FACTS ABOUT "WASTE-TO-ENERGY" INCINERATORS

Incinerators are facilities that treat waste by burning it. They come under many names such as "mass burn incinerators," "thermal treatment facilities," or so-called "waste-to-energy" (WTE) plants, and involve processes such as combustion, pyrolysis, gasification, or plasma arc. But they all have the same claim— "burning waste will make our waste problems disappear."

Among the most aggressively promoted incinerators are "waste-to-energy" facilities. Not only do they claim to make waste "disappear," they also claim to produce energy during the process.

But studies have shown that this premise is without scientific basis. The process of incineration merely transforms the waste into other forms of wastes, such as toxic ash and air and water pollution, which are harder to contain and usually more toxic than the original form of the waste. The term is also a misnomer—waste is a highly inefficient fuel and these facilities are barely able to generate even a small amount of electricity.

Detailed analysis[1] shows us that incinerators waste more energy than they produce, primarily because what we incinerate needs to be replaced by new products. Extracting virgin materials from the earth, and manufacturing and processing these into new materials to replace the ones incinerated uses up tremendous amounts of energy compared to reusing or recycling what we already have.

This paper looks at the hard facts about "waste-to-energy" incineration, and how it fails both as a waste and resource management option, and as an energy generating facility.

Municipal and city administrators, as well as communities need to look beyond the PR of "waste-to-energy" companies and choose options that promote—not undermine—sustainability. A focus on Zero Waste approaches to waste and resource management, which include reduction, reuse, recycling and composting, are cost-effective and safer options that generate jobs while protecting the climate and the environment.

FACT 1: Waste is not, and should not be fuel. Incinerators waste resources and undermine recycling and reduction efforts.

Municipal waste is non-renewable, consisting of discarded materials such as paper, plastic and glass that are derived from finite natural resources such as forests, minerals and fossil fuels. More than 90% of materials currently disposed of in incinerators and landfills can be reused, recycled and composted.[2] Burning these materials in order to generate electricity discourages much needed efforts to conserve resources and reduce packaging and waste, and also undermines energy-conserving practices such as recycling and composting.

Moreover, waste is not and should not be fuel. Aside from the toxic chemicals released when burning waste, using waste as fuel creates a never-ending demand for waste, just as coal-fired powerplants and nuclear plants create a demand for coal or radioactive fuel. In effect, incineration removes incentives for waste minimization, and creates incentives to generate more waste. In the waste hierarchy, waste minimization or prevention is identified as the best approach to waste management, followed by reusing, recycling and composting. Using waste as fuel, even under the guise of "recovery," undermines the efforts for more sustainable and preferable waste management options.

Incinerators burn many valuable resources that can be recycled and composted, and incinerators compete for the same materials as recycling programs. Because of the extremely high costs of constructing and operating an incinerator, spending taxpayer money for an incinerator means that there are significantly less funds to invest in more affordable reduction, recycling and composting solutions. More than two thirds of the materials we use are still burned or buried,[3] despite the fact that we can cost-effectively recycle the vast majority of what we waste.

Countries and regions in the European Union (EU) that have high waste incineration rates typically recycle less. Data for household waste from Denmark in 2013 clearly shows that regions with expanded incineration have lower recycling and regions with lower incineration do more recycling.[4]

For example, according to Eurostat[5], Denmark generates some of the highest per capita waste in the EU. In 2013, waste generated per capita was 747 kilograms, almost a hundred kilograms more than the next country, Luxembourg (653 kg per capita). Additionally, statistics showed that over 80% of what is burned in Danish incinerators is recyclable and compostable. A 2009 study reported that Europe throws away resources worth over USD 6 billion every year by burning and burying materials that can be recycled.[6]

FACT 2: "Waste-to-energy" incinerators consume more energy than they produce.

All incinerators are a massive waste of energy. Due to the low calorific value of waste, incinerators are only able to generate small amounts of energy while destroying large amounts of reusable materials. While older incinerators generate electricity at very low efficiency rates of 19-27%, a study in the United Kingdom[7] found that conversion efficiencies of new incineration technologies are even lower.

In contrast, Zero Waste practices such as recycling and composting conserve three to five times the amount of energy produced by waste incineration.[8] For example, the amount of energy wasted in the US by not recycling aluminum and steel cans, paper, printed materials, glass and plastic, is equal to the annual output of 15 medium-sized power plants.[9]

Because energy produced by "waste-to-energy" incinerators is marginal, it will not contribute substantially to the electricity grid. Moreover, since waste in Asia is mostly organic, incinerators would need additional energy input to first process the waste to make it suitable for burning, and then burn it, negatively affecting the energy balance of these facilities.

