes, factories, shops and offices), transport (roads, railways), water and sanitation systems (including drainage), and the power grid and telecommunications network (landlines for telephones, cellphone towers for mobile phones and copper or optical fibre lines for information technology). **Green infrastructure** refers to structures that work with nature to bring



2.29 Cities and towns can be viewed as urban systems. Inputs enter the city and undergo a series of processes to produce outputs. Some of these outputs have a feedback impact on the quality and quantity of future inputs.

environmental benefits to the population, and examples include parks, levees to provide flood protection, barriers to prevent noise pollution and vegetation plantings to reduce wind, provide shade and settle dust.

2.30 An example of grey infrastructure — an underground railway station in the Pyongyang metro, North Korea.

2.31 An example of green infrastructure — the Gardens by the Bay public parklands in Singapore. The large curved structure in the background is the Flower Dome, a 38 metre high air conditioned plant conservatory.

Industrial and infrastructural processes are **inter-related**, as each type of process impacts upon the other in a two-way relationship. The industrial and infrastructural processes also affect (and are affected by) the **urban processes** that were discussed earlier in this chapter, such as centripetal and centrifugal movements, as well as other urban processes such as urban planning, urban consolidation, intensification and spatial exclusion.

As a consequence of the interplay of industrial, infrastructural and urban processes, urban centres produce **outputs**. Many of the outputs are intended, such as the goods and services produced by the urban industries of the town or city. Other outputs are unintended (or poorly controlled), such as thermal pollution (heat), air pollution, water pollution and solid wastes.

Infrastructure improvements

As cities grow, **infrastructure** needs to be expanded and improved if the city is to function effectively. Indeed, rapid urban growth without associated infrastructure improvements poses significant problems for many cities in low-income countries, where **insufficient funds** are available to invest in roads, buildings, railways and other structures that are needed for urban industries to operate in a viable manner. Similarly, cities with **declining populations** or **contracting industries** also face

2.32 The large bus station in the centre of Kampala, Uganda, is an example of investment in transport infrastructure in a low-income country. The bus station is located beside the city markets, and is a hub for people who cannot afford cars.

2.33 Transport infrastructure in Quito, Ecuador, has received substantial investment. Modelled on the system used in Curitiba, Brazil, separate bus lanes have been built on main roads, with covered bus stops positioned for rapid boarding.

challenges in maintaining infrastructure. In such cities, the lack of taxation revenue starves authorities of the funds needed to invest in new construction or maintain existing infrastructure.

Transport is a key component of infrastructure that enables cities and industries to function. Improved transport acts both centripetally and centrifugally. Roads and railways act centrifugally upon residential areas but centripetally upon CBD functions. Private motor vehicles enable residential areas to expand outwards, and the congestion caused by motor vehicles in CBDs encourages retailing activity to move outwards to the suburbs — these are both centrifugal movements. On the other hand, the development of good public transport acts centripetally in the CBD by improving the access of workers, customers and residents to businesses operating centrally.

One of the challenges faced by government authorities that are responsible for improving or providing infrastructure is that **income from taxation** is usually meagre in **new urban areas** because the **population density is low**. For the same reason, commercial enterprises such as shops usually do not become established in new urban areas until the population size reaches the required threshold to support retail and commercial businesses. Consequently, many new urban areas are **under-served** with shops and employment opportunities and they lack infrastructure. This is especially so if the population is poor.

There are some rare **exceptions** to this general principle. The **Ma On Shan railway line** in Hong Kong is one of ten commuter train lines operated by the MTR (Mass Transit Railway) Corporation. The Ma On Shan line runs on an elevated viaduct between an interchange station at Tai Wai (that lies on the main railway line from Hong Kong Harbour to Shenzhen) and Wu Kai Sha, a new town in the north-east of the New Territories.

When the Ma On Shan line opened in 2004, Wu Kai Sha was little more than a collection of semi-rural villages. Its low population density by Hong Kong standards certainly did not seem to justify an air-conditioned electric train service with a frequency of 3-5 minutes during rush hour.

2.34 A train on the elevated track of the Ma On Shan railway line near Shek Mun station.

2.35 Lake Silver housing estate rises above Wu Kai Sha station, which is visible to the immediate right of the building. This view shows the estate shortly after it was finished.

Within a few years of the opening of the Ma On Shan line, a complex of seven high-rise housing blocks, each with 39 to 47 storeys, had been built above Wu Kai Sha Station. Named Lake Silver, the high-rise housing estate was constructed as a joint project by MTR Corporation and Sino Land, a private property development company. Lake Silver therefore added 2,218 housing units above the railway station, together with a shopping centre, car park and pre-school kindergarten. For the MTR Corporation, Lake Silver and additional housing projects above other stations represented the major source of profits, with the railway line serving to enhance the appeal of the property developments for commuters. More recently, additional high-rise housing developments have been constructed around Wu Kai Sha and other stations on the Ma On Shan line.

Urban processes

Not all urban processes are the result of centripetal or centrifugal movements. In recent years, cities have been expanding so far that they have started **coalescing** (growing into each other) in some areas. For example, in the north-east of the United States, a continuous corridor of urbanisation extends from Boston to Washington DC which also includes New York, Providence, Philadelphia and Baltimore. In New South Wales, Australia, Sydney has expanded so that it has incorporated towns such as Penrith, Campbelltown, Blacktown and Liverpool that were once separate towns. The process whereby urban areas expand into each other to create huge metropolitan areas is called **conurbation**.

One way to reduce the urban sprawl that leads to the formation of conurbations is to encourage urban consolidation. **Urban consolidation** is the process of increasing the **density of residential infrastructure** in an urban area. This can be achieved in several ways. For example, urban consolidation can be achieved by infilling gaps in an urban area, by bringing disused buildings (usually in the inner city) back into productive use, or by replacing low density dwellings with medium or high density buildings that can accommodate more people on the same land area. This last option is also known as **intensification**.

2.36 These semi-detached houses in Houston, Texas, USA, are an example of intensification of residential infrastructure, an attempt to slow the relentless urban sprawl of the metropolis.

2.37 Hong Kong's high-rise residential blocks are a spectacular example of intensification. These housing blocks are in Tai Kok Tsui on Kowloon Peninsula.

Urban consolidation represents an alternative to urban sprawl as a way of accommodating a growing population. Urban consolidation has the advantage that infrastructure such as utilities and transport are more **financially viable** to provide in areas with higher population densities. On the other hand, people in countries such as Australia, Canada and the United States have traditionally valued abundant space, and there has been some resistance to urban consolidation in those countries.

Another process of natural change is the emergence of the urban village. An **urban village** is a residential district within a city that houses a community of people sharing a common cultural background. These areas have an identity that separates them from surrounding areas. They usually have a strong community spirit, intense feelings of kinship, high levels of social and cultural contact, a well-developed sense of neighbourliness, and a desire to remain identified as a separate community.

Most large cities in Asia and Africa have identifiable **ethnic quarters**, and these are good examples of urban villages. For example, Singapore has very clear areas of ethnic difference, with Chinatown, Little India and the Arab Quarter having quite different identities. Penang in Malaysia has a large Chinatown area. Similarly, Sydney has several urban villages that can be defined on ethnic criteria, such as Chinatown (Chinese), Cabramatta (Vietnamese) and Lakemba (Lebanese).

Urban villages can be defined on grounds other than ethnicity. Many urban villages are defined on economic grounds or where a minority group feels threatened by another group. Examples of urban villages that are defined by non-ethnic criteria

include Montmartre in Paris, Greenwich Village in New York, Nowa Huta in Kraków and Notting Hill in London.

2.38 The area surrounding the Sultan Mosque in Singapore has a concentration of Muslim Malays, forming an ethnic zone known locally and informally as the 'Arab Quarter'.

2.39 High walls mark the boundary of 6th October City, a walled compound that has become a satellite town of Cairo, Egypt. Entry is only possible through guarded security gates.

2.40 Albrook Gardens in Panama City, Panama, is a closed residential complex that has a 24-hour security gate. Gated communities such as this are examples of spatial exclusion.

The distribution of urban villages within a city evolves on the basis of many factors such as price of housing, the location of markets or an historic focal point. At times, urban villages can lead to **spatial exclusion**, a process where wealthy residents become so concerned about their security and defending their luxury lifestyles that spatial access and freedom of movement becomes restricted for other residents. Evidence of this process includes security systems on houses, walled estates and access-restricted industrial estates.

QUESTION BANK 2D

1. *Think about your own home town or city in systems terms as shown in figure 2.29:*
   a. *Where do the key inputs come from?*
   b. *What are the most important 'products and services' outputs?*
   c. *Is there more in-migration or out-migration?*
   d. *What are the most important industries?*
   e. *Identify the most important elements of (i) grey infrastructure, and (ii) green infrastructure.*
   f. *Identify examples of infrastructure that are inadequate for the city's needs.*
2. *What is the difference between the terms grey infrastructure and green infrastructure?*
3. *Why is infrastructure important for an urban centre to function effectively? What are the consequences of under-investment in infrastructure?*
4. *Explain how transport infrastructure has both centripetal and centrifugal impacts in any urban centre.*
5. *Why do new urban areas often suffer from inadequate infrastructure?*
6. *To what extent is the construction of the Ma On Shan railway a possible role model for infrastructure development elsewhere? What are the advantages and disadvantages of providing infrastructure such as transport, water, sanitation, waste disposal, and telecommunications in an area prior to large-scale population growth (rather than the usual model of providing infrastructure after population density grows)?*
7. *What is 'conurbation', and why does it occur?*
8. *Explain the terms (a) urban consolidation, and (b) intensification.*
9. *In a city with which you are familiar, make a list of some urban villages, and for each urban village, write a few words to describe its main characteristics.*

CASE STUDY
Infrastructure growth in La Paz, Bolivia

With a population of about 2.5 million people, **La Paz** is Bolivia's largest city. Like many of Bolivia's urban centres, it began as a **mining settlement**. At the time it was founded in 1548, it was named La Ciudad de Nuestra Señora de la Paz, which means 'The City of Our Lady of Peace'. The **river** that flows through La Paz, the Río Choqueyapu, contained alluvial gold, and a settlement was established beside the river in the bottom of a steep canyon specifically as a **mining settlement**.

The site of the first settlement still marks the **centre** of La Paz, and it is where the city's modern, high-rise buildings are found. In this respect, La Paz is unusual. Most cities in developing nations have a zone where wealthy people live on the tops of the hills because there is a view, leaving the low areas for poorer people. In La Paz, it is the poor who live at the top of the hills in *barrios* (neighbourhoods) at an altitude of about 4,000 metres, while the wealthy live in the foot of the valley where the gold used to be found (at about 3,500 metres altitude).

2.41 Tall buildings along the banks of the Río Choqueyapu mark the original site of La Paz when it was established as a mining settlement. These buildings now mark the CBD.

2.43 Housing for high-income residents of La Paz in the bottom of the canyon.

2.44 Housing for low-income residents of La Paz towards the top of the escarpment. The concrete stairs rising up the slope are the main infrastructure provided by the government.

Power infrastructure

In La Paz, all electricity infrastructure and service provision is done by **Delapaz**, which is a subsidiary of the state power company Ende. Delapaz was

2.42 A panoramic view of La Paz, looking from a *barrio* near the top of the canyon escarpment in El Alto.

originally a private company, but it was nationalised by the government in 2012. In 1999, Delapaz was awarded a 40-year contract to distribute electricity throughout the metropolitan areas of La Paz, giving it a **monopoly** right to serve about 750,000 residential and industrial clients.

2.45 Electricity wires in downtown La Paz.

A low-income nation such as Bolivia has **limited funds** for investing in infrastructure such as electricity. This is evident in many parts of La Paz, where **erratic electricity lines** show little evidence of planning or co-ordination. Because of under-investment in power infrastructure, **refrigeration** is rare. Fortunately for public health, temperatures in La Paz remain quite cool throughout the year because of the high altitude, in spite of the city's location near the equator. This enables open-air markets to sell foods such as meat without the use of refrigeration.

Telecommunications infrastructure

In common with most developing countries, it is unusual for residents in La Paz to have **landline telephones**, which are mainly used by government agencies, public utilities such as hospitals and schools, large companies and factories. Landline telephones in La Paz are provided by private companies which have widespread reputations for low standards and inefficiency. Moreover, the **high cost** of private telephone lines (US$1,500 fee) in La Paz makes them effectively **inaccessible** for most of the population.

In recent years, most residents of La Paz have obtained access to private telephones by buying **mobile phones**. Cellular phone networks require much **less investment** in infrastructure than landlines as the primary cost, which is erecting a network of **transmission towers**, is much less than connecting lines to individual homes or businesses.

Several private companies compete in the La Paz mobile telephone market, and this has made phones accessible to most of the population by reducing fees during cut-throat competition in the market. There are now far more mobile phones than landline connections in La Paz. Although consultants argue that this is technologically inefficient in a high density urban area such as La Paz, it reflects the pricing distortions caused by the high cost of fixed line services.

Water and sanitation

La Paz receives its water from rivers that are sourced by rainfall, snowmelt and melting glaciers. La Paz's **water needs** are greatest in summer, which is when the city experiences its annual dry season. Fortunately, this coincides with the annual snowmelt, boosting the availability of water. Less fortunately, the climate of the Andes Mountains seems to be warming, which means the glaciers that supply water are a shrinking resource.

Although most houses and factories in central (lower) parts of La Paz are supplied with **running water** in pipes, houses in some of the poorer areas near the top of the escarpment have neither piped water nor adequate infrastructure for the disposal of wastes. As a general rule, the further a person lives from central La Paz, the fewer utilities are available. In these poorer (higher) areas, open

2.46 Residents of a barrio near the top of the canyon escarpment use polluted drainage water to wash their clothes and bathe.

streams carry **effluent** downhill, posing a health hazard as these streams are also used for washing by families that lack running water in their homes.

Like governments in many developing nations, Bolivia's government raises **little taxation** to provide services and infrastructure development for its people. This means that some areas of La Paz (mainly in the *barrios*) become **garbage tips** and **open toilets**. This poses a hazard for people's health as well as lowering environmental quality. Diarrhoea is a major problem in poorer areas of La Paz, and many children die each year from the effects of intestinal upsets.

In an attempt to address these long-standing issues and compensate for the lack of government funds for investment, the responsibility of operating La Paz's water supply was transferred from the public sector to the **private sector** in 1997. This meant that the government was no longer responsible for finding the funds to invest in infrastructure. The hope was that by placing water supply in the hands of a private company, the service would be run efficiently because the company's profitability depended on providing a good service to consumers. On the other hand, there was a risk that prices would rise to cover the costs of investment, which could be a problem for such a basic service as water. This concern arose because the private company set water prices on a 'user pays' basis rather than allowing cross-subsidisation through taxation, which would have forced wealthier residents to subsidise the poor.

The fears were justified, and concerns over the high cost and poor provision of water led the government to **terminate the contract** with the private supplier in 2007. Since that time, all water services in La Paz have been provided by a **municipal authority**, EPSAS (Empresa Pública Social del Agua y Saneamiento). In the period since 2007, EPSAS has managed to extend piped water infrastructure to 50% more homes. However, this improvement has not been without problems. EPSAS is heavily dependent on government funding, which accounts for 75% of EPSAS revenue. EPSAS also depends heavily on foreign aid for its funds to invest in infrastructure. This suggests that the **financial viability** of EPSAS is unsustainable, threatening future infrastructure expansion.

Today, EPSAS is funding most of its infrastructure development with **foreign aid assistance**. For example a project financed by the Netherlands Enterprise Agency was underway for a decade to provide clean drinking water to 125,000 residents of La Paz by 2017. This project was part of a wider government program that hoped to provide access to clean drinking water to every resident of La Paz by 2025. The Dutch infrastructure development project involved **five components**: collecting water in a new dam in the nearby mountains, constructing a water purification plant, transporting the water to the city, distributing it to houses, and disseminating information to future consumers about the use of the water system.

Transport

Traffic congestion has been a serious problem in most parts of La Paz ever since the introduction of motor vehicles. This is because the **street pattern** of the lower parts of the city was laid out in the centuries before cars were invented, while the higher parts of La Paz are situated on the **steep sides** of the canyon escarpment that make road construction difficult.

As a low-income country, many people in La Paz do not own cars and rely instead of **public transport**. In recent decades, **transport infrastructure** has improved with investment in a large fleet of full-sized buses, supplemented by smaller minibuses known as *micros* and shared taxis known as *trufis* that follow fixed routes around the CBD are nearby areas to the south of La Paz.

Unfortunately, as bus numbers have increased, very **little investment** has been undertaken to improve

2.47 Traffic congestion in narrow streets of downtown La Paz.

2.48 Minibuses known as *micros* provide much of the public transport in La Paz.

2.49 A gondola station on the green line of the Mi Teleférico.

roads in La Paz. Consequently, already severe traffic congestion has continued to worsen, with bus trips of just a few kilometres now taking up to an hour.

In late 2014, La Paz improved its transport infrastructure significantly by opening the first of 11 planned lines of **Mi Teleférico**, a network of **urban gondolas**. By 2020, all 11 gondola lines were in operation, covering a combined distance of 33 kilometres through a network of 39 stations, making it the longest aerial cable car system in the world. In a city such as La Paz, which has very steep terrain, the gondolas were able to provide easy transport across the rugged canyon without interference from or interfering with existing houses or roads. Building the 11 gondola lines cost about US$740 million, and construction was undertaken by an Austrian company, Doppelmayr. Finance was provided by Bolivia's national government, supplemented by a loan from the

2.50 Gondolas on the red line of the Mi Teleférico.

Central Bank of Bolivia. The gondolas can transport about 3,000 people per hour on each line at a cost of US$0.43 per trip, with half-price discounts for students, seniors and disabled, making the Mi Teleférico financially accessible to almost everyone in La Paz.

Housing

La Paz's environmental problems have worsened in recent years as population has grown due to **rural-urban migration**. Thousands of people move to La Paz each year from smaller towns and rural areas of the country. Many of these people do not have jobs or the money to buy housing. Great pressure is put upon the limited amount of housing in La Paz, and **shanty settlements** have sprung up to meet the demand for housing. About one-third of La Paz's residents live in shanty housing (officially termed 'informal dwellings'). These shanty settlements appear on **vacant land**, often land which is too steep for 'normal' building, geologically unstable and prone to **landslides**. In many cases, the shanties begin when rural-urban migrants settle on land that was once beyond the urban perimeter, but is later absorbed into the city as the urban area expands. The land is then illegally sub-divided, leaving the people living there with no legal title to the land where they are living. La Paz's areas of poor housing increase the pressures on every aspect of the city's limited infrastructure, including transport, waste disposal and electricity.

In the same way that **foreign aid** was used to address shortcomings in La Paz's water and sanitation infrastructure, a partnership between the Inter-American Development Bank, USAid and the

2.51 *Barrio* housing for poorer residents near the top of the canyon escarpment.

2.52 In contrast to the view in the photo above, significant investment in infrastructure in the lower parts of the canyon provides good roads and recreational facilities.

Venezuelan Government is attempting to improve housing for poor residents in La Paz. Known as the **Neighborhood Improvement Multiphase Program**, funding is being provided for 16 projects in 21 neighborhoods that are expected to help about 12,350 people in almost 3,000 families. Each project comprises a combination of physical infrastructure works and community development.

Infrastructure works include construction of roads, risk management analysis, and environmental improvements such squares, parks, slope protection works and reforestation. Facilities such as community centres, day care centres, and sports fields are also under construction, and basic services such as water, storm and sanitary sewers, electricity, street lighting, and sanitary modules are being built. Community development activities include strengthening of neighborhood organisations and trying to sort out disputes over the ownership of land.

El Alto

As a result of the influx of in-migrants due to rural-urban migration, the original city of La Paz grew to fill most of the Río Choqueyapu, with residential areas becoming more and more densely settled. In order to relieve the pressure of growing population density, settlement spilled onto the high plateau at the western edge of the escarpment, creating a **satellite city** known as **El Alto**. Today, about one million of La Paz's 2.5 million people live in El Alto, which has become a sprawling metropolis in its own right, notable for its traffic congestion, high air pollution and poorly developed infrastructure. With an average altitude of 4,150 metres, El Alto is the world's highest major urban area.

El Alto has even **greater water needs** than the main part of urban La Paz that is located in the canyon. This is because El Alto houses the bulk of La Paz's manufacturing factories and the city's international

2.53 An oblique aerial view of El Alto.

2.54 Many houses in El Alto do not have access to improved sanitation, so their wastes are discharged into open streams like the one shown here.

airport, in addition to a million residents. Furthermore, as a newer urban area, its infrastructure is not as well developed as the urban areas within the canyon. Indeed much of El Alto consists of slum areas, and 54% of residents there rely on communal water points. Under-investment in El Alto's infrastructure means it is the section of La Paz that most needs large-scale investment if widespread problems are to be avoided in the near future.

QUESTION BANK 2E

1. *Describe the impact of mining and landforms on the development of La Paz.*
2. *In what ways is the urban pattern of La Paz different from most other cities? Why did these differences arise?*
3. *What are barrios, and why do they exist in La Paz?*
4. *Give examples of evidence that investment in infrastructure in La Paz is not distributed evenly through the city.*
5. *Why do new urban areas often suffer from inadequate infrastructure?*
6. *Compare the advantages and disadvantages of private sector and public sector control of La Paz's water and sanitation infrastructure.*
7. *Describe the Mi Teleférico, and assess its success as an infrastructure project to relieve traffic congestion in La Paz.*
8. *Many of La Paz's infrastructure projects rely on foreign aid for finance. Outline the advantages and disadvantages of this reliance.*

Urban deindustrialisation

Deindustrialisation is the sustained decline in manufacturing activity and capacity. **Evidence** of deindustrialisation is an absolute or relative decline in output from manufacturing, or a decrease in the number of people employed in manufacturing. Deindustrialisation is the opposite of **industrialisation**, which is the growth of secondary industry (manufacturing) so that it plays a more important absolute or relative role in the economy of a country, region or city. Industrialisation occurred in Western Europe and North America during the 1700s and 1800s, and it is occurring in newly industrialising countries such as India, China, Vietnam, Brazil, Mexico and Brazil today. On the other hand, deindustrialisation is occurring in the cities of some of the countries that experienced early industrialisation such as the United Kingdom, parts of the United States, Switzerland and Sweden, and in several former socialist countries such as Russia, Ukraine, Bulgaria, and Albania.

The **causes** of deindustrialisation are invariably factors that have resulted in the manufacturing industry becoming **uncompetitive**. The underlying force (or forces) leading to uncompetitiveness varies from city to city, and country to country. In general, however, there are **five common causes** of deindustrialisation:

- **Globalisation** exposes manufacturing to competition from around the world. Factories that operate in places where costs are high have difficulty competing with factories elsewhere that can produce the same or similar products for a lower cost, even when the additional costs of transport are included. Reasons that factories may face high costs that make them uncompetitive include having to pay **wages** are higher than overseas, using **raw materials** that are more expensive to obtain, or persisting with **old technology** that is comparatively inefficient. Competition from overseas producers in places such as Mexico, South Korea, and China is the main reason that manufacturing is declining in the 'Rust Belt' of the United States. The Rust Belt spans the north-east of the US, the Great Lakes and several states in the Mid-west. As a result of deindustrialisation, cities such as Detroit, Flint,

2.55 Deindustrialisation has occurred in Detroit, Michigan, USA, with the closure and downsizing of car factories. The economic downtown that has resulted from the closures has led to the demolition of many buildings in downtown Detroit that are no longer needed. This has opened up large areas of land in the CBD for car parks on what used to be valuable real estate.

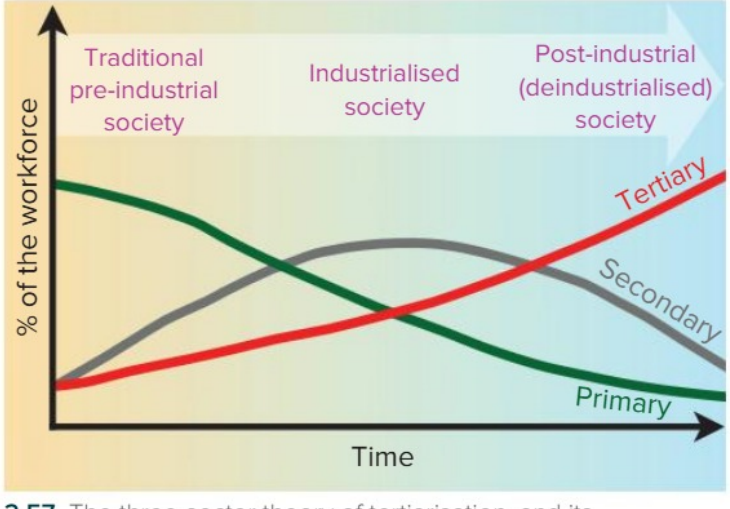
Cleveland, Dayton, Baltimore, Buffalo and Pittsburgh are experiencing widespread factory closures, economic decline, unemployment and urban decay.

- **Demand has declined** for the product that a factory or industry has been producing. Demand may fall because of changing technology, such as online music replacing CDs, which replaced cassette tapes, which replaced vinyl records. Demand may also fall because associated industries have closed. Falling demand due to **changing technology** has been the cause of deindustrialisation is some major dockland areas, such as London and Malmö. In the case of the London Docklands (UK), the introduction of large container ships meant that vessels could no longer travel to the Docklands because the Thames River was too shallow. New docks to handle larger ships were built downstream, and the old London Docks were closed, causing widespread unemployment and social dislocation. In Malmö (Sweden), the Docklands used to house the world's largest shipyard, employing 6,000 people when it was fully operational in the 1950s and 1960s. The shipyard began to decline following the oil crisis of the late 1970s, eventually closing in 1986. The nearby wharves closed completely when one of the largest factories using the facility, a Saab car factory, closed in 1991 because of high costs that made the plant uncompetitive.

- **Automation** and **upskilling** workers can cause deindustrialisation by reducing the total number of workers, leading to a net drop in total employment and especially unemployment for unskilled workers. This shift often results in increased profits for the factory, but increased wage inequality and population loss for the city where it occurs. Reductions in the manufacturing workforce were responsible for the first wave of deindustrialisation, which occurred in the United Kingdom during the 1960s to the 1980s, and in parts of the United States during the 1970s and 1980s. Automation is a major factor underpinning deindustrialisation in cities that have (or which had) automotive industries such as Detroit (USA), Turin (Italy), Mioveni (Romania) and Adelaide (Australia). Workforce reductions were also responsible for deindustrialisation and subsequent depopulation of Clydeside and Tyneside (shipbuilding areas in the UK) and in Lancashire, where the textile industry became increasingly automated.

- **Tertiarisation** occurs as a nation's economy progresses from a heavy reliance on secondary industries towards an emphasis on **tertiary industries**. This trend is also known as **post-industrialisation**, and it is generally viewed as evidence of a maturing economy. The **three-sector theory** of tertiarisation shown in figure 2.57 illustrates the changes over time in a **maturing economy**. In a traditional pre-industrial economy, most of the workforce is engaged in primary industries, especially farming. As industrialisation occurs, the balance of employment shifts from primary to secondary industry. This happens as farmers begin to produce a surplus that is used to feed factory workers. In exchange for the food they provide,

2.56 Kockums Shipyard in Malmö, Sweden, was the world's largest shipyard in the 1950s and 1960s. Since its closure in 1986, the buildings have remained abandoned.



2.57 The three-sector theory of tertiarisation, and its relationship to primary, secondary and tertiary industries.

farmers receive manufactured goods. As the economy develops further, the workforce engaged in both primary and secondary industry declines, and there is a commensurate increase in employment in tertiary (and quaternary) industries. Tertiarisation comes about as incomes rise and spending preferences shift from material possessions towards services such as health, education, travel and entertainment. Tertiarisation is a major factor in explaining the deindustrialisation that is occurring in many high-income cities around the world such as Paris, Stockholm, Amsterdam, Frankfurt, Montreal and Tokyo.

- **Political changes** can lead to deindustrialisation as **government policies** change, favouring one industry over another, or the **national economy** makes a radical shift. When countries introduce **free trade policies** and **remove tariff barriers**, manufacturing industries become exposed to global pressures and competition. Following the fall of the Berlin Wall in 1989 and the break-up of the Soviet Union in 1991, many countries that had centrally planned, socialist economies adopted **market-based capitalism**. This meant that manufacturing facilities with antiquated technology and bloated labour forces that were geared to meeting government-imposed production targets were exposed for the first time to the economic pressures and the **profit focus** of capitalism. During the communist era, new urban centres were established in Siberia and the Russian Far East to house factories, because these remote new cities were considered strategically safe from military attack. Following the fall of communism, these expensive-to-operate factories were no longer needed, so they were closed and cities were abandoned.

2.58 An abandoned gold and silver refinery near Palatka in the Russian Far East. Like many towns in the Far East of Russia, the factory closed and the town was abandoned in the 1990s following the disintegration of the USSR.

