

Revealed: the 1,200 big methane leaks from waste dumps trashing the planet

The huge leaks of the potent greenhouse gas will doom climate targets, experts say, but stemming them would rapidly reduce global heating

'It's impossible to breathe' – life by Delhi's towering landfills

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Mon 12 Feb 2024 12.00 GMT

There have been more than 1,000 huge leaks of the potent greenhouse gas methane from landfill waste dumps since 2019, the Guardian can reveal.

Analysis of global satellite data from around the world shows the populous nations of south Asia are a hotspot for these super-emitter events, as well as [Argentina](#) and Spain, developed countries where proper waste management should prevent leaks.

Landfills emit methane when organic waste such as food scraps, wood, card, paper and garden waste decompose in the absence of oxygen. Methane, also called natural gas, traps 86 times more heat in the atmosphere than carbon dioxide over 20 years, making it a critical target for climate action. Scientists have said emissions from unmanaged landfills could double by 2050 as urban populations grow, blowing the chance of avoiding climate catastrophe.

A total of 1,256 methane super-emitter events occurred between January 2019 and June 2023, according to the new data. Pakistan, India and [Bangladesh](#) lead the list of nations with the most large leaks, followed by Argentina, Uzbekistan and Spain.

Landfill emissions can be reduced by creating less organic waste in the first place, diverting it away from landfill, or at least capturing some of the methane that is being released from the landfills. Action to stem methane leaks slows global heating faster than almost any other measure and is often low-cost, with some measures even paying for themselves when the captured gas is sold as fuel.

Methane emissions have accelerated since 2007 and cause a third of the global heating driving the climate crisis today. The acceleration has alarmed scientists, who fear it is the biggest threat to keeping below 1.5C of global heating and

could trigger catastrophic climate tipping points. The rapid rise appears to be due to global heating driving more methane production in wetlands – a potential vicious circle that makes cuts of human-caused methane emissions even more urgent.

Decomposing waste is responsible for about 20% of human-caused methane emissions. Fossil fuel operations cause 40% of emissions, and the Guardian revealed there were more than 1,000 super-emitter events from oil, gas and coal sites in 2022 alone, many of which could be easily fixed. Cattle and paddy fields cause the other 40% of emissions.

Prof Euan Nisbet, a methane expert at Royal Holloway University of London, said: “Big landfills make a great deal of methane but it doesn’t cost much to bulldoze soil over a stinking, burning landfill. It’s not rocket science.”

Microbes in the soil convert methane into CO₂. “Then it’s lost 97% of its greenhouse impact,” Nisbet said.

Carlos Silva Filho, president of the International Solid Waste Association, said the global methane pledge made by 150 countries to cut 30% of methane emissions by 2030 could not be achieved without tackling emissions from the waste industry. “Cutting methane is the only solution to meet the global 1.5C temperature target,” he said. “If we really focus on reducing methane emissions from the waste sector, it is a gamechanger.” About 40% of the world’s waste still goes to unmanaged dumps.

Antoine Halff, a co-founder of the company Kayrros, which provided the satellite image analysis to the Guardian, said: “Waste is a big source [of methane] and in countries like India, Pakistan and Bangladesh it’s not only a huge source of greenhouse gas emissions but it’s also a lost opportunity to tap a fuel resource that could help meet the country’s energy needs.”

The satellite that Kayrros uses orbits the planet 14 times a day and provides global coverage, giving the location of a leak to within about six miles. Higher-resolution satellites that orbit less frequently can pinpoint the waste facilities responsible.

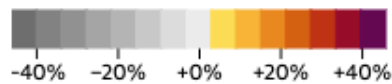
Trash mountains

Delhi, the capital of India, has had at least 124 super-emitter events from city landfills since 2020. Dr Richa Singh, of the Centre for Science and Environment in the city, said that while methane leaks from the global oil and gas industry

were getting significant attention, the waste sector also required “urgent intervention”.

Delhi, 25 November 2021

Approximate variance from atmospheric methane concentrations



Sources: Kayrros, OpenStreetMap contributors

India is extremely exposed to the impacts of the climate crisis, making methane cuts especially important, she said. Furthermore, cleaning up landfills would end the fires and serious air and water pollution they cause.

Methane is generated in landfill dumps when waste food and other organic material is decomposed by microbes in an oxygen-depleted environment. Properly managed waste systems either divert organic material from landfills into biodigesters that produce methane fuel, or cover the landfills and capture the gas. Burning converts methane to CO₂, a much less powerful greenhouse gas.

The worst event in India occurred in April 2022 in Delhi, with methane poured into the atmosphere at a rate of 434 tonnes an hour. That is equivalent to the pollution caused by 68m petrol cars running simultaneously.

