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Why solid waste incineration is not the answer to your city's waste problem

[Air Quality](#)[Clean Energy](#)[Waste](#)Originally Published: **July 2019**Author(s): **C40 Cities Climate Leadership Group, C40 Knowledge Hub**

Solid waste incineration is often presented as a ‘quick-fix’ solution to reduce rapidly growing waste volumes while producing energy, especially for cities in the Global South. Although frequently marketed as clean, profitable and even circular, incineration is actually among the worst approaches cities can take to achieve both waste reduction and energy goals.

Incineration infrastructure is expensive to build and operate, inefficient, and creates environmental risks. It locks cities into high-carbon pathways by requiring them to continue producing lots of waste to feed the incinerator, undermining efforts to reduce waste generation or increase recycling rates. In cities around the world there is growing public opposition to incineration, and it is increasingly being understood as just as unsuitable as landfilling as awareness of its environmental and climate impacts grows. Investments in incineration infrastructure are increasingly at risk of becoming ‘stranded assets’ as successful waste reduction strategies take hold and opposition to incineration grows. This article explains why incineration is unlikely to be the answer to your city’s waste problem.

Other forms of waste-to-energy

This article focuses on the process of solid waste incineration on an industrial scale, with energy (most efficiently, heat) recovery. These arguments also apply to other processes that use heat to dispose of waste –

such as pyrolysis, which uses heat to decompose biomass.



English

However, there are other positive forms of energy that can be produced from the treatment of waste, notably anaerobic digestion, which is a carbon neutral treatment for food and organic waste which produces biogas, among other valuable outputs. Landfill gas-capture is also a source of biogas, but is less efficient and more environmentally damaging than anaerobic digestion.

Producing energy from solid waste incineration is highly inefficient

In most Global South cities and cities without good waste segregation at source, municipal waste streams include large quantities of food waste. Food waste is composed of about 70% water and consequently requires considerable energy to burn.¹ The net energy gain of burning mixed waste is low or non-existent, making incineration one of the least efficient ways to produce energy when compared to renewable sources like wind, solar, hydro or geothermal.^{2, 3}

Incineration facilities in cities with a high level of food and organic waste in their waste stream – which is common in Global South cities – often require additional fuel to be added to the waste to enable the burning process, adding to costs and making waste incineration even less efficient.

Find out how much food and organic waste there is in your city's waste stream below:

Select a City

BUDAPEST - HUNGARY

Waste composition

Data sources: World Bank 2018

Because of these inefficiencies, incineration facilities do not recoup investment based on energy income alone.⁴ The main revenue supporting these facilities is typically not the sale of heat and energy, but tipping fees. However, incineration facilities also face difficulties with the consistent collection of these waste

