

POWER FROM RUBBISH

These are two examples of large municipal waste incinerators with energy recovery.

Saint Ouen in Paris

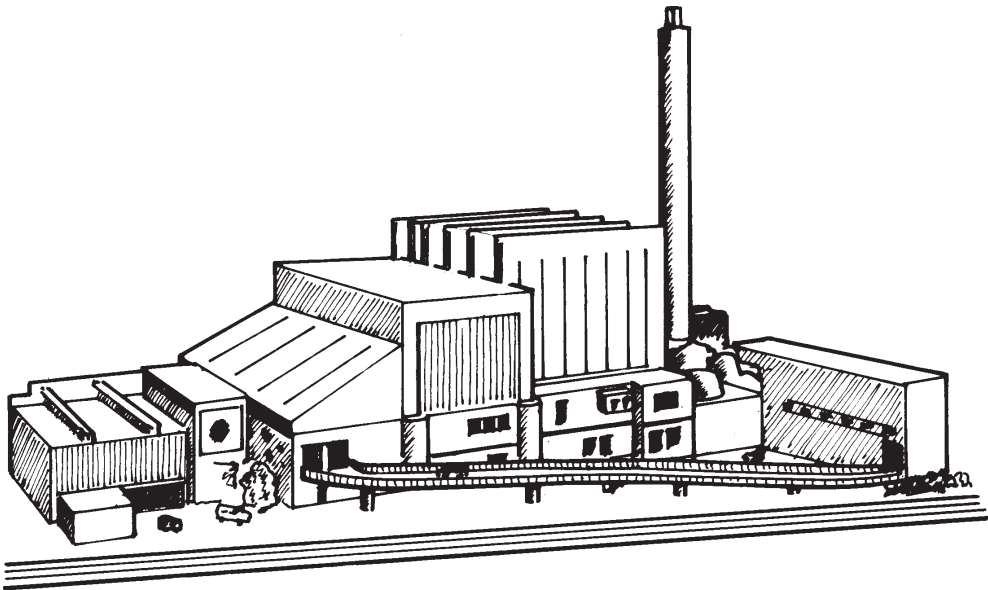
This large waste-to-energy plant is one of two in Paris providing heat to 70,000 apartments through a district heating scheme. A district heating scheme has a large boiler (the incinerator) and a network of heat mains taking hot water to buildings in the locality.

Saint Ouen also generates electricity which is sold to Electricite de France. The income from sales of heat and electricity helps to reduce the cost of waste treatment and disposal. The plant burns 2,000 tonnes of waste per day.

South East London Combined Heat and Power (SELCHP)

This is the UK's most modern waste-to-energy plant. It is designed to burn 420,000 tonnes of waste each year from the London boroughs of Lewisham and Greenwich and neighbouring areas. SELCHP produces heat and power like the plant in Paris.

One of the most important benefits of this plant is that it reduces the tonnage of waste that has to be transported then dumped in landfill sites outside London. One tonne of ash is produced from every four tonnes of waste burnt in the plant. The ash is inert and unlike untreated waste it will not produce potent greenhouse gases such as methane when dumped in landfill sites.



KEY POINTS

- Large incinerators are sited in large conurbations where there is a large supply of waste.
- Waste incinerators with energy recovery can produce electricity and useful heat.
- Heat is distributed through a district heating system to local buildings.
- Incinerating waste reduces the tonnage of material that needs to be dumped.
- The ash from incinerators is a safer material to dump than untreated waste.

INCINERATOR SITING EXERCISE

TASK

The task is to identify the pros and cons of three potential sites for a municipal solid waste incinerator with energy recovery in the fictional area of Burfield.

You should then make your recommendation for the best site for the incinerator. Your findings should be presented in a report which should include maps and charts where appropriate.

You have been provided with a map that shows the area of Burfield. The map has been coded to show the quantities of municipal solid waste that are produced in each kilometre square. This map also shows main trunk roads, railways, landfill sites and three alternative sites for a waste incinerator with energy recovery. Three large-scale maps show the immediate area around each alternative site for the incinerator with the location of possible large consumers for heat produced by the incinerator and the access to the sites.

You have also been provided with guidance notes for the siting of waste incinerators and a technical specification of this particular incinerator.

For each site you should:

- identify the size of the catchment area required to deliver 420,000 tonnes of waste per year in square kilometres.
- estimate the annual costs of transporting municipal solid waste to each site assuming that the average cost of delivery is £12,000 per square kilometre.
- estimate the annual costs of transporting ash to available landfill sites. You should assume that landfill sites 2 and 8 will take the majority of the ash and that transport costs are 50p per tonne-kilometre for road transport (measure distances along trunk roads) and 20p per tonne-kilometre for rail.
- examine the access to the site and whether it is likely to cause disturbance to the local community.
- identify the capital costs of heat mains to deliver heat from the incinerator to potential consumers (heat mains with flow and return pipes in a single trench cost approximately £100 per metre running along the sides of roads). You should compare these costs with the income generated from sales of heat to these potential customers.
Capital cost divided by the annual income gives payback period in years.
- you should try to identify any additional factors that would affect the siting of the incinerator, particularly impacts on the local community and environment. You should also briefly outline how you might reduce the impact on the local community and environment of the site you finally chose.
- Summarise your findings on the attached matrix.

