Letter to the Editor
DOI: 10.2478/aiht-2023-74-3733

Busting the myth: waste-to-energy plants and public health

Luka Traven[1,2]

[1] University of Rijeka Faculty of Medicine, Department of Environmental Medicine, Rijeka, Croatia
[2] Teaching Institute of Public Health of the Primorsko-goranska County, Rijeka, Croatia

Today, most products have a comparatively short lifespan and are being disposed of at an accelerating rate. As a result, waste management is rapidly becoming one of the most pressing global environmental issues. The European Union, for example, is experiencing a continuous rise in the amount of waste produced, with the most recent statistic reporting that, on average, in EU27 countries each person generates 530 kg of municipal solid waste (MSW) annually (1). To address this problem, the EU mandates a so-called "waste management hierarchy", which prioritizes waste prevention and minimization as the preferred methods of managing waste. Material recovery and recycling are also prioritized. In contrast, thermal treatment of waste and landfilling are the least favoured methods due to concerns about their potential adverse health and environmental effects.

Thermal treatment of waste – Waste to Energy (WtE)

Waste to energy (WtE) plants typically consist of a combustion chamber, a boiler to generate high-temperature steam, a storage pit, a bottom ash handling system, and a fuel gas cleaning system. In recent years, they have gained popularity as an environmentally friendly solution to the waste management problem. These plants use several technologies to thermally treat the waste and convert it into electricity and heat used for domestic and/or industrial purposes. For example, the WtE plant operated by Sysav in Malmö, which stands out as one of the most energy-efficient plants in Sweden, burns more than 600,000 tonnes of MSW per year, providing 270 GWh of electricity used every year within the plant and 1.5 TWh of heat energy provided to the homes of 60 % of the city's 340,000 inhabitants (2). This state-of-the-art plant ranks among the most advanced plants for thermal treatment of waste in the world.

It is important to realise that achieving material recycling rates above 50 % is exceptionally difficult and that the EU mandates a cap on waste landfilling of 10 %, which must be met by 2035. This means that approximately 40 % of residual waste will require other forms of treatment. Thus, WtE is likely to play a vital role in sustainably managing residual waste streams in the near and far future.

Corresponding author: Luka Traven, University of Rijeka Faculty of Medicine, Department of Environmental Medicine, Braće Branchetta 20/1, 51000 Rijeka, Croatia, E-mail: *luka.traven@medri.uniri.hr*

Health impacts of WtE plants

WtE plants have been the subject of much controversy due to the emissions of pollutants including polychlorinated dibenzodioxins (PCDDs) and dibenzofurans (PCDFs), nitrogen oxides, sulphur oxides, particulate matter, and others. These concerns were not unfounded since old incinerators were running few, if any, flue gas cleaning systems. Modern WtE plants are required to meet very stringent emission standards specified by the EU's Waste Incineration Directive (2000) (3). As a result, today the plants are operating sophisticated systems for cleaning and monitoring flue gasses making thermal treatment of waste a viable and environmentally friendly option for generating electricity and heat. Moreover, in December 2019, the European Commission (EC) published the new Best Available Techniques (BAT) Reference Document for Waste Incineration (4), which sets even more rigorous environmental standards, particularly with respect to emissions of toxic and persistent organic pollutants such as mercury, polychlorinated dibenzodioxins (PCDDs), and dibenzofurans (PCDDFs).

Because of this, today there is wide scientific consensus that WtE systems do not adversely impact human health. The main pollutant of concerns – particulate matter (PM), lead, mercury ,and PCDDs and PCDFs – are generally considered not to contribute to any significant degree to the ambient air concentrations of these chemicals and do not thus represent a significant health risk. Several systematic reviews have addressed the environmental and health outcomes of WtE plants providing evidence that modern WtE plants are not associated with adverse health and environmental effects (5–8). In addition, a study by Morgan et al. (9) found that when modern, well-managed WtE plants are considered, the health benefits offered by such plants outweigh any negative health effects. A recent report compiling data on the emissions to the atmosphere from 70 different WtE plants in the US provided evidence that atmospheric emissions for all criteria pollutants were significantly below the maximum achievable control technology (MACT) standard, with the exception of nitrogen oxides (NOx), whose emissions were 35 % below the emission limits (10). These results were confirmed by other reports which did not find a relationship between the level of dioxin emissions from WtE plants and their concentrations in the surrounding ambient air (11, 12).

