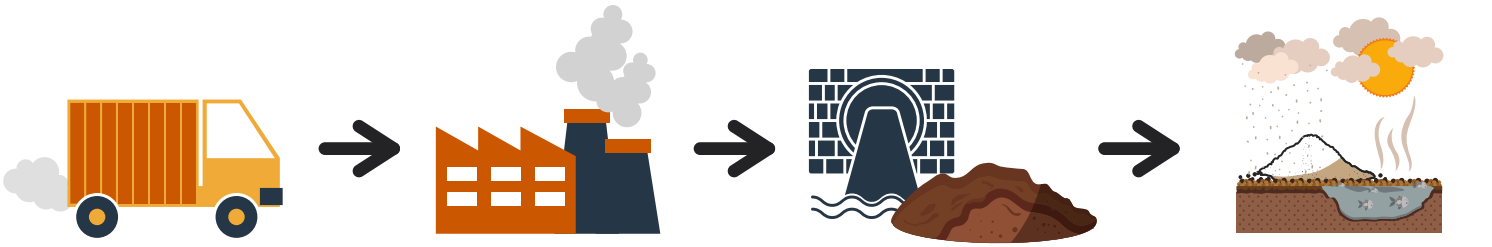
POLLUTION AND HEALTH IMPACTS OF WASTE-TO-ENERGY INCINERATION



Emissions from hauling waste to incinerators

Emissions from burning trash in incinerators

Generation of ash and waste water

Residue disposal at landfills

INCINERATION RESULTS IN POLLUTION IN EACH PHASE OF THE PROCESS, FROM WASTE HAULING TO MANAGING AIR EMISSIONS AND RESIDUES

WASTE HAULING Large, heavy-duty diesel sanitation trucks that collect and haul municipal solid waste release harmful substances. Diesel fumes, which **contain up to 40 types of hazardous air pollutants** including nitrogen oxides, particulate matter, carbon monoxide, and volatile organic compounds are carcinogens according to the National Cancer Institute. **Host communities face health burdens and risks associated with chronic exposure to such diesel particulates.**

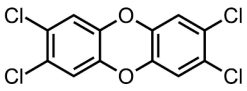
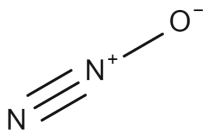
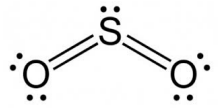
BURNING TRASH IN INCINERATORS **releases various types of emissions** including lead, mercury, dioxins and furans, particulate matter, carbon monoxide, nitrogen oxides, acidic gases (i.e., SOx, HCl), metals (cadmium, lead, mercury, chromium, arsenic, and beryllium), polychlorinated biphenyls (PCBs), and brominated polyaromatic hydrocarbons (PAHS). Direct exposure to such toxins risks the health of facility workers and residents in nearby communities while indirect exposure, through the food chain, poses global risks.

ASH & RESIDUES While advanced air pollution control equipment removes some of the toxic pollutants from the exhaust, it concentrates them in other byproducts, such as ash and wastewater. Approximately 26 - 40% of waste becomes bottom ash. **The more pollutants an air pollution control system removes, the more toxic its fly ash is.** Incineration also generates new toxic chemicals such as dioxins and furans, which can leach into soil and groundwater and accumulate in food chains.

RESIDUES REQUIRE SPECIAL TREATMENT & SEPARATE DISPOSAL, but they are mostly sent to landfills where the ash can spread via wind and air. Some ash is mixed into concrete, buried in salt mines, mixed into asphalt for roads, or even spread on agricultural lands, mislabeled as soil fertilizer.

Source: The New School Tishman Environment and Design Center (2019). U.S. Solid Waste Incinerators: An Industry in Decline; Center for International Environmental Law (2019). Plastic & Health:The Hidden Costs of Plastic Planet; Tait, P. W. et al. (2019). The health impacts of waste incineration: a systematic review. Australian and New Zealand Journal of Public Health; National Research Council (2000). Waste Incineration and Public Health; Michelle Allsopp, Pat Costner, and Paul Johnston (2001). Incineration and Human Health. Environmental Science and Pollution Research 8.2.