As well as dirtying the air, Delhi’s stinking “trash mountains”, which are miles wide and 60 metres high, are hellish to live near. Mohammad Rizwan, 36, who owns a shop next to the Ghazipur landfill, the site of India’s biggest methane

leak in the last five years, said the nearby residents were the “unluckiest people in Delhi”.

“I have watched it grow from a small rubbish heap into that huge mountain over the past 20 years,” he said. “During the summer it catches fire every week because of all the gas and then it becomes even more disgusting here. It’s impossible to breathe and everyone gets sick. It feels so dangerous to live here but I have no choice – this is where my home and livelihood is.”

Methane is a trace gas in the atmosphere, about 0.0002% by volume. “But if you go to a typical dump site in India, it can range between 3% and 15%, which is huge,” said Singh. Methane fires ignite regularly, she said, sending air pollution including carcinogens across entire cities.

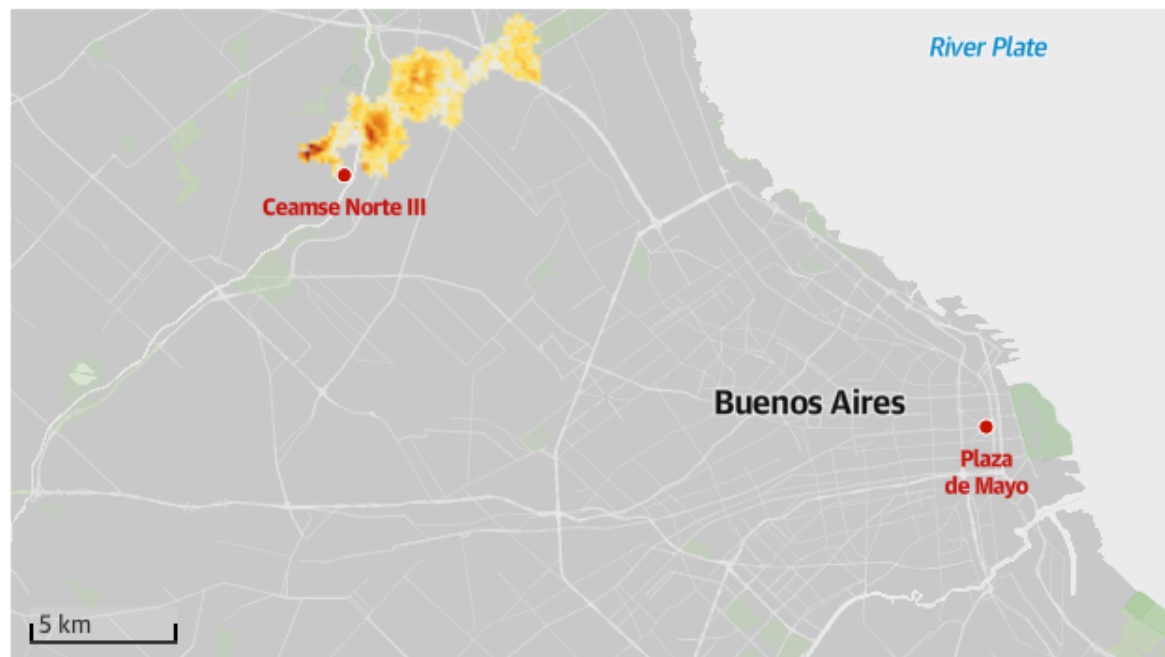
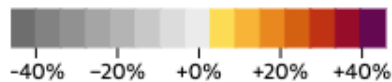
An outburst near Lahore in Pakistan in February leaked at 214 tonnes an hour, equivalent to 34m car exhausts. The assessment of methane leaks in Bangladesh is complicated because illegal tapping of gas pipes is commonplace, causing major leaks in urban areas that can be hard to distinguish from landfill emissions.

Symbolic failure

In most developed nations, regulation of landfill sites means super-emitter events are avoided. However, Argentina is an exception, with 100 super-emitter events from waste sites in the capital, Buenos Aires, since 2019. The worst was in August 2020 when 230 tonnes an hour was emitted, equivalent to running 36m cars.

Buenos Aires, 23 January 2023

Approximate variance from atmospheric methane concentrations



Sources: Kayrros, OpenStreetMap contributors

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One major site, the Norte III landfill, is wedged between working-class neighbourhoods in the north of Buenos Aires. Rubbish trucks crawl over the top of its giant earth-covered mounds and the pungent smell and the toxic dying rivers in the vicinity are symbolic of Argentina's failure to manage waste sustainably, said Juan Martin Ravetinni, the founder of QueReciclo, a waste management consultancy. "Every day I ask myself how the authorities have allowed this."

