Energy from burning waste
Where does all my non-recyclable waste go?

People produce enormous amounts of waste. The World Bank has estimated that, averaged across the Earth, each person produces more than 1kg of waste per day, but this is uneven, some regions producing far more waste than others.
Methods of waste management differ from region to region and have changed over time, but modern methods usually involve the 'three Rs' of 'reduce, reuse and recycle'. These three aim to extract the greatest value from the waste and dispose of the minimum amount of material.
However, there is still some waste that cannot be recycled or reused:

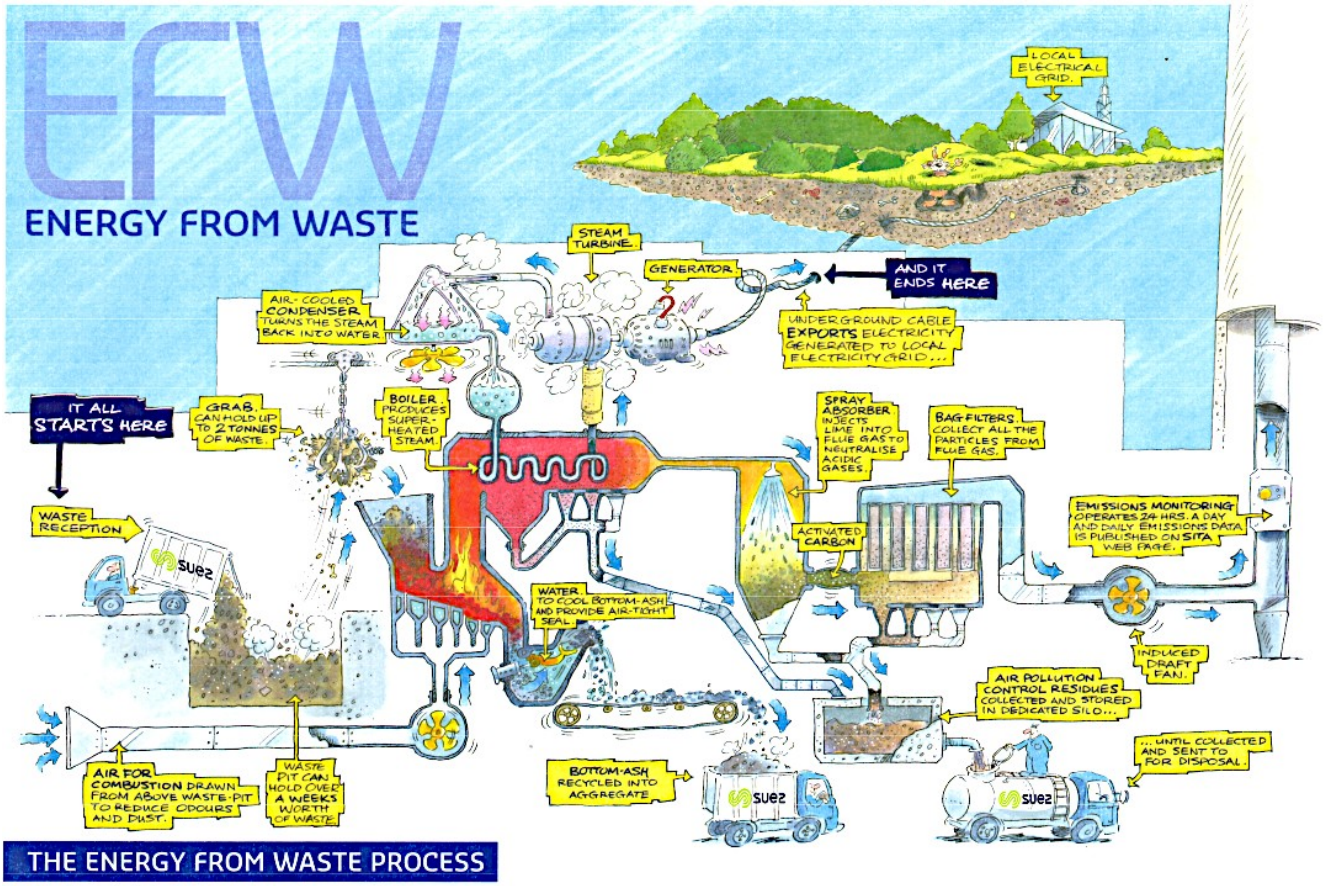
- domestic waste
- inert waste - chemically unreactive e.g. building rubble
- toxic waste - chemically reactive, e.g. paint, oils, chemicals
- radioactive waste - this releases damaging radiation for thousands of years or more.

Domestic waste
In many countries non-recyclable or re-usable waste is disposed of in landfill sites – often old quarries or brick pits but these are finite in number and have to be managed carefully.

However, in many areas of the world, domestic waste is burned to produce electricity.

Edmonton Waste Incinerator, North London

Ask the pupils to study the diagram below and make a table to show all the processes that are happening. For each process, give a tick if carbon dioxide emissions are zero and a cross if they are not.
Use the table on page 2 to explore the processes with the pupils adding extra information.