FACT 3: Waste incineration is not renewable energy—and it takes investments away from real renewable energy solutions.

Renewable energy (RE) is defined as energy created from natural processes that do not get depleted, such as wind, wave or solar energy. Municipal waste is non-renewable, consisting of discarded materials such as paper, plastic and glass that are derived from finite natural resources such as forests that are being cut down at unsustainable rates. As mentioned earlier, burning these materials in order to generate electricity creates a demand for things to burn, and discourages much needed efforts to conserve resources, reduce packaging and waste and encourage recycling and composting.

Providing subsidies or incentives for incineration encourages local governments to destroy materials, rather than investing in environmentally sound and energy conserving practices such as recycling and composting.

But not only is "waste-to-energy" incineration non-renewable, it also takes investments away from real renewable energy solutions. The world needs to shift away from fossil fuel use toward a massive uptake of real renewable energy, such as wind and solar, in order to prevent the worst impacts of climate change.

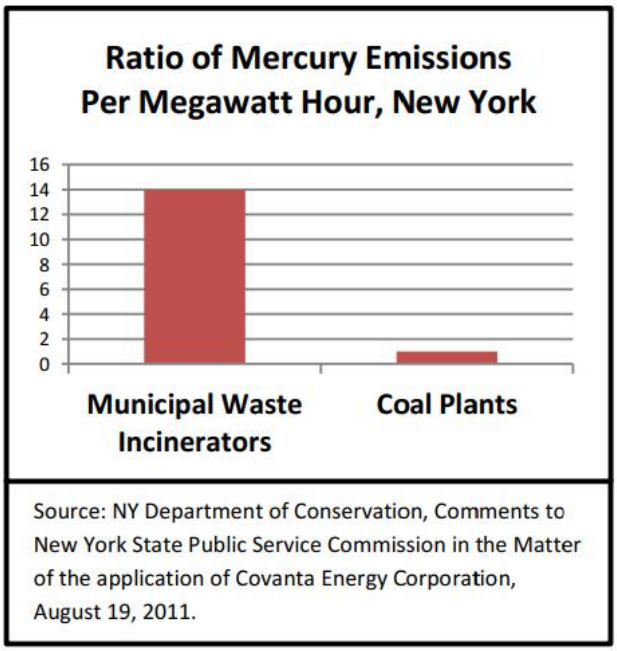
Currently, incinerator companies are deceptively marketing “waste-to-energy” incineration as “renewable energy.” Funds put into this false approach signify a lost opportunities for the development of real RE solutions.

FACT 4: “Waste-to-energy” incinerators produce the same toxic emissions as ordinary incinerators.

All incinerators pose considerable risks to the health and environment of neighboring communities as well as that of the general population. Even the most “advanced” incinerators release thousands of pollutants that contaminate our air, soil and water. Many of these pollutants enter the food supply and concentrate up through the food chain.

Incinerators are major emitters of cancer-causing dioxins and furans. Studies show a significant increase in the risk of dying from cancer in areas near incinerators.[10] Communities around incinerators are highly vulnerable. Incinerator pollution control devices are not fool-proof and there are many examples of failures of facilities even with “state-of-the-art” pollution control devices. A study published in the American Economic Review found that among US industries, the waste incineration industry has the highest ratio of negative economic impacts from air pollution compared to the financial value added by the industry.[11]

Emissions of mercury (a known neurotoxin) is also a major concern. Incinerators also emit more mercury than coal plants. The New York Department of Conservation found that the state’s incinerators emit up to 14 times more mercury as coal-fired power plants per unit of energy, and that in 2009, New York’s incinerators emitted a total of 36% more mercury than its coal plants.[12]



Source: NY Department of Conservation, Comments to New York State Public Service Commission in the Matter of the application of Covanta Energy Corporation, August 19, 2011.

