Landfill Mining

Claire Barlow, Waseem Iqbal, Simon Ashton
University of Cambridge, Institute for Manufacturing, Department of Engineering

Landfill has for the last half century been a cheap and easy way for the UK to dispose of its unwanted materials. However, times have now changed. Landfill sites are reaching capacity, and environmental and safety concerns are prominent. And there is sudden interest in landfill mining: excavating old landfill sites and re-processing their contents. We look at the reasons behind the interest, and discuss some of the technological, economic and social issues involved in landfill mining.

Why mine landfill sites?

Because of major safety concerns
Sites may be unsafe, e.g. toxic materials leaching into groundwater. Older UK landfill sites are vulnerable to damage because they used only a single liner between the pit and the ground.

Because of the value of the recyclable material
Landfill sites contain materials which can be recycled, composted or burnt for fuel.
Economically recoverable resource is very variable. Composition of landfills varies not only with location and age, but even within a single cell.

Metals: Old landfill sites may be regarded as any other mining opportunity. e.g. density of aluminium and gold in landfill sites can be as high as some metal ores.

Organic matter: Food, paper, cardboard can be used either for energy recovery (via pyrolysis or gasification), or to make compost by anaerobic decomposition.

Plastics: In theory plastics might be separated, cleaned and mechanically recycled. But the plastic is heavily contaminated, and this is not generally regarded as economically feasible.
But being made from oil, plastics are valuable for energy recovery (via pyrolysis or gasification).

Soil (used to cover landfill contents during filling) may also be recovered.

Because the site has become valuable real estate
Landfill sites which were originally outside cities are often overtaken by urban growth; the land can be very valuable for housing, recreational purposes or industrial development. Rather than simply relocating the waste excavated, the volume is reduced by removing anything which can be recycled.

Because of the wider green agenda
Lack of capacity in current landfill sites, and the difficulty of identifying new sites. e.g. sites in Bedfordshire and Essex have only between 1 and 3 years of remaining capacity; landfill waste from Naples is being transported to Germany for processing.

Why now, in the UK?
Lack of landfill capacity is high on the political agenda. Recycling technologies are improving, and availability of recycling facilities increasing. Landfill mining is being explored in other parts of the world.

History of landfill mining

The first landfill mining project was begun over 50 years ago, but only in the last ten years has the idea really taken off.

Year	Country	Location	Primary motivation for landfill mining
1953	Israel	Tel Aviv	Recovery of soil
1989	India	Deonar, Mumbai	Pilot study to investigate use of organics as compost
1990	USA	Edinburg, Texas	Landfill Mining demonstration project by New York Energy Research and Development Authority
1988	USA	Collier County, Florida	Reduce potential for groundwater contamination; soil recovery; recovery of landfill capacity.
1991-3	USA	Lancaster County	Soil recovery; energy from waste
1992	USA	Bethlehem	Avoidance of groundwater contamination; recovery of landfill capacity
1992	USA	Thomson, Connecticut	Recovery of landfill capacity
1993	USA	Nashville, Tennessee	Contamination concerns; recycling soil and ash for road base.
1993	USA	Newbury, Mass	Avoidance of groundwater contamination; recovery of landfill capacity.
1994	USA	Hague, NY	Reclaim of land: re-use site as recreational space
1994	Canada	McDougal, Ontario	Avoidance of groundwater contamination.
Before 1994	Germany	Berghot	First European site: recycling; recovery of landfill capacity
1994	Sardinia		Recovery of landfill capacity
1994	Sweden	Filborna	Pilot test
1998	Sweden	Gladsax	Energy recovery and recycling
2001	Netherlands	Arnhem	Reclaim of land
2001	Netherlands	Heiloo	Recovery of landfill capacity

Is landfill mining viable in the UK?

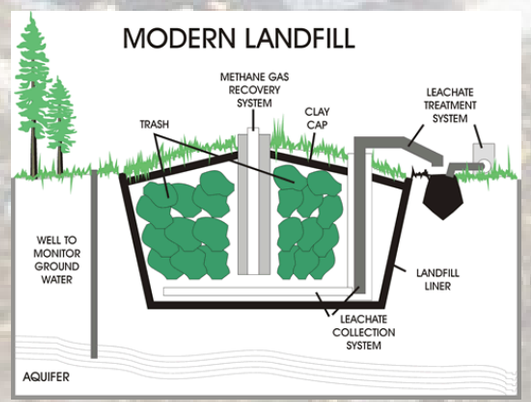
What are the problems with mining landfill sites?

Information
Although there have been a number of landfill mining pilot projects over the world, information about them is generally sparse.
Information about the contents of UK landfill sites is very incomplete.
Waste disposal and treatment in the UK is done on a regional basis. There are significant operating differences and little co-ordination or information exchange between regions.

Technical
Landfill sites are unstable for an extended time after closure (typically 30 years). Mining of unstable sites is hazardous because of gas and corrosive leachates, so only stable sites are generally reckoned to be suitable for mining.
There are also technical problems associated with recycling materials from landfill. The contents of the landfill are mixed, and must be separated for processing. The waste streams are contaminated: energy-intensive cleaning may be needed before they can be recycled. There may be dangers from hazardous chemicals and materials.

Sociological
In the densely populated UK, most landfill sites are close to populated areas; others are situated in areas which are prime sites for recreation. Closed landfill sites (e.g. old quarries) have been landscaped. Because landfill mining is a huge industrial operation, with intrusive plant and large volumes of road transport, there will always be local opposition to opening up such sites. The best opportunities may come from sites which are still in active use for landfill.

Economic
Landfill mining projects will involve local councils and private enterprise and must make money.
Existing landfill sites generate methane, which is a source of revenue. But the costs of maintaining closed sites can be high, including environmental monitoring, treatment of leachate. Factors important to the economic analysis are shown opposite.
Predicting revenue potentials is particularly difficult because the contents of landfill sites are not accurately known.



Economic analysis of landfill mining

Benefits	Costs
	Project planning Identification of suitable sites for mining
Avoided or reduced costs: Landfill Closure Remediation of surrounding area Post-closure care and monitoring Identification, purchase of and construction of new landfill sites	**Capital costs:** Site preparation Safety equipment Diggers, lorries, conveyer belts etc Materials handling facilities including sorting, shredding, washing.
Revenues from: Recyclable and reusable materials Combustibles sold as fuel Reclaimed soil used as cover material, sold as construction fill or other uses Continued use of site for landfill , or Land value of site reclaimed for other uses	**Operational costs:** Labour Equipment fuel and maintenance Landfilling residual waste which cannot be reclaimed Administrative and regulatory compliance expenses Worker training in safety procedures Hauling costs

Conclusions and predictions

Mining of existing landfill sites will happen in the UK - but the technical, sociological and economic problems are so great that nobody wants to be the first to do it.

The number of sites suitable for mining is small. Identifying them and doing the economic predictions will be difficult and costly.

The amount of waste going to landfill is being reduced, and valuable materials are being stripped out before landfilling. Future landfill sites will not be worth mining.