W e i g h i n

Visitors to Canberra's Mugga Lane Landfill during August 1994 may have wondered why a fence had been erected in the middle of a featureless pile of refuse. Adding to the mystery was the presence of a caravan on the landfill, connected to the fence by an 80-metre umbilical of black tubing.

The fence and caravan were part of a two-week field trial designed to measure how much methane is produced by an average tonne of municipal solid waste. This figure is important because landfills (along with cattle and sheep) are a major source of methane emitted as a result of human activity.

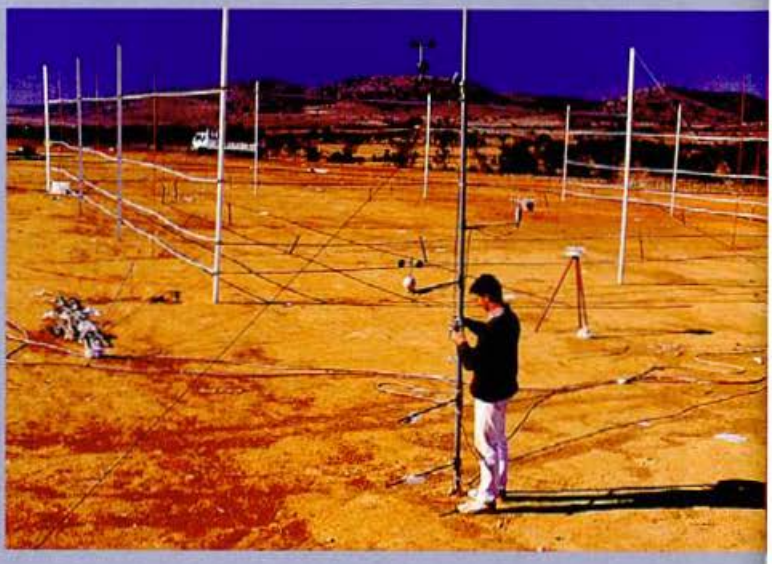
Keeping track of such emissions is the responsibility of Australia's National Greenhouse Gas Inventory (NGGI) and a number of research projects aimed at improving the accuracy of greenhouse gas estimates are funded by this organisation. One of these is a three-year study by Dr Tom Denmead and Dr Ray Leuning from CSIRO's Centre for Environmental Mechanics, and Dr David Griffith from the University of Wollongong. They are using field measurements to verify estimates of greenhouse gas emissions from animals, pastures and landfills.

At Mugga Lane, the field measurements were taken on an area of 'average' municipal solid waste. How is an average tonne of municipal solid waste defined? This is the usual collection of paper, garden waste and household scraps dumped by householders and garbos, not car bodies, refrigerators or builders' waste. It contains about 22% carbon.

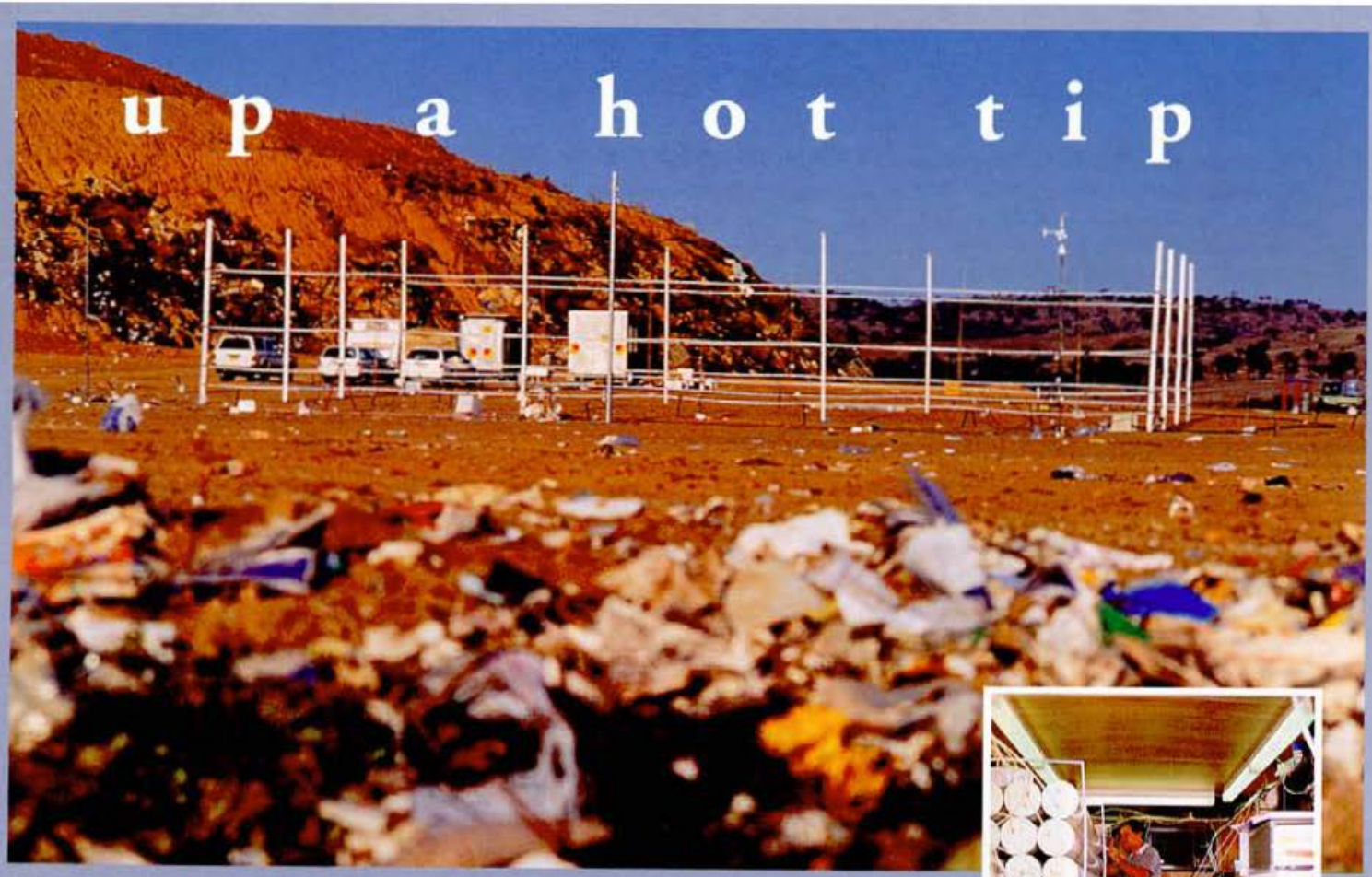
After talking to staff about the age and content of various lifts (layers of levelled and capped landfill) at the site, a suitable area was selected for the trial. A 24 by 24 metre fence was then erected. It wasn't a fence in the traditional sense; it didn't keep anything in or out. Rather, it was an arrangement of air monitoring tubes arranged in a fence-like shape.