2.59 Kadykchan was established in 1936 as a coal mining town populated by prisoners in the Russian Far East. Most of the buildings visible today date from the 1960s onwards when the town was re-settled by idealistic and enthusiastic Young Pioneers. The mine closed in 1996 following a large explosion in the mine. As a result of deindustrialisation following closure of the mine and its nearby factories, the town was officially shut down in 2003 when all services such as water and electricity were cut off. A few settlers continued to occupy buildings illegally until they too left, with the last settlers leaving in 2007. At its height, the town had accommodated 10,000 residents.

2.60 Alaverdi in Armenia is a striking example of deindustrialisation. In Soviet times the town had six copper smelters, all highly polluting but the basis of the local economy. Today, just one smelter remains, still belching toxic fumes, while the rest of the long river bank is filled with rusting factoties that are being slowly demolished as local people help themselves to metal, building materials and anything else of value.

The city of **Elbasan** in Albania is a spectacular example of deindustrialisation caused by a combination of several of the factors described

above. During the 1960s and 1970s, at the height of the Albanian Communist Party's control over the country, a vast metallurgical complex called '**Steel of the Party**' was built in the Shkumbin River valley on the outskirts of Elbasan with financial assistance from the Chinese Government. The metallurgical complex was designed to refine nickel, iron, chromium and other minerals brought in by rail from the surrounding region. This meant that for the first time, ores could be processed within Albania and exported in a refined state rather than as raw materials.

2.61 The Steel of the Party metallurgical complex in Elbasan, Albania, once employed about 12,000 workers. Today, most of this huge factory lies idle, and like most infrastructure in Elbasan, suffers from poor maintenance as the town's population shrinks.

In its heyday, Steel of the Party covered 155 hectares and employed about 12,000 workers in a number of state-owned enterprises such as the Nickel-Cobalt Plant, Cast-Iron Plant, Steel Plant, Carbonite Production Facility, Refractory, Brick factory, Thermo-Electric Plant, Oxygen Plant, Chemical Plant, Supply Enterprise, Enterprise of Transportation, and the Institute of Design and Metallurgical Studies. The various units were connected by 47 kilometres of internal railways and 35 kilometres of paved roads.

Each day, a fleet of buses carried the workers to and from the city of Elbasan. Although Steel of the Party provided the basis of Elbasan's economy because of its employment of about 12,000 workers, there was a large **environmental cost**. With no pollution controls, the complex belched huge quantities of dark, toxic smoke into the skies over the city, causing health problems such as cancer and genetic mutations among Elbasan's population.

2.62 One of the large abandoned buildings in the Steel of the Party metallurgical complex, Elbasan, Albania.

2.63 One of the plants that still functions in the metallurgical complex, Elbasan, Albania.

The combination of iron and coal particles released into the air, with heavy metal wastes released into the Shkumbin River, have poisoned the soil around Elbasan to a depth of about 40 centimetres, so that agricultural produce grown in the area today is still contaminated.

Communism collapsed in Albania in 1991, effectively starving Steel of the Party of its funding. The metallurgical complex was exposed to **global competition** for the first time, and its old technology, high pollution output, large labour force and competition from imported goods quickly combined to force most of the plants into bankruptcy. The plants were simply **abandoned**, leaving behind decaying, empty buildings that are becoming more dangerous as they deteriorate.

Today, only a few plants are still operating, mostly after purchase by **foreign companies**. A cement

plant is owned by Libya, a ferro-chrome factory is jointly owned by Austrian and Russian companies, and the steelworks, oxygen plant and metal recycling facility were bought by a Turkish company. The workforce of the entire metallurgical complex now numbers just a few hundred people. Since the closure of most of the metallurgical complex, **Elbasan's population** fell from an estimated 126,000 in 1991 to 87,800 in 2001 and 74,500 by 2016. Elbasan's population is still declining as residents move elsewhere in search of employment.

The **impacts of deindustrialisation** are always spread unevenly through an urban area where it is occurring. **Unemployment** affects low-skilled workers more than skilled labourers or managers, because unskilled workers are less likely to find alternative employment. Therefore, a usual outcome of deindustrialisation is rising **income inequality**. In cities that do not have a system to provide a social security safety net, such as unemployment benefits or pensions, the impact of unemployment on poorer people can be devastating as they may be unable to afford to keep their homes, afford medical treatment or even pay for basic needs.

Although deindustrialisation often leads to **unfortunate consequences** such as unemployment, depopulation of cities, urban decay, and income inequality, there can also be **positive consequences**. Positive consequences often take a period of time to emerge, and those who benefit are seldom the same people who have suffered from the effects of deindustrialisation.

In the case of the London Docklands and Malmö Docklands, deindustrialisation reduced the price of the land, enabling redevelopers to implement extensive **urban renewal**. In the London Docklands, large areas of old housing were demolished and replaced with new commercial and residential construction. Unlike the buildings they replaced, however, the new construction was geared towards young, professional, upwardly mobile high-income residents and workers.

In the case of the Malmö Docklands, many of the abandoned buildings have been renovated to showcase **innovative architecture**, **low energy use** and **environmental sustainability**. Among the businesses using the renovated buildings are Sveriges television (the Swedish national television broadcaster), Sweden Models (a modeling agency), BIMobject (an architectural software company) and Media Evolution (a multimedia organisation).

Urban renewal in Elbasan and Detroit is less advanced than London or Malmö. In 2015, deindustrialisation forced Detroit into bankruptcy, effectively removing any short-term hope that government funding would be available to address urban decay. In Elbasan, years of neglect and under-investment in infrastructure are being slowly addressed with some upgrading of streets in the city centre, but the declining population means taxation revenue to provide funding continues to shrink.

2.64 The cube houses in Rotterdam (Netherlands) were built during the city's inner urban renewal in 1970s to solve the problem of joining two small residential areas on opposite sides a wide railway line by linking them over a pedestrian bridge.

QUESTION BANK 2F

1. *Outline the ways in which of the five causes of deindustrialisation causes a factory or an industry to become uncompetitive.*
2. *Describe the process of tertiarisation, and explain how it relates to urban deindustrialisation.*
3. *What caused urban deindustrialisation in Elbasan (Albania), and what were its economic, social and demographic consequences?*
4. *Explain why the negative effects of deindustrialisation usually have the greatest impact on poorer people in a city.*
5. *Giving examples, describe some of the ways that deindustrialisation can have positive consequences, at least for some people.*

Chapter 3

Urban environmental and social stresses

3.1 Smoke from a coal-fired power station sends carbon particulates into the skies above Pyongyang, capital city of North Korea.

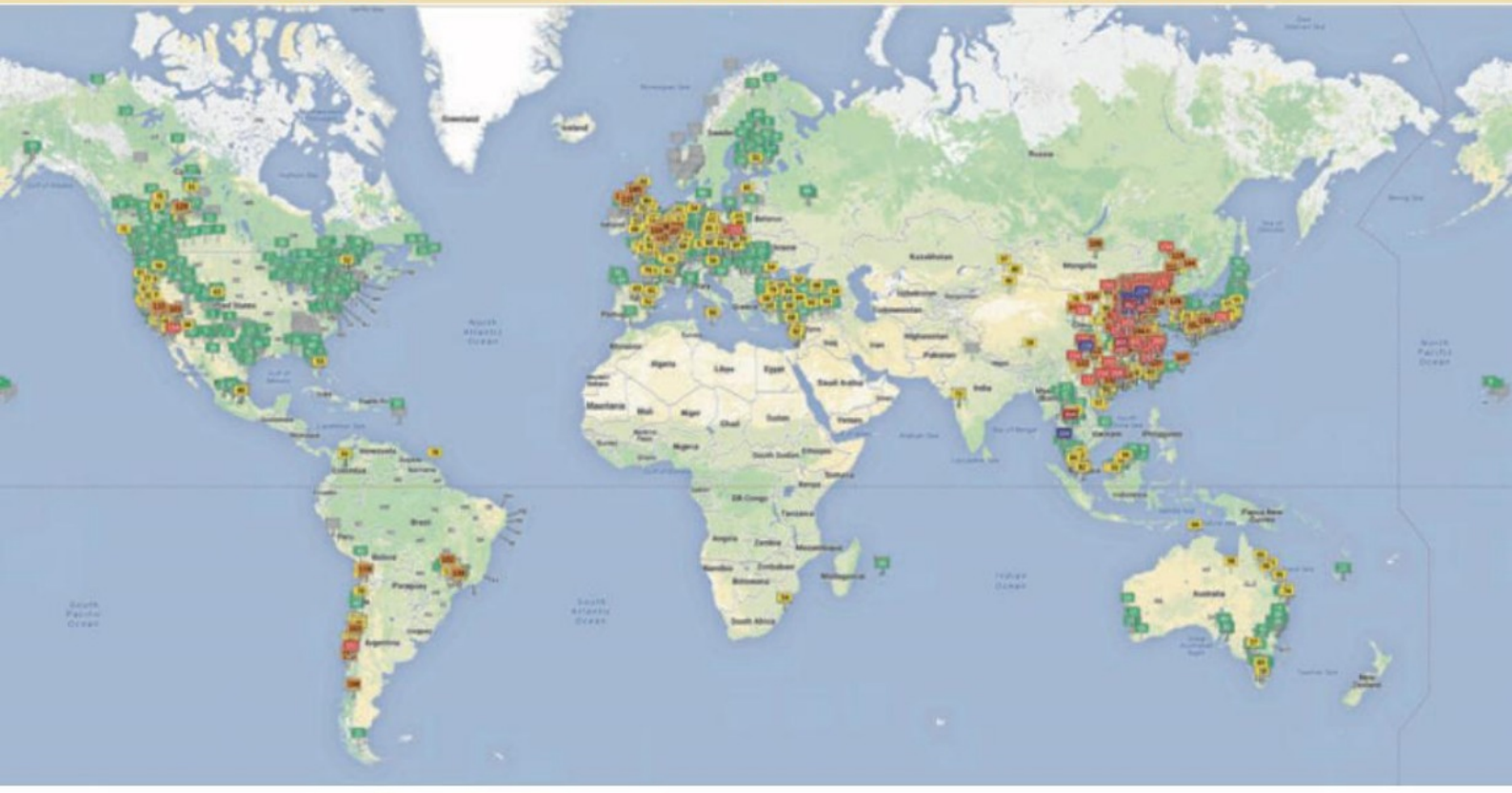
Urban microclimates

Air pollution

As countries seek to transform from a traditional society to an economically developed nation, manufacturing industry expands and motor vehicle traffic increases rapidly. This has an enormous environmental impact on their cities, as it is in cities that industry, people and traffic are concentrated in high density. The problem of pollution can be particularly severe when governments and decision makers in industry regard environmental quality as a luxury they cannot afford.

One major type of pollution in the world's cities is air pollution. Air pollution is unevenly distributed around the world. The website *aqicn.org* provides air pollution readings for many world cities on a daily basis. It uses $PM_{2.5}$ to assess air pollution, which is a measure of particulate matter in the air that is less than 2.5 μm (micrometres, or microns) in size, using $\mu g/m^3$ as the unit of measure. There are six categories of AQI (air quality index):

Good	0-50 $\mu g/m^3$
Moderate	51-100 $\mu g/m^3$
Unhealthy for sensitive groups	101-150 $\mu g/m^3$
Unhealthy	151-200 $\mu g/m^3$
Very unhealthy	201-300 $\mu g/m^3$
Hazardous	301+ $\mu g/m^3$



3.2 Air pollution on a random day in September in selected world cities. For the key to colour coding, see the text. Source: *aqicn.org*

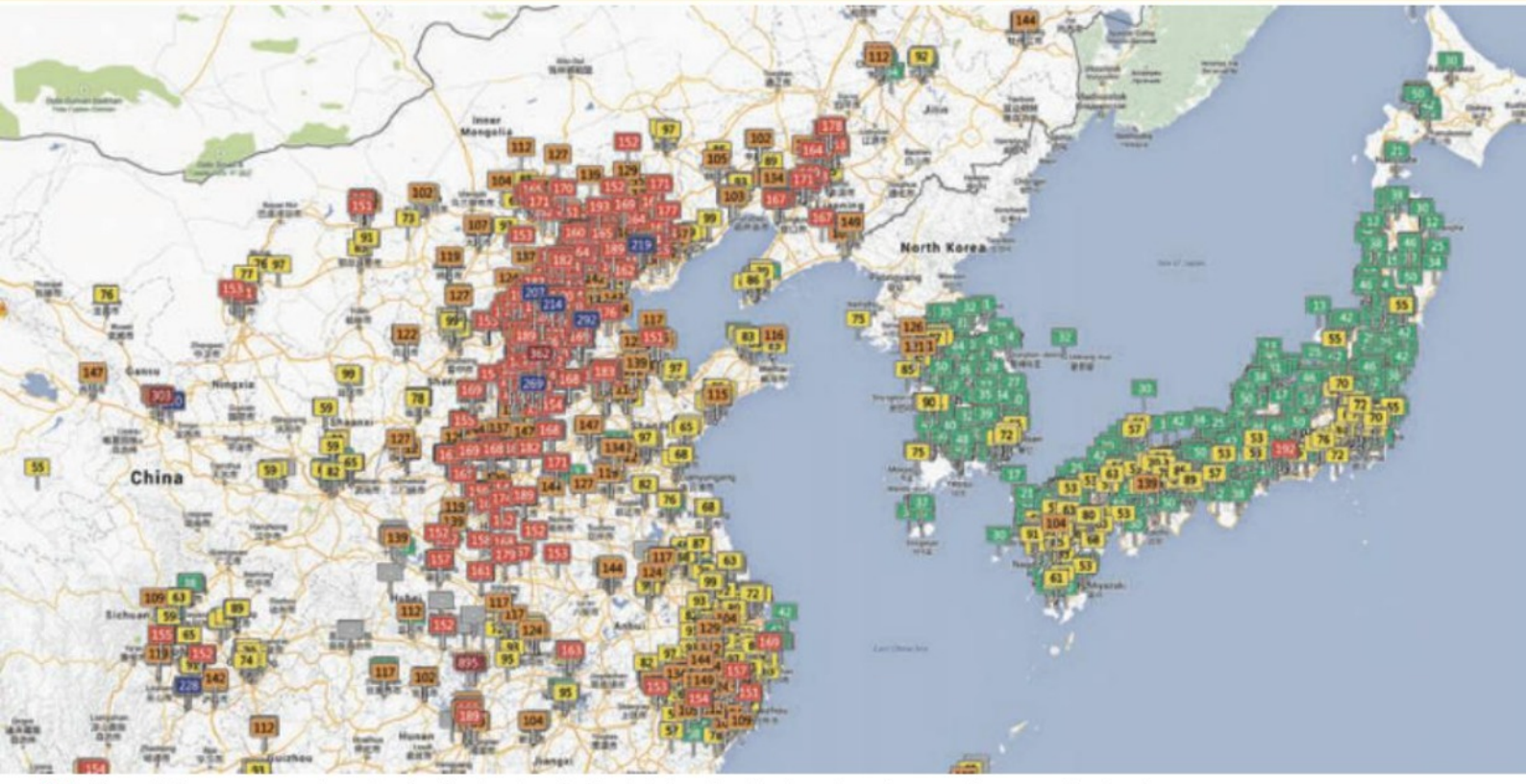
The website focuses on cities in North America, Europe, Australia, East Asia and parts of South America. Figure 3.2 shows the world distribution of urban air pollution on a typical day for cities that are measured. As the enlargements in figures 3.3 and 3.4 show, cities in Europe and North America are relatively unpolluted compared with cities in East Asia, and especially in China (figure 3.5).

An indication of the extent of air pollution in some of the world's **largest cities** is given in table 3.1. The table shows that air pollution includes a range of **toxins**, notably:

- **Sulphur dioxide (SO_2)** is produced by various industrial processes when coal and petroleum are burnt, releasing sulphur compounds that were contained within them. When sulphur dioxide is released into the atmosphere, it can combine with nitrogen dioxide (NO_2) to produce sulphuric acid (H_2SO_4), which falls as acid rain.
- **Suspended Particulate Matter (SPM)** comprises the microscopic particles (mostly carbon) that are released when coal, timber and other hydrocarbons are burned. Research shows that SPM is the most dangerous form of air pollution for humans. SPM includes much more than dust, and a particularly dangerous component in

3.3 Air pollution on a random day in September in Europe. For the key to colour coding, see the text. Source: *aqicn.org*

3.4 Air pollution on a random day in September in North America. For the key to colour coding, see the text. Source: *aqicn.org*



3.5 Air pollution on a random day in September in East Asia. For the key to colour coding, see the text. Source: *aqicn.org*

3.6 Air pollution in Shanghai, China, seen from the top of the World Financial Centre building.

microscopic particles of benzene. Less than 2.5 microns in size, these particles are inhaled into the deepest parts of the lungs where they remain, leading to cancer. Particles of benzene are almost never produced by a source other than motor vehicles. When SPM (smoke) combines with fog, **smog** is formed. One type of smog, known as **photochemical smog** or 'brown haze', arises when SPMs and carbon monoxide from motor vehicle exhausts are 'cooked' in the atmosphere by ultraviolet radiation from the sun.

- **Lead (Pb)** is released into the atmosphere when fuels containing lead are burnt. Lead is added to petroleum in some parts of the world to boost its performance. Lead is toxic to humans, and is especially dangerous to pregnant women and children because it can affect brain development. Other consequences of lead poisoning include sterility, memory loss, intellectual disabilities, anemia, seizures and death.
- **Carbon monoxide (CO)** is a colourless, odourless and non-irritating but toxic gas that is produced when fuels such as petroleum, coal, natural gas and wood are not completely burnt. The main source of carbon monoxide is exhaust fumes from motor vehicles.
- **Nitrogen dioxide (NO_2)** is produced is a reddish-brown toxic gas that is produced when fuels are burnt at high temperatures.
- **Ozone (O_3)** occurs at ground level when nitrogen dioxide from car exhausts and manufacturing processes combines with methane or other volatile gases. Although ozone occurs naturally in the upper atmosphere where it works effectively to filter harmful ultraviolet radiation from the sun that can cause skin cancer in humans, it is toxic to humans at ground level, causing asthma, and lung cancer. Ozone is a major component of photochemical smog.

Table 3.1
Air pollution in selected large cities

City	SO_2	SPM	Pb	CO	NO_2	O_3
Bangkok	✔	☠	✘	✔	✔	✔
Beijing	☠	☠	✔		✔	✘
Buenos Aires		✘	✔	☠		
Cairo		☠	☠	✘		
Delhi	✔	☠	✔	✔	✔	
Jakarta	✔	☠	✘	✘	✔	✘
Karachi	✔	☠	☠			
Kolkata	✔	☠	✔		✔	
London	✔	✔	✔	✘	✔	✔
Los Angeles	✔	✘	✔	✘	✘	☠
Manila	✔	☠	✘			
Mexico City	☠	☠	✘	☠	✘	☠
Moscow		✘	✔	✘	✘	
Mumbai	✔	☠	✔	✔	✔	
New York	✔	✔	✔	✘	✔	✘
Rio de Janeiro	✘	✘	✔	✔		
São Paulo		✘	✔	✘	✘	☠
Seoul	☠	☠	✔	✔	✔	✔
Shanghai	✘	☠				
Tokyo	✔	✔		✔	✔	☠

✔	*Low pollution. WHO guidelines are normally met*
✘	*Moderate to heavy pollution. WHO guidelines exceeded by a factor of two.*
☠	*Serious problem. WHO guidelines exceeded by a factor of more than two.*
	A blank rectangle indicates no date available or insufficient data for assessment.

SO_2	*Sulphur dioxide*
SPM	*Suspended particulate matter*
Pb	*Lead*
CO	*Carbon monoxide*
NO_2	*Nitrogen dioxide*
O_3	*Ozone*

3.7 A layer of photochemical smog (brown haze) hangs above the northern suburbs of Houston, Texas, USA.

If measurement stations had been established in cities in **India** and **Pakistan** by the organisations collecting data for figure 3.2, they would show high levels of pollution that are in some cases even worse than those in China. In Indian cities, where much of the freight transport is done by **human power**, the air pollution creates a severe hazard for the carriers who spend all day doing heavy labour, deeply inhaling the heavily polluted air. **Trucks** are replacing humans, and as Indian trucks are often old and poorly maintained, this is leading to a large increase in the emission of polluting gases. Each day, 2,000 tonnes of air pollutants are released into the air in India's capital city, Delhi, comprising 323 tonnes of nitrogen dioxide, 320 tonnes of hydrocarbons, 179 tonnes of sulphur dioxide and 1,063 tonnes of carbon monoxide. The World Health Organisation recommends that 9 parts per million of carbon monoxide should be the limit for

3.8 Air pollution is a serious health hazard for freight carriers who spend all day in the streets of large Indian cities such as Kolkata.

safety, but in Delhi, concentrations of carbon monoxide reach peaks as high as 35 parts per million.

A concentration of 25 parts per million is enough to cause poisoning in humans. According to The Times of India newspaper, the average Delhi resident visits the doctor 15 times each year for pollution-related health problems.

Motor vehicles and factories are not the only sources of air pollution in the cities of the developing world. The **burning of biomass**, wood and coal for cooking and heating purposes is also an important contributor to air pollution. In Delhi, street sweepers burn 8,000 tonnes of rubbish from the street dwellers each day, while the poor people living in shanty settlements burn plastic to keep warm, producing poisonous hydrochloric acid fumes while so doing. From these figures alone it can be seen that poor living conditions result in environmental pollution.

3.9 This woman in Bobo-Dioulasso, Burkina Faso, is using a wood-fired stove for cooking. Cooking by burning biomass is a significant source of air pollution in many low-income countries.

Fires are a significant source of air pollution in many cities of the developing world. In many low-income countries, cooking is done using stoves that burn wood. In countries such as Nepal, Ethiopia, Mali and Burkina Faso, gathering **fuelwood** causes deforestation in rural areas, but the significant problem caused by fuelwood in the cities is air pollution. Burning fuelwood releases large quantities of **fine carbon dust** in the form of **SPM** (suspended particulate matter) as well as **carbon monoxide**. When wood-burning stoves are located in inside kitchens, the smoke and toxins build up, causing health problems such as lung and chest infections. When wood-burning stoves are in outside kitchens, the hazard is reduced for the people doing the cooking, but air pollution levels rise in the urban centre.

3.10 Burning rubbish on a tip adds smoke to air pollution in Bamako, Mali.

3.11 Plastic rubbish is burnt on the river bank in Mopti, Mali, adding toxic chemicals to the air in the city.

A related issue in cities in low-income countries is air pollution caused by **burning rubbish**. Cities in poorer countries seldom have rubbish collection services, so rubbish is often disposed of by burning. Sometimes this is done at individual homes, while in other places rubbish is taken to a formal or informal tip where scavengers sift through the rubbish for valuable goods or materials that can be recycled, burning everything else. Burning plastics cause particularly severe air pollution issues as dioxins are released into the air, which are both carcinogenic (cause cancer) and hormone disrupters.

For cities in both low-income and high-income countries, **motor vehicle exhausts** are a major

source of air pollutants. The gases produced by motor vehicles include **nitrous oxides**, **carbon monoxide** and **sulphur dioxide**. In warm climates, such as those found in Bangkok, Lagos, São Paulo, Dhaka, Delhi and Jakarta, the gases emitted through car exhausts 'cook' in the sun and ozone, or **photochemical smog**, is produced. This is very harmful for the residents living in the cities concerned. Pilots flying into many cities report that they can always locate the city from a great distance away because it is covered by a characteristic brown dome of photochemical smog.

A large part of the blame for urban air pollution is placed upon the construction of **expressways**. Many cities in the developing world, such as Bangkok, Jakarta and Shanghai now have extensive networks of expressways that span the entire metropolis. In such cities, **public transport** is poorly developed and even footpaths for pedestrians do not exist in many parts of the city.

3.12 A poorly maintained truck being used to transport people belches exhaust smoke in Ouagadougou, Burkina Faso.

3.13 Air pollution over Johannesburg, South Africa.

3.14 Spectacular sunsets are often an indication that air pollution is severe, especially if there is a high concentration of suspended particulate matter. This sunset is in Cairo, Egypt.

On the other hand, not building expressways also brings problems of **wasted fuel** and air pollution as vehicles clog roads that are inadequate for the volume of traffic. In Bangkok, Thailand, expressways were not built for many years as the government felt that providing better roads would only encourage more people to use private cars rather than public transport. As a result, Bangkok has some of the worst traffic jams in the world as well as severe air pollution that causes many people's nostrils to sting when they inhale. Indeed, 20% of the Bangkok police force suffer from heart and lung disease induced by the air pollution. Meanwhile, the average car in Bangkok spends the equivalent of 44 days every year with its engine idling in a traffic jam.

Factories are major contributors to urban air pollution in many cities. In cities that have coal-fired power stations, the emissions from generating electricity are often significant sources of air

3.15 Traffic congestion in Dhaka, Bangladesh.

3.16 SPM-heavy air pollution blows across the city of Pyongyang, North Korea, from a coal-fired power station.

pollution, especially in poorer countries that feel they cannot afford the luxury of pollution controls.

All the causes of air pollution discussed so far are **anthropogenic**, which means they are caused by human actions. There are also several **natural sources** of air pollution that affect people in cities, such as:

- **Dust** blown into the city from large areas with little or no vegetation, such as deserts
- Smoke and carbon monoxide from natural **wildfires**
- Methane gas emitted from the rear ends of **animals** as they digest their food
- **Radon** gas from natural decay of radioactive materials in the earth's crust
- Ash and sulphur from **volcanic eruptions**.

The natural causes of air pollution are difficult to **manage**. In cities that experience frequent dust storms, belts of **trees** can be planted as these help to settle wind-blown dust by dispersing the air currents that carry it. The only ways to manage smoke from wildfires and methane gas from animals is to address the causes, such as by reducing the **number of cattle** raised for meat and dairy production, or conducting **controlled burns** to minimise the impact of wildfires.

3.17 Airborne dust envelopes the city of Dubai in the United Arab Emirates.

Addressing the causes of anthropogenic air pollution is a little easier than managing naturally produced air pollution, but it is still a highly **challenging task** from financial, physical and political perspectives. For example, massive **deindustrialisation** is one way to reduce air pollution, but it is seldom a solution that most people would choose to adopt voluntarily.

Motor vehicles are a major source of air pollutants, but few residents of cities are comfortable with the idea giving up their motor vehicles, especially if public transport is inadequate, run-down, infrequent or expensive. This suggests that one solution to reducing motor vehicle exhaust gases is to make **public transport** more appealing. In the words of Enrique Peñalosa, former Mayor of Bogota, Colombia, *"a developed country is not a place where poor have cars, it's where the rich use public transportation."*

3.18 The city of Curitiba in Brazil is one of several cities that are attempting to reduce exhaust emissions from buses by introducing hybrid-powered vehicles that use a mix of biofuel and diesel.

One way of managing air pollution is to apply **technology** to manufacturing processes in factories and to the engines of motor vehicles. Technology does exist to achieve this, such as mechanical dust collectors on factory chimneys, catalytic convertors

for car engines, and electrostatic precipitators to purify air. Mechanical solutions such as these are seldom cheap to implement, so **government regulations** are often required to force the adoption of these and similar measures. Government regulations to control pollution have become more common in recent decades in more affluent cities, such as those in North America, Europe, Australasia and Japan. However, governments in many developing countries are reluctant to impose such regulations because they prefer to give their emerging economies as many cost advantages as possible in a globally competitive environment.

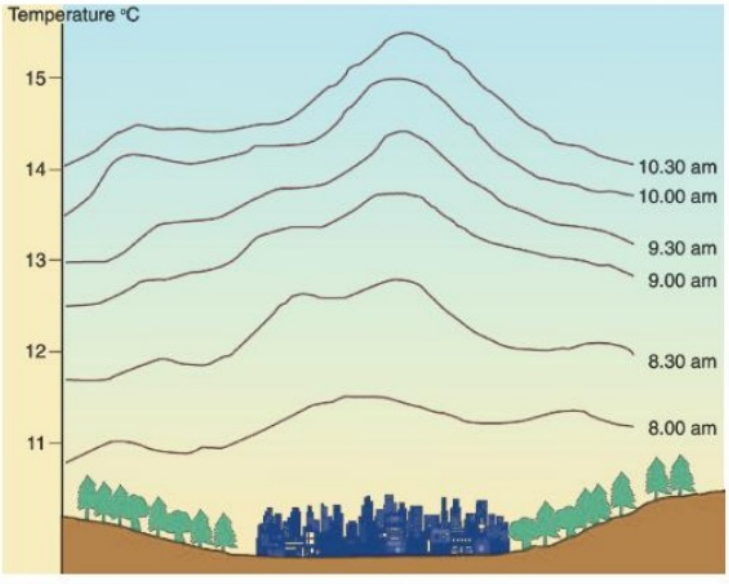
QUESTION BANK 3A

1. *Using figures 3.2 to 3.5, describe the world distribution of urban air pollution.*
2. *In figure 3.2, very little data is shown for cities in Africa and South Asia. Giving reasons, say whether you think cities in these regions would have high or low levels of air pollution?*
3. *Describe in words the information shown in table 3.1.*
4. *Suggest reasons for the pattern shown in table 3.1.*
5. *List the main types of air pollution found in large cities, divided into two groups: (a) anthropogenic air pollution, and (b) naturally caused air pollution.*
6. *Is it possible to manage air pollution in cities effectively? Explain fully, citing the challenges that must be overcome.*

Urban heat islands

It is well known that air quality in the world's cities is poorer than the air quality in rural areas. Dust and sulphur dioxide are produced from chimneys, and motor vehicles produce carbon monoxide and hydrocarbons. Nitrogen oxides are produced from both motor vehicles and chimneys. These pollutants produce **cloud nuclei** that increase both **cloud cover** and **precipitation** by about 10% in large urban areas compared with the pre-urban conditions in the same area.

