.20 Urban waste and its disposal

In this section you will learn about:

- sources of urban waste
- the relation of waste components and waste streams to economic characteristics, lifestyles and attitudes
- the environmental impacts of alternative approaches to waste disposal

What a load of rubbish!

Look at Figure **1**. Up to one-fifth of all waste generated globally is likely to be from an urban area (municipal), although the proportions are estimates (measuring, let alone classifying waste is notoriously difficult). However, from the statistics available, it would appear that:

- on average, people in HICs produce 10 to 30 times more waste than those in LICs
- waste generation globally is growing exponentially.

Urban waste is not simply domestic rubbish, but also comes from industrial and commercial activity (Figure **2**).

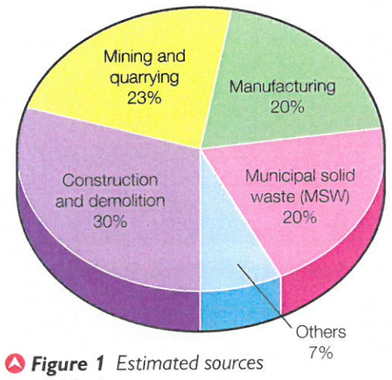

Figure 1 *Estimated sources of global waste*

Figure 2 *All sources of urban waste*

Source and type of waste	Related issues
Domestic (residential) waste is generated as a consequence of household activities such as cooking, cleaning, repairs, hobbies and redecoration. It includes empty containers, packaging, clothing, old books, paper and old furnishings.	This waste is categorised as biodegradable, recyclable or inert.
Municipal waste results from municipal activities and services such as street cleaning. It includes dead animals, market wastes and abandoned vehicles.	The term is more commonly applied in a wider sense to include solid domestic and commercial wastes – hence municipal solid waste (MSW) becoming synonymous with urban waste (see Figure **3**).
Commercial waste from offices, wholesale and retail stores, restaurants, hotels, markets, warehouses and other commercial establishments.	Again, this waste is categorised as biodegradable, recyclable or inert.
Animal and vegetable waste resulting from the handling, storage, sale, cooking and serving of food.	This waste quickly becomes putrid, producing strong smells and therefore attracting rats, flies and other vermin. It requires immediate attention in its storage, handling and disposal.
Institutional waste from institutions such as schools, universities, hospitals and research institutes. This includes wastes that are considered to be hazardous to public health and the environment.	Hospital waste is categorised as Risk or Non-Risk Waste. The latter includes 'sharps', in addition to infectious, pharmaceutical, chemical and radioactive waste. All require specialist disposal including incineration.
Ashes are the residues from the burning of wood, coal, charcoal, coke and other combustible materials for cooking and heating in houses, institutions and small industrial establishments. Ashes consist of a fine powdery residue, cinders and clinker, often mixed with small pieces of metal and glass.	When produced in large quantities at power generation plants and factories, these wastes are classified as industrial wastes.
Bulky waste include domestic furniture and 'white goods', commercial packaging and containers, and industrial crates, pallets and metal banding.	This waste require special collection.
Street sweeping waste includes paper, cardboard, plastic, dirt, dust, leaves and other vegetable matter.	The mixed nature of this waste usually makes separation of the biodegradable, recyclable or inert uneconomic.
Dead animals, both large and small, that die naturally or are killed accidentally.	If not collected promptly, dead animals are particularly offensive and a threat to public health because they attract flies and other vermin as they rot. Carcass and animal parts from slaughterhouses are regarded as industrial wastes.
Construction and demolition waste consists mainly of earth, stones, concrete, bricks, timber, roofing and plumbing materials, heating systems and electrical wires.	If not recycled, this waste will make up a significant proportion of landfill.
Industrial waste covers a vast range of substances which are unique to each industry. Major generators of industrial solid waste include thermal power plants (coal ash), integrated iron and steel works (slag) and pulp and paper industries (lime).	

