KEY FINDINGS

- Waste incineration is not a solution to the triple planetary crisis - it actually contributes to it. Incinerating waste emits large volumes of CO_2, pollutes the environment with a variety of toxic chemicals including dioxins, mercury, and many others in quantities exceeding planetary limits, and contributes to biodiversity loss.
- Waste incineration destroys valuable phosphorus resources in biowaste and disrupts global biogeochemical cycles.
- Communities living near incinerators may be at higher risk of health issues due to their harmful effects.
- Air emissions are not the only pollution pathway from waste incinerators: Both fly ash and bottom ash from incinerators are highly contaminated with dioxins and other chemicals such as PFAS.

- Emissions to air from waste incinerators are not fully controlled, as some very toxic substances are monitored for only a few hours twice a year or not measured at all.
- Waste incinerators cannot operate without state subsidies and other forms of economic support from public budgets.
- Alternatives to waste incineration exist for most waste streams, with examples included in the report.

Waste incinerators represent an outdated, unsustainable, and expensive way of managing waste that has negative effects on the environment, human health, and the planetary ecosystem.

Industry promotes including their newer incinerators in the circular economy system and are therefore looking for ways to use the bottom ash, which remains up to one third of its original weight from the incinerated waste (Chapter 3.3.3). In this regard, too, for example, the oversized Dutch incinerators have already hit an imaginary ceiling, and the Nobel Prize winner Ernst Worrell therefore described the Dutch roads built from incinerator bottom ash as "linear landfills" (Chapter 3.3.3.1)

While industry hopes that incineration will make waste seem to magically disappear, the reality is that by burning waste we destroy valuable raw materials that we can no longer reuse, recycle or compost, while an unusable one-third of the original weight of waste remains as hazardous waste, enriched with toxic substances. By operating incinerators, we support linear waste management, which requires a constant supply of waste and conversely, generates significant volumes of hazardous waste as a result.

The choice of waste management technologies our governments make inherently comes with significant local and global impacts. The destruction of finite resources by entrenching waste incineration leads to a linear instead of circular economy.

In this study, we have highlighted the key impacts of waste incinerators on the environment, human health and the economy. As can be seen, waste incineration contributes to the disruption of the Planetary Ecosystem, particularly through global chemical pollution (Chapter 4.2), greenhouse gas emissions (Chapter 4.1), biodiversity loss (Chapter 4.3), and biogeochemical flows (Chapter 4.4).One of the biggest problems associated with waste incineration is dioxins, which have serious negative effects on human health (Chapter 6), including cancer, damage to the immune system, reproductive problems and developmental defects (Chapter 5.1.1).

Despite strict emissions limits, waste incinerators are responsible for almost one fifth of all dioxins released into the air in the European Union (Chapter 5.1.1.1). It is evident that

pyrolysis and plasma gasification of waste, as well as technologies now summarized under the name "chemical recycling" of plastic waste, do not represent functional substitutes for waste incineration and are similarly problematic in terms of environmental impacts or have different negative effects than "classical" waste incinerators (Chapters 3 and 6). The most suitable alternatives in the field of waste management therefore appear to be greater investment in waste prevention, sorting and recycling, which primarily includes bio-waste composting (Chapters 8 and 9.1.3). For municipal waste, the most appropriate solution is to set up systems called zero waste (see Chapter 8.1), even though some residual waste still remains.

This report adds to the growing body of evidence that waste incineration undermines more sustainable Zero Waste policies and the goal of a Circular Economy.

Many countries rely on the European Best Available Technique (BAT) guidelines (European Commission, 2019) as the basis for their own country specific industrial regulation standards to justify approving incinerator projects. Yet this report highlights the significant failures of these guidelines as experienced by the Czech Republic and many other European countries. The material reality of the adverse impacts of waste incineration on those communities living close to such facilities is underscored by this document.