The amount of air pollution in an urban area depends on two main factors. First, it depends on the quantity of pollution produced. **More air pollution** tends to be created in cities in low income countries than in high income countries. The second factor is the amount of **wind** that blows through the city. Winds can **dilute** and **disperse** urban air pollution, although whether winds blow through an urban area depends mainly on the surrounding topography and especially whether sea breezes are available. **Tall buildings** have an effect on winds, as the narrow canyon-like streets created between skyscrapers can **funnel winds**, causing dust and litter to irritate passers-by in the street. On the other hand, buildings of one and two storeys create **friction** with wind and therefore act to **slow down moving air**.



3.19 The urban heat island is shown by the increase in temperatures over a small town at half hourly intervals between 8:00 am and 10:30 am.

A combination of processes **increases temperatures** in urban areas compared with their rural surrounds (figure 3.19). **Sealed surfaces** such as roads and paths together with **dark roofs** absorb large amounts of heat during the day – perhaps 85% of the solar energy that reaches them. The heat absorbed by these hard surfaces is retained during the day and released slowly at night, warming the air of the city. Furthermore, heat is generated in urban areas by **industrial processes**, domestic **heating**, **cars** and **people working**. All these processes combine to make urban areas warmer than their surrounds, creating an effect known as the **urban heat island**.

During the day, the urban heat island is only warmer by a degree or two. At night the difference is much greater, with urban areas being perhaps 3C° or 4C° warmer than their rural surrounds. The urban heat island effect explains why flowers in urban areas tend to bloom earlier each year than flowers in rural areas and why cities have fewer frosts each year than rural areas.

3.20 The effect of the urban heat island can be seen in this oblique aerial view of Montreal, Canada. Snow has melted in the urban area of Montreal, exposing the dark roofs and paved surfaces. In contrast, snow that has fallen on the surrounding rural areas remains white and unmelted.

QUESTION BANK 3B

1. *What causes the urban heat island effect?*
2. *With reference to figure 3.19, describe the changes which took place between 8:00 am and 10:30 am.*
3. *Explain why temperatures in figure 3.19 appear to have been higher over the town than over the surrounding rural area.*

CASE STUDY
Air pollution in Beijing, China

Beijing is China's capital city, and has a population of almost 13 million people. Like all Chinese cities, Beijing has problems with air pollution. However, as China's capital city, more effort has been made to reduce the problem in Beijing than in most parts of China.

The **main source** of air pollution in Beijing, as in most Chinese cities, is the burning of coal. **Coal** is the main fuel used for heating, cooking and for industry. China has huge reserves of coal, but most of it is of **poor quality**. China's coal contains large quantities of **sulphur**. The air in Beijing is often heavily polluted coal dust, especially in winter when coal is used for heating, and even more so when a high pressure area over Beijing traps pollutants close to the surface. It is estimated that each year, China produces 11 trillion cubic metres of waste gases and 16 million tonnes of coal soot; each three years the production of soot equals the weight of all Chinese people!

Two American reporters who lived in Beijing for several years, Nicholas Kristof and Sheryl WuDunn, wrote about their experience of air pollution in Beijing in their book *China Wakes*:

> *"After an hour or two outside in winter, we would come home and find our nostrils blackened from the soot. The coal dust would creep into our apartment through every cranny, and when I went on one of my six-mile jogs through Beijing, I would come back with a blackened tongue. Finally, I decided that running might be doing my health more harm than good. I stopped jogging in the winter".*

Just over 60% of Beijing's total energy consumption is coal, representing a little over 30 million tonnes per annum. Of this quantity, **manufacturing industry** consumes about 70%, **domestic households** about 20% with the other 10% being used by other activities such as **transport** and **shops**. The use of coal is **highly seasonal**, however. In Beijing, heating is strictly regulated, and all heaters are turned on at the beginning of winter on the same date, and all are turned off simultaneously with the onset of spring. During the 'heating season', average daily consumption of coal rises 30% above the annual average. Beijing has over one million small coal pellet stoves and almost 8,000 heating furnaces that add pollutants into the atmosphere every winter.

However, the burning of coal adds more than just soot to the air. One of the by-products of burning coal is **sulphur dioxide** (SO_2). During the 'heating season', small stoves and central heating devices account for 48% of Beijing's lower atmosphere sulphur dioxide. There is a dramatic increase in sulphur dioxide in Beijing during the 'heating

3.21 Air pollution on Chang'an Avenue in Beijing.

3.22 Sulphur dioxide in the air over Beijing in the 'non-heating season' (top) and in the 'heating season' (bottom). Sulphur dioxide is measured in milligrams per square decametre.

season' (figure 3.22). At this time, the average sulphur dioxide content of the air is 0.23 milligrams per cubic metre compared with an average of 0.05 milligrams per cubic metre during the rest of the year. The **main concentration** is in the **inner suburbs** due to the **high density** of population in that area. By contrast, the main concentration in the 'non-heating season' is in Beijing's **western suburbs** where there is a high concentration of **heavy manufacturing** industries.

Government officials in Beijing are aware of the air pollution problems faced by the city. They propose that in the decades ahead the **quality of coal** available for residents is to be improved, meaning that fewer pollutants will be produced when it is burnt. In the long-run, they hope to encourage people to **replace** their coal stoves with gas appliances. Although about 85% of homes in Beijing now have gas stoves for cooking, only 15% of homes have replaced coal with gas for heating.

There are two additional sources of air pollution in Beijing which, while less important than the burning of coal, are still important. One is **fine dust** from soil erosion which blows into Beijing from inland areas. In many inland areas of China, the soil is composed of very fine clay particles called **loess** that can easily be eroded by the wind. Overgrazing and deforestation has destabilised large areas of loess, and the prevailing north-westerly winds blow substantial quantities of dust into Beijing.

Many Beijing women wear scarves, not so much as an item of fashion as much as to protect their hair from the dust. In recent years, **trees** have been **planted** many parts of Beijing. They are designed to act as **wind-breaks**, causing the dust to settle. Known as the 'Great Green Wall of China', this program has reduced the problem of airborne dust, although it has certainly not eliminated it.

3.23 Trees on Xuanwumen Avenue provide shade for pedestrians and help settle the dust.

3.24 A pedestrian park lined with trees in central Beijing.

3.25 Traffic in central Beijing, 1982.

3.26 Traffic in central Beijing today.

The other main source of air pollution in Beijing is exhaust fumes from **motor vehicles**. As recently as the 1980s, Beijing had very few motor vehicles as most residents used bicycles or buses. Today, Beijing experiences the same (or worse) traffic congestion as most major world cities despite massive programs of road and expressway construction.

Exhaust fumes from motor vehicles produce nitrogen oxides (NO_x) and carbon monoxide (CO). **Nitrogen oxides** have risen markedly with the increase in numbers of motor vehicles in Beijing. In general, concentrations of nitrogen dioxide are highest at traffic intersections and along major road arteries.

There has also been a significant increase in concentration of **carbon monoxide** in Beijing. Carbon monoxide is produced by cars, especially those that are moving slowly, and by incomplete burning of coal in small coal stoves. Therefore, carbon monoxide concentrations are highest in the 'heating season' and where traffic congestion occurs. Like nitrogen oxides and sulphur dioxide, carbon monoxide is a poisonous gas that leads to breathing problems and some cancers such as leukemia. Greater awareness of air pollution has led to the construction of several air pollution monitoring stations with public displays in Beijing over the past few decades.

One of the most worrying aspects of Beijing's air pollution is the high concentration of BaP, or **Benzo[a]-pyrene**, a chemical which induces lung cancer and which is produced by heavy industry without adequate pollution controls. The incidence of lung cancer in Beijing in 1958 was 7.9 people per 100,000; by 1979 this had risen to 15.5 people per 100,000. The rate of lung cancer rose further to 49 per 100,000 in 2002, rising to 75 per 100,000 by 2010.

There are **three concentrations** of BaP in Beijing: the densely settled centre of the city, the area surrounding the Capital Iron and Steel Works in the western suburbs, and in an area near a coking plant in Beijing's eastern suburbs. The health risks are greatest during the 'heating season' when an area of 500 square kilometres of Beijing exceeds the accepted standard of 1 milligram per 100 cubic metres of BaP. On the other hand, during the non-heating season only a few small areas exceed the standard. However, in the areas around the iron and steel works and the coking plant, the concentrations remain above 4 milligrams per 100 cubic metres for most of the year. The solution to this serious problem seems to be to require stricter standards of pollution emission, especially from heavy industry in Beijing.

3.27 Air pollution over the western suburbs of Beijing.

People have affected the atmosphere above Beijing in other ways besides pollution, notably by the creation of an **urban heat island**. An urban heat island exists when there is a difference in average temperatures between a city's inner areas and its suburbs. In general, when the difference exceeds 0.5C°, a heat island is said to exist.

Beijing's heat island is among the strongest of the world's major cities. A study of twenty of the world's major cities showed average temperature differences between city centres and outskirts of 0.7C°. In Beijing, the average annual difference is 1.7C°, while during the heating season the difference averages 2.5C°. Figure 3.28 shows the isotherms on one clear winter's day when there was very little wind.

3.28 Isotherms in Beijing at 8:00 am on a winter's day (January). The figures show temperatures in degrees Celsius.

The difference in temperatures in heat islands causes **movements of air** because of the formation of **convection currents**. The inner urban areas, having relatively warmer air, tend to have lower air pressures than outlying areas with cooler, descending air. Thus, air rises in the city centre, **bringing in pollutants** from outer industrial suburbs as air flows in from the cooler surrounds.

Beijing's authorities have committed themselves to **cleaning up** the atmosphere over Beijing. When an important event is imminent, such as an international conference or a major sports competition, **factories** in Beijing are routinely closed for a week or so to allow the air to clear for the celebrations. Sometimes, these measures are supplemented by **restricting cars** to an 'odds-and-evens' system in which only cars with licence plates ending in an odd number are permitted on the roads on odd-numbered days of the calendar, and so on. Of course, closing all the city's factories is not a viable long-term solution to the problem of air pollution, but Beijing has nonetheless made significant strides towards improving the quality of its air, at least during these periods.

QUESTION BANK 3C

1. *Identify the main source of air pollution in Beijing.*
2. *What is the 'heating season' in Beijing, and why is it significant? In your answer, refer to the information in figure 3.22.*
3. *What can be done realistically in Beijing to reduce air pollution arising from (a) burning coal, (b) dust, and (c) car exhausts?*
4. *What is BaP, and why is it a problem in Beijing?*
5. *Use figure 3.28 to draw a cross-section graph of Beijing's temperatures on the date shown. Use the information you have plotted to describe Beijing's heat island on that day.*
6. *Describe and account for the varying impacts of (a) air pollution, and (b) the urban heat island, upon people in different parts of Beijing.*

Traffic congestion

Patterns, trends and impacts

For several decades, the growth in the number of motor vehicles has **exceeded** the population growth in every city of the world. In 1950 there were 53 million cars in the world. This figure reached one billion in 2010, and it is expected that the number of cars will reach two billion by 2035. Although the majority of motor vehicles are in economically more developed countries, the fastest growth is occurring

3.29 Traffic congestion in central Mexico City, Mexico.

3.30 Traffic congestion is a problem in the central areas of old cities where street layouts were designed in the pre-car era. This example of congestion is in Quito, Ecuador.

3.31 Traffic congestion is more likely to occur in areas with a high population density, as shown here in the Central district of Hong Kong.

3.32 Traffic congestion within cities in low-income countries often arises because of disorganised management of the flows of different types of traffic, such as trucks, rickshaws, bicycles and pedestrians, as seen here in Kolkata, India.

today in developing countries. Road construction has failed to keep pace with the rising number of motor vehicles in most cities in the world, and the inevitable result is increasing **traffic congestion**.

Traffic congestion occurs when the **density of cars** on a road exceeds the **carrying capacity** of the road. **Evidence** of increasing traffic congestion is slower speeds of travel, longer trip times and queues of vehicles. Short-term traffic congestion can be caused by road works, accidents or lane closures. However, the long-term cause of increasing traffic congestion is the rapid increase in **motor vehicle numbers**, especially in urban areas. This increase has pushed many roads **beyond their capacity**, a situation that is known as road **saturation**.

3.33 Traffic congestion occurs when large volumes of traffic are funnelled from narrow streets onto a few large thoroughfares, as seen here in Damascus, Syria.

Few cities in the world are escaping the trend towards increasing traffic congestion. In large cities, this causes several **negative impacts**:

- The **time wasted** sitting in traffic queues represents a **financial loss** of billions of dollars (the **opportunity cost**) for drivers in a typical large city.
- Traffic congestion **discourages** entrepreneurs from **investing** in a city if less congested alternatives are viable.
- Traffic delays cause people to miss meetings, education and employment obligations, **reducing productivity** and leading to **lost wages**, foregone business dealings or disciplinary action.

- **Fuel is wasted** in idling traffic, and **exhaust emissions** are increased with negative effects on air pollution.
- **Wear and tear** on vehicles is increased because of frequent alternating use of brakes and accelerators.
- Traffic congestion prevents **emergency vehicles** getting to accidents, hospital or other crisis situations.
- In extreme situations, traffic delays can lead to **road rage**, leading to aggressive behavior that may result in injuries or even murder.

Traffic congestion is a challenging problem for government officials and urban planners, not least because solutions are likely to be either extremely **expensive** or very **unpopular**, or both. **Possible solutions** fall into three broad groups: (a) road engineering, (b) promotion of mass transit systems, or (c) discouraging motor vehicle use in certain congested areas.

Road engineering can take many forms. If land is not scarce, **road widening** can increase the carrying capacity of a road. However, this is often impossible in urban areas because of the constraints imposed by existing buildings and infrastructure. One solution to this constraint can building **elevated roads** or **tunnels** that go above or below existing infrastructure, but these are both expensive options.

Other road engineering solutions attempt to make more efficient use of existing roads. This can be done in various ways such as **reversing the direction of lanes** at different times of the day, reserving separate **lanes for buses**, and allocating some lanes as **tollways** so that people who are in a

3.34 Road widening and expressway construction can relieve traffic congestion in the short-term, but the extra traffic volume that these roads attract soon leads to further congestion, as seen here on the I-294 freeway in Chicago, Illinois, USA.

3.35 A dedicated bus lane separates mass transit vehicles from other traffic in Bogotá, Colombia.

3.36 Suburban railways can relieve traffic congestion by carrying hundreds of passengers on each journey, especially when trains operate through tunnels or on lines that are separated from roads, as seen here in Cairo, Egypt.

3.37 The Bangkok Metro separates trains from roads by using elevated rails in the downtown district.

hurry have the option to pay a premium price for faster travel. **Information technology** can also play a role by informing drivers of traffic delays through smartphone apps so that alternative routes might be chosen, thus helping to **distribute traffic flows** more evenly through the road network.

Mass transit systems are often proposed as alternatives to road engineering. Mass transit proposals are made because research shows that widening or improving roads increases people's willingness to use the roads, and therefore any relief of traffic congestion will only be **temporary**. The most common types of mass transit systems used in cities are bus and rail systems. **Buses** are **cheaper** to introduce than trains, and they are more **flexible** because they can travel either on existing roads or on designated bus lanes. **Railways cost more** to build, especially if they are underground or use elevated viaducts, but they offer greater passenger **capacity** than buses and **higher speeds** of travel. A variation on mass transit is to encourage **car sharing** (or **car pooling**) schemes so that one individual motor car comes to perform the role that several single-driver vehicles used to fill.

The third solution is to use **management strategies**, such as **reducing the speed** of cars (which allows more cars to fit on a road), installing **traffic lights**, or **discouraging** or **prohibiting** motor vehicles from designated areas. One approach is to close a road or several streets to create a **pedestrian plaza**. Another approach is to **restrict** traffic from a defined area, such as the CBD, either by **banning** cars during certain times of the day or by imposing

3.38 Electronic Road Pricing (ERP) operates in the CBD of Singapore to regulate traffic congestion, with toll prices for entry varying according to congestion levels at different times of the day.

3.39 This popular bicycle-train interchange point at Rotterdam Blaak Railway Station in the Netherlands encourages commuters to avoid using their cars, thus reducing traffic congestion.

toll charges to enter the area. For these solutions to work well, alternative transport systems need to be in place. This may be building a comprehensive **bicycle network** (if the city is fairly flat), or ensuring **mass transit** systems are capable of absorbing additional passengers, or having an effective **park-and-ride scheme** that enables quick and efficient car-to-transit transfers.

QUESTION BANK 3D

1. *Define the term 'traffic congestion', and describe the evidence that traffic congestion exists in a city.*
2. *What are the main causes of traffic congestion?*
3. *What are the main impacts of traffic congestion? Do these impacts affect all groups of people uniformly? Explain.*
4. *What is BaP, and why is it a problem in Beijing?*
5. *Describe the three main approaches to reducing traffic congestion, and comment on their relative effectiveness.*

CASE STUDY
Sustainable traffic management in Curitiba, Brazil

Curitiba is a city in southern Brazil with a population of almost two million people. Capital of the state of Paraná, it has emerged as an example of outstanding city planning and sustainable development as a response to the challenges of urban growth and traffic congestion.

During the 1950s and 1960s, farms in rural areas of Brazil went through a rapid process of **agricultural mechanisation**. This resulted in widespread **unemployment** among agricultural workers, many

of whom migrated to cities such as Curitiba in search of work. Curitiba experienced some of fastest **urban growth** in Brazil, with average annual population growth reaching 5.7% per annum during this period. The uncontrolled urban expansion caused **severe problems** in housing, sanitation and traffic congestion as the city's **infrastructure** struggled to cope with the influx of in-migrants.

Following the appointment of Jaime Lerner as Mayor in 1971, city planners in Curitiba began to address the problems by focussing on four main areas of **sustainable city management** — transport, recycling, parks and affordable housing.

One of the first decisions made by Curitiba's planners in the early 1970s was that the city should be developed for **people, not cars**. They began by closing Curitiba's busiest street, Rua XV de Novembro, and converting it into Brazil's first **pedestrian plaza**.

3.40 Rua XV de Novembro, the first pedestrian plaza in Curitiba, Brazil.

Despite considerable opposition from business owners to the plan, the conversion was completed in 72 hours over one weekend. Subsequent experience showed that the change **improved business** for local firms because pedestrians were more relaxed and thus more willing to spend time shopping.

In contrast to many cities around the world, where traffic congestion is managed by building wider streets and more expressways, Curitiba's planners decided to **emphasise public transport** and make it attractive and affordable for commuters. Restrictions were introduced to prevent more **tall buildings** being constructed in the congested downtown area, and **permits** were only granted for new buildings in areas where mass public transportation could be provided. Five routes were identified radiating out from the downtown area, allowing urban expansion to occur in a regulated way. Thus, **new schools** and **businesses** were **located along routes** where buses could replace cars as the main means of transportation, encouraging the growth of **multiple linear centres** at the expense of a single concentrated city centre.

The five axes were converted into a distinctive **trinary** (three-part) **structure**. The axes used three parallel streets that were designed to work together to ease traffic flow (figure 3.41). In the trinary system, which still operates today, the central street is divided into three sections. The central section of the central road is a two-way road that is reserved for Curitiba's large **bi-articulated buses**, with bus stops every 500 metres. Having separate **bus lanes** enables people to travel quickly regardless of traffic conditions on surrounding roads. The bus lanes are also used by emergency vehicles such as police and ambulances when needed.

3.41 Curitiba's trinary road system.

On either side of the bus lanes are lanes for cars that need access to local businesses and buildings. One block away from the central road, in each direction, are the other roads that complete the trinary road system. Known as *hoppidas*, these are three to six-lane one-way avenues that provide high-speed cross-city roadways for cars. This trinary road system covers about 70 kilometres of Curitiba's main roadways. **One-way roads** have been shown to **reduce congestion** because the waiting times at traffic lights are reduced and cars never have to wait for oncoming cars before turning into cross streets.

3.42 A two-way dedicated bus lane runs through the middle of a two-way central street in the trinary road system in Curitiba.

3.43 A *hoppida*; a six-lane one-way street in central Curitiba.

3.44 A two-way bus lane runs along the side of a one-way road for cars in suburban Curitiba.

For the bus stops, a special **tube station** design was adopted to improve efficiency. Passengers can enter and leave buses without the inconvenience of steps, and they pay fares at the tube station, thus eliminating the collection of fares within the bus.

The buses are colour-coded to indicate their function and hierarchical position within the system. **Blue buses** are super-express buses that connect outer suburbs of Curitiba with the CBD. They use dedicated bus lanes and stop only at major bus terminals, by-passing all other stops.

Red buses are either articulated or bi-articulated, and they travel exclusively along dedicated bus

3.45 Passengers wait for their bus at a tube station in Curitiba.

3.46 Boarding ramps snap into place when buses stop at tube stations, facilitating boarding and disembarking.

3.47 A transfer interchange between two bus routes at Marechal Floriano Station, near Technoparque, Curitiba.

lanes in the centre of the middle road of trinary road system, connecting outer areas of Curitiba with the downtown. Each **bi-articulated bus** can carry up to 270 passengers, and during peak hours, the average frequency of buses is just 50 seconds.

Grey buses travel along the fast lanes of streets, but stop only every two to three kilometres, using the special tube stations when they do so. The grey buses are thus the fastest way of travelling over longer distances in Curitiba.

Yellow, orange and green buses connect local towns to transport hubs where passengers can transfer to other buses without paying additional fares. This enables passengers to use connecting bus stations to reach their destinations, avoiding downtown areas and reducing the central city congestion that plagues many world cities. Thus, over 60% of Curitiba's residents use buses to get to work each day, even though Curitiba has the second highest rate of car ownership in Brazil (one car per three inhabitants). Evidence of Curitiba's emphasis on public transport planning is that **no person** in the city has to walk **more than 400 metres** to reach a bus stop.

Curitiba's public transport system represents a relatively **low-cost solution** to traffic congestion. The total cost of the infrastructure and vehicles is about US$1 million per kilometre, compared with the cost of building a subway (rail) system, which would be about US$100 million per kilometre. In practice, however, Curitiba's bus system functions like a subway system because it is separated from the rest of the road network and uses its own dedicated routes.

3.48 A biarticulated bus in central Curitba.

3.49 Yellow buses provide access to local areas over short distances in Curitiba.

3.50 In an effort to improve Curitiba's air quality, an increasing number of buses are being powered by biodiesel, a fuel made completely from soybeans grown in Brazil. Biodiesel buses are marked with a large green sticker.

3.51 Although traffic planning in Curitiba has reduced traffic congestion, it has not eliminated it. Traffic delays in central Curitiba are quite common, especially in the morning and evening rush periods.

It has been estimated that Curitiba's transport system has resulted in a **reduction** of about 40 million **car trips** per year, saving about 40 million litres of fuel annually. Compared to eight other Brazilian cities of similar size, Curitiba uses about 30% **less fuel** per person, resulting in one of the lowest rates of **air pollution** in Brazil. Today, Curitiba's residents make about **2.3 million trips** on the buses each day, a figure that exceeds a rate of one trip for every person living in the city. Perhaps most significantly, people in Curitiba spend only about 10% of their income on travel, a figure that is well below Brazil's national average.

Despite its successes, Curitiba's system is subject to some **criticisms**. Residents of Curitiba complain about **overcrowding** during the morning and evening rush hours, and residents who live in the **outer fringes** of Curitiba grumble that bus services are inadequate, requiring them to change buses and pay additional fares to get home. Others complain that more buses are needed, requiring **additional investment**, if Curitiba's traffic congestion is to be overcome. When buses are overcrowded and passengers cannot board, they become discouraged and resume using their cars, causing congestion.

In spite of the criticisms, Curitiba's low-cost answer to traffic congestion has been copied by several other cities eager to avoid the high cost of building a rail metro system. Variations of the Curitiba model are seen in Bogotá (Colombia), Quito (Ecuador), and Guatemala City (Guatemala), among others.

QUESTION BANK 3E

1. *Explain the key points of Curitiba's traffic management strategy and the problems it was designed to overcome.*
2. *A former mayor of Curitiba claimed that if every city in the world adopted Curitiba's sustainable city management, the world would not be facing the challenges of traffic congestion today. Do you agree?*
3. *It has been said that Curitiba shows what a city would look like if urban planners rather than politicians designed cities. What is your opinion on Curitiba's urban planning?*

Contested land use changes

In most cities of the world, **economic forces** are the main influences on the way land is used (the '**land use**'). Land which is viewed as being desirable because of its **accessibility** or **situation** (its location within the context of its surroundings) is worth more, and so it tends to attract activities that offer the potential to make high earnings from the land (more '**land rent**'). The forces underpinning this process were explained in figure 1.13.

In most cities of the world, economic forces operate within **constraints** imposed by governments through **land-use zoning** regulations. Land-use zoning prescribes the land uses that may or may not be undertaken in designated areas. For example, land may be designated as residential, educational, commercial, retail, parkland, and so on. Engaging in a land-use that is contrary to the

3.52 Land uses in Pyongyang, North Korea, are highly regulated and are determined by government planners without any consideration of economic forces. Forced changes in land uses here, such as relocation to new housing, are uncontested.

land-use zoning would be **illegal** and punishable under the law. In a few cities located in countries where the government controls the economy through central planning, such as in North Korea, **political forces** completely over-ride any economic influences — in these cases, all land uses are determined by government planners.

3.53 Robin Hood Lane in Tower Hamlets, part of London's East End. This view shows the area in 1987 when the area's long-term residents were being forcibly evacuated under protest.

3.54 Robin Hood Lane today. The area that was a hotel in 1987 is now a medical centre for low-income residents.

When land uses change, an array of **interest groups** become involved. In addition to the land-owner, builders, subcontractors, architects, marketing agents, speculators, developers, legal and financial consultants all play a part in obtaining approval from government authorities. In most cities of the world, many of the decisions made to develop land are based on the **profit motive**. For example, a land-owner or a developer may see the opportunity to make money from renovating old properties or initiating a process of gentrification.

Speculative activity to develop land often leads to the **displacement** of communities as people living in low value properties find they can no longer afford to stay living in an area. This was a significant consequence of the Docklands redevelopment in London's East End when the area's long-term working class residents were forced out of their homes. **Forced relocations** also occur when cities take on large-scale reconstruction projects, such as hosting an international sporting event such as the Olympic Games. It is also a significant factor on the **rural-urban fringes** of sprawling cities as farmers find that financial pressures are forcing them to move to make way for new housing areas.

Changes in land-use due to redevelopment are often **piecemeal** because of patterns of ownership of the land. A speculator who intends to buy residential land for a large-scale development has

3.55 The residents of these houses in the Barra district of Rio de Janeiro, Brazil, were forcibly evicted to make way for constructions for the 2016 Olympic Games.

3.56 Houses that have been forcibly demolished in Ashgabat, Turkmenistan.

to negotiate with several (or many) land-owners who may be reluctant to sell. Negotiations like this sometimes lead to '**holding out**' by some land-owners who hope to receive a higher price for their property. Although 'holding out' is understandable from the perspective of a land-owner, it can cause inflated land values which increase the cost of redevelopment or perhaps an undesirable mix of incompatible land uses.

In some cases, residents of cities become **frustrated** at proposed land-use changes or the lack of progress in addressing their problems that they turn to radical solutions. Cities are often the centres of political **dissent** and **protest**. When people's livelihoods are threatened with the loss of their homes or jobs, the reaction may be to demonstrate or even resort to **violence**.

In **Ashgabat**, the capital city of Turkmenistan, the government has a policy of **rebuilding** the entire city using **white marble**. In order to implement this program of **forced urban renewal**, 50,000 residents have been forcibly evicted from their homes. The forced evacuations are done with little or no financial compensation, often with just a few days notice. As it is the responsibility of the former homeowner to find new accommodation, many demolish their own homes and take the materials to try and re-build elsewhere.

Turkmenistan has an authoritarian government, so **no public protests** have occurred. However, residents are privately highly critical of the program and the government officials behind it, and a few cases of suicides have been reported.

3.57 White-clad high rise buildings on Atamyrat Niyazov Avenue, Ashgabat, show how the entire city will appear when the forced program of urban renewal has been completed.