	Site A	Site B	Site C
Size of catchment area (km ²)			
Waste delivery costs (£)			
Ash transport costs (£)			
Road access (good/fair/poor)			
Payback on district heating (years)			

MUNICIPAL SOLID WASTE INCINERATOR -
TECHNICAL SPECIFICATION

Refuse throughput	420,000 tonnes per annum 2 waste streams 29 tonnes per hour
Storage capacity	5000 tonnes (4 days full plant capacity)
Lorry movements	180 in and 180 out per working day (i.e. not holidays or weekends) between 7 am and 8 pm.
Number of tipping bays	11
Steam output	420,000 tonnes of steam per hour at 395 degrees Celsius and 46 bar
Flue gas treatment	Semi-dry lime scrubbers followed by high performance Bag House type filters, ejecting into a double flue 100 metre chimney.
Odour controls	Tipping halls and storage areas are kept under negative pressure to prevent odours escaping.
Ash and residues	Residues are reduced to 25% of the weight of the waste input. Residues are mainly ash from burning the waste and solid matter resulting from the flue gas treatment. Ferrous metals are recovered from the ash for recycling (5% of input tonnage).
Operating staff	55 persons
Site area	2.5 hectares
Design and construction costs	£85 million
Electricity generation	Maximum export capacity 32 MW generating 200,000 MWh per year.
District heating	Maximum export capacity 50 MW providing 370,000 MWh of heat per year - sufficient for over 7500 homes.

GUIDANCE FOR THE SITING OF MUNICIPAL SOLID WASTE INCINERATORS

Size of site

At least 2 hectares.

Catchment area

Incinerators are usually only considered viable with a minimum waste input of approximately 200,000 tonnes per year to a single plant, equivalent to the waste generated from around 500,000 people.

To compete successfully against other disposal options, the incinerator will need to be as close as possible to where the waste is collected in order to minimise costs for the companies delivering the waste to the incinerator. The maximum economic distance for delivery of waste is 15 km but an optimum distance would be under 5 km. Therefore only sites in large urban areas need be considered.

Access

It is likely that most waste will be delivered by lorry resulting in large numbers of vehicle movements each day. This means that there needs to be good road access that does not pass through residential areas. The incinerator will produce large quantities of ash (20%-30% of the input tonnage) which will need to be disposed of to landfill sites. This ash could be taken away from the incinerator by road or rail.

Energy production

Incinerators can be used to generate both useful heat and electricity.

In the case of heat (usually in the form of hot water or steam), there need to be consumers of the heat in the locality of the incinerator (within 4 km). These might be industrial users who need process heat in the form of steam at or below 400 degrees Celsius and a pressure of 40 bar. They could also be domestic users who would use the heat for space and water heating. In the case of domestic users they are most likely to be living in existing complexes of high rise flats which have central boiler plant. Other possible uses for the heat are swimming pools and hospitals.

Electricity would be sold to a Regional Electricity Company (REC) or to a large industrial user neither of which need to be near the incinerator. RECs might buy the electricity as part of their obligation to buy electricity generated from non-fossil fuels, in which case the price for the electricity will be increased by a subsidy.