POLLUTANTS & HEALTH IMPACTS OF WASTE INCINERATION

	Sources	Properties	Health Impacts
 DIOXINS & FURANS	Burning of plastics or fuels such as wood, coal and oil; formed in stack gases in waste incinerators	Highly toxic, potent carcinogens, one of the most concerning pollutants emitted from WTE facilities	Cancer & cancer-related mortality; neurological damage; growth defects; DNA damage; endometriosis; disruption to reproductive, immune, respiratory systems
 NOx	Food and yard waste; formed when nitrogen-containing waste reacts with oxygen in the air	Major contributor to smog, haze, acid rain, and particulate matter; forms ozone through reactions with other pollutants in the presence of sunlight	Increased respiratory illness; breathing problems, headaches, chronically reduced lung function, eye irritation, loss of appetite and corroded teeth
 SULFUR OXIDES & DIOXIDES	Tires and gypsum wallboard; results from the burning of either sulfur or materials containing sulfur	Toxic gases with a strong odor; comprised of gaseous and particulate chemical components; major contributor to acid rain	Components can damage lung tissue; irritate skin, eyes, nose, throat, and lungs; short term exposure impacts respiratory system
PM10 PM2.5 PARTICULATE MATTER	Consists primarily of entrained non-combustible matter in the flue gas and the products of incomplete combustion	A complex mixture of extremely small particles and liquid droplets in the air; PM2.5 poses health risks even at very low concentrations	Irritation of respiratory tract; aggravated asthma; chronic obstructive pulmonary disease; decreased lung function; heart attacks; heart disease mortality

Source: Centers for Disease Control and Prevention (2019). Air pollutants. Retrieved from www.cdc.gov/air/pollutants.htm; U.S. EPA (2019). Criteria Air Pollutants. Retrieved from www.epa.gov/criteria-air-pollutants.

POLLUTANTS & HEALTH IMPACTS OF WASTE INCINERATION

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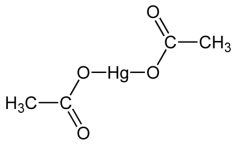
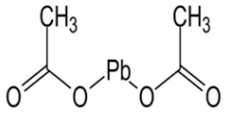
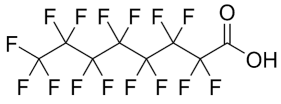
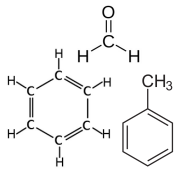
 MERCURY	Mercury-containing waste, electronics, antiques, batteries, etc.	Common and dangerous silvery-white heavy metal; bio-accumulates, particularly in marine food web	Damage to nervous, digestive, and immune systems and to brain, lungs, kidneys, skin, and eyes; any exposure can lead to neurological and behavioral disorders
 LEAD	Lead-containing waste; paint, toys, furniture, water pipes, ceramics, etc.	Highly prevalent in environment and affects virtually every organ system in humans and animals. No safe level of lead exposure	Cardiovascular effects; high blood pressure; decreased kidney function; reproductive problems; neurotoxin; particularly dangerous to children and pregnant women
 PFAS	Food packaging, stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, etc.	A group of man-made chemicals, such as PFOA, PFOS, GenX; Both PFOS and PFOA very persistent in the environment and human body	Increased cholesterol levels; effects on infant birth weights; damage to immune system, cancer (for PFOA), and thyroid hormone disruption (for PFOS)
 VOLATILE ORGANIC COMPOUNDS (VOCS)	PVC, food residues, cleaning agents; degradation of polymer chains when plastic is burned	Organic chemicals that have a high vapor pressure at room temperature, resulting from a low boiling point	Eye, nose and throat irritation; headaches; respiratory problems; nausea; damage in central nervous system, liver & kidney; cancer in humans and animals

Source: Centers for Disease Control and Prevention (2019). Air pollutants. Retrieved from www.cdc.gov/air/pollutants.htm; U.S. EPA (2019). Criteria Air Pollutants. Retrieved from www.epa.gov/criteria-air-pollutants.