3.58 An oblique aerial view of Ashgabat, Turkmenistan, shows the extent of new white high-rise construction. Many of these buildings have been built on land where forced evacuations occurred.

CASE STUDY
Skopje, Macedonia

Skopje is the **capital city** of Macedonia. It is also the **largest city** in Macedonia, having a population estimated to number about 650,000 people. The area has a long history of settlement dating back to Neolithic times (the new stone age) some 6,000 years ago. Skopje has been occupied by a series of empires, including the Romans, Byzantines, Bulgarians, Serbians, and Turks. Following World War II, Macedonia became part of Yugoslavia, and after Yugoslavia's break-up in 1991, Macedonia became an independent republic. Macedonia is land-locked, meaning it has no coastline.

3.59 The location of Skopje, Macedonia.

Skopje is an **ethnically diverse** city. The dominant ethnic group is Macedonian, most of whom are Christian, whose people comprise two-thirds the population. Substantial minority groups include Albanians, most of whom are Muslim (20% of the population), Roma (6%), Serbs (3%), Turks (2%) and Bosniaks (2%). In general, the Macedonians are the most affluent group, the Roma are the poorest, and the Albanians, Turks and Bosniaks fall between the two extremes. The various ethnic groups do not mix very much, and they live in separate parts of the city, largely ignoring each other.

Much of Skopje was destroyed in an **earthquake** on 26th July 1963. Although the earthquake was fairly weak, it destroyed many buildings in the city and 70% of the population lost their homes. Over 1,000 people were killed and 3,300 more were injured. The city was re-built by the Yugoslav administration in the style that was favoured in socialist countries of Europe at the time, with **modernist** and **brutalist** high-rise housing blocks dominating the skyline. Land-uses were allocated by **central planners**, with specific blocks being allocated to certain purposes.

3.60 Typical socialist-era buildings of the type that were built in Skopje after the 1963 earthquake. This scene is representative of Skopje in areas south of the Vardar River where ethnic Macedonians dominate.

3.61 The old town of Skopje is where most of Skopje's ethnic Albanians and Turks live.

Skopje is situated on the Vardar River, which flows through the centre of the city, so the river was used as a natural axis for **parkland** when Skopje was re-built. **Shops** and **high-rise housing** blocks were built along the main boulevards, leaving the outer suburbs for **lower density housing** and **manufacturing** industry. On the northern side of the Vardar River, the **old historic zone** of Skopje was restored and re-built with low-rise, stone buildings and a maze of stone-surfaced laneways.

3.62 Houses inhabited by ethnic Albanians in Skopje's old district show the types of homes that were forcibly demolished to make way for the Skopje 2014 program.

3.63 Looking from the old stone bridge northwards to an area that was cleared to make way for a monumental plaza in central Skopje, Macedonia.

This enabled the **ethnic zones** of Skopje to be preserved, with Muslim Turks, Albanians and Roma living north of the river, while Christian Macedonians mostly lived on the south side of the river. With the exception of the old town and the ancient fortress beside it, Skopje was re-built as a modern but drab regional Yugoslav city.

Following independence in 1991, Macedonia's government decided to **re-build** the central area of the city to make Skopje a **classical showpiece** of **Macedonian nationalism**, highlighting ancient military victories under Alexander the Great and Philip II of Macedon. Despite protests from neighbouring Greece that Macedonia was appropriating Greek history, and even using a Greek name for the country, a program known as **Skopje 2014** was announced in 2010.

Skopje 2014 was named after its original proposed date for completion, but it later changed to become an ongoing program of urban renewal, converting the river parklands into showcase buildings. The **aim** is to replace Skopje's stark socialist buildings with grand, elegant, neoclassical public buildings befitting the status of a national capital city, with monuments, large open plazas and fountains.

Skopje 2014 is certainly **grand in scale**. It includes:

- reconstruction of **Macedonia Square**, Skopje's central plaza, including installation of a 25 metre high statue of a warrior on a horse, generally believed to represent Alexander the Great;
- about **40 large monuments** to historical Macedonian figures including Justinian I, Mother Teresa, the Mothers of Macedonia, Tsar Samuil, Philip II of Macedon, and Saints Cyril and Methodius;

3.64 Construction for Skopje 2014 underway along the northern bank of the Vardar River.

3.65 Looking towards Macedonia Square, dominated by the equestrian statue that reportedly represents Alexander the Great.

- construction of **five themed bridges** across the Vardar River featuring busts of famous Macedonians;

3.66 Macedonia Square, a renovated plaza in central Skopje featuring a 25 metre high statue of an equestrian warrior.

3.67 One of the new bridges spanning the Vardar River, lined with statues of ancient warriors, looking towards the new Museum of Archeology.

3.68 The new bridges and buildings built as part of Skopje 2014 are flood-lit at night. In the left background, one of the four galleons being built in the Vardar River can be seen.

- **four new public buildings** (the Museum of Archeology, the Museum of Macedonian Struggle, the Philharmonic Orchestra Hall, and the National Theatre);
- **eight large government buildings** (Agency for Electronic Communications, Criminal Court Building, Financial Police Building, Ministry of Finance, Ministry of Foreign Affairs, New City Hall, Old City hall, Water Management Building);
- **new facades** on existing buildings to convert them to a neoclassical style (City Trade centre, Department of Transport and Communications Building, Government of the Republic of Macedonia Building, MEPSO Electricity Utility Building, Ministry of Justice Building, Parliament Building, and all buildings in four CBD streets);
- **four replica galleons** (old sailing ships) in the Vardar River to house restaurants and cafés, plus several fountains in the middle of the Vardar River; and
- reconstruction of **Kale Fortress**, the historic fort located near the old town that dates from the 6th century.

As soon as it was announced, **controversy** erupted among Skopje's residents. The **Albanian minority community**, some of whose homes were to be destroyed to make way for the monumental buildings, complained about **forced evictions** for a project that was going to ignore their past and glorify the history of another ethnic group. Indeed, many members of Skopje's Albanian minority believe Skopje 2014 is an attempt by the

3.69 The Museum of Archeology and fountains in the Vardar River, seen from the southern side of the river. The graffiti on the pavement translates to read "Colourful Revolution".

government to **marginalise** them and **re-write history** in a way that will disempower them from being seen as true Macedonians. The Albanian community was especially upset that a large section of their residential area between the Church of Saint Demetrius and the old Stone Bridge was demolished to make way for a large open plaza featuring large statues of Macedonian historical figures.

Skopje 2014 has also been widely criticised for its **high cost**, which is thought to be somewhere between US$220 million (government estimate) and US$1.1 billion (critics' estimate). Whatever the actual amount spent, it is a vast sum for a small country facing significant challenges of poverty and unemployment. The program has also been condemned for its **poor aesthetics**, which have been described by many people in Skopje as "kitsch", "mini Las Vegas" and "like a theme park".

3.70 The Arch of Triumph in central Skopje has been attacked by demonstrators who have used paint ball guns to express their anger at government policies, including Skopje 2014.

3.71 A close view of one attack by protesters on the Arch of Triumph. Translated, the graffiti reads "Art of Citizens", "Freedom" and "Shit can't cover thieves".

3.72 Protesters have expressed their anger at Skopje 2014 by attacking one of its construction projects. Translated, the graffiti on the pavement reads "Murder hides the blood on unwashed hands".

3.73 Protesters have gathered at night in Macedonia Square in central Skopje to protest by throwing buckets of red paint representing blood across the pavers.

In September 2015, a public **opinion poll** in Skopje showed that 67% of residents disapproved of the Skopje 2014 project from a financial perspective, and 73% believed it should be abandoned. Public discontent flared into public rage in mid-2016 when thousands of **protesters** took to the streets and demonstrated against government corruption, including the way the Skopje 2014 program was changing their city. Protesters pelted public buildings and monuments with paintballs, launching what they termed the "**Colourful Revolution**". Protests have continued since that time, painting pavers in public squares red to represent blood and pouring laundry detergent into public fountains to make them foam. Statues of

lions in public places periodically have their eyes and testicles painted red as another form of protest, and social media is used to notify the public when protest actions are about to occur.

CASE STUDY
Mediaspree, Berlin, Germany

Berlin is the capital city of Germany. It has a population of about 3.6 million people, making it one of Europe's largest cities. From 1945 to 1989, Germany was **divided** into two separate countries, capitalist West Germany (also known as the Federal Republic of Germany) and communist East Germany (also known as the German Democratic Republic). During this period, Berlin was situated within East Germany, but special treaty arrangements between the US, UK, USSR and France divided Berlin into capitalist West Berlin and communist East Berlin. Between 1961 and 1989, a high concrete wall (known as the **Berlin Wall**) separated the two parts of Berlin, dividing the city and making travel between the sectors extremely difficult.

The areas on either side of the Berlin Wall became a tense, heavily guarded, vacant **border zone** that was the front line of the Cold War. Commercial development was impossible during that period, and on the East German side, several of the buildings were converted into watchtowers to assist with border security.

When the Berlin Wall fell and the Germany was **reunited** in 1989, the areas around the route of the Wall became available for development for the first time in a generation. One such area was a four kilometre long strip along the banks of **River Spree**, centred on a stretch where two streets in East Germany, Holzmarktstrasse and Mühlenstrasse, contained a section of the Wall, marking a section of the East-West boundary.

Following the fall of the Wall, the banks of this section of the River Spree were quickly changed from **wasteland** to **parkland**. There were also some derelict **factory** and **warehouse** buildings constructed in the 1800s and early 1900s. The section of the Wall along Mühlenstrasse was preserved as a memorial and decorated with artists' murals, being named the **East Side Gallery**. However, by the mid-1990s, the high potential value of the land was recognised by developers, and proposals began to emerge to convert the riverbanks and old buildings into new **commercial** and **industrial** facilities. Nothing came of these proposals at first because of the weakened state of Germany's economy following reunification.

3.74 This is the section of the River Spree where the Mediaspree development is underway. During the period in which Berlin was a divided city, the bank on the left was in East Berlin, whereas most of the bank on the right (all except the foreground section) was in West Berlin. Several new buildings constructed as part of the Mediaspree development can be seen in this view, such as the orange building with the sloping roof (Hotel Ibis), the aqua building behind it (EnergieForum Berlin), and the large aqua triple block building beside the river towards the foreground (Berliner Verkehrsbetriebe, Berlin's main public transport company). In the left foreground, new high-rise housing blocks have been built to redevelop an area of socialist housing that was built before the fall of the Berlin Wall. In the right foreground, the industrial complex with the two tall chimneys is the Heizkraftwerke Mitte, a gas-and-steam combined cycle power station, largely surrounded by new, up-market residential housing blocks.

3.75 An abandoned factory beside the River Spree awaits demolition on land that entrepreneurs wish to redevelop.

3.76 A banner at the entrance to this squatters' compound in Köpernickerstrasse urges "Overthrow Mediaspree".

3.77 This old building in Mediaspree has been taken over by squatters, activists and unemployed young people. These residents oppose the land-use changes of Mediaspree because they fear the developments will raise land values, forcing them to move if the building where they live is demolished.

In 2004, a company called **Mediaspree** was formed to co-ordinate the acquisition of public land along the banks of the River Spree for investors and businesses. The company was dissolved in 2008 and replaced by property association, also called Mediaspree, to advance **urban renewal** of the area and attract new businesses, many of which were intended to have a media focus. Since that time, the redevelopment zone of this section of the River Spree has become known as Mediaspree.

Today, Mediaspree is one of Berlin's largest property redevelopment projects. Some 50 projects that required large areas of land have opened, including buildings for Universal Music, MTV Germany, BASF, and the O_2 Arena.

The proposal to **change the land-uses** of Mediaspree from parkland and old industrial buildings to new commercial and hi-tech manufacturing is **commercially driven**, the aim being to make money. This contrasts with the urban redevelopment of the central Skopje, which is **politically motivated** without any profit motive. In both cases, however, riverside parkland is being replaced with new urban development, and both sets of land-use changes are **contested** by their local populations.

Mediaspree has been heavy **criticised** because it has taken public land and turned it over to private, profit-driven corporations, in some cases with government-funded subsidies. Criticism has been especially strong from **subcultural groups**, **squatters** who have settled into abandoned warehouses and factories for shelter, and **activists** who believe the government's main priority should be unemployed people's welfare rather than corporate profits. Poorer residents in nearby housing blocks have also complained about Mediaspree, fearing that **gentrification** of the area will force them out of their run-down but cheap and affordable housing.

Protesters have expressed their anger at the Mediaspree development by holding **public demonstrations** with the support of **social activist institutions** such as Hedonist International, Fuckparade and the Transgenialer CSD. Protests have been **co-ordinated** by two groups, a citizen's initiative group known as Mediaspree Versenken (Sink Mediaspree) that was founded by a local

3.78 New buildings beside the River Spree in the Mediaspree zone, Berlin, used by Berliner Verkehrsbetriebe.

3.79 Graffiti on the former GASAG offices overlooking the River Spree unambiguously expresses local residents' opposition to the Mediaspree program.

architect, and the Bündnis Informationsveranstaltungen für Anwohner (the Informational Events for Residents Alliance). Protests have involved **boat demonstrations** on the river in rubber dinghies and paddle boats, **bicycle protests** and mass **neighbourhood walks** involving several thousand people, although these protests have not had any apparent impact on slowing the Mediaspree development.

Other more **anarchic protesters** have acted more subversively by painting **graffiti** and **slogans** on buildings in the area. There is a long-standing tradition in Berlin of decorating buildings and public spaces with street art, often in the form of graffiti, and this tradition is expressed vigorously in Mediaspree.

QUESTION BANK 3F

1. *Describe the forces that influence land use patterns in cities.*
2. *Explain why land use changes often lead to social displacement and the break-up of communities.*
3. *Describe the land use changes underway in Ashgabat, and explain why there have been no public protests even though the forced changes are deeply unpopular.*
4. *Compare and contrast the land use changes that are occurring in Skopje and Berlin using the following sub-headings:*
   a. *who or what is causing the changes in land uses;*
   b. *what are the old land uses, and what new land uses are replacing them;*
   c. *who gains from the land use changes, and which groups suffer;*
   d. *how discontent is being expressed;*
   e. *ways you believe the conflict should be addressed.*

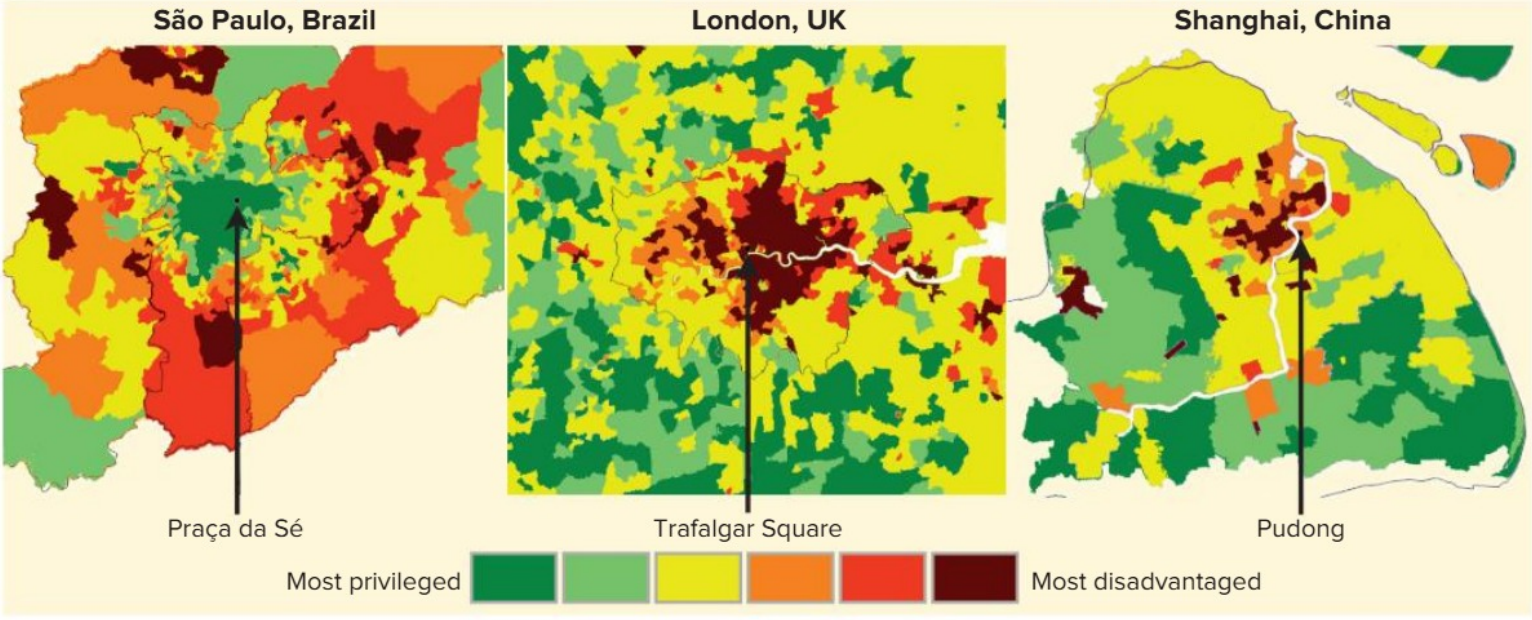
Urban social deprivation

In every city in the world, whether in a high-income or low-income country, there is a **gap** between the **incomes** and **assets** of rich and poor people. The **cost of housing** varies in different parts of any city because of factors such as accessibility to transport routes, elevation, distance from the CBD and other areas of employment, and so on. Differences in the costs of housing and accommodation throughout a city result in a **sorting** of wealth and poverty as people locate in the areas they can afford. Consequently, wealth, affluence and poverty are never distributed evenly through an urban area.

When people are forced to live in areas where facilities such as housing, education, hospitals, roads, sewerage and drainage are inadequate, sub-standard, or inferior to the rest of the city, we say they are experiencing **urban social deprivation**.

Urban social deprivation is difficult to quantify because its threshold standard **changes over time**, and **varies from place to place**. A house with no electricity or sewerage may be considered sub-standard in a high-income city today, but a hundred years ago it may have been considered quite satisfactory. Similarly, an average dwelling in a low-income country today may be considered sub-standard in a city in a high-income country. We should therefore distinguish between **relative urban social deprivation**, which is hardship caused by lack of access to services that most other people in the same city have, and **absolute urban social deprivation**, which is hardship that is potentially life-threatening, or which leads to physical or mental health problems. In cities located in high-income countries, most urban social deprivation is **relative**, as it is based on comparisons with wealthier families living in the same city rather than (for example) an shanty dweller in a city in Sub-Saharan Africa or South Asia.

A person's **occupation** is a major indicator of urban social deprivation because income levels depend largely on occupation. This is why people in occupations that earn generous remuneration, such as lawyers and doctors, tend to **cluster** in more expensive districts, while low-income earners and unemployed people live in much less expensive areas.



3.80 The distribution of urban social deprivation in three large world cities. The scale of each map is 100 kilometres by 100 kilometres. Source: Drawn from data in the Urban Age Project, London School of Economics, Deutsche Bank's Alfred Herrhausen Society.

In most cities of the world, **segregation** (separation) of people with different **occupations** occurs most strongly at the extremes of earning capacity. In other words, very high-income earners cluster in certain expensive areas, very low-income earners cluster in socially deprived areas, while occupational groups without extremes of status do not segregate markedly. Low-income earners simply **cannot compete** in the housing market, so their residential locations are **forced upon them**, whereas high-income earners have the option to make a selection from several locations. In **ethnically diverse cities**, different groups tend to work in certain occupations, and where this occurs, occupational segregation also means that **ethnic clustering** mirrors urban social deprivation.

Many measures could be used to quantify urban social deprivation, but **long-term poverty** is the most commonly used measure. Long-term poverty (and therefore urban social deprivation) results from unemployment, lack of access to welfare payments, medical disabilities and discrimination.

In the United Kingdom, the government developed a more complex measure of urban social deprivation known as the **Multiple Deprivation Index** (MDI). The MDI includes **seven components** to measure deprivation:

- income
- employment
- access to health care and disabilities
- education skills and training
- barriers to housing and services
- crime
- quality of the living environment.

Using measures such as the MDI, it can be seen that urban social deprivation is **unevenly distributed** across urban areas. Figure 3.80 shows the distribution in three large world cities. In **São Paulo**, Brazil, social deprivation is concentrated on the **outskirts** (**periphery**) of the urban area where transport is poor and the provision of social services such as medical care is sparse. Other cities in developing countries show a similar pattern, largely because **shanty** and **slum** areas inhabited by unemployed rural-urban migrants usually become established on unused land on the edges of the city.

By contrast, **London's** urban social deprivation is concentrated in **inner city areas**, especially to the east of the CBD in the area known as the East End. This is a common pattern in well-established cities in economically developed countries, and it reflects the urban decay that follows deindustrialisation as inner city manufacturing industries have closed or relocated.

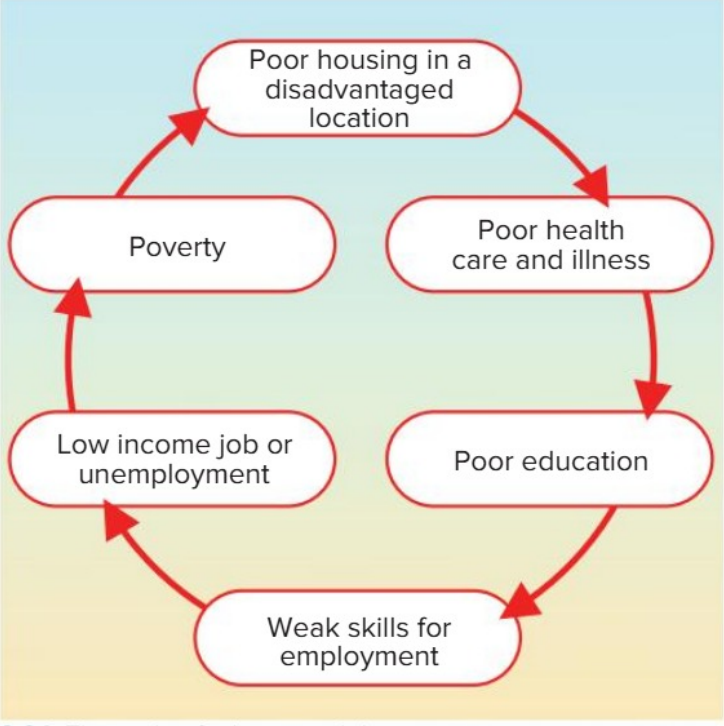
Although **Shanghai** is located in a developing economy, its urban social deprivation is also concentrated in **inner city areas**. Shanghai has no shanty or slum areas on the periphery of the city, and the inner-city areas are still dominated by older, government-subsidised housing that is used by elderly residents and low-income earners.

3.81 Guaruihos, an area of urban social deprivation on the outskirts of São Paulo, Brazil.

3.82 Elephant and Castle, an inner area of urban social deprivation in London, UK.

3.83 Beizhan, an inner area of urban social deprivation in Shanghai, China.

Urban social deprivation tends to be **self-perpetuating** for the most deprived parts of the population, and people find they are **trapped** in disadvantage that passes from one generation to the next. This is known as the **cycle of deprivation**. The cycle begins when children born into disadvantaged households must confront early health and developmental challenges, followed by educational deprivation, which leads to employment deprivation which in turn results in economic deprivation. Economic deprivation restricts housing choices, forcing people into disadvantaged areas that perpetuate the deprivation for the following generation.



3.84 The cycle of urban social deprivation.

Breaking free from the cycle of deprivation is difficult, but the best chance of doing so occurs with education. In almost every city in the world, children receive a lower **quality of education** if they live in socially disadvantaged areas. This is not usually the fault of the schools in such areas. The disadvantage arises because when they are compared with children in affluent areas, children in socially disadvantaged areas:

- are often **less ready to start** schooling because their vocabulary, knowledge of numbers, ability to concentrate for extended periods and social skills are less developed;
- have higher **absenteeism** rates because of sickness;
- are less likely to have access to **learning resources**, such as academic books and internet access at home;
- often have **lower aspirations**; and

- live within a **community culture** that often places less emphasis on education as a priority over other ways of spending time and money.

If socially disadvantaged children can obtain a good education, and in low-income countries this means achieving basic **literacy**, then the spiral can be broken.

Crime rates tend to be higher in areas of urban social deprivation than elsewhere in cities. To some extent, this is understandable given the combination of poverty, higher than average use of illegal drugs and high rates of unemployment. It is a serious **problem** because urban crime in socially deprived areas is often violent, and therefore threatens human welfare, and it reinforces poverty by discouraging financial investment. Crimes that are more common in socially deprived urban areas than elsewhere include murder, assault, rape, drug possession and selling, burglary, car theft, and robbery (sometimes in public with violence, which is mugging).

3.85 A typical home in Sabama, an area of urban social deprivation in Port Moresby, Papua New Guinea, that is populated by rural-urban migrants of different ethnicities from various parts of the country. The corrugated iron fencing is intended to discourage burglars, and is almost universally used to surround houses in Sabama.

Reasons that crime rates are high in socially deprived urban areas include:

- **Inequality:** It is commonly believed that poverty leads to crime. The theory is that when people lack the money to satisfy basic needs, some will decide out of desperation to obtain funds illegally by committing a crime. However, research suggests that poverty is not a cause of crime, but poverty is an outcome of the types of social behavior that lead a person to want to commit crimes. Inequality may, however, be a cause of criminal activity as frustrated people who lack access to material possessions want the things that they see other people have.
- **Unemployment:** Statistics in many cities show that unemployed male youths are statistically more likely to be involved in crime, especially crime with violence, than other members of their community.
- **Drugs and alcohol:** Use of drugs and alcohol is higher than the general community average in socially deprived areas, and this can lead to a lack of self-control and poor judgement;
- **Organised crime:** Criminal organisations are often based in areas of social deprivation, especially in the shanty settlements of low-income countries;
- **Inadequate protection:** Houses in socially deprived areas are less likely to have effective defences against burglary or armed attack, such as electronic arm systems;
- **Ethnic diversity:** Socially deprived areas in many cities often contain a diverse ethnic mix, especially in developing countries, and some residents feel that crime against a different ethnic group is easily justified; and
- **Poor urban infrastructure:** Poorer urban neighbourhoods are more likely to lack street lighting, have vacant buildings occupied by squatters, and be criss-crossed by thin alleyways, situations that make crimes easier to commit.

QUESTION BANK 3G

1. *Define the term 'urban social deprivation'.*
2. *What causes urban social deprivation?*
3. *Compare the spatial distribution of urban social deprivation in São Paulo, London and Shanghai.*
4. *Describe the cycle of deprivation, and say why it is significant.*
5. *Explain why education represents the best opportunity for socially deprived residents to break free of the cycle of deprivation.*
6. *Why are areas of urban social deprivation more prone to crime than other parts of cities?*
7. *What are the main causes of crime in areas of urban social deprivation?*

Chapter 4

Building sustainable urban systems for the future

4.1 New housing to accommodate urban growth in Houston, Texas, USA.

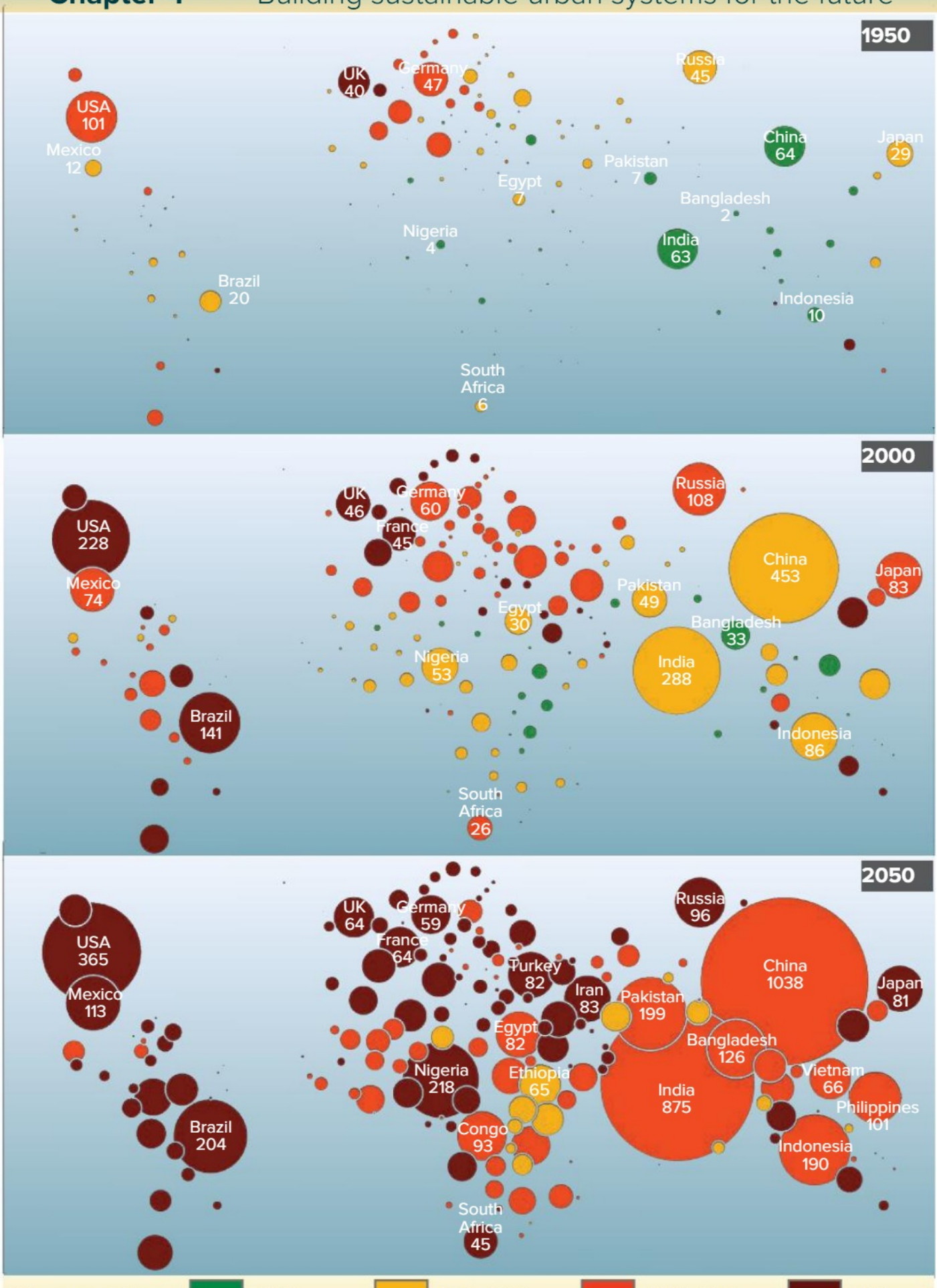
Urban growth projections

The **first urban centres** appeared in the Middle East about 6,000 years ago. It is claimed that Sana'a, the capital city of Yemen, is the world's oldest city, having been established by Shem, one of Noah's sons. This claim is disputed by some other cities that claim to be the oldest settled places, such as Damascus (Syria) and Erbil (Iraq).