Each of the fence's four horizontal 'railings' were actually lengths of 25-millimetre tubing perforated at one-metre intervals with capillaries of very fine medical tubing. During the two weeks of the trial, air was drawn in equally along each of the 16 tubes and pushed down heated air lines to a central measuring point: the caravan. Inside the caravan the air samples were diverted and analysed for their gas composition.

From this analysis, the concentration of methane in the air surrounding each section of tubing could be determined. But how much of this total was already present in the air, and how much was emitted by the landfill itself?



g up a hot tip



Garbage in or garbage out? Measuring methane emissions from the Mugga Lane Landfill involved setting up a field trial and temporary laboratory on a pile of municipal waste.

To calculate the amount of methane actually produced by the landfill, a trace gas budget was used. This involved subtracting the amount of methane carried into the trial area by the wind from the amount carried out. The difference is the amount of methane produced inside the 'fence'.

The amount carried into the area was obtained by multiplying the methane concentrations measured at each level by the wind speed at that level, and then integrating that number over both upwind fences. Similar calculations for the downwind fences yielded the amount carried out. Continuous measurements of wind direction were used to identify the points at which the wind entered and left the trial area.

What was the result? From the field measurements made at Mugga Lane, the research team concluded that about 10 kilograms of methane was produced annually per tonne of average municipal solid waste. This was lower than the figure of 13 kg/tonne used by the National Greenhouse Gas Inventory.

Denmead says a possible reason for the discrepancy was that the field experiment found the proportion of methane to carbon dioxide in the emitted biogass to be 50:50. The ratio used in the NGGI algorithm, however, is 60:40.

This difference is probably due to the fact that the algorithm used by the NGGI is based on measurements taken deep down in the landfill, where methane concentrations are greater than they are above the ground. After re-calculating the algorithm using the 50:50 ratio, the annual tonnages arrived at by each technique were in closer agreement.

This simple change, which has been fed back to the NGGI committee responsible for preparing the inventory, is enough to reduce the estimate of Australia's human-made methane emissions by 220 000 tonnes a year.

A fence-shaped arrangement of tubing was used during the Mugga Lane experiment to capture samples of the air entering and leaving the trial area. The air was then analysed for its methane content.

Techniques developed by the team from Environmental Mechanics are also being applied to measuring methane emitted by agriculture. The 'fence' has been used to record the gas output of pasture-munching cattle (see picture on page 31), and later this year the team will travel to Japan to measure emissions from rice production, one of the world's largest sources of methane.

In the meantime, a return trip to Mugga Lane is being planned, but it's probably not a prospect that the scientists relish. Denmead and his colleagues have vivid memories of their time spent at the exposed site, with westerly winds raining beer and coke cans, 'VB' cartons, shredded paper and grit, and easterlies blowing directly from the animal dump nearby.

But there are still a few 'uncertainty factors' needing to be ironed out before the algorithm can be verified fully. This means accounting for variables such as the age dependence of methane emission, (the current inventory allows for emission continuing, but at a decreasing rate, for 30 years) and compiling statistics to enable extrapolation of their findings to the rest of the landfill and to others.

So next time you make a trip to the local tip, spare a thought for how much methane your bit of garbage is contributing to the greenhouse gas inventory, and for the people whose job it is to measure it!

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