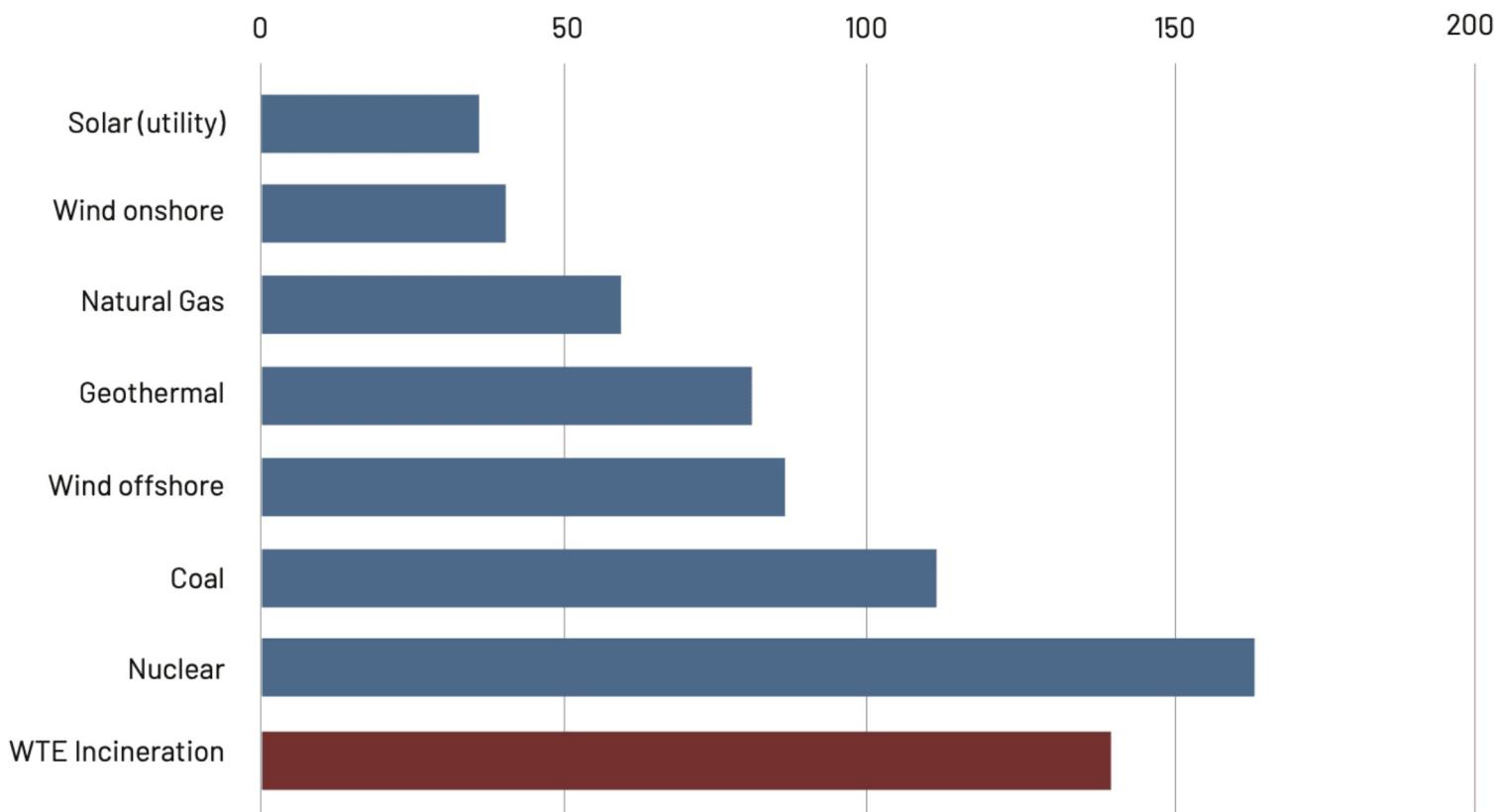
fees, particularly where strong business and operational models are lacking.



Incineration is a highly expensive way to make energy and deal with city waste

Burning waste for energy recovery costs more than most existing energy sources per same unit of energy. It costs nearly four times more than solar power and onshore wind energy, and twice as much as fossil gas, as shown in the figure below.⁵ This is linked to its inefficiency.

Global levelised cost of energy generation (USD/megawatt hour as in 2023)⁶



Waste incineration can be successfully integrated into the waste management system if there is:

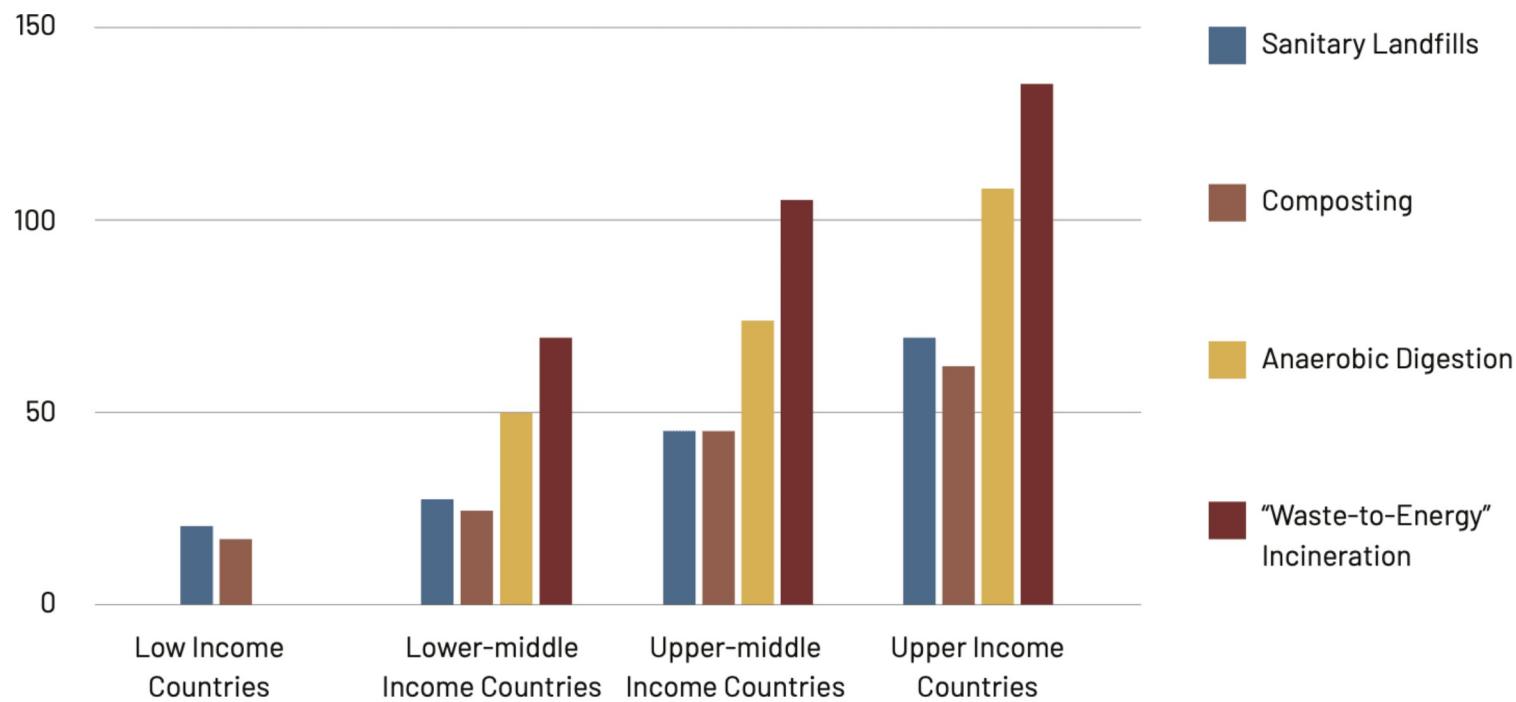
- Strict and enforced segregation at source;
- Relatively high tipping fees;
- An extreme scarcity of land, making land-based disposal extremely expensive; and
- High demand for heat and power.

However, even if these conditions are met, the lifecycle costs of recycling and waste reduction are lower than the costs of incineration. Cities meeting these conditions and with existing facilities in operation are increasingly decommissioning incinerators.

The scale of investment needed means that they require public sector finance to underwrite private investment. Cities choosing incineration pay for these facilities for decades through debt repayments and long-term power-purchase agreements, locking them into a future of waste incineration. The costliest operational expense is the environmental controls required to mitigate air pollution (see below), which need to be progressively upgraded as regulations tighten.

In addition, these systems are complex, requiring highly skilled staff to ensure optimal technical and environmental performance, and regular maintenance. Finding qualified plant operations personnel is another challenge faced by many facilities, particularly in the Global South. The figure below shows how incineration has the highest operational expenditure of all waste management options in all countries measured.

Operational expenditure of different waste management options (USD/tonne)⁷



Because of the inefficiencies involved in the process, incineration facilities do not recoup investment based on energy income alone.⁸ The main revenue supporting these facilities is typically not the sale of heat and energy, but tipping fees. However, incineration facilities also face difficulties with the consistent collection of these waste fees, particularly where strong business and operational models are lacking.