Wherever the first cities appeared, urban centres were 'invented' separately in various parts of the world to meet the needs of rural people. Among the places where ancient cities sprang up were south-western Nigeria and Egypt in Africa, the North China Plain, Indus Valley and Mesopotamia in Asia, the Central Andes Mountains in South America, and Mexico in central America.

For cities to be viable, farmers in surrounding rural areas had to start producing a **surplus of food** to feed the urban inhabitants. For many centuries, agricultural surpluses were small, so the growth of urban centres was restricted.

As farming productivity improved, larger numbers of urban dwellers could be supported, and cities were able to grow. This trend accelerated when manufacturing industries in cities began producing machinery that further boosted farming productivity. As farming productivity increased,



4.2 The urban population size of countries and territories with populations exceeding 100,000 in 1950, 2000 and 2050. Figure show urban populations in millions of people. Source: UNICEF.

Table 4.1
Megacities in 2050.

Rank	City	Country	Continent	Expected population
1	Mumbai	India	Asia	42,403,631
2	Delhi	India	Asia	36,156,789
3	Dhaka	Bangladesh	Asia	35,193,184
4	Kinshasa	Congo	Africa	35,000,361
5	Kolkata	India	Asia	33,042,208
6	Lagos	Nigeria	Africa	32,629,709
7	Tokyo	Japan	Asia	32,621,993
8	Karachi	Pakistan	Asia	31,696,042
9	New York	USA	North America	24,768,743
10	Mexico City	Mexico	North America	24,328,738
11	Cairo	Egypt	Africa	24,034,957
12	Manila	Philippines	Asia	23,545,397
13	São Paulo	Brazil	South America	22,824,800
14	Shanghai	China	Asia	21,316,752
15	Lahore	Pakistan	Asia	17,449,007
16	Kabul	Afghanistan	Asia	17,091,030
17	Los Angeles	USA	North America	16,416,436
18	Chennai	India	Asia	16,278,430
19	Khartoum	Sudan	Africa	15,995,255
20	Dar es Salaam	Tanzania	Africa	15,973,084
21	Beijing	China	Asia	15,972,190
22	Jakarta	Indonesia	Asia	15,923,577
23	Bangalore	India	Asia	15,619,514
24	Buenos Aires	Argentina	South America	15,546,223
25	Baghdad	Iraq	Asia	15,087,672
26	Hyderabad	India	Asia	14,611,856
27	Luanda	Angola	Africa	14,301,327
28	Rio de Janeiro	Brazil	South America	14,287,336
29	Nairobi	Kenya	Africa	14,245,579
30	Istanbul	Turkey	Europe/Asia	14,175,543
31	Addis Ababa	Ethiopia	Africa	13,212,273
32	Guangzhou	China	Asia	12,996,279
33	Ahmedabad	India	Asia	12,431,006
34	Chittagong	Bangladesh	Asia	12,211,707
35	Chicago	USA	North America	11,925,691
36	Ho Chi Minh City	Vietnam	Asia	11,860,301
37	Lima	Peru	South America	11,571,387
38	Bogotá	Colombia	South America	11,555,257
39	Shenzhen	China	Asia	11,196,456
40	Paris	France	Europe	11,124,389
41	Bangkok	Thailand	Asia	11,079,598
42	Tehran	Iran	Asia	10,998,668
43	Pune	India	Asia	10,923,535
44	Abidjan	Côte d'Ivoire	Africa	10,708,876
45	Kano	Nigeria	Africa	10,444,151
46	Wuhan	China	Asia	10,255,365
47	Moscow	Russia	Europe	10,235,265
48	Osaka-Kobe	Japan	Asia	10,188,099
49	Tianjin	China	Asia	10,149,945
50	Sana'a	Yemen	Asia	10,052,562

Source: Hoornweg & Pope (2014) *Socioeconomic Pathways and Regional Distribution of the World's 101 Largest Cities.*

cities grew, and as they grew, they provided more goods and services that allowed still further improvements in agricultural productivity. The growth of cities and improvements in farming productivity thus became a **symbiotic relationship**, which each assisted the other.

Notwithstanding the gains in farming productivity, it was not until 1950 that the world reached the point where 30% of the global population were living in urban areas. Since that time, the pace of **urbanisation has accelerated**, and today, about 55% of the world's population live in urban areas. Extrapolating this trend, it is expected that by 2050, 66% of the world's population will live in urban areas. This change means that the percentage of people living in urban areas will have more than doubled during the 100 years from 1950 to 2050.

4.3 According to current projections, Mumbai will be the world's largest megacity by 2050, when the population is expected to exceed 42 million people.

As figure 4.2 and table 4.2 show, the trend in urbanisation has not been uniform in all parts of the world, nor is it expected to be so in the years leading to 2050. In 1950, only a few countries had more than half of their population living in urban areas, and those that did were almost all high-income, economically developed nations in North America, Europe and Australasia.

Since that time, some 90% of **urban growth** has occurred in Asia and Africa, and between now and 2050, the largest urban growth is expected to occur in China, India and Nigeria. These three countries alone will add about 900 million to the number of people living in urban centres by 2050. On the other hand, there are a few countries, such as

Table 4.2

Urban population as a percentage of total population in 100 selected countries, 1950 to 2050.

Country	1950	1975	2000	2010	2020	2030	2040	2050	Country	1950	1975	2000	2010	2020	2030	2040	2050
Singapore	99.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Ukraine	35.5	58.4	67.2	68.7	70.9	73.5	76.3	79.0
Qatar	80.5	88.9	96.3	98.7	99.5	99.7	99.8	99.8	Iraq	35.1	61.4	68.5	69.0	70.2	72.4	75.2	78.0
Belgium	91.5	94.5	97.1	97.6	98.0	98.3	98.5	98.6	Italy	54.1	65.6	67.2	68.3	69.8	72.1	74.9	77.7
Japan	53.4	75.7	78.7	90.5	95.3	96.9	97.4	97.7	South Africa	42.2	48.1	56.9	62.2	67.2	71.4	74.6	77.4
Uruguay	77.9	83.4	92.0	94.4	96.0	96.8	97.2	97.5	Albania	20.5	32.7	41.7	52.2	62.0	68.8	72.8	75.8
Netherlands	56.1	63.2	76.8	87.1	92.8	95.1	96.0	96.4	China	11.8	17.4	35.9	49.2	61.0	68.7	72.8	75.8
Iceland	72.8	86.7	92.4	93.6	94.6	95.2	95.7	96.1	Austria	63.6	65.3	65.8	65.9	66.4	68.4	71.5	74.7
Argentina	65.3	81.0	89.1	91.0	92.4	93.4	94.1	94.7	Ireland	40.1	53.6	59.2	61.8	64.8	68.0	71.4	74.6
Israel	71.0	86.6	91.2	91.8	92.5	93.2	93.8	94.5	Ecuador	28.3	42.4	60.3	62.7	65.0	67.9	71.3	74.5
Luxembourg	67.2	77.3	84.2	88.6	91.4	92.9	93.7	94.3	Morocco	26.2	37.7	53.3	57.7	62.6	67.0	70.7	74.0
Chile	58.4	78.4	86.1	88.6	90.3	91.4	92.3	93.1	Croatia	22.3	45.1	55.6	57.5	60.7	64.6	68.6	72.3
Australia	77.0	85.9	87.2	88.7	90.1	91.2	92.1	92.9	North Korea	31.0	56.7	59.4	60.2	61.9	64.8	68.5	72.1
Greenland	49.0	74.4	81.6	84.4	88.1	90.3	91.5	92.3	Thailand	16.5	23.8	31.4	44.1	55.8	63.9	68.2	71.8
Venezuela	47.3	75.8	88.0	88.8	89.3	90.1	91.0	92.0	Syria	32.7	45.1	52.0	55.7	59.7	63.8	67.8	71.5
Denmark	68.0	82.2	85.1	86.8	88.5	89.9	91.0	91.9	Indonesia	12.4	19.3	42.0	49.9	57.2	63.0	67.2	70.9
Lebanon	32.0	67.0	86.0	87.2	88.4	89.6	90.7	91.7	Ghana	15.4	30.1	43.9	50.7	57.2	62.6	66.8	70.5
Brazil	36.2	60.8	81.2	84.3	86.8	88.7	89.9	91.0	Poland	38.3	55.3	61.7	60.9	60.7	62.6	66.2	70.0
UAE	54.5	79.8	80.2	84.1	86.8	88.5	89.7	90.8	Namibia	13.4	23.7	32.4	41.6	51.3	58.8	63.8	67.8
Sweden	65.7	82.7	84.0	85.1	86.6	87.9	89.2	90.3	Nigeria	7.8	19.8	34.8	43.5	51.7	58.3	63.0	67.1
New Zealand	72.5	82.8	85.7	86.2	86.5	87.4	88.6	89.8	Romania	25.6	42.8	53.0	53.8	55.6	58.7	62.7	66.8
Jordan	37.0	57.7	79.8	82.5	84.8	86.6	88.1	89.3	Turkmenistan	45.0	47.6	45.9	48.4	51.9	56.4	61.0	65.5
Finland	43.0	67.8	82.2	83.6	84.9	86.3	87.8	89.1	Liberia	13.0	30.4	44.3	47.8	51.8	56.2	60.8	65.2
Saudi Arabia	21.3	58.4	79.9	82.1	84.1	85.9	87.4	88.7	Kazakhstan	36.4	52.6	55.7	53.7	53.4	55.8	60.1	64.6
United Kingdom	79.0	77.7	78.7	81.3	83.8	85.7	87.3	88.7	Angola	7.6	17.3	32.4	40.1	47.8	54.4	59.4	63.8
Costa Rica	33.5	41.4	59.1	71.7	80.6	85.2	87.2	88.6	Benin	5.0	21.9	38.3	41.9	46.3	51.3	56.4	61.3
South Korea	21.4	48.0	79.6	81.9	83.1	84.5	86.1	87.6	Laos	7.2	11.1	22.0	33.1	43.6	50.9	55.9	60.8
Canada	61.0	75.6	79.5	80.9	82.7	84.5	86.1	87.6	Mali	8.5	16.2	28.4	36.0	43.7	50.3	55.4	60.3
USA	64.2	73.7	79.1	80.8	82.5	84.2	85.9	87.4	Zambia	11.5	34.9	34.8	38.7	43.3	48.2	53.3	58.3
Norway	50.5	68.2	76.1	79.1	81.7	83.9	85.7	87.2	Togo	4.4	22.9	32.9	37.5	42.5	47.7	52.9	57.9
Mexico	42.7	62.8	74.7	77.8	80.6	82.8	84.7	86.4	Pakistan	17.5	26.3	33.2	36.6	41.2	46.6	52.0	57.5
France	55.2	72.9	75.9	78.4	80.7	82.8	84.6	86.3	Egypt	31.9	43.3	42.8	43.0	43.8	46.7	51.4	56.5
Spain	51.9	69.6	76.3	78.4	80.7	82.8	84.6	86.3	Philippines	27.1	35.6	48.0	45.3	44.3	46.3	51.1	56.3
Peru	41.0	61.5	73.0	76.9	80.1	82.6	84.5	86.2	Bangladesh	4.3	9.8	23.6	30.5	38.0	44.9	50.5	55.7
Malaysia	20.4	37.7	62.0	70.9	77.7	81.9	84.2	85.9	Myanmar	16.2	23.9	27.0	31.4	36.9	42.8	48.8	54.9
Greece	52.2	66.9	72.7	76.3	79.6	82.1	84.1	85.9	Yemen	5.8	14.8	26.3	31.7	37.5	43.2	48.6	54.1
Libya	19.6	62.8	76.4	77.6	79.6	81.8	83.9	85.7	Vietnam	11.6	18.8	24.4	30.4	36.8	43.0	48.4	53.8
Belarus	26.2	50.6	70.0	74.6	78.5	81.4	83.4	85.3	Tanzania	3.5	11.2	22.3	28.1	35.1	41.9	47.7	53.0
Mongolia	20.0	48.7	57.1	67.6	75.6	80.4	82.9	84.8	Burkina Faso	3.8	6.4	17.8	25.7	33.9	41.0	46.5	52.0
Colombia	32.7	58.5	72.1	75.0	77.8	80.2	82.4	84.3	Uzbekistan	28.9	39.1	37.4	36.2	37.2	40.9	46.3	51.9
Iran	27.6	45.8	64.0	70.6	75.8	79.4	81.9	83.9	India	17.0	21.3	27.7	30.9	34.8	39.5	44.8	50.3
Turkey	24.8	41.6	64.7	70.7	75.7	79.3	81.7	83.7	Sudan	6.8	18.9	32.5	33.1	35.0	38.8	44.2	49.8
Cuba	56.5	64.2	75.3	76.6	77.7	79.3	81.4	83.4	Afghanistan	5.8	13.6	21.3	24.7	28.9	34.0	39.5	45.3
Germany	68.1	72.6	73.1	74.3	76.4	78.6	80.9	83.0	Kenya	5.6	12.9	19.9	23.6	27.9	32.8	38.2	43.9
Bulgaria	27.6	57.6	68.9	72.3	75.5	78.3	80.7	82.8	Zimbabwe	10.6	19.9	33.8	33.2	32.2	33.8	38.2	43.7
Algeria	22.2	40.3	59.9	67.5	73.4	77.4	79.9	82.1	Eritrea	7.1	13.5	17.6	20.6	25.0	30.2	35.9	42.1
Hungary	53.0	62.2	64.6	68.9	73.4	76.9	79.6	81.8	Tajikistan	29.4	35.5	26.5	26.5	27.5	30.4	35.4	41.0
Russia	44.1	66.4	73.4	73.7	74.6	76.3	78.7	81.1	Ethiopia	4.6	9.5	14.7	17.3	21.8	26.8	32.1	37.6
Switzerland	44.4	57.4	73.3	73.7	74.4	76.1	78.4	80.8	Cambodia	10.2	4.5	18.6	19.8	22.0	25.6	30.6	36.2
Bolivia	33.9	41.3	61.8	66.4	70.4	73.8	76.7	79.4	Eswatini	2.0	14.0	22.7	21.5	21.5	23.0	25.8	28.8
Czechia	54.2	69.9	74.0	73.3	73.1	74.3	76.8	79.3	Papua N Guinea	1.7	11.9	13.2	13.0	13.3	15.0	18.3	22.7

Source: United Nations Department of Economic and Social Affairs Population Division (2014) *World Urbanization Prospects; the 2014 Revision. Note that projected populations from 2020 onwards are based on the medium-fertility variant. Countries are arranged in descending order of their expected urban population percentage in 2050.*

Russia and Japan, where the number of people living in cities is expected to decline slightly as the national population size shrinks.

The number of people living in urban centres has grown from 746 million in 1950 to about 4 billion today. This number will grow to 6.4 billion by 2050. Although 66% of people are expected to live in cities by 2050, urban areas will take up only 2% of the world's land surface area, thus posing significant **challenges** for planners and government agencies as they struggle to provide housing, transport, employment, energy and services to support such large numbers of people in high density environments.

4.4 A major factor in rapid urbanisation in many countries in Africa, Asia and South America is rural-urban migration. This leads to the unplanned growth of large shanty areas such as this one in Cotonou, Benin. Settlements like this will expand considerably by 2050.

One of the consequences of global urban growth is an increase in the number of megacities (cities with a population of more than ten million). In 1990 there were ten megacities, accommodating 7% of the world's urban population (153 million people). By 2014, there were 28 megacities containing 12% of the world's urban dwellers (453 million people). As shown in table 4.1, by 2050, it is expected there will be 50 megacities, which will represent 14% of the world's urban population (893 million people).

QUESTION BANK 4A

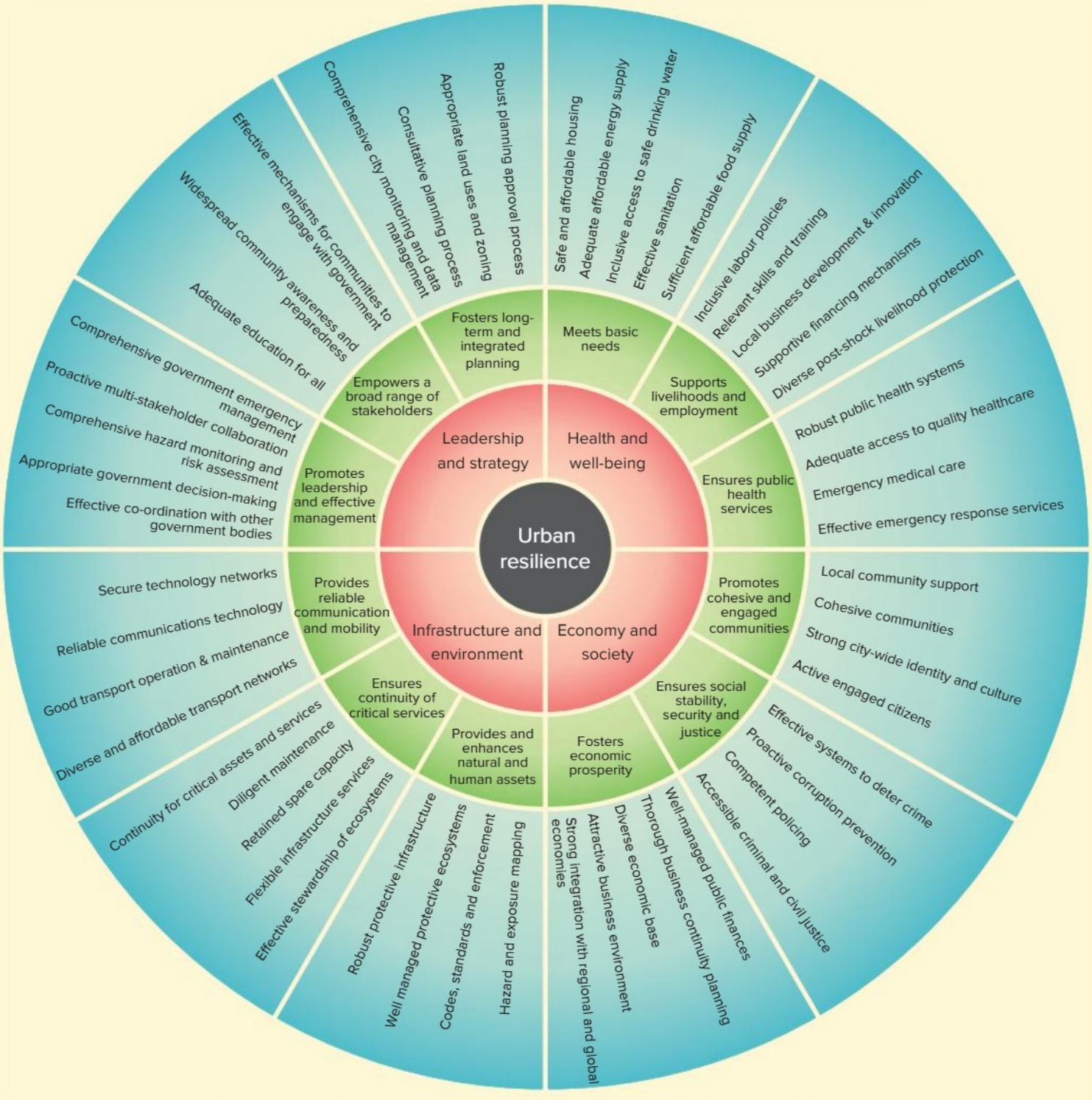
1. *Explain why the rate of urbanisation is accelerating at an unprecedented pace in the world today.*
2. *With reference to figure 4.2, compare the changes in the percentage of urban population in the UK, USA, India and China from 1950 to 2050. What does this tell you about the movement of people from rural to urban areas in the world today?*
3. *Draw a line graph showing the growth in the number of urban residents in the UK, USA, India and China from 1950 to 2050. What does this tell you about the distribution of rapid urbanisation in the world today?*
4. *For each continent, write a few lines to describe the changes in (a) the number of urban residents and (b) urban population as a percentage of total population shown in figure 4.2. (For this answer, use the following continental divisions: North America, South America, Africa, Europe, Australia, Australasia).*
5. *Construct a graph with the vertical axis showing 'urban population as a percentage of total population', and a horizontal axis showing 'years' from 1950 to 2050. Make sure the intervals on the horizontal graph are evenly spaced to represent each period of time accurately. On this graph, plot data from table 4.2 to show changes in urban population in the following countries: Australia, Brazil, China, India, Japan, Mali, North Korea, Papua New Guinea, Singapore, South Korea, United Kingdom, plus three other countries of your choice.*
6. *Describe and account for the trends shown in the graph you constructed in your answer to the previous question.*

Resilient city design

Rapid growth of the world's cities places severe **strains** on their **infrastructure** and urban **processes**. This is especially the case in cities in developing countries where urban growth is fastest and financial resources to address problems are scarce.

Urban planners and government administrators face the challenge of equipping cities to withstand the acute shocks and chronic stresses imposed by rapid growth. **Chronic stresses** weaken cities on a daily or cyclical basis, some examples being overtaxed or inefficient public transport, unemployment, inadequate rubbish disposal, high rates of violence and chronic shortages of food or water. **Acute shocks** are sudden, sharp events that threaten a city, such as earthquakes, floods, outbreaks of disease or terrorist attacks.

To address the chronic stresses and acute shocks, the concept of **urban resilience** has become a focus of attention. Urban resilience is defined as the capacity of individuals, communities, institutions, businesses, and systems within a city to **survive**, **adapt**, and **grow** no matter what kinds of chronic stresses and acute shocks they experience.



4.5 The four dimensions of urban resilience are shown in the red ring. Each dimension has three drivers, and all 12 drivers are shown in the green circle. The 12 drivers are also considered goals, and success in achieving the 12 goals is measured by the 52 indicators that are shown in the blue circle. Source: re-drawn from 100 Resilient Cities.

The concept of urban resilience has been developed through the **100 Resilient Cities** project, a philanthropic program initiated by the Rockefeller Foundation in the US and supported financially by some 80 other large donors including the American Geophysical Union, Arup, the Asia Society, CISCO, CSIRO, Microsoft, Siemens, the World Bank and WWF. The Rockefeller Foundation committed US $500 million to provide resources to 100 cities to help them become more resilient through **four strategies**:

- providing financial and operational guidance to establish the new position of **Chief Resilience Officer** in city government with the role of leading the city's resilience efforts;
- providing expert support to help develop a robust **resilience strategy**;
- facilitating **access** to solutions, service providers, and partners from the private, public and NGO sectors who can help develop and implement resilience strategies; and

Table 4.3
Cities in the 100 Resilient Cities network.

	City	Country		City	Country
1	Accra	Ghana	51	Melaka	Malaysia
2	Addis Ababa	Ethiopia	52	Melbourne	Australia
3	Amman	Jordan	53	Mexico City	Mexico
4	Athens	Greece	54	Miami	USA
5	Atlanta	USA	55	Milan	Italy
6	Bangalore	India	56	Minneapolis	USA
7	Bangkok	Thailand	57	Montevideo	Uruguay
8	Barcelona	Spain	58	Montreal	Canada
9	Belfast	UK	59	Nairobi	Kenya
10	Belgrade	Serbia	60	Nashville	USA
11	Berkeley	USA	61	New Orleans	USA
12	Boston	USA	62	New York	USA
13	Boulder	USA	63	Norfolk	USA
14	Bristol	UK	64	Oakland	USA
15	Buenos Aires	Argentina	65	Panama City	Panama
16	Byblos	Lebanon	66	Paris	France
17	Calgary	Canada	67	Paynesville	Liberia
18	Cali	Colombia	68	Pittsburgh	USA
19	Can Tho	Vietnam	69	Porto Alegre	Brazil
20	Cape Town	South Africa	70	Pune	India
21	Chennai	India	71	Quito	Ecuador
22	Chicago	USA	72	Ramallah	Palestine
23	Christchurch	NZ	73	Rio de Janeiro	Brazil
24	Colima	Mexico	74	Rome	Italy
25	Da Nang	Vietnam	75	Rotterdam	Netherlands
26	Dakar	Senegal	76	Salvador	Brazil
27	Dallas	USA	77	San Francisco	USA
28	Deyang	China	78	San Juan	Puerto Rico
29	Durban	South Africa	79	Santa Fe	Argentina
30	El Paso	USA	80	Santiago	Dominican Rep
31	Enugu	Nigeria	81	Santiago	Chile
32	Glasgow	UK	82	Seattle	USA
33	Guadalajara	Mexico	83	Semarang	Indonesia
34	Haiyan	China	84	Seoul	South Korea
35	Honolulu	USA	85	Singapore	Singapore
36	Huangshi	China	86	St Louis	USA
37	Jaipur	India	87	Surat	India
38	Jakarta	Indonesia	88	Sydney	Australia
39	Juarez	Mexico	89	Tbilisi	Georgia
40	Kigali	Rwanda	90	Tel Aviv	Israel
41	Kyoto	Japan	91	The Hague	Netherlands
42	Lagos	Nigeria	92	Thessaloniki	Greece
43	Lisbon	Portugal	93	Toronto	Canada
44	London	UK	94	Toyama	Japan
45	Los Angeles	USA	95	Tulsa	USA
46	Louisville	USA	96	Vancouver	Canada
47	Luxor	Egypt	97	Vejle	Denmark
48	Manchester	UK	98	Washington	USA
49	Mandalay	Myanmar	99	Wellington	NZ
50	Medellin	Colombia	100	Yiwu	China

Source: 100 Resilient Cities.

- membership of a **global network** of member cities who can learn from and help each other.

When the 100 Resilient Cities Project was announced, applications were invited from city administrations around the world that wished to include their city in the program. The first 32 cities were announced in December 2013. In 2014, the Project received 330 applications from cities in 94 countries, of which 35 were added to the scheme in December 2014. In May 2016, the final group of cities was added, bringing the total **number of cities to 100** (table 4.3).

The 100 Resilient Cities Project developed a **City Resilience Index** (CRI) to help cities measure and monitor a range of factors that contribute to their resilience to withstand the impact of chronic stresses and acute shocks. The CRI does not calculate a quantitative measure or provide a ranking, but provides a common basis of measurement for city government, researchers, community groups and NGOs to identify a city's strengths and weaknesses in addressing resilience.

The CRI begins by breaking urban resilience into **four dimensions** as shown in figure 4.5. Each of the four dimensions is underpinned by three driving goals, making **12 goals** in total that every city should strive towards in order to achieve resilience. In order to measure the extent to which the 12 goals are being met, **52 indicators** have been identified that fit into seven qualities of resilient systems:

- **reflective:** strategies should use past experiences to inform future decisions
- **resourceful:** strategies should recognize ways to use resources
- **inclusive:** strategies should prioritise broad consultation to create a sense of shared ownership in decision-making
- **integrated:** strategies should bring together a range of distinct systems and institutions
- **robust:** strategies should be well-conceived, well-constructed and well-managed
- **redundant:** strategies should include spare capacity to accommodate disruption
- **flexible:** there should be willingness and ability to adopt alternative strategies in response to changing circumstances.