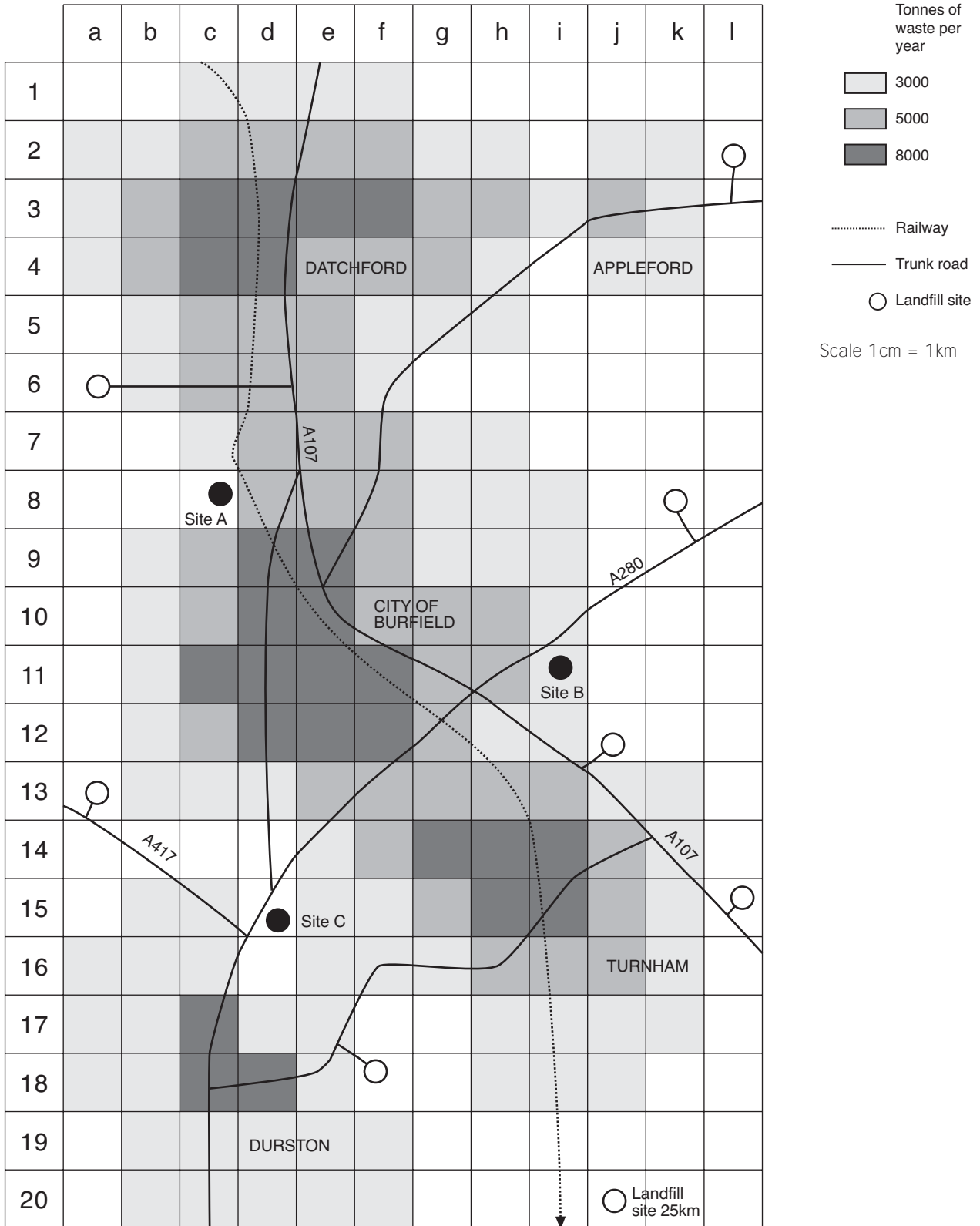
In general it is easier to sell electricity rather than the heat produced by incinerators with energy recovery. These energy sales are an important source of income which will affect the economic viability of any scheme.

Emissions and other environmental pollution

Waste incinerators have to conform to strict emission standards set down by the European Commission. The greatest public concern about emissions centres on dioxins. Under the EC regulations, concentrations of dioxins have to be below 1 gramme per 10 billion cubic metres of flue gases. Production of dioxins can be reduced by strict control of combustion temperatures.

Other environmental pollution is of a very local nature, such as smells from the waste before incineration, dust from the ash, noise from vehicles.

