

## Energy from buried waste: Landfill gas

Landfill is where we dispose of waste material – by burying it in holes in the ground. These are usually disused stone quarries or clay pits, where clay had been dug for making bricks or pottery. If the waste materials are of organic origin, such as food waste, paper, wood or cloth, then it will gradually break down and generate gases, including methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>). If these are allowed to escape into the atmosphere they will act as greenhouse gases. They can, however, be trapped in the landfill and piped out to burn the methane as a fuel or to be used to generate electricity.

A good example of this is at the former brickworks at Stairfoot, 2 miles from the centre of Barnsley in South Yorkshire.



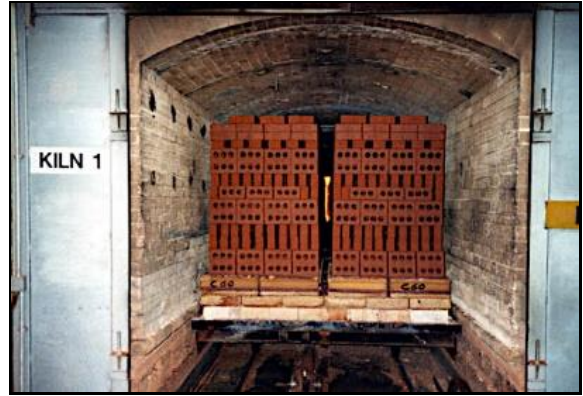
Stairfoot brickworks. The foreground is landfill in a former clay pit. The dark mound is a vast compost heap and finished bricks are stacked to the left of the picture.

As their clay pits became exhausted, the firm allowed the town council to use the hole to dispose of domestic waste, containing a lot of organic material. This was done carefully, in cells; pipes were laid to collect the gases and the whole mound was covered with impermeable clay.



The clay pit being prepared to receive landfill

As the gases were given off they were piped to the brick kilns and the methane used to bake the clay into bricks. This saved the company about one third of its use of natural gas, which is a fossil fuel.



Bricks emerging from the heat of the kiln

In addition, the brickworks manager invited the local primary school children to plant willow cuttings on top of the landfill mound. Willow grows very quickly and the intention was for the willow trees to be harvested, chipped into small fragments and used to fire the school's boilers.



The clay pit reclaimed after landfill. In the foreground it has been grassed over: in the background willow cuttings have been planted.

Finally, the company asked the local council to bring its garden waste from its parks and flower beds to turn into garden compost on a big scale. Some of the brickyard machinery was not in use all the time and could spend a few minutes each day turning the compost heap as it heated up and destroyed the weed seeds.



The manager explaining the compost making process. He is holding a long temperature probe for testing the heap.

Study the pictures and discuss this project. Then decide which of the activities were releasing

greenhouses gases to the atmosphere. Which were helping to reduce emissions of greenhouse gases in comparison to using fossil fuels? Which were failing to collect the gases from landfill?

Show your suggestions by a tick and a brief comment in the table below:

Activity	Releases carbon	Neutral	Reduces carbon
Bringing waste from the local area to Stairfoot			
Building up the landfill and capping it off			
Decay of organic waste in capped-off landfill			
Trapping of gases and piping them to the kilns			
Burning of landfill methane in the kilns			
Less use of fossil natural gas in the kilns			
Use of willow chips in school boilers			
Making garden compost from organic waste			

### The back up

**Title:** Energy from buried waste.

**Subtitle:** Landfill gas.

**Topic:** A case study of good practice by an industrial firm to try to reduce its use of fossil fuels and to assist the local community in reducing its carbon footprint.

**Age range of pupils:** 14 years upwards

**Time needed to complete activity:** 30 minutes

**Pupil learning outcomes:** Pupils can:

- explain how gas generated from landfill can be trapped and used as a source of fuel; explain

that methane from landfill is not a fossil fuel, but is a greenhouse gas;

- understand that the use of landfill gas is not entirely carbon-neutral but does cut down on the need for fossil fuels;
- understand that forward-looking industrial firms seek ways of reducing their fuel bills and carbon emissions.

### Context:

It is vital that modern technologies are developed not only to manage waste but also to ensure that minimal 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.

Suggested answers to the activity table are shown below:

Activity	Releases carbon	Neutral	Reduces carbon
Bringing waste from the local area to Stairfoot	√ Diesel lorries, although the landfill site is not far from the urban centre		
Building up the landfill and capping it off	√ Diesel earthmovers		
Decay of organic waste in capped-off landfill		√ Few gases will escape if the landfill is well-managed during construction	
Trapping of gases and piping them to the kilns		√ Few gases will escape from the pipework	
Burning of landfill methane in the kilns	√ CO <sub>2</sub> is released when methane is burned but is a less potent greenhouse gas than the methane		
Less use of fossil natural gas in the kilns			√ Although CO <sub>2</sub> is produced it is less than that from fossil fuels alone
Use of willow chips in school boilers			√ Saves on fossil fuel (coal in this case)
Making garden compost from organic waste			√ Saves waste going to landfill and thus avoids generation of methane

**Following up the activity:** Not all former quarries or brick pits are suitable for landfill. The disused quarry in the photograph below is in attractive moorland in the Peak District near Sheffield. In 1960, Sheffield City Council proposed to use it for landfill, but this was opposed by the Council for the Preservation of Rural England. So a large incinerator was built in the industrial part of the city instead.



Brown Edge Quarry, Ringinglow, near Sheffield.

Suggest the reasons given by the people who were opposed to the plan to use this quarry for landfill (*Possible answers: Heavy traffic bringing in waste, destroying delicate moorland habitat, disturbance to wildlife, smell, noise, water pollution, loss of a geological site for research and education*)

It is just as well that the quarry is still there for geologists to investigate and to educate geology

students. Indeed, it features in the Earthlearningidea workshop video, *Any Quarry Guide!*

[https://www.earthlearningidea.com/Video/V36\\_Quarry1.html](https://www.earthlearningidea.com/Video/V36_Quarry1.html)

**Underlying principles:**

- Landfill gas typically contains 45% to 60% methane and 40% to 60% carbon dioxide by volume, with small amounts of other compounds.
- Landfill gas reaches peak output about 2 years after completion of the fill and continues to produce gases for about 15 years.
- The gas from one million tonnes of landfill can produce up to 0.78 MW of electricity, or the equivalent in heat.

**Thinking skill development:**

A pattern develops as pupils work through the process of managing the landfill site. Discussion of the release or reduction of greenhouse gases involves metacognition and will include cognitive conflict as pupils disagree. Applying the process to the real world involves bridging

**Resource list:**

- these pages on paper or on a screen
- access to the internet

**Useful links:** [Ref to ELI "Energy from waste"](#)

**Source:** Peter Kennett of the Earthlearningidea team. All photographs by Peter Kennett

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