Waste incineration creates air pollution and requires strong environmental controls

When waste is burned in incineration facilities it produces hazardous air pollutants including particulate matter ($PM_{2.5}$ and PM_{10}), carbon monoxide, acid gases, nitrogen oxides and cancer-causing dioxins.⁹ The biggest source of these emissions is the incineration of materials made from fossil-fuel-based materials,

like plastics and rubber.



To mitigate these risks, cities that decide to use incineration must implement strict environmental controls, which are typically the most expensive operational cost. When operators of incineration facilities struggle to make returns, they will often try to reduce or shut down these environmental controls, putting the nearby population at significant risk. **Cities that lack strong environmental controls, monitoring and enforcement capabilities, or where a third party needs to make a return on their investment from operational revenues, should not build these facilities.** Read *Why clean air is vital for your city's health and prosperity* to understand the dangers of air pollution, particularly PM_{2.5}, for cities and citizens.

Incineration can also cause water pollution, odour, noise, and vibrations, which impact on residential and commercial neighbours. In addition, it produces hazardous wastes associated with fly ash and bottom ash, which require careful handling and disposal.¹⁰

Energy produced from waste is NOT clean or renewable

The CO₂ emissions of a waste incineration facility are roughly equivalent to a natural-gas-fired power plant, with some estimates pointing to emissions similar to those of coal-fired energy generation.^{12, 13} It is not clean energy.

Waste contains materials that are derived from fossil fuels, like plastics. Energy produced from waste incinerators is therefore not clean or renewable. The myth that waste is a source of renewable energy comes from the fact that waste streams have, historically, been increasing and therefore constantly replenished – or ‘renewable’ – but this is a false premise. Cities should instead be focusing on waste reduction,¹¹ which helps to reduce emissions across material and product lifecycles.

Some regions like Australia, the European Union and 23 states in the United States have historically considered waste incineration to be a renewable energy source, making incineration projects eligible for green subsidy support and for participation in clean energy market mechanisms.¹⁴ As recognition of the need for divestment in solid waste incineration grows, these financial benefits are coming to an end. For example, since January 2017 member states of the European Commission have been encouraged to raise incineration taxes, phase out subsidies for waste-to-incineration, ban the construction of new facilities, and decommission old ones.¹⁵

Incineration undermines zero waste objectives

Investment in incineration ‘locks-in’ demand for high waste volumes, which are needed to feed the incinerator to enable power generation. These facilities are very inflexible in their operating capacity.

Cities are often required to enter into contracts for guaranteed amounts of waste, and to pay for the upfront cost of the facility can take cities decades to repay. This strongly discourages waste reduction and material recovery, recycling and reuse, minimising incentives to transition towards sustainable, zero waste objectives.

Incineration is not an effective way to create good, green jobs

Investment in waste incineration is often touted as an engine for green job creation, especially for cities in the Global South. What these claims overlook is that incineration creates relatively few jobs (compared to other waste management systems).

In addition, waste incineration systems are complex, requiring highly skilled staff to ensure optimal technical and environmental performance, and regular maintenance. Finding qualified plant operations personnel is challenge faced by many facilities, particularly in the Global South – and without adequate training programmes in place, these jobs will often be inaccessible to many residents.

Waste incineration jobs are also not ‘green’; given that incineration is neither a sustainable form of waste management nor a source of clean energy. Cities would do better investing in training and employment opportunities that support workers to participate in sustainable waste management and a just energy transition. This could mean focusing, for example, on engaging informal workers in a transition to sustainable collection and treatment of organic and recyclable waste, and on creating equitable and inclusive jobs in the renewable energy sector.¹⁶

The idea of solving cities’ waste problems and producing inexpensive energy through incineration can sound promising to city leaders. Many cities have been flooded with unsolicited proposals on new incineration projects from consultants, business developers and investors, and often spend a lot of money investigating the viability of these projects. The overwhelming majority of projects never progress due to the limitations of these technologies and impacts with regard to fuel requirements, operational costs, air quality and other issues outlined in this article.



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