METROPOLITAN AREA OF BURFIELD



SITE A

Site description

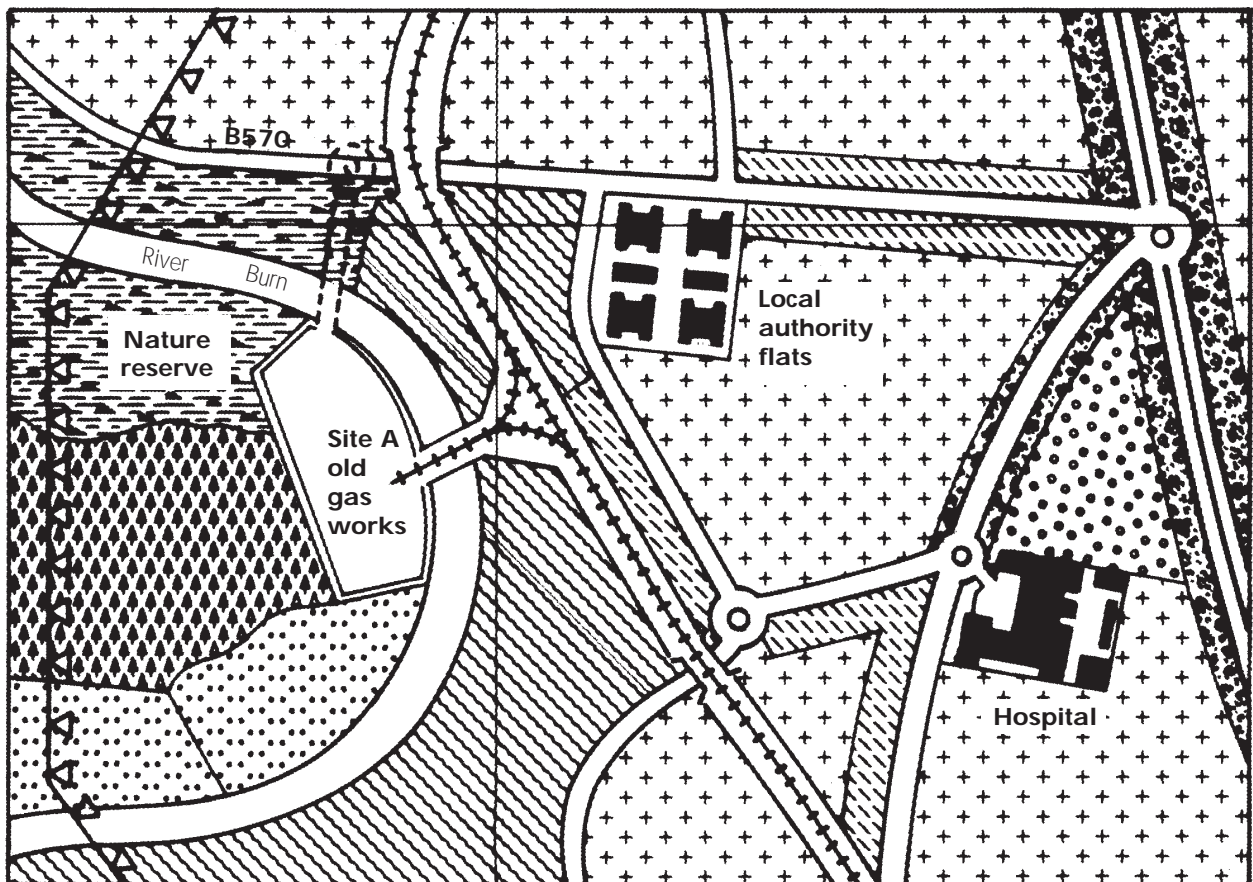
This is the 5 hectare site of an old gas works beside the River Burn. All the buildings on the site were demolished ten years ago and since then it has been waste land. It is zoned by the local planning authority for industrial development. To the north west of the site, along the river valley is a RSPB nature reserve.

Access












The site does have access by rail but not by road. The route for a new road access from the B570 to the north of the site is marked on the map. This would include building a new bridge across the River Burn. The total capital cost for the new road access would be £180,000. There is access to the electricity network via a 132kv pylon line just west of the site. The cost of a sub-station to make the connection would be £100 000.

Customers for heat

There are two potential customers for heat from the incinerator. The first is a complex of local authority flats with a heat requirement of 5000 MWh / year and the second is a hospital with a requirement of 6000 MWh / year. The income generated from these sales of heat would be approximately £132,000 / year.



KEY

 Residential	 Industrial	 Commercial	 Retail	 Proposed road
 Arable	 Woodland	 Nature reserve	 Open space	 Electricity substation
				 Small river

SITE B

Site description




This is a 4 hectare site, which was until a year ago used as a timber yard. The site is on the edge of a large residential area with a secondary school on the northern boundary of the site.