WASTE PRODUCTS OF INCINERATION

Incineration creates another waste management issue, as it produces highly toxic by-products, such as fly ash, bottom ash, and wastewater. Pollutants remaining in the ashes threaten air and water quality and pose health risks for workers and nearby communities, whether they end up in landfills, cement kilns, mines, or agricultural lands. While the ash must be properly treated and disposed in hazardous waste landfills in order to minimize the environmental health impact, many companies attempt to use the toxic ash for road and construction material or food production, reintroducing the toxins in the environment.

BOTTOM ASH

- Bottom ash, also known as “slag”, comes from the furnace. It constitutes 75-85% of the total ash generated in an incinerator.
- It is approximately 10% by volume and 20- 35% by weight of the solid waste.
- Mixed bottom ash can carry high levels of dioxins and heavy metals, and the leachability of dioxins and furans also increases when bottom ash is mixed with fly ash.

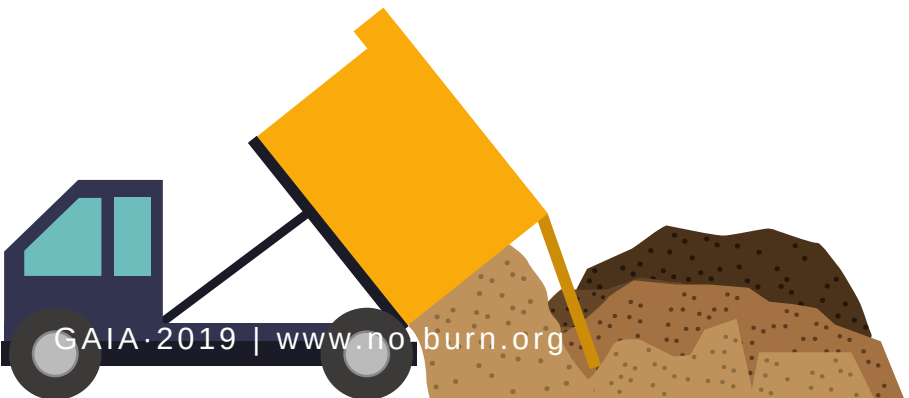
FLY ASH

- Fly ash is particulate matter in flue gases, which contain hazardous substances such as mercury, dioxins, and furans.
- The toxicity of fly ash is greater than bottom ash because filters and scrubbers capture toxins in the waste and concentrate them in fly ash. Fly ash is also readily windborne and more likely to leach.

OTHER RESIDUES

- Waste incineration also produces other residues, such as boiler ash and wastewater
- Some incinerators produce scrubber salts, filter cake, and sludge depending on the pollution control system.
- The residues may contain dioxins and high levels of other persistent organic pollutants.
- The toxins in the residues are available to leach and travel, especially in contact with rainwater.

Source:
IPEN Dioxin, PCBs and Waste Working Group (2015). After Incineration: The Toxic Ash problem; The New School Tishman Environment and Design Center (2019). U.S. Solid Waste Incinerators: An Industry in Decline; Center for International Environmental Law (2019). Plastic & Health:The Hidden Costs of Plastic Planet.



ROUTES OF HUMAN EXPOSURE

The pollutants in air emissions, water and residues can enter human body through:

- Breathing harmful air
- Drinking polluted water
- Eating food that was grown in contaminated soil
- Eating fish, meat or dairy high in the food chain