Some parts of the sites appear to be well managed, according to Nadia Mazzeo, a waste management specialist at the University of Buenos Aires. "Buenos Aires has the most advanced landfill site in Argentina and one of the best in Latin America". However, a huge amount of rubbish – about 15,000 tonnes a day – is dumped at the site, and satellite data in a [2022 study](#) suggested the uncovered new waste piles may be the source of the emissions. Norte III could use temporary covers in the open area, said Prof Ilse Aben at the Netherlands Institute for Space Research (SRON), who was part of that study.

The Norte III site is run by Ceamse, a private company belonging to the government of the province of Buenos Aires. “The fact that the detected emissions come from a small uncovered area is an indication of the effectiveness of the [methane] capture and treatment system on the rest of the module surface,” said a spokesperson for the company. He said an uncovered face in the dump was necessary because 2,000 lorries a day emptied their waste there.

Ceamse said in 2021 that new equipment would lead to emissions dropping. But they had not fallen by late 2022, with the company blaming the rising amounts of waste being dumped. SRON data from January shows huge emissions continue in Buenos Aires.

The spokesperson said that in early February Ceamse’s president had approved the signing of an agreement with the Global Methane Hub foundation to use satellite images to improve the management of methane.

‘Deeply counterintuitive’

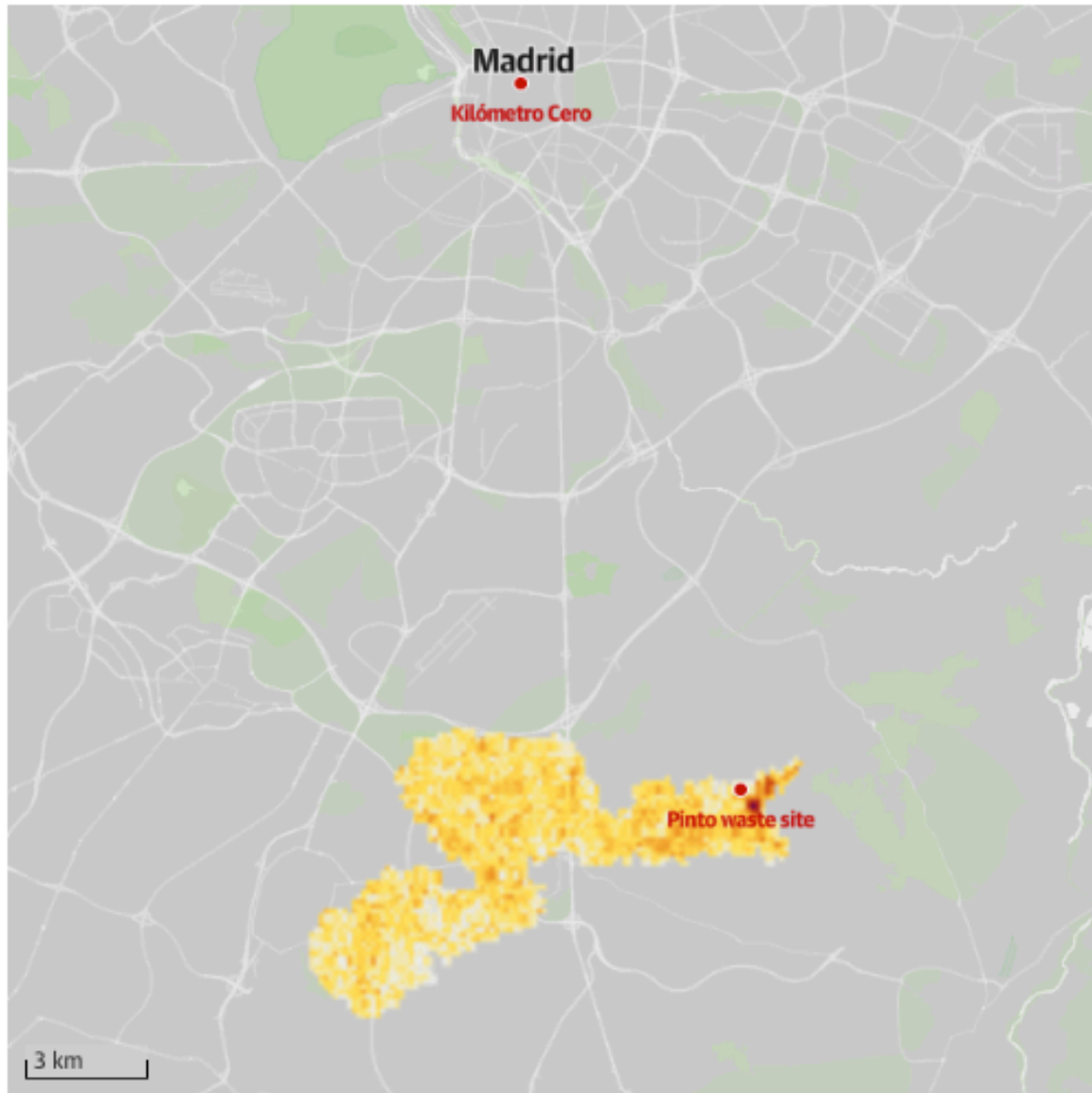
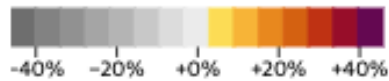
Super-emitter events were also spotted by the satellites in Madrid, Spain, with 17 leaks since 2021, and four major leaks in the first half of 2023. The largest was 25 tonnes an hour, recorded on 23 January and equivalent to 3.9m running cars.