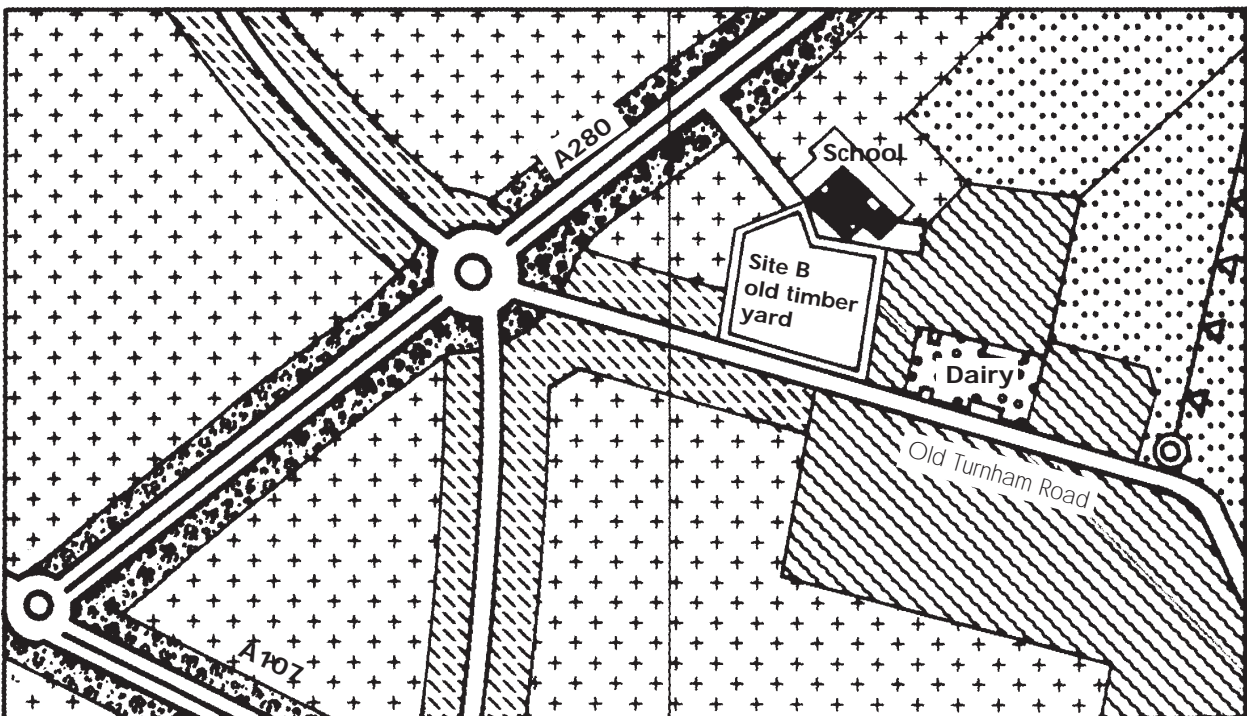
Access

The site has road access to the A280 and the Old Turnham Road. The road access to the A280 is shared with the school. There is access to the electricity network via a substation half a kilometre from the site.

Customers for heat

There is one large potential customer for heat generated by the incinerator. This is the local dairy with a heat requirement of 55,000 MWh / year. This would generate an income of £660,000 / year. A double heat main would be required to carry the heat from the incinerator to the dairy.

	Proposed road widening
	Proposed site
	Railway



SITE C

Site description

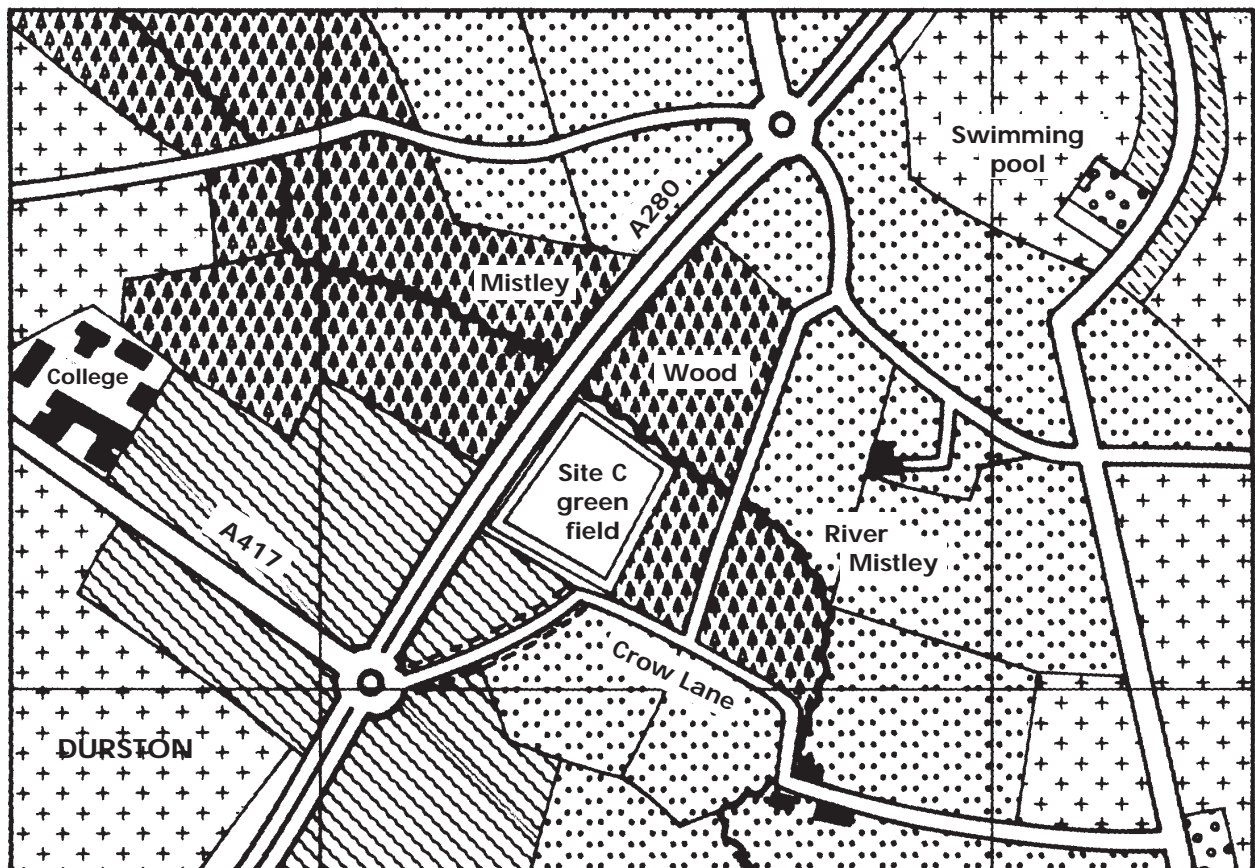
This is a 4 hectare green field site adjacent to an industrial area on the edge of Durston. The site is currently poor quality pasture land and has been zoned for industrial development by the planning authority. The northern boundary of the site is the River Mistley. Mistley Wood, is a designated Site of Special Scientific Interest and bounds the Northern and Eastern edges of the site.