Incinerator emissions are also a source of particulate matter—tiny particles of dust that can lead to decreased lung function, irregular heartbeat, heart attacks, and premature death. A public health impacts report[13] states that modern incinerators in the EU are a major source of ultra-fine particulate emissions. In 2017, another study revealed that particulate matter contributed to over 4 million premature deaths globally in 2015. China and India were identified as the nations most affected by health effects and death from the said pollution.[14]

Aside from toxic air emissions, incineration technologies produce highly toxic by-products. Pollutants captured by air filtering devices are transferred to the facility’s by-products, such as fly ash, bottom ash, boiler ash/slag, and wastewater treatment sludge that are then released into the environment.[15]

Finally, US regulatory agencies have found that incinerators are prone to various types of malfunctions, system failures and breakdowns, which routinely lead to serious air pollution control problems and increased emissions that are dangerous to public health.[16]

FACT 5: “Waste-to-energy” incinerators contribute to climate change.

Incinerators emit more CO_2 per megawatt-hour than coal-fired, natural-gas-fired, or oil-fired power plants. Incinerating materials such as wood, paper, yard debris, and food discards is far from “climate neutral”; rather, incinerating these and other materials is detrimental to the climate.[17]

According to the US Environmental Protection Agency (EPA), “waste to energy” incinerators and landfills contribute far higher levels of greenhouse gas emissions and overall energy throughout their life cycles than source reduction, reuse and recycling of the same materials.[18] Incineration also drives a climate changing cycle of new resources pulled out of the earth, processed in factories, shipped around the world, and then wasted in incinerators and landfills.

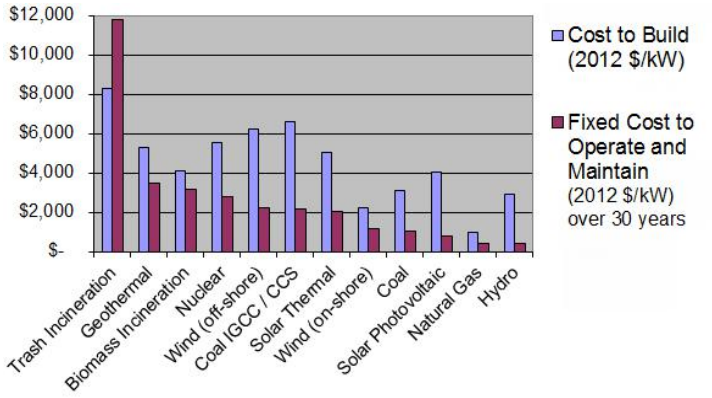
Denmark—the poster child of Europe’s incinerator industry—recently discovered that its incinerators were releasing twice the amount of carbin dioxide (CO_2) than they originally estimated, and had probably been doing so for years. This caused Denmark to miss its Kyoto Protocol greenhouse gas reduction targets.[19]

In contrast, a 2009 study by the US EPA concluded that up to 42% of US greenhouse gas emissions could be mitigated through Zero Waste strategies such as recycling and composting.[20]

FACT 6: WTE incinerators are prohibitively expensive.

Incinerators are the most expensive method to generate energy and to handle waste, while also creating a significant economic burden for host cities.

Incinerators are capital intensive. According to the US Energy Information Administration, the projected capital cost of new waste incinerator facilities is twice the cost of coal-fired power plants and 60% more than the cost nuclear energy facilities.[21] Waste incinerator operations and maintenance costs are also 10 times the cost for coal plants and four times the cost of nuclear plants.[22]

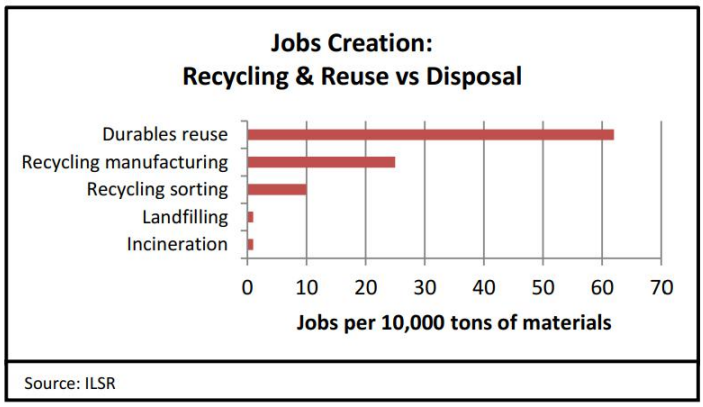


Source: Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants," Energy Information Administration, April 2013, p.6. (www.eia.gov/forecasts/capitalcost/pdf/updated_capcost.pdf)