Despite the claims of waste incineration proponents and governments that the EU BAT standards for waste incineration operations are robust and protect human health and the environment, yet the most dangerous substances (such as dioxins or mercury) that are produced during combustion are monitored in emissions only twice a year, and many of them are not monitored at all (Chapters 3.1 and 5.1.1.1). Waste incinerators also release significant amounts of mercury and other toxic metals into the environment with negative effects on health. Due to emission limits, incinerators must clean their flue gases. However, this creates another flow of toxic waste in the form of ash and air pollution control (APC) residues, which should require strict handling and treatment regulations as a hazardous waste. (Chapters 3.3 and 5.1.1.3). The failure to adequately account for and regulate fly ash, and therefore the dioxins and other POPs it contains, significantly contributes to exceeding the planetary limits of chemical pollution (Chapter 4.2). The volume of unregulated dioxins in fly ash, out of control, corresponds to the maximum tolerable intake of these substances for the population of up to 133 planets Earth.

As the Global South faces a concerted push to establish waste incineration widely, particularly in the Southeast Asian region, where there is little experience with such technologies and industrial regulatory oversight is not assured, the protection of the environment and human health subsequently faces many serious threats.

Incinerating waste, while producing the energy that powers our modern, energy-intensive lives, also actively contributes to the cycle of climate change. Emissions of carbon dioxide, created by the combustion process, are one of the driving forces behind the greenhouse effect, which has serious consequences in the form of global warming and climate change. By 2050, the conversion of plastic waste to energy (including incineration in WtE) will lead to greater emissions of carbon dioxide than the burning of fossil fuels. Energy utilization of waste therefore does not help solve global climate change but contributes to it and thus represents a dead end in replacing coal (Chapter 4.1).

Excerpts from country situation studies in the report

EU situation

A 2023 report by Zero Waste Europe suggests that the EU has an excess of incineration capacity and recommends considering a moratorium on the construction of new incinerators. The report also notes that between 2004 and 2020, there was an annual increase in waste incineration capacity of approximately 8 million tonnes, and that by 2023, total capacity could reach up to 220 million tonnes.

Additionally, the report calls on Member States with excess capacity to implement a moratorium and potentially reduce capacity. Janek Vahk, Zero Pollution Policy Manager at Zero Waste Europe, commented on the situation at the EU level. He stated that waste management and environmental sustainability are becoming increasingly important. The conclusions of the study for Zero Waste Europe are clear: it is time for a moratorium on incineration. The European Union must rethink the role of incineration in the waste hierarchy, especially with overcapacity looming and recycling targets on the horizon. The report even suggests decommissioning 5 % of incinerators annually. Implementing a moratorium would promote sustainable waste management (Hogg 2023).

The European Commission has made it clear in a number of policies, targets and regulations that govern the EU Taxonomy and guidance for major European Financial Institutions, that waste to energy incineration is not supported in terms of climate impacts and that it is an industry that represents a threat to the Circular Economy

Norway, Denmark, Sweden

Danish legislators decided in 2020, as part of carbon emission reduction efforts, to reduce the capacity of their incinerators by 30 % within ten years, leading to the closure of 7 of 21 waste incineration plants in Denmark (Gardiner, 2021). Norway's Klemetsrud incinerator, on the other hand, imports waste from Manchester or Leeds in the United Kingdom. As waste processing incurs fees, it's economically viable to export waste from Norway to Sweden for incineration, as incineration there is cheaper.

Incineration only utilizes approximately 20 % of the energy stored in these waste materials, while recycling saves 3 to 5 times more energy compared to primary resource utilization or virgin production (GAIA, 2013). Specifically, in the case of office paper production, recycling saves 2.5 times more energy.

Czechia

There are currently four WtE plants in operation in the Czech Republic that use municipal waste (MSW) for energy recovery. In 2021, the Czech Republic had 23 incinerators that cannot be classified as WtE and that incinerate industrial or medical waste. By way of comparison, in 1992 there were more than 230 waste incineration plants in the Czech Republic, most of which had a small annual capacity. A large number of them failed to meet stricter requirements - emission limits or technological requirements - and had to be closed

During the period 2011 to 2023, several other plants have gone through the Environmental Impact Assessment (EIA) process and received approval from the Ministry of the Environment, and it can be assumed that they will be built if they receive funding.