Access

Current access to the site is by an undesignated road - Crow Lane, which would need to be upgraded at a capital cost of £40,000. There is no direct access to the electricity network and 5 km of new transmission line would need to be constructed at a capital cost of £125,000.

Customers for heat

There are two potential customers for the heat - a local authority swimming pool with a heat requirement of 3000 MWh and a technical college with a heat demand of 4000 MWh. This heat requirement would generate an income of £84,000 per year.



POWER FROM RUBBISH - ENERGY POLICY

Burfield Council have a big waste problem, they have until now disposed of nearly all of their waste to landfill sites but the holes are running out and filling up. Burfield's problem is a common one as the great majority of UK wastes (90%) are dumped in landfill sites. There are approximately 4,000 active landfill sites in the UK but their capacity is very limited.

Burfield Council's Waste Strategy

From now on, Burfield strategy is to incinerate 420,000 tonnes out of the annual 700,000 tonnes of waste needing disposal that is generated within the local authority's borders. A second incinerator to burn the remaining waste is planned to be operational in five years time. Burfield has 8 active landfill sites which are being used for the disposal of municipal solid waste (general refuse) as detailed on the attached sheet. The council has calculated that any increase in the quantities of waste generated over the next fifteen years will be cancelled out by increased recycling of materials - therefore the quantities requiring disposal are forecast to remain the same.

Task

Research the problems associated with the disposal of municipal solid waste in landfill sites and methods of dealing with and using landfill gas.

Evaluate Burfield Council's strategy for the disposal of waste via incineration and landfill dumping for the next fifteen years taking into account the following factors:

- minimising the environmental impact on the areas around landfill sites both in the short term and the long term
- maximising the political acceptability of the strategy

You have been provided with some newspaper articles that highlight some of the more contentious issues about waste management and an article on landfill sites.

You should present your findings as a briefing sheet for Burfield's Councillors. The briefing should include a waste flows diagram showing how much waste will be disposed of at each landfill site during the next fifteen years. You should clearly identify why each landfill site is used for the disposal of untreated waste and/or incinerator ash and why it should be used during the time period you have allotted.

Note: You should assume that the incinerator has been built on the site recommended in the first part of this unit and that the incinerator will be operational next month.

ACTIVE LANDFILL SITES IN THE BURFIELD AREA

Landfill site	Grid reference	Site Description	Capacity already used cubic metres	Available capacity cubic metres
1	a6	An old landfill site on the edge of an industrial area. It has potential for landfill gas production selling heat to local companies.	150,000	100,000
2	l2	A very large new site in a disused quarry. It is half a kilometre from the very pretty and prosperous village of Appleford.	0	2,000,000
3	k8	A site that has been in use for five years. The site is surrounded by agricultural land. There have been some problems with groundwater contamination.	200,000	400,000
4	a13	An old site which is adjacent to agricultural land and woodland near the River Mistley. The wooded river valley is a designated Site of Special Scientific Interest.	100,000	100,000
5	f18	An old site that is 200 metres away from a large council estate. There have been problems with a buildup of landfill gas in the site.	150,000	100,000
6	j12	A new site that has only been in use for one year. The site has been carefully engineered to reduce problems with landfill gas. It is near housing and industrial premises.	20,000	100,000
7	l15	A large site that has been in use for 10 years. It is near a brick works which is a potential customer for landfill gas.	300,000	200,000
8	25 km outside area	A very large site in an old open-cast mine which is outside the area. The main factor determining its use is transport costs.	1,000,000	2,000,000
				TOTAL 5,000,000

Note: 0.8 tonnes of untreated waste will occupy about one cubic metre in a landfill site whereas 3.6 tonnes of incinerator ash will occupy a cubic metre.

Use of landfill gas - This is only economically viable on sites which contain over 200,000 cubic metres of waste and where there are potential customers for the gas or heat.

COUNCILLOR ATTACKS WASTE PLAN

Councillor Jack Lambert attacked Burfield Council's plan to build a waste incinerator in the area. Speaking after today's presentation about the proposed incinerator, Councillor Lambert said: "There is no need for this monstrosity in the area - we should continue to dispose of waste in landfill sites. Burning the waste produces ash which will still have to go in the landfill sites - it makes no sense at all."

Chair of the Environmental Services Committee, Jane Withinshaw defended the plan: "There is only sufficient capacity for five years more direct disposal of waste to landfill sites in this region. Burning waste reduces its volume and we will be able to produce useful energy for the area as well."

