

# Gas Converters

Lichen Renewal has developed a method of turning the environmental liability of methane gas emissions from landfill sites into power for local communities. **Quinton Richards**, Director of Planning and Communications, explains how...

**E**nvironmental liabilities are often brought under management either by pressure from regulation or because of the level of risk to responsible parties. The multiple concerns in the waste sector pertaining to unregulated landfill sites are addressed by Lichen Renewal's solution that delivers immediate environmental, economic and social benefits.

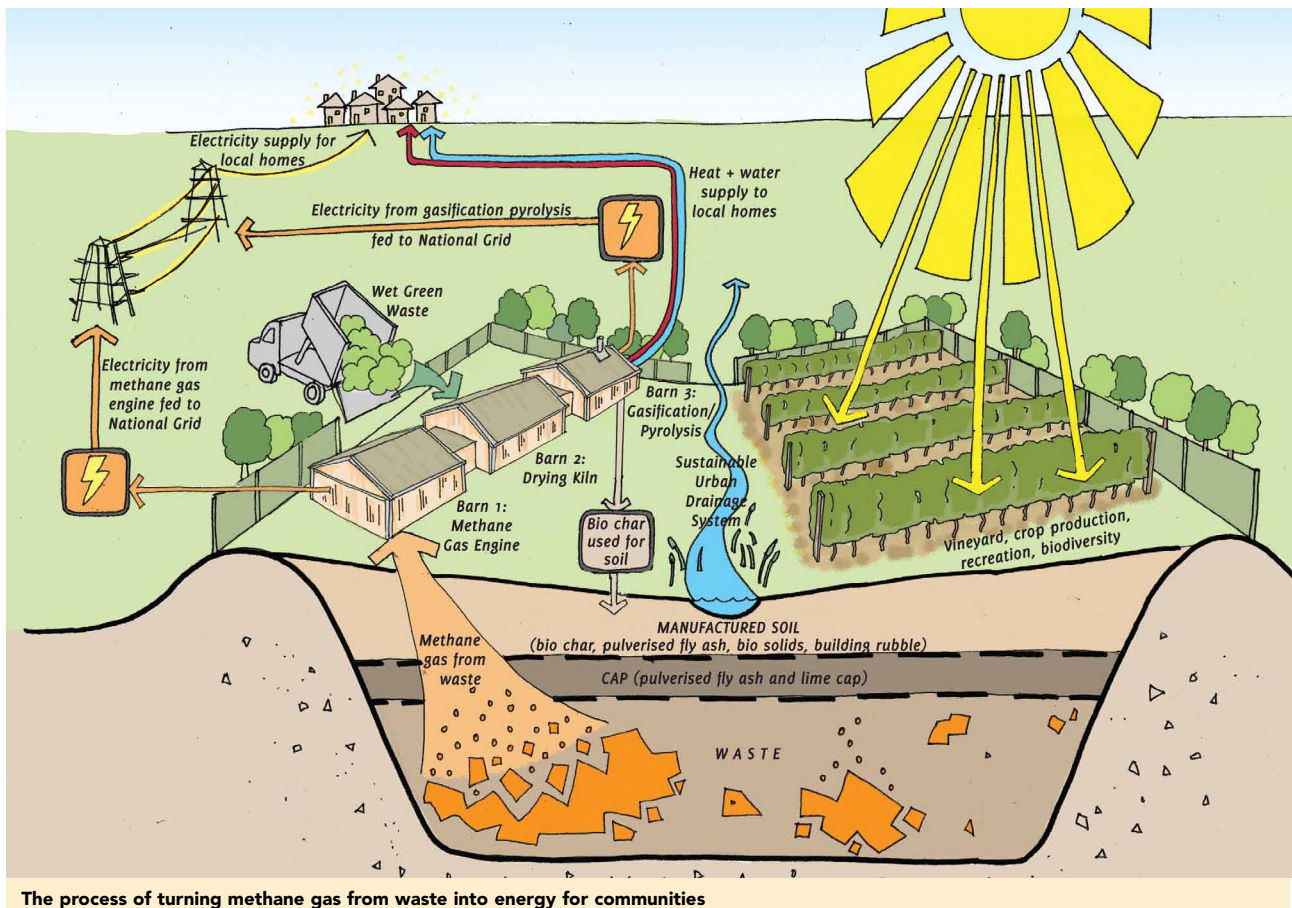
Lichen Renewal restores historic landfill sites using redundant coal ash as an impermeable cap so that the energy from landfill gas is captured, creating a carbon-rich topsoil and generating heat and power locally.