Municipal solid waste (MSW)

Municipal solid waste (MSW) is known commonly in the UK as refuse or rubbish (Figure **3**). Most definitions do not include industrial waste, agricultural waste, medical waste, radioactive waste or sewage sludge. Furthermore, the composition of MSW varies greatly from country to country and changes significantly through time. For example, at the start of the twentieth century, the majority of domestic waste (53 per cent) in the UK consisted of coal ash from open fires. Nowadays, in HICs and NEEs (without significant recycling activity), MSW predominantly includes food wastes, market and street wastes, plastic containers and product packaging materials, and other miscellaneous solid wastes from residential, commercial and institutional sources.

Type of waste	Examples
Biodegradable waste	Food and kitchen waste, green waste and newspaper (most can be recycled although some plant material may be excluded if difficult to compost)
Recyclable materials	Paper, cardboard, glass, bottles, jars, tin cans, aluminum cans, aluminum foil, metals, certain plastics, fabrics, clothes, tyres and batteries
Inert waste	Construction and demolition waste, dirt, rocks and debris
Electrical and electronic waste	Electrical appliances, light bulbs, washing machines and other 'white goods', TVs, computers, mobile phones, alarm clocks and watches
Composite wastes	Waste clothing, drinks cartons and waste plastics such as toys
Hazardous waste	Most paints, chemicals, tyres, batteries, light bulbs, electrical appliances, fluorescent lamps, aerosol spray cans and fertilisers (Figure **4**)
Toxic waste	Pesticides, herbicides and fungicides
Biomedical waste	Expired prescription (pharmaceutical) drugs

Figure 3 *A typical classification of MSW*

Figure 4 *Assorted hazardous waste material awaiting recycling*

Waste streams

Both the nature of waste and its 'journey' from source to disposal will vary according to the economic characteristics, lifestyles and attitudes prevalent within any particular society. The complete flow of waste from its domestic, commercial or industrial source, through to recovery, recycling or final disposal is known as a **waste stream**. In HICs, this is increasingly regulated and managed. However, in most LICs and NEEs indiscriminate and improper dumping of MSW without treatment is particularly common. This raises several serious environmental issues including:

- loss of recyclable resources such as metals, plastic and glass
- loss of potential resources such as compost from organic waste, and energy from controlled incineration
- contamination of land and water bodies (from **leachates**)
- air pollution due to emissions from burning and the release of methane from decomposition
- multiple risks to human health (including respiratory problems, skin and other diseases).

Did you know?

Ninety per cent of all products bought become waste within six months of purchase!

Global waste trade

The **global waste trade** is the international trade of waste between countries for its disposal, recycling or further treatment. The trade is predominantly from HICs of the North to NEEs and LICs of the South. A notable exception is the THORP reprocessing plant at Sellafield in Cumbria. It imports used nuclear (power) fuel rods from all over the world in order to extract reusable uranium and plutonium (see 5.19).

Critics of the global waste trade claim that inadequate regulation has allowed many NEEs and LICs to become toxic dumps for hazardous waste. Most of the world's most dangerous and toxic wastes are produced by western countries (such as the USA and in Europe), yet people in countries that produce little or no toxic waste suffer negative health effects. NEEs and LICs do not always have safe recycling processes or facilities, and workers process the toxic waste with their bare hands, leading to both illness and death (Figure **5**).

Also, hazardous wastes are often not disposed of properly or treated, leading to poisoning of the surrounding environment and disastrous effects upon natural ecosystems. For example, an estimated 50 million tonnes of waste electrical and electronic equipment (WEEE) are produced each year, the majority of which comes from the United States and Europe. Most WEEE is shipped to NEEs and LICs in Asia and Africa to be processed and recycled. Heavy metals, toxins and chemicals leak from these discarded products into surrounding waterways and groundwater, poisoning the local people. Workers in the dumps, local children searching for items to sell and people living in the surrounding communities are all exposed to dangerous health risks as a consequence.

Figure 5 *Workers in New Delhi, India dismantle obsolete computers and extract valuable materials such as nickel and copper with their bare hands*

Manila, the Philippines

Manila in the Philippines is typical of an NEE facing major waste-disposal problems. It is estimated that only around 10 per cent of Manila's waste is (officially) recycled or composted, leaving thousands of tonnes of MSW generated daily to be disposed of. Four-fifths is collected and transported to vast landfill sites – the rest is burned or dumped illegally.