SNIPE ! THE GREEN BIT- HOLES OR HEAT?

There are not enough holes in the ground any more." This was the complaint of the Director of Environmental Services - he is running out of holes in which to put Burfield's rubbish. Each year the council puts about a million cubic meters of rubbish into holes but there are only 5 million cubic meters of space left. So in five years time the bin man might stop coming!

What is the council's answer to the lack of holes - recycling? No, the main proposal is to burn the rubbish. This will reduce its volume to 25% which make the holes four times bigger - Got that? At the same time

the council says it can heat homes and produce electricity with its wonder incinerator.

The Greens have been quick to point out that there is no smoke without fire - sorry I mean - there is no fire without smoke. When you burn rubbish this can be very poisonous smoke containing nasty things called dioxins.

The engineers who want to build the incinerator don't talk about smoke at all. The stuff that comes out of the chimney is called flue gas. They say that they will filter and scrub their flue gases until they smell like fresh sea breezes. What they actually mean is they have to meet stringent European Union emissions standards.

The rubbish row goes on - so watch this space!

VILLAGERS TO FIGHT DUMP PLAN

150 residents of the village of Appleford held a protest meeting last night. This marked a new phase in their campaign to fight plans for a rubbish dump in a nearby disused quarry.

Burfield Council have bought the quarry and have gained planning permission to turn it into an "a landfill site". Director of Environmental Services, Mr John Baxter said:

This site will provide about 2 million cubic metres of capacity for waste. The quarry is a vital element in the council's strategy to dispose of rubbish with the minimum environmental impact."

This comment angered Parish Council Chairman, Mr Donald McCarthy: "The villagers of Appleford are being expected to put up with noise, smells, and disturbance caused by the dumping of city dwellers rubbish. It will ruin our village and we will fight it all the way."

A council spokesman, at last night's meeting, explained that the dump will be required despite plans to burn much of Burfield's rubbish in a new incinerator. The proposed dump will take ash from the incinerator. He claimed the ash would be biologically inactive and odour free. The dump will be lined to stop any contamination of ground water.

EXPLOSION AT DUMP

Residents living near the Bilton Lane Landfill Site at Durston were woken by a series of small explosions during the early hours of Thursday morning. The fire brigade were called and they spent five hours pumping water onto one section of the site.

The site is owned by Burfield Council and is used for the dumping of domestic refuse. A council official said today that the cause of the explosions had been the very warm weather causing a build up methane gas. Though no damage to property had been reported, the official promised a full investigation into the blasts. Residents have complained for years about the dump and this is not the first occasion on which explosions have been reported.

DUMP POLLUTES RIVER

The Durston and District Angling Association is claiming that the run off from a rubbish dump is polluting the River Mistley. Association Secretary, Richard Simon said that the number of different species of fish caught by his members had declined markedly over the last five years. In the last year his members had also reported seeing large numbers of dead fish particularly during periods of heavy rain.

The claims are to be investigated by the National Rivers Authority (NRA). Dr Sarah Hamilton of the NRA said that they took reports from anglers very seriously but that it was too early to say if the rubbish dump was the cause of the problem.

LANDFILLS - WHAT A WASTE!



The recent crisis in the Gulf has reminded the world - once again - of its vulnerability over oil supplies and once more brought to the fore questions of energy. Most human activities use energy and produce waste. They also have an impact - whether good or bad - on our personal or global environment. Many people are now acutely aware of environmental issues and anxious to minimise damage by reducing adverse effects as far as possible.

Even before recent events in the Gulf, prophets of doom were well supplied with topics to focus upon, and over which to spread alarm and dependency. Almost every food we eat has been declared harmful, either because of its inherent make-up or because of the chemicals used in its production; road and air transport are condemned as major sources of air pollution; even apparently innocuous leisure pursuits like rambling and gardening have been accused of putting pressure on unspoilt countryside or depleting scarce peatlands.

ENERGY

Global warming has held the headlines for many months. Reducing greenhouse gas emissions has been targeted by most developed countries

as a necessary move. Energy production and use is inextricably linked with such emissions.

GREENHOUSE GASES

Fossil fuel fired power stations, together with vehicle emissions, have been cited as two of the main contributors to CO₂ emissions. Lately, in the specialist press, attention has been paid to the contribution made by methane - calculated to have up to 30 times the effect of CO₂ - generated from landfill sites filled with rotting waste.

LANDFILL

Many countries landfill more of their domestic waste than they process by other means - Britain landfills over 95%! Landfilling has been the traditional means of disposing of

waste for centuries, dictated by convenience, and cost. Acknowledging that poor landfill standards have contributed to poor environmental control and considerable environmental damage, laws have been formulated to improve and tighten standards for landfilling throughout the world. More landfill sites are tapping the gas generated for use as an energy source, if not simply flaring it off, somewhat wastefully, simply to get rid of the problem. Cases of explosions wrecking property near landfills are well documented. In the UK local authorities have embarked on an extensive, and expensive, project to assess and monitor gas-producing sites as well as requiring the installation of controls. Since gas may be generated for up to 50 years, many of the problem sites have been closed for some years.