There are many examples of municipalities that have ended up in debt because of incinerators. In 2011, Harrisburg, Pennsylvania became the largest US city to declare bankruptcy, and the financial blame rests on the staggering debt payments for upgrades to the city's incinerator.[23] Detroit taxpayers have also spent over USD 1.2 billion in debt service payments from constructing and upgrading the world's largest waste incinerator.[24] As a result, residents have had to pay high trash disposal fees of over USD 150 per ton. The city could have saved over USD 55 million in just one year if it had never built the incinerator. For a fraction of these costs, investments in recycling, reuse and remanufacturing would create significantly more business and employment opportunities.[25]

FACT 7: WTE incinerators take away jobs

Incinerators require huge capital investments, but they offer relatively few jobs when compared to recycling. There are also no green jobs in "waste-to-energy" incineration, and they take away jobs from people who need them most. In the US, recycling typically creates 10-20 times more jobs than incinerators. With a national recycling rate of less than 33%, the US recycling industries currently provide over 800,000 jobs. A national recycling rate of 75% would create 1.5 million jobs.[26]



Source: ILSR

In developing countries like the Philippines, incinerators will take jobs away from informal waste workers including waste pickers, recyclers and haulers. The materials burned in incinerators are often the same materials that sustain recycling such as paper and plastics. Recycling is the livelihood of millions of waste workers worldwide, and burning recyclables means robbing waste workers of their source of income. In contrast, investment in recycling, reuse and composting will create more jobs[27] and can enable informal workers to transition to these green jobs.

FACT 8: WTE incineration is not compatible with a sustainable circular economy.[28]

From the broader perspective of sustainability, incinerators are a losing proposition and are fundamentally incompatible with a closed-loop and circular economy. They are essentially destroyers of discarded products and materials, and concentrators of toxicity. Incinerators exacerbate waste disposal problems because they do not eliminate waste. Instead, they produce large quantities of hazardous ash (amounting to as much as 30% of the total waste burned[29]), which must then be disposed. By reducing the volume—but increasing the toxicity of waste—incineration merely replaces one waste stream with another. Incinerator ash, as mentioned above, is highly toxic and has no useful purpose, and is therefore a complete loss to the system.

FACT 9: The world is shifting away from incineration and embracing Zero Waste.

In recent years, many incinerator companies are approaching cities and municipalities in developing countries, particularly in Asia, to peddle these waste burning facilities. Incinerators are sold as "high-tech solutions" that "have worked" in developed countries.

But many developments today reveal that the world is waking up and realizing the failures of incineration. Developed countries that have previously relied on incineration are now shifting away from it.

Europe, home to some of the most advanced waste burning facilities in the world, has taken the first step to phase out incinerators. The impetus for this change was the EU Action Plan for the Circular Economy. A circular economy is "one in which the value of products, materials and resources is maintained for as long as possible, minimizing waste and resource use." Last January, a European Commission communication on the role of "waste-to-energy" in the circular economy[30] has advised member states to issue a moratorium on new incinerators, decommission old facilities, and phase out public support and subsidies for incineration.

Globally, there is a strong move away from incineration and towards Zero Waste. In the US, no new incinerators have been built since 1997 due to resistance from the public, health risks and high costs. Stronger waste reduction and recycling targets have also made incineration unnecessary for many large cities.

Similarly in the EU, higher targets for organics management, recycling, waste reduction and waste diversion have caused incineration overcapacity, meaning there are more incinerators than waste available for burning. This overcapacity has led to waste importation in Germany, the Netherlands, United Kingdom, Sweden, Denmark and Spain.

Many countries on the other hand, are embracing Zero Waste and are investing in long-term waste management strategies, including shutting down their incinerators. Hundreds of municipalities in Italy and Spain have now set Zero Waste as a goal.

ENERGY LOSS IN SO-CALLED "WASTE-TO-ENERGY" INCINERATORS

From: Neil Tangri, *Waste Incineration: A Dying Technology,* Global Alliance for Incinerator Alternatives, 2003.

Some incinerators, particularly large ones, are married to a boiler and turbine in order to capture a portion of the heat generated as electricity. These are then billed as "waste-to-energy" or "energy recovery" facilities. Proponents argue that these facilities take an unusable waste and convert it to a resource by burning it. However, "waste-to-energy" facilities waste more energy than they capture (see table in next page).[i]

To understand this, it is necessary to recognize that any object that may end up as waste represents more energy than the heat released when it is burned. Any basic life-cycle assessment[ii] will show that the calorific value of most items is a small fraction of their "embodied energy," the energy used to extract and process raw materials, turn them into products, and transport those products to market. The embodied energy is all lost when an item is burned in an incinerator.