Look at Figure **6**. Payatas is the largest of Manila's landfill sites – six mountains of rubbish tens of metres high covering 200 hectares! Opened in 1973, it remains in use despite being officially closed following a collapse during a rainstorm in July 2000 which killed over 200 people. More than 80 000 slum dwellers live around Payatas – their lives blighted by the stench, and drinking water contaminated with heavy metals, lubricants and solvents. Over 4000 waste-pickers face severe health problems including typhoid, hepatitis, cholera and other infectious diseases.

Figure 6 *Waste disposal, Manila, Philippines. Over 4000 waste pickers, including children as young as five, sort through rubbish at Payatas landfill site. They sell what they find to dealers who resell to manufacturers to produce new products from the waste.*

Alternative approaches to waste-disposal

Given the potentially harmful environmental impacts of the phenomenal quantities of MSW produced in urban areas, effective management is essential. Disposal methods vary globally according to location, economic and political circumstances.

EU and UK government legislation and targets relating to submarine dumping, landfill, incineration and recycling are both strict and regularly reviewed. For example, in the UK, submarine dumping of sewage sludge has been prohibited since 1998 and radioactive waste since 1999. The latter is buried in steel-clad or concrete and lead-lined vitrified glass containers (see 5.19). Only fish wastes and inert material of natural origin such as rock and mining wastes are now dumped at sea. Indeed, over 99 per cent of submarine dumping is locally-generated sediment resulting from the dredging of harbours and their approaches to ensure they are navigable. (In order to minimise ecological impacts on the sea bed, most dredged material is dumped at established sites. It is also used for beach nourishment or land reclamation.)

Nowadays, incineration and recycling tend to be the first thoughts in waste management. Yet burial in landfill remains the most usual fate of MSW whether directly or following extraction of recyclable waste in materials recovery facilities (MRFs). But landfill sites in HICs are not the vast, hazardous waste mountains typified by Manila's Payatas in the Philippines (Figure **6**). A modern sanitary landfill is not a dump, but more usually a well protected, engineered facility distant from built-up areas. Most commonly, after the waste is dumped, it is compacted by large machines and then sealed with plastic sheeting before burial under top soil. Health, safety and environmental controls are strict and so associated pollution minimised. The arguments for and against landfill, incineration and recycling are nothing if not powerful! (See Figure **7**.)

Finally, composting, resource and energy recovery targets feature explicitly in many new initiatives given ambitions for a more sustainable future (Figure **8**).

Landfill

For

- Makes good use of abandoned quarries
- Easily managed
- Methane can be vented and used as a fuel
- On reaching capacity can be sealed, top-soiled and landscaped for recreational use
- Cost-effective and relatively safe if managed efficiently

Against

- Attracts vermin, flies and scavenging birds
- Wind-blown material becomes unsightly litter
- Burying organic waste leads to anaerobic decay
- Subsidence is common as the waste degrades
- Produces methane – a powerful greenhouse gas
- Leachates percolating into groundwater can be toxic
- Heavy, dirty lorry traffic is generated
- Smell is unpleasant, particularly in hot weather

Incineration

For

- Produces energy from burning MSW
- Heat, steam and ash produced are valuable resources
- Requires far less land than landfill sites
- Long life span
- Cost-effective once constructed and operational
- Safe disposal of hazardous waste such as medical waste

Against

- Particulate emissions require managing
- Chimney emissions can be toxic if not managed
- Carbon dioxide emissions are a greenhouse gas
- Not all MSW is combustible

Recycling

For

- Doorstep 'wheelie-bin' collection sanitary and safe
- 'Single-stream recycling' – all recyclable materials in one bin popular and convenient
- Organic waste can be composted and sold to enrich garden soil
- 'Resource recovery' implicit given reprocessing of recycled materials into new products
- Supports associated niche markets such as architectural salvage
- More recycling means less landfill