GAS USE

Where landfills already exist and are generating gas, it clearly makes better sense to use that gas than to either let it disperse to atmosphere with unknown effects or to simply flare it off to destroy it. However, landfill gas utilisation is calculated to be only 30% efficient, and should not be considered as a whole solution to future wastes disposal problems - nor an energy-efficient option.

EMISSIONS

Both CO₂ emissions from fossil fuel power stations, and gas emissions from landfill sites, could be addressed at a stroke by using combustible wastes to produce electricity. There are countries where a proportion of the wastes is already burned, making a small but valuable contribution to power demand - but more importantly perhaps reducing the pollution those same wastes would have produced if directly landfilled. In the UK, 30 million tonnes of household and commercial waste generated each year could be utilised. Why are we not leaping at such a solution?

IMAGE

Incineration has a bad image. People imagine tall chimneys spewing out black smoke and dropping smuts on their washing and their cars, polluting the air they breathe. Incineration technology has moved on a long way from that, and there is now no technological reason for waste incineration to be polluting.

EMISSIONS (LANDFILL)

Emissions of methane-containing landfill gas seeping from rubbish tips are not so visual. But they are polluting. No-one likes rubbish tips, but as long as they are sited away from habitation, they are not as negatively perceived. Permission for new ones is increasingly hard to obtain however - another good reason to extend their lives as far as possible. Well-run, properly managed landfills should not pollute nearly as much as their open tip predecessors, especially if sealed to the draft EC proposals, which most UK sites are not. Even those model sites will still pollute however. Landfill gas from such sites is impossible to control or monitor in the precise way that emissions from an incinerator can be.

That's not really the point. Alongside recycling of glass and paper, plastics and cardboard, we should be looking at recycling the energy of that waste which no longer has a material value. That may be 50% of it, if we are successful with our materials recycling schemes - or a higher percentage if we are not. Putting only noncombustible wastes, and incinerator residues, into the landfill will reduce volumes by up to 90%, and extend landfill life. It will also reduce gas generation, making site management cheaper and easier.

DIRECTIVE

An EC Directive on Landfilling Wastes, presently at fifth draft, will require uniform standards. We will always need landfill, whatever level of recycling we reach and whichever

waste disposal option we pursue. Well-run landfills, like the excellent Packington site near Birmingham in England, have a vital role to play - but it should be a last resort, not a first choice.

US STUDY CITES HEALTH DANGERS IN INDUSTRY BY-PRODUCT

DIOXIN POLLUTION RISKS 'WORSE THAN FEARED'

Environmentalists, backed by concerned doctors, yesterday urged the Government drastically to cut dioxin pollution produced by industry after a comprehensive US study revealed new dangers, including damage to unborn babies and infertility caused by low sperm counts.

Links between dioxin and cancer were confirmed with even "greater confidence" said Dr Lynn Goldman, of the US Environmental Protection Agency which produced the report. Unexpected from earlier work were dioxin's non-cancer dangers, which include suppression of the immune system.

The Government reacted cautiously, but appears already committed to a review of dioxin hazards by the chief medical officer as a result of the study's disturbing conclusions.

The Department of Environment said yesterday that the American government report "will be studied in detail for the implications it might have in the UK."

Last year the Royal Commission on Environmental Pollution recommended increasing incineration capacity as a way of dealing with Britain's burgeoning waste problem. Initially this solution appeared attractive to the Government, but then drafts of the damaging findings of the US study began to circulate in Whitehall. When the Government formally responded to the Royal Commission in July it said much would depend on the "thorough and wide-ranging study" by the US authorities.

The chemical industry claims that dioxin damage in humans is remote and theoretical at real levels of exposure. But Dr Goldman said the dangers were real and concluded that "we can infer from the data that average everyday exposures are close to exposures that are known to cause effects on laboratory animals".

"Dioxins are just about the perfect poison," said Dr Vyvyan Howard, from the department of foetal and infant pathology at Liverpool University. "The penalty the foetus may pay is permanent deformity." The US study shows that dioxins retard foetus growth in animals leading to permanent kidney, brain and lung damage. Dr Howard and Professor Claude Hughes, a doctor who helped write the US study, yesterday joined Friends of the Earth, Greenpeace and The Women's Environmental Network in calling for an end to chlorine production and incineration. Dioxins are unavoidably formed after the production and subsequent incineration of chlorine compounds widely used in plastics, solvents and paper production. They have been described as the most toxic man-made substance.

The US Environmental Protection Agency is setting tighter limits on incinerator emissions and President Clinton announced in January a national strategy for "substitution, reducing or prohibiting the use of chlorine and chlorinated compounds."

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