4.6 San Francisco (California, USA) is a member of the 100 Resilient Cities network. The city faces several interrelated threats: earthquakes, climate change, sea level rise, obsolete infrastructure, social inequity and unaffordability. To address these challenges, San Francisco has developed a resilience strategy with four goals: (1) plan and prepare for tomorrow, (2) mitigate, adapt and retrofit, (3) ensure housing for San Franciscans today and after a disaster, and (4) empower neighbours and neighbourhoods through improved connections. Actions to be undertaken as part of this strategy include:

- establishing a new Office of Resilience and Recovery;
- creating capacity to house a population expected to grow to one million residents by 2040;
- developing a disaster housing and governance plan for long-term recovery;
- launching a regional resilience design challenge;
- constructing a disaster-resilient waterfront by 2040;
- retrofitting seismically vulnerable buildings and setting a higher level of safety for new buildings; and
- advancing city-wide adaptation planning for sea level rise.

4.7 A key element of goal 1 in San Francisco's resilience strategy ('plan and prepare for tomorrow') is investing in infrastructure and transportation. Unlike many US cities, San Francisco already has a solid network of trams (streetcars) to build upon, including several routes that use historic vehicles such as the one shown here on Market Street in the downtown area.

4.8 A priority in San Francisco's resilience strategy plan is building and re-building infrastructure to make the streets more liveable. A network of cycleways covers much of the city as an example of this work.

City planners use the CRI to **self-assess** their performance against each of the 52 indicators, and then look at changes over time to see whether the city is becoming more resilient or not. For example, if a city's administrators wanted to ensure the city had the resilience to manage threats from **climatic risks**, it could identify the points in figure 4.5 and develop a strategy that focuses on the relevant goals and indicators. Two cities in Brazil, Porto Alegre and Rio de Janeiro, are using the 100 Resilient Cities framework to do this. The city officials have appointed a Chief Resilience Officer using funds from the Rockefeller Foundation and they have developed a set of indicators of individual and community resilience in co-operation with the World Resources Institute. These indicators recognise that climate factors do not present in isolation, so the indicators include links to related factors such as social cohesion, institutional reach, climate change risk perception and economic resources.

Until the program ended in 2019, cities in the 100 Resilient Cities Network received financial and intellectual support to boost resilience. Of course, most of the world's cities were not members, but administrators and planners in most cities of the world still attempt to boost resilience to a diverse range of threats, including terrorism, waste disposal, transport stresses and climate change.

The **three case studies** that follow showcase three different approaches to urban resilience. The first study, **Rio de Janeiro** (Brazil), is an example of an

urban resilience strategy based on **climate threats** in a large city. The second study, **Byblos** (Lebanon), shows an urban resilience strategy in a small city that focuses on threats from **geopolitical risks**. Both Rio de Janeiro and Byblos were members of the 101 Resilient Cities network. The third case study, **Cairo** (Egypt) was not a member of 100 Resilient Cities, and shows how a minority ethnic group can build urban resilience in **traditional ways** without expensive outside support.

CASE STUDY
Rio de Janeiro, Brazil

With a population of over 11 million people, **Rio de Janeiro** is one of the world's **megacities**. It is the second largest city in Brazil after São Paulo, with much of the city's growth coming from rural-urban migration over several decades. As a consequence of the city's rapid, unplanned growth, there are significant disparities between the rich and poor. Extensive areas of favelas, or slums, have been built throughout the city, many of them constructed on steep slopes that can become unstable when rainfall is heavy.

Rio de Janeiro was a member of the 100 Resilient Cities network, and the way it approaches the challenges of resilience fits within the framework of that group. Six **resilience challenges** have been identified in Rio de Janeiro:

- **ageing infrastructure** that results in accidents such as gas explosions and leaks, power outages, and water supply disruptions.
- **climate-related stresses** including the effects of intense rainfall (floods and landslides), strong winds, heat islands and heat waves, droughts, sea level rise coastal flooding.
- **criminal activities** such as vandalism, murder, theft, abuse and corruption.
- **epidemics** and **pandemics** (most recently the zika virus).
- **insufficient sanitation** (43% of the population do not have access to the full cycle of basic sanitation), with consequent water pollution, infectious diseases and infant mortality.
- over-taxed, underdeveloped and unreliable **transport** and **road systems.**

4.9 A general view over Rio de Janeiro. The area shown in this view is Botafogo, an upper middle class neighbourhood.

4.10 Favelas on a steep hillside overlooking Copacabana, which is an expensive beachfront district of Rio de Janeiro.

In order to address these challenges, Rio de Janeiro announced a **resilience strategy** in 2016 based on achieving **six goals**, each of which contained several action statements:

Goal 1: Better understand and mitigate impacts of severe **weather** and **climate change**

- Establish a Rio de Janeiro climate change panel
- Implement a portfolio of climate mitigation and adaptation
- Monitor climate trends and impacts
- Integrate multi-hazard risk maps

Goal 2: Mobilise Rio de Janeiro to be prepared to respond to **extreme weather events** and other shocks

- Create a disaster recovery plan for the metropolitan region
- Develop an operational Olympic legacy

4.11 Sea level rise poses economic as well as physical threats to Rio de Janeiro's tourism industry, much of which is based on attracting visitors to the city's beaches, such as Copacabana (seen here).

- Execute simulations for crisis response
- Expand the Resilient Communities program

Goal 3: Cultivate **green, cool, safe** and **flexible urban spaces**

- Implement LED street lighting
- Create plazas with trees
- Improve mobility resilience
- Grant equal access to diverse cultures
- Expand native forests
- Perpetuate the Olympic spirit

Goal 4: Provide high quality, **basic services** to all citizens, through **sustainable** and **resilient** use of **resources**

- Develop a water use strategy
- Implement a solar energy strategy
- Improve energy and water efficiency in public buildings
- Work towards universal access to sanitation
- Improve access to safe housing
- Establish a public authority for the Guanabara Bay

Goal 5: Promote an **inclusive, diversified, circular and low-carbon economy**

- Create an agency for the promotion of the circular economy
- Raise the value and usefulness of solid and organic waste, including composting

4.12 This cycleway along the beachfront in the Barra district is an attempt to make transport more sustainable and attractive.

4.13 Avienda das Américas is one of the first roads in Rio de Janeiro to have its transport infrastructure upgrade. The road has been widened to relieve congestion, and separate bus lanes have been constructed so public transport is not delayed by traffic jams. The building to the left of the bus lane is the Interlagos bus interchange station.

- Implement the Rio + B project, a program that encourages companies and business networks to evaluate and become aware of their social and environmental impact
- Promote a culture of entrepreneurship
- Evaluate the social and environmental impacts of investments

Goal 6: Increase the overall **resilience of citizens** and promote **social cohesion**

- Educate youth for resilience
- Create a MOOC (massive online open course) for urban resilience
- Develop resilience indicators
- Improve primary health care

- Encourage co-operation between social groups
- Provide shelter for the homeless
- Improve the quality of government communications

Rio de Janeiro's resilience strategy reflects the city's **size** and **complexity**, and it will take many years to implement. Initial implementation work was done in the Barra district to upgrade **transport infrastructure** and construct **new housing** in support of the Summer Olympic Games that were held in this area in 2016.

4.14 Initial implementation of Rio de Janeiro's resilience strategy was undertaken in the Barra district. This view shows new housing and roads that were built in that area near the Olympic Games venues.

CASE STUDY
Byblos, Lebanon

Like Rio de Janeiro, **Byblos** was a member of the 100 Resilient Cities network, but the challenges faced by Byblos are quite different to the issues faced by Rio de Janeiro. Byblos is a much **smaller city** than Rio de Janeiro, having an urban population of just 40,000 people, with an additional 60,000 people living in its surrounding rural area. Located on the coast of Lebanon, Byblos has a **long history**, with settlement dating back to some time between 8800BC and 7000BC (historical estimates differ). The city has been settled continuously since 5000BC, and it has experienced invasion and occupation by a succession of foreign powers, including Egypt, Assyria, Persia (today's Iran), Rome, Turkey and France. Even today, its landscape is dominated by the **ruins of a castle** built during the 12th century by the occupying Crusaders from western Europe.

4.15 Beirut, Lebanon's capital city, is 40 kilometres south of Byblos, and therefore exerts a strong influence. Beirut is recovering from a period of intermittent political violence, with widespread new construction to replace buildings damaged by shelling, such as the old Holiday Inn shown here.

4.16 The city of Tripoli also exerts a strong influence on Byblos because of its size and proximity, being 40 kilometres north of Byblos. It is a centre of religious and political tensions, illustrated by the political posters and wall graffiti shown here.

Byblos is located about 40 kilometres north of Lebanon's capital city and largest urban centre, **Beirut**. Byblos is also situated about 40 kilometres south of **Tripoli**, Lebanon's second largest city and a centre of **religious and political tensions**. The tensions in Tripoli spill over into violence from time to time, with armed conflict between the majority population, who are Sunni Muslims, and supporters of the Syrian regime, who are Muslims of the Alawite sect.

Being situated mid-way between Beirut and Tripoli, Byblos faces a number of **challenges** to its resilience. Given the complex environment in which Byblos is situated, it is understandable that the city's resilience challenges span the physical, environmental, economic, societal and political

4.17 The archeological zone near the ruined Crusader castle is the basis of Byblos' tourism industry. The ruins date from the 3rd and 2nd millennia BC.

4.18 New industrial buildings on the peninsula in the background clash with the architecture of Byblos' old town, shown in the foreground. This is an example of fragmentation and environmental change, two of the challenges identified that threaten Byblos' resilience.

realms. The **five key challenges** that Byblos seeks to address in its resilience strategy are:

- **Fragmentation**. For most of its history, Byblos was a small fishing town. Rapid population growth in recent decades has led to urban sprawl, and the city has expanded up from the narrow coastal plain on to the nearby hills in an uncontrolled and unregulated manner. Consequently, Byblos has lost much of its intimacy and sense of community, leading to a reduction in social cohesion and interaction as accessibility has declined.
- **Environmental change.** The environmental quality of Byblos is declining as a result of rapid population growth, rural-urban migration, unplanned urbanization and unregulated construction. This is affecting the appearance of city's coastline, river valleys, beaches, orchards and agricultural land. Rivers and aquifers are especially affected by pollution from solid and liquid wastes, sewage, and seepage from the city's landfill site.
- **Political tensions.** Byblos is located in a region with multiple political and religious tensions, including armed conflict, oppression, radical ideologies and religious extremism. Although Byblos has a tradition of relative peace and security within Lebanon, all of these tensions have the potential to threaten stability in the city. In-migration of refugees from Syria is beginning to increase the stresses on social cohesion in Byblos even though the numbers are still fairly small compared with other parts of Lebanon.
- **Cultural heritage.** The older sections of Byblos resemble an open-air museum, reflecting the city's long and varied history. However, traditional businesses such as fishing and crafts are being replaced by more profitable activities, leading to a loss of culture and customs. If the city's tourism industry is to be protected, the city's traditions will need to be preserved.
- **Economic diversification.** The economy of Byblos has become increasingly specialised in recent years as fishing and agriculture have declined at the expense of growing industries such as tourism and retailing. Growing unemployment and the out-migration of young people are discouraging new investment, threatening economic resilience.

In response to these challenges, Byblos has developed a **five-point resilience strategy**, with each strategy designed to address one of the challenges that has been identified. The five points of the resilience strategy, with the associated action points, are as follows:

- Make Byblos a **connected city** that pioneers **innovative and inclusive** urban solutions. This will be achieved by:
  - building the city's digital infrastructure
  - connecting the city's neighbourhoods and limiting urban sprawl
  - designing a blue-green network to integrate water and parkland development

- Make Byblos a **resource efficient** city that optimises **ecosystem services**. This will be achieved by:
  - demonstrating environmental responsibility and promoting stewardship by citizens
  - investing in efficient and renewable energy
- Make Byblos a **peaceful city** that embraces and promotes **social cohesion** and **cultural diversity**. This will be achieved by:
  - encouraging civic engagement and participation in decision-making
  - managing safety risks, threats and civil unrest
  - promoting social networks and relationships between the city's communities and those in surrounding towns and villages
- Make Byblos a **cultural city** that protects and honours **cultural assets**, **tradition**, and **local identity**. This will be achieved by:
  - protecting the city's historic assets and coastal heritage
  - establishing local markets to cherish and protect local identity and traditional businesses
- Make Byblos a **thriving city** that **diversifies** its economy and **flourishes** from its cultural and human resources. This will be achieved by:
  - promoting innovative economic enterprises that create future opportunities by building upon Byblos' existing strengths
  - strengthening the city's role in regional economic development
  - improving the socio-economic conditions of Byblos' residents.

The Byblos resilience strategy is quite **ambitious** for a small city in a developing country, so a fairly long timeframe has been set for its achievement; the target date is **2030**. Although the resilience strategy was released in 2016, several actions have **already been implemented** to advance the achievement of its goals:

- A preliminary **transport capacity study** has been completed in partnership with the city of Carcassone, France, to begin planning an effective transit system for Byblos;
- Together with representatives of four other Lebanese cities, city officials have participated in the UNISDR Making Cities Resilient campaign, which focused on **preparing for and responding to emergencies**;
- City officials participated in the MED-3R solid waste management project to identify suitable **urban waste strategies**;
- A multifunctional **public park** was created to achieve the dual benefits of recreation and environmental management;
- The **souk** (old market) **façades** in the old section of the city were restored;
- A **cultural centre** for Byblos was developed in co-operation with the Ministry of Culture;
- A **new municipal building** was constructed, creating an impressive community centre to link

4.19 As a coastal city on the Mediterranean Sea, beach tourism is central to Byblos' economy. Economic diversification, building on tourism, is one of the five resilience strategies identified for Byblos. For this to succeed, new buildings may need to be more environmentally sensitive than those shown here.

4.20 The new cultural centre, shown here, was one of the first projects undertaken in Byblos to enhance is resilience.

the old section of the city with newer areas east of the main highway;

- Parking meters, electric shuttles and pedestrian footpaths were introduced into the old section of the city to **reduce traffic congestion**;
- A new community **sports complex** was constructed for local recreation as well as international sports events, funded by the world's richest man, Carlos Slim.
- City officials met with representatives from Mtskheta, Georgia, to define risk preparedness plans and risk mitigation measures for the two cities in the hope of **obtaining funding from UNESCO** for enhanced protection status.

CASE STUDY
The Zabaleen Community of Cairo, Egypt

Cairo, the capital city of Egypt, is one of the world's **megacities**. With a population approaching 17 million people, it is the **largest city** in both the continent of Africa and the region of the Middle East. Cairo is surrounded by **desert**, so its residents depend entirely on the waters of the Nile River for their survival.

The city is widely known for its high levels of **air pollution**, **lack of street cleanliness** and **traffic congestion**. In recent years, Egypt has experienced **political turmoil**, with several tumultuous changes of government. There have also been violent attacks attributed to terrorist organisations. Given the significant **demographic**, **environmental** and **political challenges** faced by Cairo, it is easy to see that Cairo lacks urban resilience, being **vulnerable** both to **chronic stresses** and **acute shocks**.

A significant chronic stress faced by Cairo is the **climatic risk** imposed by **garbage disposal**. Rubbish disposal is a major contributor to **global warming** as solid waste **landfill** tips are one of the largest sources of anthropogenic (caused by humans) methane.

Methane is a very powerful greenhouse gas as it is 23 times more effective in trapping heat in the atmosphere than carbon dioxide. Cairo's huge population produces about 10,000 tonnes of garbage each day. If all this rubbish were to be dumped in a landfill, the greenhouse emissions would amount to the equivalent of 3,600 tonnes of carbon dioxide per day, or 1.3 million tonnes per annum. This quantity of carbon dioxide is the equivalent of burning about 200 million litres of petroleum. With an effective program of **recycling**, Cairo's resilience to withstand the risk of **global warming** would be enhanced.

Unlike Rio de Janeiro and Byblos, Cairo is not a member of the 101 Resilient Cities network, and it has not taken steps to develop an explicit resilience strategy. However, a minority group within Cairo, the **Zabaleen community**, is making a significant impact to address the **climatic risks** caused by unsustainable **waste disposal**.

The word Zabaleen means 'garbage people'. The Zabaleen community in Cairo is a **Coptic Christian** minority of about 25,000 people in a city that is overwhelmingly Muslim. The Zabaleen originally lived in southern Egypt, but they migrated to Cairo

4.21 A typical street in Mansheya Nasir, the district of Cairo inhabited by the Zabaleen community.

4.22 An overview of Mansheya Nasir, Cairo, Egypt.

in the 1930s and 1940s when subsistence farming could no longer support their community. They first settled in Giza, in western Cairo, but in 1970 they were suddenly evicted by government authorities. At that time, the Zabaleen moved to **Mansheya Nasir**, the site of an abandoned quarry beside the Mokattam Escarpment in eastern Cairo. Today, Mansheya Nasir is one of the **poorest areas** in Cairo. It has narrow streets and a high population density, and many of the houses in Mansheya Nasir lack basic services such as running water, sewers and electricity.

Since the 1940s, the Zabaleen community has taken on the role of **collecting** household, commercial, industrial and street **rubbish**, transporting it to the district where they live, sorting and recycling it. Cairo's streets are often littered with garbage as the city's rubbish collection infrastructure and services,

4.23 A typical small pickup truck used by the Zabaleen community to bring rubbish to Mansheya Nasir.

4.24 Bags of rubbish lie in the street awaiting sorting. Note the pulley on house on the left that is used to haul rubbish to the roof for sorting and recycling.

4.25 Paper and cardboard is unloaded for sorting and recycling by the Zabaleen community.

4.26 Loading sorted cardboard for recycling.

both public and private, are inadequate to meet the needs of the city's huge population.

The Zabaleen collect about one-third of Cairo's garbage, mainly from the city's poorer areas. This amounts to more than 3,000 tonnes of rubbish per day, and it is done at no cost to the government and only a minimal charge to residents. The garbage is collected using a combination of small pick-up trucks and carts pulled by donkeys. The rubbish is then transported to Mansheya Nasir where it is unloaded for sorting, either in the streets or in the people's homes.

Although men and boys collect the rubbish, much of the sorting for recycling is done by women and girls. Typically, Zabaleen residents spend 10 to 12 hours per day, six days per week, sorting garbage for recycling. The houses where Zabaleen people work double as garbage sorting warehouses. Zabaleen houses are multi-storeyed, and winches

4.27 Zabaleen women sort garbage in the streets of Mansheya Nasir, Cairo.

4.28 Women assist with winching a large load of rubbish to an upper floor of their home for sorting and recycling.

are used to hoist garbage to upper floors for sorting and recycling. Rooms in individual homes are allocated to specialise in different types of garbage, with plastics in one room, cardboard in another room, and so on.

Animals such as ducks and goats are kept on the roofs and in the yards of some houses as they eat organic wastes. Until 2009, the Zabaleen raised **pigs**, which were an important part of the recycling process because they ate almost any type of organic waste material. The Zabaleen were unique in Cairo by raising pigs, as pigs are considered religiously unclean by the city's majority Muslim population. However, as Christians, raising pigs was an acceptable activity for the Zabaleen. In 2009, the **government banned** the keeping of pigs, officially because of fears of swine flu.

This adversely affected the Zabaleen as they lost a major component of their recycling system. The Zabaleen continue to believe that the ban had nothing to do with swine flu (as there had been no outbreak of swine flu in or near Egypt), but was an act of government persecution of them as a religious minority group.

The Zabaleen make their living by sorting through the garbage to retrieve any useful or **recyclable materials**, such as plastic bottles, paper and cardboard, metal cans, glass, and so on. In this way, the Zabaleen not only help to keep the streets of Cairo clean, their work is the main mechanism for resources to be recycled sustainably in the city.

The Zabaleen's labour-intensive sorting processes mean they typically recycle about 80% of the waste they collect, compared with 20% to 25% that is typical in developed countries. This makes the Zabaleen recycling system one of the most efficient in the world.

4.29 Paper and cardboard that has been sorted for recycling has been loaded on a small truck for transport.

4.30 A Zabaleen woman recycles paper and cardboard to produce high value, hand-made art paper in a micro-enterprise established in Mansheya Nasir, Cairo.

People in the Zabaleen community sell most of the recyclable waste, and they use other recyclable material to make products such as notepaper, glass products and ornaments for sale.

In 2003, the Zabaleen community's work was threatened when the Cairo Municipal Government awarded multi-million dollar contracts to three foreign-owned and one locally-owned **garbage disposal companies**. Two of the companies were from Spain, and one was from Italy. According to their contracts, they were required to recycle only 20% of the garbage they collected, with the balance going into **two new landfill tips** that were opened for the purpose.

Unlike the Zabaleen, who collect garbage by calling **door-to-door**, the large companies insisted that garbage be collected only from **central collection points** in the streets because their trucks were too large to fit through many of Cairo's narrow streets. Consequently, many of Cairo's residents objected to the new government-imposed system because they were being required to pay more for a poorer service.

Initially, the Zabaleen were badly affected by the new arrangements because they were prohibited from engaging in the only livelihood they knew. However, it soon emerged that the foreign companies were only fulfilling about half of the requirements in their contracts, partly because political instability had led to such a shortage of funds that they were not being paid by the government. Therefore, the Zabaleen returned to the underserved areas to collect the garbage once again for recycling.

The Zabaleen's **recycling efficiency** and **environmental-friendliness** was recognized at the Rio Earth Summit in 1992. The Zabaleen community's recycling efforts have also been recognized by the World Bank, the Ford Foundation and Oxfam, all of which have provided start-up funding, training, and equipment to organise small **micro-enterprises** to convert garbage into marketable products, such as shoes, textiles, pots and pans. Moreover, the Mega-Cities Project had led up the Zabaleen approach towards recycling as a **model** for use in other cities, and especially in Manila and Mumbai.

The Zabaleen community's work in the areas of garbage collection and recycling addresses only one facet of Cairo's overall resilience. Moreover, the Zabaleen community's work does not form part of

4.31 A central garbage collection point in Sakiat Mekki, a district in south-western Cairo.

4.32 Central collection bins in Sakiat Mekki overflow with garbage in the street, remaining uncollected by the large garbage collection company assigned to the area.

4.33 Cloth goods made by Zabaleen women by recycling discarded materials are on sale in a small shop in Cairo.

4.34 This label on material products made by recycling cloth informs buyers that the product was made as part of an innovative recycling program that empowers women in the Zabaleen community.

a wider resilience strategy of the kind found in Rio de Janeiro or Byblos. Nonetheless, recycling by the Zabaleen is **reducing Cairo's greenhouse gas emissions by 238,000 tonnes per annum**. This figure is based on the fact that the Zabaleen handle one-third of Cairo's garbage, and they recycle 80% of it compared with the recycling target of just 20% by the large companies that collect the remaining two-thirds of Cairo's rubbish. If the Zabaleen were to process more of Cairo's garbage, the reduction in greenhouse gases would be even greater. Thus, the work of the Zabaleen brings significant benefits for residents of Cairo by reducing climatic risks at no cost to the government, addressing one of Cairo's significant chronic stresses — its large volume of solid wastes.

QUESTION BANK 4B

1. *What is the difference between 'chronic stresses' and 'acute shocks'? Give two examples of each, and say how chronic stresses and acute shocks are related to urban resilience.*
2. *What is the 100 Resilient Cities program, and what are its key strategies?*
3. *Outline the structure of the City Resilience Index.*
4. *Identify the key threats to San Francisco's urban resilience, and describe the actions being taken to reduce them.*
5. *Identify the six resilience challenges faced by Rio de Janeiro, and outline the goals of its resilience strategy that are intended to address these challenges.*
6. *Identify the five resilience challenges faced by Byblos, and outline the five goals of its resilience strategy that are intended to address these challenges.*
7. *In your opinion, has Rio de Janeiro or Byblos been more effective so far in reducing its resilience challenges? Which city faces the greater challenges? Give reasons to explain your answer.*
8. *Explain why recycling is an effective strategy to reduce climatic threats to urban areas.*
9. *Describe the method and the effectiveness of the way the Zabaleen community helps to make Cairo more resilient in the face of the chronic stresses of climatic risk.*

Eco city design

Eco cities are cities that have been designed to implement principles of environmental sustainability. For a city to be **environmentally sustainable**, resources are used in ways that meet present human needs while also preserving the environment so that these needs can also be met indefinitely into the future. In practice, this means any process that interacts with the environment replenishes at least what it uses so that the process is capable of continuing **in perpetuity**.

In most cities in the world, resources are used at faster rate than they are replaced. This pattern of resource use is environmentally **unsustainable** because it cannot continue in perpetuity, and so it is fair to say that most cities are environmentally unsustainable in their present form.

Eco city design tries to take a different approach to enhance sustainability. In its **ideal form**, an eco city would produce **no carbon wastes**, it would **recycle** all waste products, it would produce all energy through **renewable** sources, it would use locally produced **resources** to develop a **self-contained economy**, and it would preserve the **natural environment**, working within its confines rather than attempting to change it or destroy it. At the same time, the ideal eco city would achieve **full employment**, stimulate **economic growth**, reduce **poverty**, eliminate **discrimination**, improve people's **health**, and operate **efficiently** with a high **population density** and efficient **public transport**.

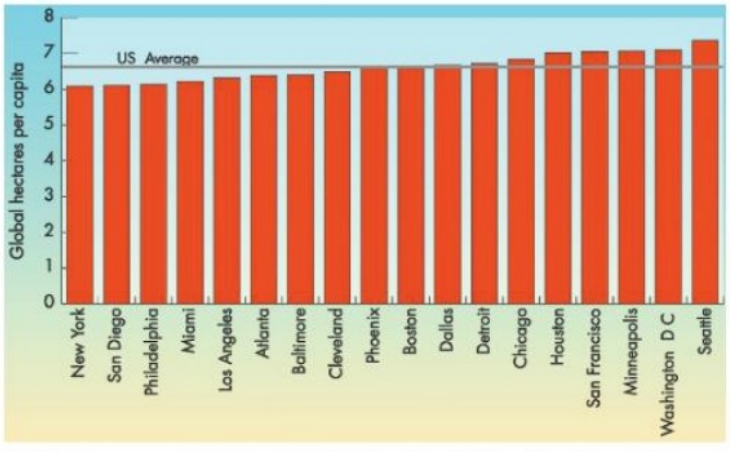
One way of measuring a city's sustainability is to examine its **ecological footprint**, which is the area of land needed to support current consumption levels, assuming present technology. More specifically, the ecological footprint looks at the resources required (and the area of land needed to

produce them) to support food consumption, housing, transport and waste production, and it measures this need in **global hectares** (gha).

It is estimated that the **average biologically productive area per person** worldwide is approximately 2.70 global hectares (gha). In other words, about 2.7 hectares of land are needed to provide the resources to support each person on the planet. This compares with a **global average bio-capacity** of 1.78 gha per person, leaving a deficit of 0.92 hectares per person. According to the Global Footprint Network, this means that humanity uses the equivalent of 1.5 planets to provide the resources we use and absorb our waste. Expressing this in another way, it takes the Earth 1.5 years to renew the resources that are used each year.

Of course, this figure **varies widely** for people in different countries. For example, the average ecological footprint for each person in the USA is 7.99 gha, while that of the Netherlands is 4.20 gha per person and China is 2.19 gha per person.

In general, the ecological footprint is higher for people who live in urban areas compared with rural dwellers. Urban ecological footprints are closely related to transport use, with public transport making a significant impact in lowering the figures. Only a few cities have calculated their urban ecological footprints, but among those that have done so are Calgary, Canada (8.5 gha), San Francisco, USA (7.1 gha), London, UK (4.5 gha) and Berlin, Germany (4.06 gha). Calgary's figure is relatively high because private car usage is high due to the cold temperatures in winter. On the other hand, London's figure is relatively low because a high proportion of the population uses public transport, especially trains and buses. Similar results have been found in wider comparative studies of the urban ecological footprints in US cities (figure 4.35).



4.35 The average urban ecological footprint of residents in various cities in the United States. Source: D Moore (2011) Ecological Footprint analysis San Francisco-Oakland-Fremont, CA, Global Footprint Network: p.6.

Table 4.4

Urban and national carbon footprints for 12 selected cities.