Against

- Public collection points, such as bottle banks, can generate litter
- Public recycling facilities require expensive, safe operation to avoid hazardous leakage – acid in batteries and CFC gases in old fridges
- Public resistance if separately charged
- Public separation of paper, (washed) plastic, metals, garden waste and landfill inconvenient and prone to error
- Electrical and electronic waste (WEEE), such as computers, contain toxic components including lead, cadmium and beryllium, so careful dismantling is essential

Figure 7 *Arguments for and against landfill, incineration and recycling*

Energy from Waste (EfW), Lincoln

Lincolnshire's £125 million Energy from Waste facility started operating in July 2013. The site processes 462 tonnes of MSW every day that would otherwise be dumped in landfill. Eleven MW of electricity is generated, enough to power 15 000 homes each year! The 24-hour facility employs 33 people and the visitor centre is a popular educational resource. All ash is recycled and air pollution is minimal and strictly controlled (Figure **8**).

Figure 8 *Lincolnshire's Energy from Waste facility, North Hykeham, Lincoln*

Waste management in Bristol

Bristol is the largest city in the south-west of England with a population expected to reach 500 000 by 2029. The UK's first city to be awarded European Green Capital status (2015), it is committed to a programme of radical economic, social and environmental changes, so improving quality of life markedly for its citizens. Urban regeneration, a changing economic structure, improved (integrated) transport infrastructure, new green spaces, and cultural and sporting facilities are transforming this 'core city.' Increasingly efficient waste management is an integral element of this overall strategy (Figure **9**).

Bristol City Council committed to:

- reducing the amount of waste generated per household by 15 per cent
- reducing the amount of MSW sent to landfill
- increasing waste recycling to 50 per cent.

Initiatives include specialised kerbside collections of recyclable waste, exacting targets for waste management contractors and recycling education in schools. Furthermore, the Avonmouth waste treatment plant processes 200 000 tonnes of MSW per year, incinerating enough non-recyclable waste to generate electricity for nearly 25 000 homes.

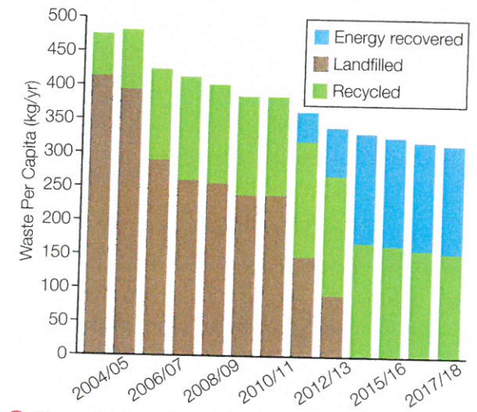

Figure 9 *Existing and projected changes in Bristol's waste management*

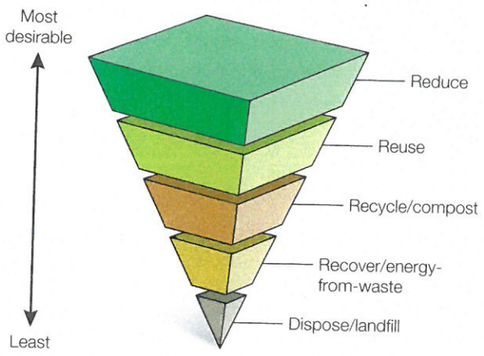

Figure 10 *The 3Rs – reduce, reuse and recycle*

ACTIVITIES

1 Suggest reasons for the following statements:
   - **a** On average, people in HICs produce 10 to 30 times more waste than those in LICs.
   - **b** Waste generation globally is growing exponentially.

2 Outline the political, economic, social and environmental arguments for reducing landfill, but increasing recycling and incineration.

3 Look at Figure **10** and again at Figure **7**. Discuss the following statement.
   'The key to sustainable MSW management is the *3Rs* – reduce, reuse and recycle.'

4 Study Figure **9**. Describe the existing and projected changes in Bristol's waste management.

STRETCH YOURSELF

Read section 4.26 on the *circular economy*.
To what extent could the circular economy be a way forward in addressing environmental issues associated with urbanisation?