Northumberland County Council

Processes:	
waste arrives by lorry (probably burning diesel) and is put into a waste pit	x
mechanical grab (probably burning diesel) collects waste	x
grab puts waste into the furnace	x
waste is dried before being burned at temperatures around 1,000°C; if the burn temperature is allowed to drop too low, dioxins can be produced (dioxins are persistent organic pollutants POPs)	√
air for combustion is drawn from above the waste pit to reduce odours and dust	√
hot flue gases pass through a boiler, and are mixed with water to create steam. This super-heated steam goes to a steam turbine	√
steam drives the steam turbine	√
exhaust steam returns through an air-cooled condenser which turns steam back into water - a closed-loop system	√
steam turbine drives the generator which produces electricity	√
underground cable exports electricity to the local grid	√
water cools the Incinerator Bottom Ash (IBA) and provides an air-tight seal	√
IBA travels on conveyor to a storage pit; magnets extract iron-rich metals which are recycled	√
IBA is recycled into aggregate and taken away by lorry	x
flue gases, produced by burning, are sprayed with lime to neutralise acidity (process of making lime emits CO_2)	x
gases pass through activated carbon which picks up residual contaminant gases, such as nitrogen compounds	√
bag filters collect all the particles from the flue gases	√
residue flue gases from the boiler and from the filters are collected by lorries and stored in dedicated silos – the bulk is very small compared with the bulk of the original waste	x
flue gases pass through an induced draught fan to an exhaust pipe; they are monitored 24 hours a day and the data are published on a web page	√

Back up

Title: Energy from burning waste

Subtitle: Where does all my non-recyclable waste go?

Topic: Discussion about the treatment of domestic waste

Age range of pupils: 14 years upwards

Time needed to complete activity: 30 minutes

Pupil learning outcomes: Pupils can:
- realise that people produce an enormous amount of waste;
- realise that waste has to be managed in a way that does least harm to the environment;
- explain that modern methods of waste management usually involve the ‘three Rs’ of ‘reduce, reuse and recycle’;
- explain how electricity can be produced by burning domestic waste;
- describe how the gases and residues from burning are managed to keep pollution to a minimum.

Context:
The population of the world is increasing rapidly and with it the amount of waste material. It is vital that modern technologies are developed not only to manage the waste but also to ensure that no harmful by-products are allowed to pollute the air or the ground. We must re-cycle as much as possible and mitigate the effects of non-recyclable material.

Following up the activity:
- Research what happens to the domestic waste in your area. Details are usually given on local websites.
- Discover what happens to the recycled material in your area. Is plastic sent overseas and, if so, what happens to it?

Underlying principles:
- People produce an enormous amount of waste.
- Modern methods of waste management usually involve the ‘three Rs’ of ‘reduce, reuse and recycle’.
- Available landfill sites are becoming scarce in many countries.
- Increasingly, much domestic waste is burned to produce electricity.
- Where domestic waste is burned, harmful gases and residues are kept to a minimum.
- Producing electricity from waste instead of using fossil fuels such as coal, gas, and oil, helps to reduce greenhouse gas emissions.
- Countries differ enormously in how they manage their waste material.

Thinking skill development:
A pattern emerges when investigating how a waste disposal incinerator works. Discussion of all the stages of the process involves metacognition and may include cognitive conflict. Applying what happens in the diagram to the real world is bridging.

Resource list:
- diagram of a waste disposal incinerator
- access to the internet

Useful links:
Any UK County Council's website.
Search ‘net-zero’ on the Earthlearningidea website to find other Earthlearningideas relating to climate change mitigation or adaptation. A list is shown on the next page.

Use a search engine like Google to explore the internet for more information about likely global impacts of ‘net-zero’. You can access a tool to help visualise how climate change might affect your local area in the UK at:
https://www.bbc.co.uk/news/resources/idt-d6338d9f-8789-4bc2-b6d7-3691c0e7d138

Source: Elizabeth Devon of the Earthlearningidea Team with reference to Exploring Geoscience across the globe, IGEO
http://www.igeoscied.org/teaching-resources/geoscience-text-books/

This information was as accurate as possible in spring 2021.

The ‘How will the ‘net-zero’ target affect your local area?’ series of Earthlearningideas

Topic			Earthlearningidea title
Introduction			How will the ‘net-zero’ target affect your local area?
Possible mitigation measures	Use alternative energy sources	Solar	Harnessing the power of the Sun
		Wave	Harnessing the power of waves
		Wind	Farming the wind: through onshore and offshore windfarms
		Tidal	Tidal energy
		Nuclear	Nuclear power - harnessing the energy of the atom
		Nuclear waste	Nuclear waste disposal
		Biofuel	Liquid biofuels: keeping our wheels turning into the future
		‘Blue’ hydrogen	Blue hydrogen: the fuel of the future? *Also:* Hydrogen of many colours
		Geothermal – hot rocks	Deep geothermal power from ‘hot dry rocks’: an option in your area?
		Geothermal – flooded mines	A new use for old coal mines
		Hydro – small scale	Small-scale hydroelectric power schemes
		Heat pumps	Heat from the Earth
		Waste – incineration	Energy from burning waste
		Waste – methane	Energy from buried waste
	Stop fuels releasing greenhouse gases	Carbon capture	Capturing carbon?
	Store energy from sources that give irregular energy supplies	Batteries	Nuclear batteries: the future?
		‘Green’ hydrogen	Green hydrogen used to even out renewable energy supplies? *Also* Hydrogen of many colours
		Hydro – storage	Matching supply and demand using stored water
		Compressed gas	Storing gas underground: What can we store? How can we do it? How will it help?
	Provide raw materials for new technologies	Electric vehicles	Electric vehicles: the way to go?
		Insulation	How do I choose the best insulation?
	Remove carbon form the atmosphere	Enhanced weathering	Speeding up nature to trap carbon dioxide
		Tree planting	Let’s plant some trees
Possible adaptation measures		Coastal flooding	How will rising sea level affect our coastlines?
		Inland flooding	Inland flooding: a Sheffield case study
		Landslides	Landslide danger
		Agriculture	The future for global agriculture