## Methane From Landfills

THERE ARE 22 000 historic landfill sites in the UK, some of which may have the potential to release greenhouse gases and discharge pollutants into groundwater, due to the operational practice and limited environmental legislation at the time they were built and operated. In this regard, pulverised fly ash (PFA), a redundant by-product from burning coal for electricity, presents a unique opportunity. Around 6m tonnes of PFA is produced each year by the coal industry and whilst 3m tonnes is sold

to other industries, the rest is sent to landfill or is often deposited in large stacks beside coal plants.

The issues of historic landfill sites and millions of tonnes of unused PFA can be solved by using it to engineer a low permeability layer to cap these sites. This has multiple functions, which include preventing the uncontrolled escape of methane, minimising water infiltration and allowing for better control of the methane. The solution is an opportunity for the coal industry to make use of its remaining 3m tonnes of PFA and to partially offset emissions. Like a tight seal, the PFA cap restricts



The process of turning methane gas from waste into energy for communities

water from entering and allows it to be used in a sustainable drainage system that prevents its contamination. Since the amount of water entering is minimised, the waste becomes drier and, in effect, increases the available methane for extraction. The PFA cap also allows methane to be sucked out from the landfill without drawing excess oxygen in, which can result in a flammable mix of gases and potentially underground fires. As described below, the extracted landfill gas is used to generate both electricity and heat.



## New Soil Horizon

THE PFA cap needs to be protected from drying out or being damaged by tree roots and burrowing animals which would, in effect, increase the permeability. The system creates a soil layer that achieves this as well as providing a platform for the proposed future use, which could be recreational, renewable energy or vegetation.

Generating a carbon-rich artificial soil horizon supports the policy objective of moving waste up the waste hierarchy. The content of the soil layer is made up of diverse materials including biochar, biosolids and brick rubble.

We can create biochar on site using local organic waste delivered through green waste contracts with local authorities. Biochar is unique: whilst it is formed by burning organic matter, it locks in carbon rather than releasing CO<sub>2</sub> during the process. Furthermore, carbon is stored for hundreds of years in biochar compared with carbon in compost, for example, which is released in 10 years or so.

In addition, biochar provides a free-draining structure that slowly releases nutrients into the surrounding soil. Biosolids include sewage sludge cake and de-watered paper sludge, which also provide nutrients to the artificial soil. The brick rubble is another valuable material, which can be positioned as a drainage layer immediately above the low permeability cap. Other useful sources of material for the soil layer include compost for added nutrients, waste soils from development sites and existing soil retrieved from the previous soil layer.

The methane extracted from the former landfill site can be used to generate electricity for local communities or it can be used to dry the local green waste from around 50 percent moisture content to nearer 20 percent, prior to gasification and/or pyrolysis. This drying step means the gasification and/or pyrolysis process is made more efficient.

Gasification and pyrolysis involve converting carbon-based products such as biomass into carbon monoxide, hydrogen and biochar via a controlled chemical reaction. The resulting mixture of gasses is commonly known as synthetic gas, or syngas. This gas is collected and used to produce heat and electricity.

## Policy Framework

BY TAKING measures such as this to remediate historic landfill sites, an alternative way to turn liabilities into resources, and meet a number of policy directives can be found. In particular, moving waste up the waste hierarchy, by using materials such as PFA to capture greenhouse gas emissions and by diverting PFA from disposal within landfill sites, satisfies the revised Waste Framework Directive. The process also fulfils the Renewable Energy Directive through gasification and pyrolysis and by creating a platform for solar photovoltaics. Furthermore, the draft Soil Framework Directive is met through remediating damaged land and the Water Framework Directive is met by protecting groundwater from polluting leachate. The advantages of the above package of activity can be summarised as:

- environmentally damaged land is brought back in to a far more productive land use (as opposed to default private and public open space)
- millions of tonnes of waste is used as a resource in the engineering of the low permeability cap and the manufacturing of soil horizon
- thousands of tonnes of carbon dioxide equivalents, in the form of methane, are prevented from uncontrolled escape to the atmosphere
- methane and syngas are used to generate renewable heat and electricity
- biochar sequesters carbon for hundreds of years
- woodland is brought back in to more beneficial use – acidification of soils caused by inappropriate coniferous plantation is reverted into heath land and deciduous woodland by the application of manufactured soil (biochar having an alkaline pH)
- green jobs are created
- local authority costs for remediation, restoration and on-going environmental monitoring are absorbed by the remediator using this process and an increased business rate income for local authorities generated. [CIWM](#)

**Trials are being conducted in Scotland and England. Lichen Renewal is in communication with local authorities in the southeast with a view to taking on these environmental liabilities and turning them into valuable resources. The process also presents opportunities for the coal industry and the company is in discussions with certain members of this sector**

**The opinions expressed in this article are that of the author and not necessarily those of CIWM**