Recycling of the object, on the other hand, avoids the energy costs of additional raw material extraction, as well as some of the transportation and processing energy. Reuse, by eliminating manufacturing, saves the most energy. Since incinerators have limited thermal efficiency, only a portion of the fuel value of the material burned can be recovered. In a standard waste-to-energy incinerator, at most only 35 percent of the calorific value of the waste is genertaed as electric power.[iii]

In many cases, incineration also concentrates ownership and control of energy generation into the hands of a single firm. Whereas waste was produced by society as a whole, the electricity generated by the incinerator is owned by the operator, and sold back to society. In this manner, the larger society is forced to invest increased energy in production to replace those materials destroyed in the incinerator, and pay the incinerator operator for the privilege of getting back a small fraction of the energy in their own waste.

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[i]Denison, Richard, "Environmental Life-Cycle Comparisons of Recycling, Landfilling, and Incineration: A Review of Recent Studies Annual Review of Energy and the Environment, vol. 21, pp. 191–237, 1996; see also ECOTEC Research and Consulting Limited, Beyond the Bin: The Economics of Waste Management Options, Friends of the Earth and UK Waste and Waste Watch, 2000.

[ii]For a comparison of various life-cycle assessments contrasting municipal waste incineration with landfilling and recycling, see Denison, 1996.

[iii]Rand, T., Haukohl, J., Marxen, U., "Municipal Solid Waste Incineration: Requirements for a Successful Project," World Bank Technical Paper No. 462, 2000.

Recycling versus incineration: an energy conservation analysis[v]

Energy conserved in recycled content manufacturing compared with energy from waste incineration

Waste stream materials	Energy conserved by substituting secondary for virgin materials (MJ/Mg)	Energy generated from MSW incineration (MJ/Mg)
Paper		
Newspaper	22,398	8,444
Corrugated cardboard	22,887	7,388
Office (ledgers & printouts)	35,242	8,233
Other recyclable paper	21,213	7,600
Plastic		
PET	85,888	21,004
HDPE	74,316	21,004
Other containers	62,918	16,782
Film/packaging	75,479	14,566
Other rigid	68,878	16,782
Glass		
Containers	3,212	106
Other	582	106
Metal		
Aluminum beverage containers	256,830	739
Other aluminum	281,231	317
Other Nnn-ferrous	116,288	317
Tin and bi-metal cans	22,097	739
Other ferrous	17,857	317
Organics		
Food waste	4,215	2,744
Yard waste	3,556	3,166
Wood waste	6,422	7,072
Rubber		
Tires	32,531	4,7771
Other rubber	25,672	11,505
Textile		
Cotton	42,101	7,283
Synthetic	58,292	7,283
Others	10,962	10,713

[v]Morris, Jeffrey, and Canzoneri, Diana, Recycling Versus Incineration: An Energy Conservation Analysis, Sound Resource Management Group (SRMG) Seattle, Washington, September, 1992. (This report has been summarized in the Sound Resource Management's publication, The Monthly UnEconomist, vol. 2, no. 2-4, February, March and April 2000.)

[1] See box item; see also Neil Tangri, *Waste Incineration: A Dying Technology,* Global Alliance for Incinerator Alternatives, 2003.

[2] Platt, Brenda et al, Stop Trashing the Climate, ILSR, Eco-Cycle & GAIA, 2008.

[3] U.S. EPA, 2006 MSW Characterization Data Tables, "Table 29, Generation, Materials Recovery, Composting, Combustion, and Discards Of Municipal Solid Waste, 1960 To 2006," Franklin Associates, A Division of ERG. www.epa.gov/garbage/msw99.htm

[4] Data from Eurostat, 2015.

[5] *Ibid.*

[6] Friends of the Earth Europe, Gone to waste – the valuable resources that European countries bury and burn, October 2009.

[7] Fichtner Consulting Engineers Limited, The Viability of Advanced Thermal Treatment in the UK, 2004, p.4.

[8] Morris, Jeffrey, Comparative LCAs for Curbside Recycling Versus Either Landfilling or Incineration with Energy Recovery, The International Journal of Life Cycle Assessment, July 2005. Available at: http://www.springerlink.com/content/m423181w2hh036n4/

[9] U.S. Senate. Bill S. 3654 [109th]: Recycling Investment Saves Energy. Introduced July 13, 2006.

[10] Waste Incineration and Public Health (2000), Committee on Health Effects of Waste Incineration, Board on Environmental Studies and Toxicology,Commission on Life Sciences, National Research Council, National Academy Press, pp. 6-7.