Rank	City and country	Urban carbon footprint (tonnes per capita)	National carbon footprint (tonnes per capita)	Urban footprint is smaller than national footprint	Urban footprint is smaller than the average global footprint	Gross National Income per capita 2018 (US$)
1	Delhi, India	0.70	0.27		✔	$2,020
2	Manila, Philippines	1.14	0.48		✔	$3,830
3	São Paulo, Brazil	1.15	2.44	✔	✔	$9,140
4	Beijing, China	1.18	1.00		✔	$9,460
5	London, UK	1.19	2.07	✔	-	$41,770
6	Jakarta, Indonesia	1.38	3.28	✔		$3,840
7	Seoul, South Korea	1.59	2.71	✔		$30,600
8	Tokyo, Japan	1.63	2.59	✔		$41,310
9	Mexico City, Mexico	1.85	1.21	✔		$9,180
10	New York, USA	1.94	5.37			$63,080
11	Singapore, Singapore	2.73	2.73	-		$58,770
12	Los Angeles, USA	3.68	5.37	✔		$63,080

Footprints include direct and responsible emissions from transport, buildings and industry, agriculture (when applicable), and waste (when applicable). The footprints depicted here are almost entirely based on CO_2 emissions, although emissions from CH_4 and N_2O were incorporated for cities with substantial agricultural, forestry, and/or waste activities and then converted to a carbon equivalent. Footprints are for each metropolitan area as defined by its political boundary, rather than the greater metropolitan region, and the numbers are given for carbon instead of carbon dioxide. Source: BK Savacool & MA Brown (2010) Twelve metropolitan carbon footprints: A preliminary comparative global assessment, *Energy Policy*, 38: 4856-4869.

Table 4.5

Existing carbon policies in the 12 selected cities shown in table 4.4.

City	Energy use in buildings					Transport					Agri-culture	Waste	Climate change action plan
	Energy efficiency programs	Building standards	Solar water heating	Renewable fuel mandates	Heat and power incentives	Congestion pricing	Concentric ring roads	Clean vehicle mandates	Extensive public transit	Prohibit-ions on driving	Integrated crop-forestry manage-ment	Landfill waste capture	
Delhi									✔	✔			✔
Manila	✔			✔									
São Paulo	✔		✔	✔				✔	✔	✔	✔	✔	✔
Beijing	✔			✔			✔	✔	✔	✔			
London	✔	✔			✔	✔			✔			✔	✔
Jakarta	✔			✔									
Seoul	✔	✔	✔	✔	✔		✔	✔	✔	✔		✔	✔
Tokyo	✔	✔	✔	✔		✔	✔	✔	✔				✔
Mexico City	✔		✔				✔	✔	✔		✔	✔	✔
New York	✔	✔	✔	✔	✔			✔	✔			✔	✔
Singapore	✔	✔				✔	✔		✔			✔	✔
Los Angeles	✔	✔	✔	✔	✔			✔	✔			✔	✔

Source: BK Savacool & MA Brown (2010) Twelve metropolitan carbon footprints: A preliminary comparative global assessment, *Energy Policy,* 38: 4856-4869.

Table 4.6

Sources of carbon emissions in the 12 selected cities shown in table 4.4.

City	Carbon emissions from energy use in buildings, industry and electricity		Carbon emissions from transport		Carbon emissions from agriculture and forestry		Carbon emissions from waste	
	%	Primary source	%	Primary source	%	Primary source	%	Primary source
Delhi	32	Electricity	66	Private cars	2	Livestock	<1	Wastewater treatment
Manila	39	Electricity	51	Private cars	9	Livestock	1	Landfills
São Paulo	24	Electricity	51	Private cars	2	Deforestation	23	Landfills
Beijing	87	Heating and manufacturing	5	Private cars	1	Nitrogen fertilisers	1	Food waste
London	76	Space heating for buildings	23	Private cars	<1	N/A	<1	N/A
Jakarta	56	Electricity	41	Private cars	<1	Deforestation	<1	Landfills
Seoul	44	Heating for industry	42	Private cars	1	N/A	13	Landfills
Tokyo	67	Commercial energy use	32	Private cars	<1	N/A	<1	N/A
Mexico City	45	Processing needs for manufacturing	35	Private cars	6	Deforestation	<1	Landfills
New York	77	Electricity and heating fuels for buildings	23	Private cars	<1	N/A	<1	N/A
Singapore	83	Electricity	17	Private cars	-	N/A	-	N/A
Los Angeles	52	Electricity	48	Private cars	<1	N/A	<1	N/A

Source: BK Savacool & MA Brown (2010) Twelve metropolitan carbon footprints: A preliminary comparative global assessment, *Energy Policy,* 38: 4856-4869.

A related measure is the **carbon footprint**, which is the total quantity of greenhouse gases produced per capita in the city. This is measured in kilograms or tonnes of carbon dioxide per person. The **global average carbon footprint** is 1.19 tonnes (or 1,190 kilograms) of carbon dioxide per person. Table 4.4 shows data for twelve cities in different parts of the world. Four of the cities shown in the table have carbon footprints that are smaller than the global average — Delhi, Manila, São Paulo and Beijing — partly because of the relatively high usage of public transport in those cities. London was close to the global average, while Los Angeles had by far the largest carbon footprint, followed by Singapore, New York and Mexico City. Tables 4.5 and 4.6 provide further insights into the carbon policies and practices in the same cities and the impact these have on urban carbon footprints.

A third measure of urban sustainability is the **Sustainable Cities Index** (SCI), developed by Arcadis, a multinational design, engineering and consulting company based in the Netherlands. The SCI is a composite measure of sustainability that considers **three dimensions**, or what are termed '**pillars of sustainability**':

- **People:** This dimension measures **social performance** by rating health (life expectancy and obesity), education (literacy and universities), income inequality, work-life balance, the dependency ratio, crime, housing and living costs. These indicators can be broadly thought of as capturing '**quality of life**'.
- **Planet:** This dimension measures **environmental sustainability**, looking at factors such as energy, pollution and emissions by rating cities on energy consumption and renewable energy share, green space within cities, recycling and composting rates, greenhouse gas emissions, risk of natural catastrophe, drinking water, sanitation and air pollution. These indicators can broadly be thought of as capturing '**green factors**'.
- **Profit:** This dimension measures **economic health** and the business environment by combining measures of transport infrastructure (rail, air and traffic congestion), ease of doing business, tourism, GDP per capita, the city's importance in global economic networks, connectivity in terms of mobile and broadband access and employment rates.

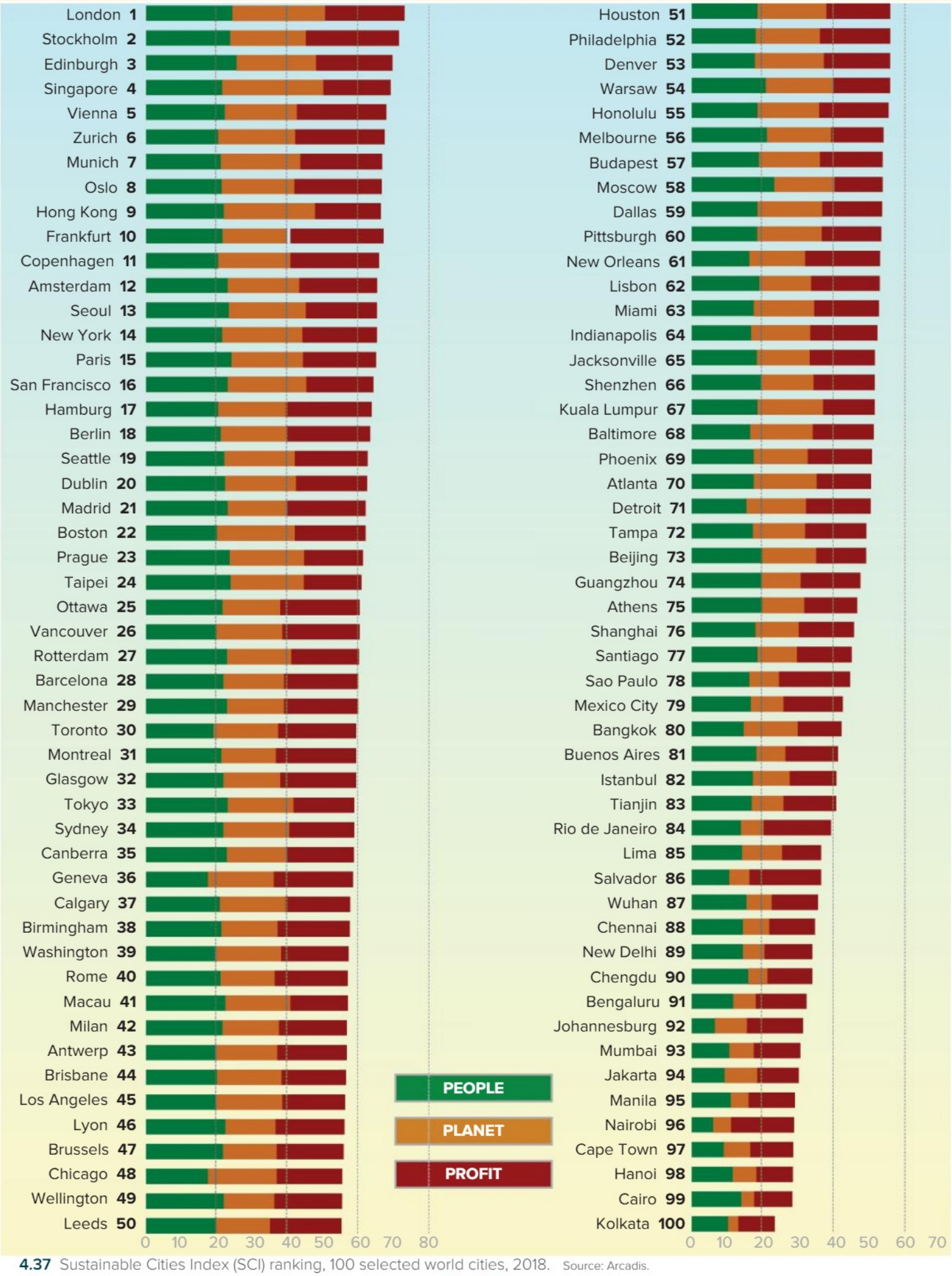
4.36 Urban sustainability is enhanced when principles of eco city design are introduced into existing urban areas. This view of Bourke Street Mall in central Melbourne, Australia, shows four aspects of eco city design: a car-free pedestrian plaza, green vegetation, communal meeting areas and low-pollution public transport, in this case an electrically-powered tram.

The SCI rankings for 100 selected world cities are shown in figure 4.37. The SCI ratings show that:

- **No city** is effectively balancing three dimensions of sustainability;
- **European cities** are generally functioning more sustainably than cities in other parts of the world, filling 13 of the 15 top places in the rankings;
- **US cities** perform better on business (profits) sustainability than on social and environmental dimensions;
- **Cities in China, Latin America and South Asia** generally have poor sustainability, suggesting that economic development helps to create the funds needed to build sustainable cities.

Ecological footprints, carbon footprints and composite measures such as the SCI provide valuable insights into the forces that **enhance urban sustainability** as well as those that undermine it:

- **Densely populated cities** offer greater energy and carbon efficiency than sprawling cities. This is because public transport is more likely to serve a greater proportion of the population, and be financially viable, in cities with a high population density.
- **Carbon emissions per person** are lower in densely populated cities than in sprawling cities. This is because sprawling cities cannot be serviced by public transport that is financially viable, and residents must therefore use private motor vehicles over long distances.



4.37 Sustainable Cities Index (SCI) ranking, 100 selected world cities, 2018. Source: Arcadis.

4.38 Stockholm, Sweden, has the second highest ranking for urban sustainability on the SCI. A major factor in reducing Stockholm's carbon footprint has been the city's efficient suburban electric train service which, as seen here in the city centre, has reduced traffic congestion on the city's roads.

4.39 Underground stations on the Stockholm Subway are decorated artistically to encourage the use of public transport.

- Cities with low carbon emissions tend to have well-developed **suburban railway networks**. Railways can even help sprawling cities lower their carbon footprints substantially, thus improving their sustainability.
- A city's **climate**, the **fuels** used to generate electricity, and **electricity prices** affect urban sustainability. Cities in cold climates almost invariably have higher carbon footprints because of the energy used to heat indoor areas, although this can be offset in cities that use renewable sources such as hydro or wind power, or nuclear energy. Cities that charge higher prices for energy also have lower carbon footprints, suggesting that high power prices cause people to reduce their use of energy.

Designing and building a brand-new, 'greenfield' eco city has not been attempted on a large-scale, but eco city concepts are being **incorporated** into an increasing number of **existing cities**. Managing existing cities sustainably means adopting a **holistic approach** that includes all facets of the urban environment, including the **social** (such as housing quality and crime), the **economic** (such as income and employment) and the **environmental** aspects (air, water, land and resources). Among the **strategies** used to manage cities sustainably and implement eco city design are the following:

Resource use and environmental quality:

- **Renewable energy** is employed wherever possible, using wind turbines, solar panels, biogas, tidal turbines, and so on.
- **Water consumption** is minimised by using technology such as rainwater harvesting, low-flow shower heads, and half-flush toilets.
- **Blackwater** (water containing urine and faeces) and **greywater** (domestic and industrial waste water that does not contain sewage) are prevented from entering streams and groundwater by recycling for purposes that don't involve human consumption.
- **Urban farming** is encouraged as a means of producing fresh, locally-grown food that does not need to be transported long distances to market.

Transport:

- Reliance on easily **accessible public transport** such as trains and buses reduces the need for private motor vehicles.
- Public transport uses **carbon-free power** wherever possible, such as hybrid-electric buses, buses that use liquid natural gas for fuel, and trains that run on electricity generated by renewable sources.
- **Double-deck** buses and trains are used to raise passenger capacity without increasing their surface area, thus reducing traffic congestion.
- **Cycleways** are an integral part of urban design to encourage bicycle riding as an important element of urban transport.

4.40 Double-deck buses are used in many cities to reduce carbon footprint by carrying large numbers of passengers, thus reducing the number of buses needed while also taking up less road space than articulated buses. This double deck bus is in Pyongyang, North Korea.

4.41 This view of Kwangkok Street, Pyongyang, North Korea, shows several aspects of eco city planning, including wide pavements to encourage walking, separate cycleways for bicycles, electric tram public transport, streetside tree plantings and high density residential buildings to reduce urban sprawl.

- **Pedestrian pathways** and **plazas** are integrated with building design to encourage as much travel as possible by walking.

Buildings and architecture:

- Buildings are designed to **minimise resource use**, especially in the area of energy. LEED (Leadership in Energy and Environmental Design) certification is an internationally recognised measure of sustainable building design that examines water efficiency, energy and atmosphere efficiency, materials and resources efficiency, design innovation and impact on the site and surrounding areas.
- Buildings are designed to use **natural ventilation** systems that reduce or eliminate the need for air conditioning.
- Buildings use **photovoltaic cells** to generate solar thermal energy, reducing or eliminating the need for heating.
- Buildings are well insulated, using techniques such as **green roofs** and **vertical landscaping**.
- Adjoining buildings are connected by **bridges** to reduce the use of elevators (lifts) and escalators.
- Buildings are designed for **high-density** and **medium-density** occupancy to minimize urban sprawl and the need for people to travel long distances.

4.42 This elevated bridge joining two buildings in a school in Singapore has a 'green wall' which reduces the heat load in the building's interior in the hot, tropical climate.

4.43 An example of urban infilling — a new medium-density office block has been built on the site of old. low-density buildings while preserving their historic facades in Perth, Australia.

- **Urban infilling** is used to reduce urban sprawl as historic buildings are restored for new purposes, and new buildings are constructed on vacant land in inner suburban areas, thus increasing population density.
- **Parkland**, **playgrounds** and **green open spaces** are integrated into urban design.

Social, cultural and health needs:

- By tightening standards for environmental pollutants and toxins, **public health** should be improved, especially in areas such as respiratory diseases and toxicity-induced cancers.
- By minimising urban sprawl, **diseases** caused by exhaust fumes, stress-related conditions such as heart disease and strokes, as well as fatalities in road accidents should be reduced.

4.44 Millennium Park in Chicago, Illinois, USA, is an example of open parkland in the CBD of a large city that is designed to provide 'lungs' for the city.

- Green open spaces, including parklands and urban forests, are an important feature of eco cities, improving air quality, reducing medical conditions caused by high levels of airborne particulates, carbon monoxide, nitrogen dioxide and sulphur dioxide, and improving **health issues** related to exercise and stress such as depression and obesity.
- Eco cities rely on fresh, locally produced food that is grown organically without fertilisers or pesticides, and this should **reduce rates of obesity** and other **diet-related conditions** such as diabetes and hypertension.

QUESTION BANK 4C

1. *What is meant by the terms 'eco city design' and 'environmentally sustainable'?*
2. *Outline the characteristics of an ideal eco city?*
3. *Explain what is meant by the term 'urban ecological footprint'.*
4. *Why are urban ecological footprints usually higher than rural ecological footprints?*
5. *Explain why Calgary, Canada, has a larger urban ecological footprint than London, UK.*
6. *What is meant by the term 'carbon footprint'?*
7. *With reference to table 4.4, describe the general relationship between urban carbon footprint and Gross National Income per capita.*
8. *Five cities listed in table 4.4 have carbon footprints that are equal to or less that the global average. Explain why these cities have relatively small carbon footprints.*
9. *With reference to table 4.5, identify the carbon policies that seem to be (a) implemented widely, and (b) most effective in reducing the carbon footprint.*
10. *In table 4.6, there does not seem to be any clear relationship between the sources of carbon emissions and the carbon footprint. Choose one of the cities listed, and suggest ways that the carbon footprint in that city might be reduced.*
11. *Explain why the Sustainable Cities Index is a more (or less) accurate of urban sustainability than either the ecological footprint or the carbon footprint.*
12. *Using figure 4.37, divide the ranking into ten groups of ten cities (numbers 1 to 10, 11 to 20, 21 to 30, and so on). Label the groups band 1, band 2, band 3, and so on to band 10. For each band, note the continent where the largest number of cities is located. (If one band has two continents appearing equally frequently, note them both).*
13. *Using your answer to the previous question, describe and account for the broad world pattern of urban sustainability as measured by the SCI.*
14. *Using information gathered in the SCI, describe the forces that enhance urban sustainability.*
15. *List the strategies that are used to design eco cities, using the headings (a) resource use and environmental quality, (b) transport, (c) buildings and architecture, and (d) social, cultural and health needs.*

CASE STUDY
Malmö, Sweden

Although it has a population of just 280,000 people, **Malmö** is the third largest city in Sweden. It is located near the southern tip of Sweden, and is connected to neighbouring Denmark by the Øresund Bridge, which is a 7.8 kilometre long road and railway bridge.

Founded soon after 1000, Malmö grew slowly over the centuries, reaching a population of 2,300 by 1700. A bubonic plague epidemic caused the population to fall to 1,500 by 1727, but it soon started to grow again after a harbour was built in 1775. By 1815, the population had grown to 6,000.

Soon after the harbour's construction, Malmö became a **manufacturing centre** focusing on the **shipbuilding industry**. Kockum's Shipyard grew to become one of the largest shipyards in the world, attracting other industries to the city such as textiles and engineering. By 1900, Malmö's population had grown to 60,000 people. Further expansion of manufacturing industry led to further population growth, with numbers reaching 100,000 by 1915, 200,000 by 1952 and 265,000 by 1971.

Sweden experienced an economic recession during the 1970s and 1980s, and this caused a number of Malmö's manufacturing industries to shrink or close. Malmö's largest employer, Kockum's Shipyard, closed in 1986, further deepening the city's **economic malaise**. By 1995, Malmö's population had fallen to 200,000 people and the city had the highest unemployment rate in Sweden.

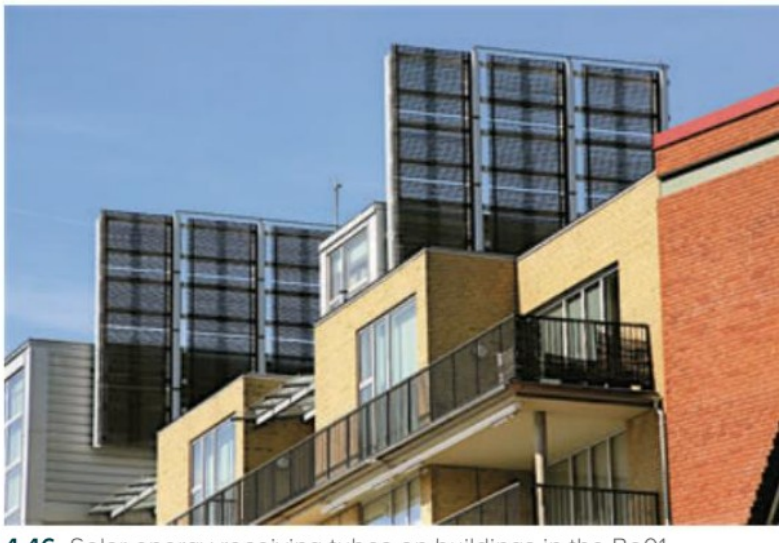
Malmö's economic decline left the city with a **degraded physical environment**. The area around the harbour, where the shipyard had been located, was an empty zone of dilapidated and decaying buildings. The soil was contaminated with oil residues. City administrators decided to turn the problems into a new opportunity, renewing the run-down environment and making Malmö a **sustainable eco city** that could serve as a model for urban areas elsewhere.

The transformation began in the area known as **Western Harbour**, which was an expanse of flat reclaimed land where many of the factories that had closed had been located. The first development in Western Harbour was in a district known as

4.45 The Kockum's Shipyard facility in Malmö remains an area of urban dereliction.

Bo01. The Bo01 project aimed to design and build a new suburb of office buildings and residences that would use **100% local renewable energy** drawn from solar, wind and heat pump sources.

Heat pump energy is an uncommon source of renewable energy, but very important in Malmö. In winter, cold water is stored in underground aquifers at a depth of 70 to 90 metres beneath the surface. In summer, this cold water is pumped upwards using wind-generated electricity and carried through pipes to cool buildings. As the water flows through buildings, it heats up. When the water has become too hot to cool the buildings, it is pumped back down into the limestone aquifers. The warm water stays there until winter, when it will be pumped up to heat buildings using the same pipe networks. Heat pump energy produces 5 million kilowatts of heating energy and 3 million kilowatts of cooling power in Malmö each year.



4.46 Solar energy receiving tubes on buildings in the Bo01 district of Western Harbour.

Waste recycling and **clean disposal** of garbage was built into the Western Harbour development. Different systems have been used to achieve this, from simple **waste grinders** in kitchens through to **mobile vacuum systems**, where wastes are stored underground in large vacuum tubes before being sucked out of centrally located transportation pipes at high speed into mobile tankers. Recycling is further encouraged by the city's housing company, MKB, which has built **weather-proof waste receiving points** with clearly labeled bins for food waste, paper, glass, cardboard, metal, plastic and batteries.

4.47 Receiving chutes for wastes in Western Harbour.

4.48 This bus in central Malmö is powered entirely by biogas that has been produced through recycling food waste.

In Malmö, it is compulsory for residents and businesses to **sort food waste**. Food waste is collected and processed to produce **biogas**, which is used to fuel the city's buses, taxis, cars and garbage trucks. All the buses in Malmö run on gas, often a mixture of biogas and natural gas, although the proportion of biogas-only buses is increasing, reducing emissions of greenhouse gases and particulates.

4.49 Open ponds and vegetation gardens in parks are used to purify stormwater before it flows to the sea.

4.50 Drainage pipes and open channels in Western Harbour.

4.51 The ponds and gardens in the middle of this housing block in Western Harbour are used to purify stormwater as well as providing a recreational area for the residents.

Bo01 pioneered the use of green space to promote **water management**, an approach that has been subsequently adopted in other areas in Malmö. Open areas of **green parkland** were incorporated into the urban design, and the parks are used both as **recreational areas** (incorporating children's playgrounds) and to **manage drainage**. Runoff from the roofs of buildings is channelled into ponds in the parks. Once the water reaches the ponds, it is cleansed by plants and aerated by bubbling before flowing to the sea through canals that are designed to look like natural streams.

When water is drained from the roofs of buildings in Western Harbour, it enters a carefully designed system of **surface stormwater drainage**. The water is channelled downwards through drainpipes on the sides of buildings, and when it reaches the ground surface it is directed into gravel beds that absorb the downward energy. The water seeps through the gravel into narrow channels that carry the water to gardens and ponds within the housing block. Like the ponds in parklands, the residential ponds slow the flow and purify the water before it is released to flow the sea.

4.52 A modern, biarticulated, CNG-hybrid bus in Malmö.

4.53 Bars are provided on the pavement in many areas of Malmö for the secure storage of bicycles.

4.54 A cycleway in central Malmö that is separated from the road network.

4.55 This cycleway has an electronically triggered sign that gives a running total of the number of bicycles that have passed by since the beginning of the day.

Western Harbour also pioneered an eco-friendly **transportation system** that has since been expanded to other areas in Malmö. Modern, clean, comfortable, high frequency buses connect Western Harbour to central Malmö every five minutes as a way of reducing the need to use private motor vehicles. Each bus stop has an electronic display to inform passengers when the next bus will arrive.

The bus system was supplemented by a comprehensive network of **cycleways** to encourage bicycle travel. Fortunately, Malmö is a fairly flat city, so bicycles are a popular mode of transport. Malmö's bicycle network contains more than 500 kilometres of two-lane cycleways. About 30% of all

journeys in Malmö are made by bicycle, and the figure rises to 40% for commuting journeys to work or school. In many parts of Malmö, the bicycle network is quite separate from the road network, thus improving the air quality for cyclists.

4.56 An elevated handrail for cyclists at an intersection.

4.57 A cycleway underpass in Malmö.

4.58 Free air pumps are provided throughout Malmö for cyclists.

Underpasses have been built where cycleways cross many of the city's major roads so that cyclists can cross easily without any delays or danger. In the CBD, a **sensor system** has been incorporated into traffic lights so that cyclists are given priority. Cyclists are also assisted at intersections where they have to stop and wait by **elevated handrails** that they can grab, steadying themselves while stopped at traffic lights without having to dismount.

Even though Malmö's public transport and cycleways have significantly reduced the need for private car journeys, some trips nonetheless require cars. Malmö encourages **car sharing** by restricting the number of parking spaces available in public areas, in apartment buildings and in the central zone of the CBD. As part of this strategy, many residential parking spaces are located some distance away from the residences, requiring a considerable walk, sometimes in very cold winter weather.

Car pools have been established in many areas of Malmö in which a number of people share several cars, only paying when they use a car. When members of a car pool require the use of a car, they make a booking using their computer or smartphone, and then unlock the car using a smartcard when it is time to use the vehicle.

A **new suburb** in the south of Malmö, **Hyllie**, has been designed and built entirely according to eco city principles of urban sustainability. Centred on a retail and commercial hub beside the railway station, Hyllie has been designed to function entirely from **renewable** or **recyclable energy sources**. The Lillgrund wind farm, which is located

4.59 New, energy-efficient office buildings in Hyllie.

4.60 The bike-and-ride station at Malmö's Central Railway Station.

4.61 A solar-powered charging station for electric cars in the Western Harbour district of Malmö.

in the Øresund strait to the immediate south-west of Malmö in the water separating Sweden and Denmark, already produces enough electricity for 60,000 households, and further expansion of wind farms is planned. Hyllie also includes a large-scale **smart grid** where smartphones can be used to calculate and control personal energy consumption, and even generate energy for lighting, heating and cooling.

Hyllie was the site of Malmö's first **bike-and-ride station**, which was a parking facility beside the railway station where 1,000 bicycles could be parked free of charge. In addition to providing free parking, the bike-and-ride station provided storage areas for bike helmets and wet weather gear, showers, lounges, bicycle repair areas and free bicycle pumps to inflate tyres. The Hyllie bike-and-ride station was so successful that a larger bike-and-ride station accommodating 1,500 bicycles was opened later at Malmö's Central Station.

The design of Hyllie is based on **minimal use of private motor vehicles**. Residential buildings provide an average of just 0.65 car spaces per apartment, but the companies that build and rent the apartments organise car sharing (car pooling) schemes. Officials in Hyllie believe that car pools make land available for other more useful purposes, and each car pool replaces about five motor vehicles, thus **reducing carbon emissions** by between 5.7 and 8.5 tonnes per car pool per year.

Residents who do need to use private cars are encouraged to buy **electric cars** to minimise carbon emissions. **Charging stations** are found in many areas of Malmö so electric cars can be charged in an environmentally friendly manner by linking charging to smartphone apps that show the changing cost of electricity at different times of the day. Electric cars can also be used to **store electricity** in their batteries, **selling it back** to the grid when electricity is scarce and prices rise.

At the centre of Hyllie, a large shopping plaza known as the Emporia Shopping Centre serves as the focus of the suburb. The 27,000 square metre surface of Emporia's roof has been developed as a **green roof**, making it one of the world's largest living roofs. Individual gardens feature about 50 different plant species to create **biodiversity**, and pathways winding between the gardens to create an elevated park, with seating for people to rest. The roof contains more than 30,000 plants, a mix of perennials, sedum, grasses and trees. Ventilation equipment and other technology is hidden in artificial hills. The effect of the green roof is to

4.62 The green roof on the Emporia Shopping Centre, Hyllie.

provide **insulation** for the multi-storey shopping centre beneath, significantly reducing the energy needed to operate the mall.