STUDIES ON DIRECT HEALTH IMPACTS OF INCINERATION

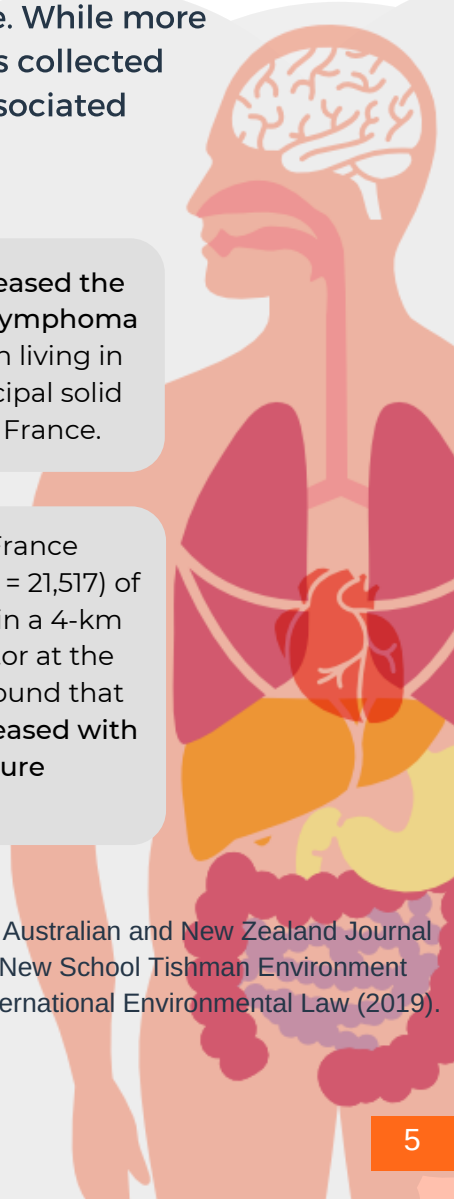
Despite limitations in methodology and data sources, existing epidemiological studies provide sufficient evidence of direct health impacts of incinerators, which range from neoplasia to congenital anomalies, infant deaths and miscarriage. While more research can be done on newer incinerators when enough data is collected over time, the findings of existing studies suggest serious risks associated with incinerators, both for nearby and distant populations.

A study analyzed the occurrence of miscarriages in women aged 15-49 years residing near seven incinerators in Northern Italy (2002-2006), and found that **an increase of PM10 caused by incinerators was associated with an increased risk of miscarriage.**

A 2005 study in Japan found that proximity of schools to municipal waste incineration plants may be associated with **an increased prevalence of wheeze, headache, stomach ache, and fatigue** in school children.

Dioxin emissions **increased the risk of non-Hodgkin's lymphoma** among the population living in the vicinity of a municipal solid waste incinerator in France.

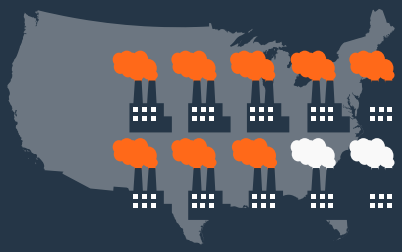
Another study in France considered all births (n = 21,517) of women residing within a 4-km radius of an incinerator at the time of delivery and found that **pre-term delivery increased with increased exposure** (2003-2010).



Source: Tait, P. W. et al. (2019). The health impacts of waste incineration: a systematic review; Australian and New Zealand Journal of Public Health; National Research Council (2000). Waste Incineration and Public Health; The New School Tishman Environment and Design Center (2019). U.S. Solid Waste Incinerators: An Industry in Decline; Center for International Environmental Law (2019). Plastic & Health:The Hidden Costs of Plastic Planet.

ENVIRONMENTAL JUSTICE COMMUNITIES AT HIGHER RISKS

Incinerators are disproportionately built in low-income and socio-politically marginalized communities, burdening them with air pollution from incinerators, diesel trucks transporting waste, toxic ash, noise pollution, accidents, and much more.



In the U.S., **8 out of every 10** MSW incinerators are located in low-income communities and communities of color.

Residents face adverse environmental health impacts, public debt due to costly construction and maintenance of incinerators, and the stigma of being a dumping ground.

Often, the communities are already overburdened with disproportionate amounts of pollution from a multitude of sources, such as coal power plants and petrochemical plants.

Source: The New School Tishman Environment and Design Center (2019). U.S. Solid Waste Incinerators: An Industry in Decline; See Lara Schwarz, Tarik Benmarhnia & Lucie Laurian (2015). Social Inequalities Related to Hazardous Incinerator Emissions: An Additional Level of Environmental Injustice, 8(6) Envtl. Just; Marco Martuzzi, Francesco Mitis & Francesco Forastiere (2010). Inequalities, inequities, environmental justice in waste management and health (2010), 21(6) The Eur. J. of Pub. Health 21, 21-26; Ana Isabel Baptista & Kumar Kartik Amarnath (2017). Garbage, Power, and Environmental Justice: The Clean Power Plan Rule, 403 Wm. & Mary Envtl. L. & Pol'y Rev. 41.

This publication is supported in part by The JPB Foundation.