[11] Muller, Nicholas Z., Robert Mendelsohn, and William Nordhaus. 2011."Environmental Accounting for Pollution in the United States Economy." American Economic Review, 101(5): 1649-75.

[12] NY Department of Conservation, Comments to New York State Public Service Commission in the Matter of the application of Covanta Energy Corporation, August 19, 2011.

[13] Howard, C.Vyvyan, Statement of Evidence, Particulate Emissions and Health, Proposed Ringaskiddy Waste-to-Energy Facility, June 2009.

[14] Health Effects Institute. 2017. State of Global Air 2017. Special Report. Boston, MA:Health Effects Institute. Downloadable from: https://www.stateofglobalair.org/sites/default/files/SoGA2017_report.pdf.

[15] Römbke, J., et al. Ecotoxicological characterisation of 12 incineration ashes using 6 laboratory tests. Waste Management, 2009.

[16] Massachusetts Department of Environment citations for violations by Covanta Haverhill Incinerator: http://www.cjcw.org/notice/Covanta_Massachusetts_environmental_violations.pdf

[17] Platt, Brenda et al, Stop Trashing the Climate, ILSR, Eco-Cycle & GAIA, 2008.

[18] U.S. EPA, "Solid Waste Management and Greenhouse Gases, A Life-Cycle Assessment of Emissions and Sinks 3rd edition," 2006.

[19] Buley, Jennifer, "Plastic Surgery for Copenhagen's Recycling Policy," The Copenhagen Post, April 14, 2011. http://www.no-burn.org/plastic-surgery-forcopenhagens-recycling-policy.

[20] U.S. EPA, Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices, 2009.

[21] http://www.eia.gov/oiaf/beck_plantcosts/pdf/updatedplantcosts.pdf

[22] U.S. Energy Information Administration (Department of Energy), Updated Capital Cost Estimates for Electricity Generation Plants, November 2010.

[23] Lewis, Al, Don't trash my city, Harrisburg activist warned, Market Watch, October 19, 2011, http://www.marketwatch.com/story/dont-trash-my-cityharrisburg-activist-warned-2011-10-19?reflink=MW_news_stmp

[24] Guyette, Curt, Fired Up: Detroit Incinerator's Long Simmering Opposition, Detroit Metro Times, April 2008. http://www.metrotimes.com/editorial/story.asp?id=12748

[25] Seldman, Neil, Recycling First -Directing Federal Stimulus Money to Real Green Projects, E Magazine, 2008.

[26] Tellus Institute, More Jobs, Less Pollution: Growing the Recycling Economy in the United States, 2011. www.recyclingworkscampaign.org.

[27] Institute for Local Self-Reliance, 1997. Recycling means business. Available at http://www.ilsr.org/recycling/recyclingmeansbusiness.html.

[28] This section is taken from: Neil Tangri, *Waste Incineration: A Dying Technology,* Global Alliance for Incinerator Alternatives, 2003.

[29] Kalogirou, E., The development of WtE as an integral part of the sustainable waste management worldwide, Recuwatt -Recycling and Energy conference, October 2012.

[30] http://ec.europa.eu/environment/waste/waste-to-energy.pdf

Zero Waste: the solution

The world urgently needs an approach to waste management that looks at addressing waste issue in the context of related social and environmental issues. Waste is not a stand-alone issue and cannot be solved by a one-dimensional mechanical fix. This is the crucial gap that incineration cannot address.

The sustainable way forward is Zero Waste. Unlike incinerators, Zero Waste is not a one-shot technological fix, or an end-of-pipe solution. Zero Waste is a management solution that addresses the waste problem at root. By looking at the relationship between waste and people, it takes into consideration communities, equity and justice, health and the environment. Zero Waste is also one of the fastest, cheapest, and most effective strategies we can use to protect the climate and the environment.

As an approach to the use of resources, Zero Waste is both a goal and a plan of action. The goal is to ensure resource recovery and protect scarce natural resources by ending waste disposal in incinerators, dumps, and landfills. The plan encompasses waste reduction, composting, recycling and reuse, changes in consumption habits, and industrial redesign.

But just as importantly, Zero Waste is a revolution in the relationship between waste and people. It is a new way of thinking that aims to safeguard the health and improve the lives of everyone who produces, handles, works with, or is affected by waste—in other words, all of us. For more information about Zero Waste, please visit www.no-burn.org.

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