“We don’t associate western European countries with landfills that have uncontrolled methane emissions,” said Halff. “So to me it’s deeply counterintuitive.”

The events were detected near landfill sites to the south of the city centre, where biogas extraction plants also operate to capture methane. Satellite data analysis in 2021 and a ground-based survey in 2018 both detected significant methane leaks in the area.

Madrid, 24 February 2023

Approximate variance from atmospheric methane concentrations



Sources: Kayrros, OpenStreetMap contributors

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Madrid's city council, which operates the major waste facilities in the area, said other landfills it did not control in the wider Madrid region could be responsible, and that satellite estimates were not as reliable as ground measurements. It said large leaks at the biogas plant would have been detected and that all the plants met all environmental regulations.

At the Las Dehesas site, the officials said about 20% of methane was estimated to escape and that this was a normal level for a controlled landfill with biogas extraction. The officials said they were now planning “a real-time monitoring system for the fugitive emissions at the Las Dehesas controlled landfill” and robotic inspections to gather data by the end of 2024.

Detecting methane super-emitters with satellites is more difficult in tropical regions as high levels of water vapour and clouds in the atmosphere interfere with the measurements. So super-emitters in central Africa and south-east Asia may not be picked up, although new satellites being deployed will improve detection in these regions. Smaller but longer-lasting leaks from waste sites will also release large amounts of methane into the atmosphere.

‘Out of sight’

Most rich nations have dealt with major methane leaks from waste dumps, although some concerns remain about biodigesters, which in the UK for example have been found to leak 4% of their gas.

The lack of action elsewhere is as much to do with the low profile of the waste sector as to do with cost, said Silva Filho. “Waste is still an overlooked topic and it’s not a priority in many countries, mostly in the global south. It is like a magic service – waste simply disappears from the kerbside, so people don’t care if it is going to a recovery facility or a dump site, just that it’s taken out of their sight.”

Nisbet said: “[People] haven’t thought about it, stressed local authorities have got other things on their mind. It’s a governance issue.”

Covering landfills with soil is quick and cheap but is only a partial solution to all their pollution problems, said Singh. “Most of the landfills in India and most of the developing economies are not constructed in a scientific manner, with no kind of mechanism to collect landfill gases or the hazardous waste.

“We can call them pollution hubs,” she added. “You name any sort of pollution – be it land pollution, surface and groundwater pollution, air pollution – you will find everything there, and that is very, very concerning.”

But Singh said action had begun: “By the intervention of the government of India’s Clean India Mission, there has been a drastic change in the way we see waste. We want to make our country free from garbage.”

She said the Central Pollution Control Board in India had identified more than 3,000 dumps and about a third of old landfill waste had been treated so far.

This involves excavating the dumps, aerating the organic waste to break it down to CO₂, using burnable waste as fuel and taking the remaining non-toxic material for aggregate in building.

Even if global heating does not always inspire action, cleaning up cities does, said Singh. “The climate impact of methane may be a bit technical for a layman to understand but everybody wants to see their city clean. The garbage mountains have been on the primetime news, and [affected] election results.”

The city of Indore, in Madhya Pradesh, has been judged India’s cleanest city and now separates much of its organic waste at source – the crucial step in avoiding new methane-producing landfills. Instead, a new biomethane plant can produce 17 tonnes of methane fuel a day.

The city has also remediated 40 hectares (100 acres) of landfill and is replacing most of it with a city forest. “Something that was initially producing methane greenhouse gas is now being converted into a place which can actually sequester CO₂,” Singh said.

Silva Filho said: “The best option is the one we can afford – and by going step by step with simple solutions, solving the problems at the local level, we can upgrade the system gradually.” As well as India, progress is being made in countries such as Colombia, Chile and Malaysia, he said. “But population growth will be registered mostly in the global south, where we lack waste infrastructure, so we will have a big problem if we continue with current practices.”

Nisbet said cutting methane was a very good climate investment. “If you’ve got \$1m to spend on climate change, [cutting] methane should be high on your priority list, because you get much more impact for your dollar.”