Currently, other plants (with a total capacity of about 300,000 $t.y^{-1}$ of MSW) are seeking approval in the EIA process also. If they were to receive permission to build and operate then the total capacity of facilities in the Czech Republic would increase to more than 2,700,000 $t.y^{-1}$ (2,200,000 $t.y^{-1}$ excluding co-incineration in cement plants).

Increases in waste incineration capacities in the Czech Republic will undermine the ability to meet recycling targets after 2035. Incineration and recycling facilities will increasingly compete for the same materials, (because the current composition of wastes that are directed to WtE facilities, contain materials that can be composted, reused or recycled.

Estonia

According to data from Eurostat for the year 2015 (see Figure 10.5), Estonia utilized 58 % of municipal waste for energy and only 9 % was landfilled (EUROSTAT, 2015). From older data, it's evident that this was achieved through the construction of the waste-to-energy plant (WtE) in Tallinn. Looking at how Estonia deals with municipal waste raises the question of how it will meet the EU target for municipal waste recycling. The political framework for a circular economy in the EU set recycling at 65 % of municipal waste. Today, Estonia recycles only 33 % of it. An article from September 2013 states that the Iru plant is already unable to manage Estonian manage with Estonian waste alone. Hence, it needs to add 10 % from imports from Ireland or Finland to reach ninety percent of its required waste inputs

Ethiopia

The Ethiopian government fast-tracked the Reppie Waste-to-Energy (WtE) Project, led by a consortium including Cambridge Industries Ltd (CIL), China National Electric Engineering Co (CNEEC) and Ramboll of Denmark. This $118 million initiative was promoted as being capable of converting 350,000 tons of solid waste annually into 50MW of electricity, fulfilling 30 percent of household energy requirements. Planned to commence operations in 2018, the project's scope later expanded to include the establishment of WtE plants in Uganda, Kenya, Cameroon, Senegal, and Djibouti.

In 2022, the steam turbine and generator of the plant underwent repairs under a two-month maintenance scheme that was scheduled to conclude at the end of December 2022, according to Project Manager Biruk Eba, but it is not clear if the plant ever returned to full operation. The plant is currently incinerating 600 tons of waste daily, about 150,000 tons short of the annual 350,000 ton projection, considering disruptions in power generation. Also it now generates only 25 MW of power, casting doubt on the initial 50MW power estimation in terms of time, money, and resource allocation. For the same investment amount, the Addis Ababa city administration could have implemented an efficient Integrated Solid Waste Management System (ISWMS), creating thousands of jobs, Alemu (2019) suggests.

Since the major composition of wastes generated in most African cities is biodegradable, organic materials as shown in graph at Figure 10.7 (Adebayo Bello & bin Ismail, 2016), with low calorific value and high moisture, cities should prioritise investment in composting systems which come with a much smaller budget instead of investing in wasteful WtE.

China

In the five years from 2016 to 2020, the amount of municipal solid waste incineration (MSWI) in China increased by about 98 %.

Sorting waste has been a success, but this means less capacity for WtE .... The composite challenge lies in adhering to the more important principles of reduction, recycling, and safety outlined in China's Solid Wastes Law (Jiacheng 2023). It also highlights just how significantly waste incineration undermines the recycling sector and better waste management outcomes.

Recent studies highlight the risk of overinvestment in municipal solid waste incineration (MSWI) and landfill capacity due to discrepancies between planned and projected MSW quantities. Even without sorting food waste, overcapacity is anticipated in Anhui and Tianjin by 2030, potentially discouraging more effective sorting and recycling efforts

While incineration has aided in reducing landfill sites, it has raised concerns about economic, health, and environmental risks. Studies indicate health risks associated with

waste-to-energy facilities, emphasizing the need for safe buffer distances of at least 1,500 meters, which is five times the current required distance of 300 m (Boré et al. 2022)

Large municipal waste incineration capacities also result in significant dioxin emissions. …one study shows that the overburden of dioxin emissions is in the same regions which were found to have overcapacity of municipal waste incinerators (Shapiro-Bengtsen et al. 2020).

An earlier study assessed health risks in relation to PCDD/Fs in areas surrounding two MSWI in China and concluded that the atmospheric pollution by PCDD/F surrounding one MSWI was relatively serious; the environmental impact of the other MSWI was not significant (Jin et al. 2012).