As a long-established city, many **older parts** of Malmö do not lend themselves to the radical eco city design principles that were possible in Hyllie. Significant efforts are being made to incorporate eco city principles into established areas of the city without the need for extensive demolition.

One older suburb where this process is well underway is **Augustenborg**, about mid-way between Malmö's CBD and Hyllie. Buildings in Augustenborg were built in the 1940s and 1950s, and many of the buildings were damaged during the 1970s when the exterior walls were covered with steel sheeting and external insulation. By the 1990s, Augustenborg was a run-down district.

In the late 1990s, it was decided to **refurbish** many of the older buildings to make them more environmentally sustainable. The exterior walls were **restored** to their original appearance, but with improved insulation. **Garden courtyards** were renovated with flowers and native trees, and the approach pioneered in Bo01 to cleanse water by using wetland plants and aeration was introduced. Today, about 90% of Augustenborg's stormwater is directed through the canals and ponds, and is thus purified by plants before flowing to the sea. The ponds in the gardens also serve to **control flooding** as they store runoff during heavy rain, preventing it flowing to roads and car parks, and into low-lying parts of buildings.

One of the problems faced in many of the older buildings was flooding of their basements and parking lots during periods of heavy rain. To address these problems and supplement the impact of the garden ponds, **green roofs** were installed on many of the buildings. This improved **thermal insulation** in the buildings, reduced the quantity of rainwater **runoff** during storms, encouraged **bees**, and provided **nesting habitats** for migratory birds. Houses in Augustenborg have over 2,000 square metres of green roofs, and factories in the area have an additional 9,000 square metres.

Malmö's schools, pre-schools and hospitals all serve meals comprising 100% **organic food** that is grown locally. The meals always include vegetarian options, and even non-vegetarian meals

4.63 A new garden courtyard to store and oxygenate water beside some older, renovated housing in Augustenborg.

4.64 A green roof on a factory complex in Augustenborg.

4.65 A green wall on an office building in Augustenborg.

are **vegetable-dominant**, because greenhouse gas emissions are substantially lower per kilogram of vegetables produced compared with meat. City officials believe that vegetable-heavy food is not only more environmentally sustainable, but is **healthier** for human consumption.

4.66 A water purification pond in a factory compound in Augustenborg. This factory also has a green roof and solar collection panels.

4.67 Solar panels on a green roof on an office building in Augustenborg.

Malmö has also made a city-wide decision to increase the proportion of food and drinks that are **ethically labelled**, **fair-trade** and **organically grown**. Malmö became a certified **Fair Trade City** in 2006, which meant government agencies were required to serve Fair Trade tea and coffee in their offices and canteens, local businesses and community groups used Fair Trade products, Fair Trade products were readily available in the city's shops, and the city established a Fair Trade steering group. A few hundred companies in Malmö have made formal decisions to take **ethical coffee breaks**, and the city government increased its internal purchases of **ethically certified coffee** from 0.5% in 2006 to 92% in 2015.

Malmö has been very successful in shaping itself as an eco city. It is achieving this by taking a **holistic approach** towards **environmental sustainability**,

4.68 The interior of one of Malmö's organic food supermarkets.

integrating water, energy, vegetation, transport and buildings to achieve a coherent urban design. Malmö is fortunate in having strong government leadership that is committed to urban sustainability and is willing to invest heavily in eco city design. The city government produced a strategic plan in 2014 that placed a strong emphasis on furthering Malmö's eco city design. Malmö has managed to win the support of its residents to participate in the city's sustainable lifestyle, and this has helped the city win several awards for urban sustainability, including 'Earth Hour Capital of Sweden' and the 'Scroll of Honour Award' from UN Habitat.

QUESTION BANK 4D

1. *Why has the government in Malmö placed so much emphasis on eco city design?*
2. *Explain how heat pump energy works.*
3. *Describe the sustainable practices that have been implemented in Western Harbour district of Malmö.*
4. *List the ways that bicycle use is encouraged in Malmö.*
5. *What measures have been taken to make transport in Malmö sustainable, and how effective have they been?*
6. *Compare and contrast the implementation of eco city design in Hyllie and Augustenborg.*
7. *In what ways are green roofs and green walls useful techniques to improve environmental sustainability?*
8. *How do Malmö's efforts to encourage locally produced, organically grown and ethically certified foods support its environmental sustainability?*
9. *How successful are Malmö's environmental strategies?*

CASE STUDY
Sponge City, Berlin, Germany

Sponge city is the term used to describe an urban area that has been developed or modified in ways that enable the ground to act like a sponge, absorbing rainwater rather than allowing it to escape as overland runoff.

4.69 This courtyard garden in Rummelsburg attempts to replicate the workings of the natural environment.

Most urban centres have large areas covered by impermeable, impenetrable surfaces such as sealed roads, concrete pathways and buildings that prevent rainwater reaching the ground surface. Such areas typically channel rainwater into constructed drains, canals and watercourses, thus preventing seepage into the ground. On the other hand, sponge cities attempt to **replicate the operation of the water cycle in natural environments**. In a sponge city, rainwater soaks into the ground where it is filtered by the soil and allowed to infiltrate downwards into aquifers, thereby recharging the groundwater. In some urban areas, this process is done sustainably so that the groundwater can be extracted, treated and used for the city's water supply.

4.70 Water retaining plants in a housing estate in Rummelsburg.

4.71 Green roofs on housing blocks in Rummelsburg.

4.72 Porous surfacing in Rummelsburg that allows water to infiltrate into the soil.

Germany's capital city, Berlin, has embraced the concept of the sponge city, or *stadtschwamm* as it is known locally. Several areas within the urban zone have been developed to function as a sponge city by implementing measures that include:

- establishing **wetland gardens and ponds** within urban areas;
- integrating permeable surfaces – including streets, pathways and parking lots – to create a **network** of places that can **absorb and store water** during periods of heavy rainfall;
- planting extensive areas of **new trees**;
- constructing **awnings** over pathways to provide shade;
- arranging new buildings in ways that leave channels open for **air movement**;

4.73 A roadside bio-swale in Rummelsburg.

- insisting that new buildings are constructed with integrated **green roofs**, and retrofitting older buildings with green roofs that absorb rainwater and release it later through evaporation, thus cooling the air and reducing the runoff into streams and waterways;
- constructing new buildings with **light-coloured exteriors** that reflect heat rather than absorbing it;
- building roadways with **heat-resistant materials** that prevent melting.

4.74 A close view of roadside bio-swale shows the open channels that allow water to drain from the road into the swale.

In some districts such as the Stralau Peninsula, new housing blocks have been constructed around open green areas with **interconnected waterways** and ponds that not only encourage infiltration of water but serve as recreational facilities for the population. In other areas such as Rummelsburg, older housing blocks that were built during the late 1990s have been extensively **remodelled** with green roofs, bio-swales, gardens that retain moisture and water recycling facilities.

In Berlin, the sponge city has been applied with the **aim** of keeping rainwater in the areas where it has fallen. This approach views rainwater as a valuable **resource**, enabling falling water to recharge the local area's soil moisture and groundwater, as well as cooling and humidifying its atmosphere when the water evaporates.

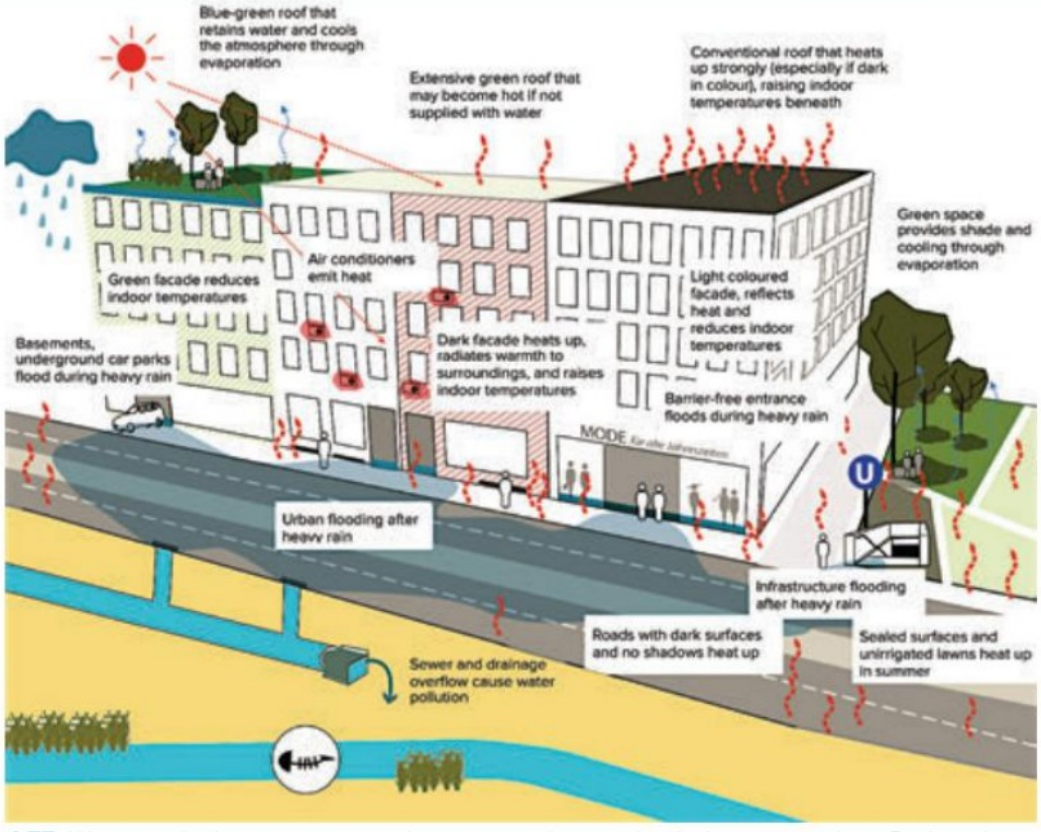
4.75 A green roof on a housing block in Rummelsburg.

4.76 New housing on the Stralau Peninsula is lined with gardens of rainfall-absorbing plants and porous gravel that allows infiltration of rainwater.

In Rummelsburg, buildings have been modified to have **green roofs** with vegetation growing on a layer of soil that is between six and eight centimetres in thickness. Water is drained from the roofs into **courtyard gardens** within the housing blocks, and beneath this soil layer of about 80 centimetres, underground garages have been constructed. The plants in the courtyard gardens absorb much of the water, and later release it into the atmosphere through transpiration.

Some buildings also have **green** (vegetation-covered) **facades** which further enhance the

retention of water. At street level, urban wetland gardens and roadside depressions known as **bio-swales** trap and retain water, and then cool the air by increasing rates of evaporation. Rummelsburg has no network of underground pipes for draining water. Instead, water flows from the road surfaces into the bio-swales, where it gathers in a depression before infiltrating down into the ground. The higher rates of **evaporation** that result from the sponge city measures mean that Rummelsburg is notably cooler than its surrounding suburbs, especially on hot summer days when it matters most to residents.



4.77 Ways in which sponge city techniques can be used to help cities such as Berlin adapt to warming temperatures and climate change. Source: Re-drawn from SenStadtUm/bgmr.

Some roofs are designed specifically to provide temporary water storage during heavy rain, storing it until it can be released gradually without a risk of flooding. Such roofs are known as **blue roofs**. In general, blue roofs are constructed on flat or very gently sloping roofs where urban flooding is a risk because so few permeable surfaces are available for rainwater to soak into the ground.

Water retention on blue roofs and green roof cover can be implemented either independently or together as a combined strategy. When green and blue roof strategies are combined on the same roof, they are known as **blue-green roofs**. Blue-green roofs are particularly suitable as a way to reduce the impact of warming temperatures and climate change. This is especially so when water is stored for longer periods of time, as storage can increase the rate of evapotranspiration from the roof during dry periods, thus contributing to cooling the city.

QUESTION BANK 4E

1. *List features of Berlin that show evidence of eco city design.*
2. *Compare the effectiveness of Berlin's sustainable urban planning with planning in Malmö. Giving evidence, suggest which of the two urban areas better fulfils the ideals of eco city design.*

Smart city design

A **smart city** is an urban area that uses **information and communication technology** (ICT) to enhance residents' ability to access and use the city's resources and infrastructure. Typically, smart cities **integrate** ICT with infrastructure such as transport, hospitals, schools, libraries, power plants, water supply networks, and so on, giving residents access to information and, in some areas, control through their smartphones, tablets, laptops and desktop computers.

The particular branch of ICT that is used in smart city design is IoT, or the **Internet of Things**. IoT involves the digital networking of physical devices, which might include buses, trains, buildings, machines, sensors, and of course computers that have the required network connectivity, software and sensors to enable a two-way information flow.

Smart city technology is used at two levels. At the **personal level**, members of the public can access technology to help them access information such as real-time data on trains and buses or energy costs that reduce their costs or improve their efficiency. At the **administrative level**, smart city technology

is **embedded** in government systems, providing urban planners with data that helps address **immediate problems**, such as traffic congestion, and information to assist with **long-term infrastructure development**. Smart city technology can be a valuable tool to reduce environmental pollution, conserve water resources, reduce energy use, relieve congestion in overcrowded areas, improve health care, mitigate traffic congestion, and much more.

Smart city designers use technology to collect data from two types of sources. First data is collected **directly** from IoT devices that have been installed for purposes such as monitoring energy use, traffic flows, pedestrian movements, lengths of queues, locations of buses and parking spaces that are available. Second, data is gathered from the **wider internet**, such as through discussions on **social media** where residents exchange opinions about the city, the problems they are facing and the places they like to visit to enjoy themselves.

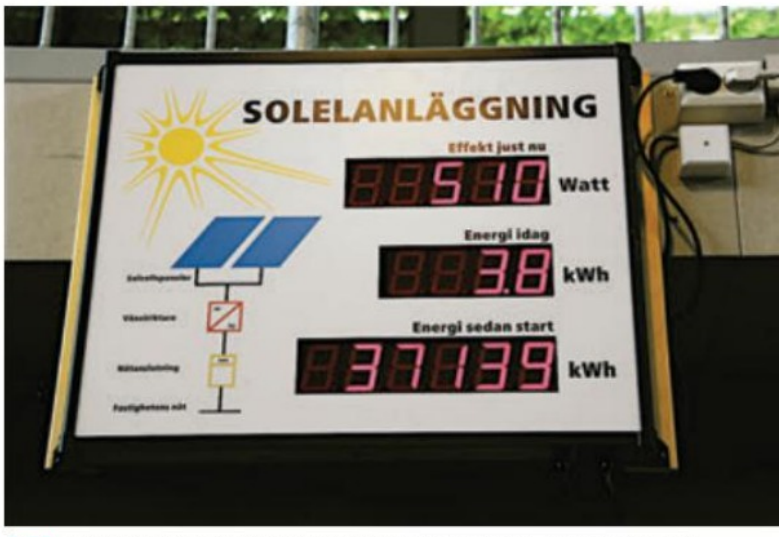
Despite the **high cost of investment**, smart city design brings **economic advantages** to urban places where it is used because of the **efficiencies** that can be obtained. Data can help administrators and planners decide which services can be obtained **more cheaply**, which will be **less wasteful** of resources and which are likely to produce **lower emissions**. This works most effectively when data is **shared openly**, such as using **cloud data** and **open-source technology**, because this enables the general population to contribute in meaningful consultations and make well-informed decisions that enhance the city's overall resilience and sustainability. However, the high cost of the investment needed means that smart city design is beyond the reach of cities in **developing countries** at this stage.

Smart city design can also help overcome some of the design problems of **older settlements**. For the past half century, many cities in the world have built wide freeways and high buildings, but these often have the effect of breaking up communities and isolating individuals within them. ICT can help to overcome these physical barriers by **building digital bridges** of communication, breaking down **social isolation**. This is sometimes referred to as **'massive small'**, which is the use of technology to create massive amounts of small-scale innovation.

4.78 In many cities, such as Chicago, Illinois, USA seen here, freeway construction has physically divided communities, leading to social dislocation and isolation. Smart city design can help to reduce these issues by building digital bridges and communication networks.

Smart city technology works in **five dimensions** of urban design:

- **Buildings** are designed to function sustainably using a mix of solar, wind and geothermal energy, automatically adjusting energy use to meet demand in the most efficient cost-effective manner that minimizes emissions. Sensors monitor power, heating, air conditioning, lighting, ventilation, elevators, fire detection systems and security, making any adjustment required to meet pre-set targets. The US state of Missouri replaced the separate control systems for its 1000+ buildings with one single integrated control system, and saved 30% on its maintenance and energy costs as a consequence.



4.79 This digital display provides workers in an office block in Malmö, Sweden, with a real time display of the building's use of solar energy.

- **Infrastructure** must be resilient and adaptable to changing conditions, and networked sensors play a pivotal role in monitoring factors such as traffic flow, water use, energy consumption and movements of people. London's Dockland Light Rail network operates with driverless trains that are centrally controlled through networked sensors. In Amsterdam, sensors adjust the brightness of street lighting according to weather conditions and traffic needs. In Birmingham, a specially designed app developed by hackers gathers data on leftover food in restaurants and professional kitchens that enables the food to be redistributed to shelters for homeless people.

- **Transport** is a key component of smart city design as cities grow and the potential for congestion increases. Real-time monitoring of traffic flows, electronic road pricing that varies according to traffic numbers and real-time network analysis can all help to relieve congestion delays, reduce emissions and improve safety. In Malmö, traffic lights have sensors that favour cyclists over cars so that cyclists riding at the optimum speed of 20 kilometres per hour should be able to ride for many kilometres without encountering a red signal.

- **Mobility** is enhanced with smart city design in several ways. Smart parking is the system where drivers receive updates via their smartphones on the nearest available parking spaces. Grab-and-go cars are becoming more common in many cities, which is a form of car sharing that is organized via smartphones or computers. Payments for road tolls are increasingly being handled by e-tags that automatically deduct the amount payable from the driver's account without having to stop or slow the car, while payments for parking are often handled by tap-and-go cards that are linked to the driver's bank account. Commuters who travel by bus or train are able to obtain real-time travel information on their smartphones in a growing number of cities, helping with travel scheduling and planning that avoids over-crowded vehicles. Barcelona is an example of a city that supports this technology with a city-wide freely accessible public wi-fi network with over 1,500 access points in public spaces, in parks, on buses and in metro stations.

4.80 Trains on the Docklands Light Rail in London, UK, operate without drivers, relying instead on a central, automated control system.

- **Energy** is a priority for smart city design as energy providers seek to provide the power needed in the most efficient, low-cost and non-polluting manner possible. Smart grids and smart meters help this process by monitoring energy demand and switching flows as soon as a need is detected. Demand is adjusted by introducing sliding cost scales for power based on real-time monitoring of energy use. Fujisawa SST (Sustainable Smart Town) on Tokyo's outskirts insists that every new house is equipped with solar panels and an energy storage system as a way of reducing carbon emissions.

Smart city design does not require **purpose-built settlements**, although new areas with optic fibre cables and fast wi-fi networks certainly help ICT and IoT to work quickly and effectively. Smart city design principles can be **retrofitted** in **existing urban areas**, and some examples where this has been done include:

- In **Hong Kong**, pedestrian crossings are controlled by sensors that monitor traffic flow.

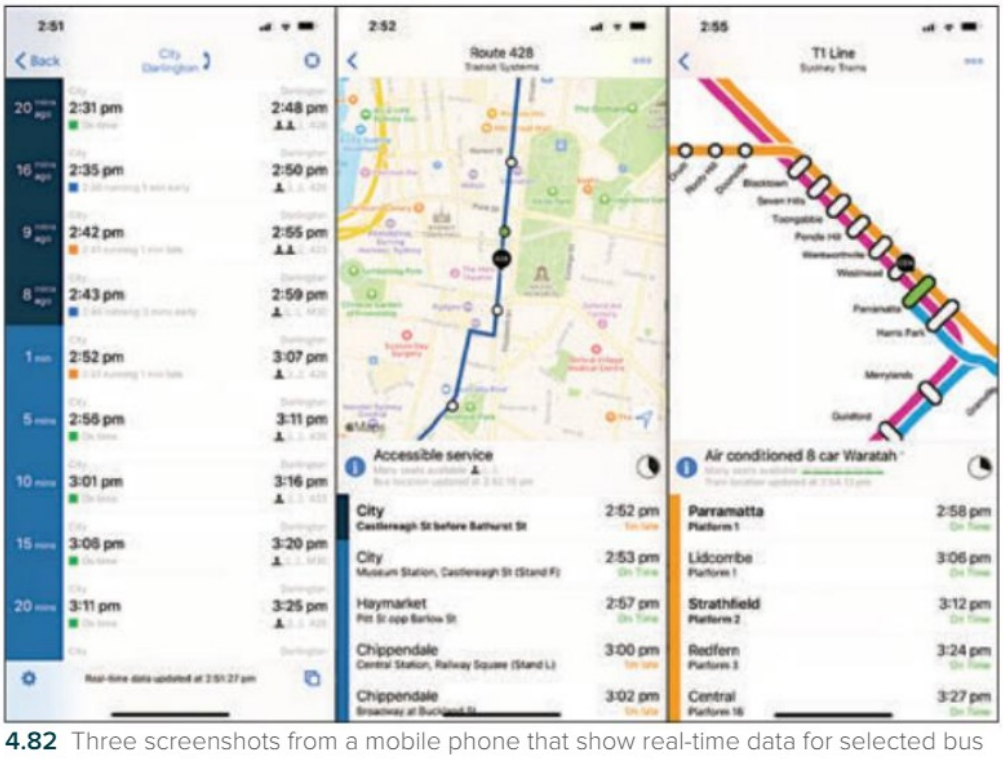
- In **Singapore**, sensors monitor traffic congestion and adjust the cycles of traffic signals to clear any congestion that is detected.

- In **Barcelona** (Spain), traffic lights are adjusted by sensors to allow emergency vehicles to proceed through intersections with priority.

- In **Malmö** (Sweden), bus stops provide passengers with a real-time display to let them know precisely when the next buses will arrive.

4.81 A real-time electronic display at a bus stop in Malmö, Sweden shows the waiting times for buses.

- In **Sydney** (Australia), all buses and trains are fitted with GPS sensors so passengers can access information on their precise locations and times using free smartphone apps.
- In **Milton Keynes** (UK), sensors on public rubbish bins notify waste collection authorities when they are full and require emptying.
- In **New York**, smart monitors are installed throughout the city to warn the population about potential problems or hazards, and to publicise community events.



4.82 Three screenshots from a mobile phone that show real-time data for selected bus and train routes in Sydney, Australia. On the left screen, the expected arrival times for buses are shown, with information about delays and the amount of crowding. On the middle screen, a map shows the location of a selected bus in real-time, taking data from the GPS tracker on the bus. The right screen shows the real-time location of an approaching train.

A leading expert on smart city design is Rick Robinson, the IT Director for Smart Data and Technology at Amey, a UK-based infrastructure and engineering services company. Robinson proposed a set of **23 principles** of smart city design:

Design Principles for Digital Urbanism

Principle 1: Consider urban life before urban place; consider urban place before technology.

Principle 2: Demonstrate sustainability, scalability and resilience over an extended timeframe.

Principle 3: Demonstrate flexibility over an extended timeframe.

Physical Infrastructures and Construction

Principle 4: New or renovated buildings should be built to contain sufficient space for current and anticipated future needs for technology infrastructure such as broadband cables; and of materials and structures that do not impede wireless networks. Spaces for the support of fixed cabling and other infrastructures should be easily accessible in order to facilitate future changes in use.

Principle 5: New or renovated buildings should be constructed so as to be as functionally flexible as possible, especially in respect to their access, infrastructure and the configuration of interior space; in order to facilitate future changes in use.

Connectivity and Information Accessibility

Principle 6: Any development should ensure wired and wireless connectivity is available throughout it, to the highest standards of current bandwidth, and with the capacity to expand to any foreseeable growth in that standard.

Principle 7: Any new development should demonstrate that all reasonable steps have been taken to ensure that information from its technology systems can be made openly available without additional expenditure. Whether

4.83 An automated streetside bicycle hire station in London. The bicycle hire scheme, which is designed to reduce traffic congestion and carbon emissions in London, is controlled by computer software that is also used by similar schemes in Montreal (Canada), New York and Washington DC (USA) and Melbourne (Australia).

or not information is actually available will be dependent on commercial and legal agreement, but it should not be additionally subject to unreasonable expenditure. And where there is no compelling commercial or legal reason to keep data closed, it should actually be made open.

Principle 8: The information systems of any new development should conform to the best available current standards for interoperability between IT systems in general; and for interoperability in the built environment, physical infrastructures and smarter cities specifically.

Principle 9: New developments should demonstrate that they have considered the commercial viability of providing the digital civic infrastructure services recommended by credible research sources.

Sustainable Consumerism

Principle 10: Any data concerning a new development that could be used to reduce energy consumption within that development, or in related areas of a city, should be made open.

Principle 11: Property development proposals should indicate how they will attract business and residential tenants through providing up-to-date sustainable infrastructures for heat and power such as CHP, smart metering, local energy grids and solar energy.

Urban Communities

Principle 12: Consultations on plans for new developments should fully exploit the capabilities of social media, virtual worlds and other technologies to ensure that communities affected by them are given the widest, most immersive opportunity possible to contribute to their design.

Principle 13: Management companies, local authorities and developers should have a genuinely engaging presence in social media so that they are approachable informally.

Principle 14: Local authorities should support awareness and enablement programs for social media and related technologies, particularly "grass roots" initiatives within local communities.

Principle 15: Urban development and regeneration programs should support the formation, activity and success of local food initiatives by cooperating with local community and business support programs to support the infrastructures they need to succeed and grow.

Principle 16: Residential accommodation should incorporate space for environmental monitoring, interactive portals, and connectivity to enable remote support, telehealth systems and homeworking.

Economic Development and Vitality

Principle 17: New developments should demonstrate through the use of the latest urban modelling techniques that they will increase connectivity – particularly by walking and cycling – between important value-creating districts and economic priority zones that are adjacent or near to them.

Principle 18: Developments should offer the opportunity of serendipitous interaction and innovation between stakeholders from different occupations.

Principle 19: Developments should provide, or should be adaptable to provide, facilities to enable the location and success of future ways of working including remote and mobile working, "fab labs", "pop-up" establishments and collaborative working spaces.

4.84 The Octopus card in Hong Kong is an example of smart technology that is integrated with many aspects of the city's geography. Octopus cards are contactless stored value smart cards that use encrypted transfers through RFID (radio frequency identification) chips. They were introduced to pay for trips on all forms of public transport in Hong Kong — buses, trains, trams, minibuses and light rail. Since their introduction, the uses of Octopus cards have expanded to include payments in car parks, supermarkets, convenience stores, fast-food outlets, parking meters, vending machines and petrol stations. Some schools also use Octopus cards to take students' attendance. Octopus cards can be recharged automatically from designated bank accounts. Similar, but less flexible, cards have been introduced in London, UK (the Oyster card) and Sydney, Australia (the Opal card).

Governance

Principle 20: Planning, usage and other policies governing the use of urban space and structures should facilitate innovation and changes of use, including temporary changes of use.

Privacy and public safety

Principle 21: Any information system in a city development should provide a clear policy for the use of personal information. Any use of that information should be with the consent of the individual.

Transport

Principle 22: Transport plans supporting new developments should demonstrate that they have not only provided for traditional transport demand, but also that which might be created by online business models and other social technologies.

Extensions

Principle 23: New developments should demonstrate that their design takes account of the latest best and emerging practices and patterns from Smarter Cities, smart urbanism, digital urbanism and place making.

These 23 principles, and smart city design in general, require broad, easy, open **access to data** and information to work. Universal (or at least widespread) **broadband connectivity**, such as through networked smartphones and optical fibre cables to homes and offices, is therefore of central importance to effective design and functioning of smart cities. Whatever changes in technology bring in the future — brain-computer interfaces, 3D printing, biotechnology, and more — a robust **communications network** will be required. This is why cities such as Amsterdam, Hong Kong, Seoul, Singapore, Stockholm, Taipei and Tokyo that are committed to smart city design are investing heavily in IoT devices, widespread public wi-fi and ICT networks.

QUESTION BANK 4F

1. *Define the term 'smart city'.*
2. *Outline the characteristics of smart city design.*
3. *Explain the difference between ICT and IoT.*
4. *What are the differences in the ways that smart city design assists private citizens compared with city administrators?*
5. *How do smart city planners collect data to assist with decision-making?*
6. *Explain why open access to data and information is important in smart cities.*
7. *Describe the benefits and the challenges of retrofitting smart city technology into older settlements.*
8. *Briefly describe each of the five dimensions of smart city design, and provide a working example of each.*
9. *Outline five examples where technology has been successfully retrofitted to older settlements.*
10. *Consider the 23 principles of smart city design. Giving reasons, suggest which three principles you think are the most important.*
11. *Are any of the 23 principles of smart city design unimportant or irrelevant in your opinion? Give reasons to explain your answer.*
12. *Is smart city design possible in areas where broadband networks are poorly developed? Explain your answer.*

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