Risk perception of WtE plants

Health risk characterisation is a well-established, although sometimes controversial, scientific field. However, it is still very difficult to bridge the gap between real risks posed by WtE plants estimated by domain experts and the perceived risks by inhabitants living near such plants. The NIMBY (Not In My Backyard) effect is a well-known phenomenon in the field of waste management. It implies that people are generally in favour of waste treatment plants, but are against such a plant being built near their homes. The NIMBY effect results in public opposition, protests, and even legal action against such plants, even if they are necessary for managing the waste generated by the community. The NIMBY effect makes it difficult to find suitable locations for waste plants and often results in waste being transported longer distances for treatment, increasing the carbon footprint and dramatically raising the costs of waste management. When WtE plants are concerned, risk attributes are a source of frustration, but they must be acknowledged when communicating health impacts to the public. Addressing the concerns of the public and engaging with them in the decision-making process can help mitigate the NIMBY effect and improve the acceptance of a waste management plant in the community.

In light of the above, it is clear that a transdisciplinary approach to the problem is urgently needed in waste management and public health because of the complex and interrelated challenges that cannot be addressed by a single field or discipline. Environmental, engineering, and social sciences are just some of the fields that must work together to address the environmental problems and public health issues. In the context of public health, the example of HIV campaigns shows what happens when scientists from different fields work together (13–15). The spread of HIV has been effectively contained not only because of rapid advances in biomedical science and the development of antiviral therapies, but also because of effective behaviour change campaigns needed to minimise the risk of transmission. The same model could be applied to the problem of WtE plants in particular and waste management in general. By bringing together different perspectives and expertise, transdisciplinary science can help find solutions that better meet the needs of communities and are more effective.

In conclusion, modern WtE facilities are required to meet very stringent emission standards, making thermal treatment of waste a viable and environmentally friendly option for generating electricity and heat which can then be used for domestic, commercial, or industrial applications. As reported in this Letter there is broad scientific consensus on the health risks associated with running modern, well designed WtE facilities backed by evidence from several studies and systematic reviews which have found that WtE facilities do not adversely impact human health. Still, the NIMBY effect remains a challenge when siting such facilities. Therefore, policymakers and waste management authorities should continue to prioritize waste prevention, minimization and material recovery of waste, but should also develop effective communication strategies to address public concerns about the health effects of WtE plants. The best results would be obtained using a trans-disciplinary approach involving scientists and experts from different domains.

REFERENCES

1. Eurostat Statistics Explained. Municipal waste statistics [displayed 20 April 2023]. Available at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Municipal_waste_statistics
2. Sysav. One of the world's most advanced. The Waste to Energy plant [displayed 20 April 2023]. Available at https://www.sysav.se/en/The-Waste-to-Energy-plant/
3. Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste [displayed 20 April 2023]. Available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32000L0076
4. Cusano G, Roudier S, Neuwahl F, Holbrook S, Gómez Benavides J. Best Available Techniques (BAT) reference document for waste incineration: Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control). Luxembourg: Publications Office of the European Union; 2019. doi: 10.2760/761437
5. Campo L, Bechtold P, Borsari L, Fustinoni S. A systematic review on biomonitoring of individuals living near or working at solid waste incinerator plants. Crit Rev Toxicol 2019;49:479–519. doi: 10.1080/10408444.2019.1630362
6. Cole-Hunter T, Johnston FH, Marks GB, Morawska L, Morgan GG, Overs M, Porta-Cubas A, Cowie CT. The health impacts of waste-to-energy emissions: a systematic review of the literature. Environ Res Lett 2020;15:123006. doi: 10.1088/1748-9326/abae9f
7. Psomopoulos CS, Bourka A, Themelis NJ. Waste-to-energy: A review of the status and benefits in USA. Waste Manage 2009;29:1718–24. doi: 10.1016/j.wasman.2008.11.020
8. Tait PW, Brew J, Che A, Costanzo A, Danyluk A, Davis M, Khalaf A, McMahon K, Watson A, Rowcliff K, Bowles D. The health impacts of waste incineration: a systematic review. Aust N Z J Public Health 2020;44:40–8. doi: 10.1111/1753-6405.12939
9. Morgan G, Cole-Hunter T, Cowie C, Johnston F, Marks G, Morawska L, Overs M, Porta-Cubas A. Waste-to-Energy processes: what is the impact on air pollutants and health? A critical review of the literature. Environ Epidemiol 2019;3:275. doi: 10.1097/01.EE9.0000608940.77808.aa.
10. Castaldi MJ. Scientific Truth about Waste to Energy. New York: Chemical Engineering Department, The City College of New York, City University of New York; 2021.
11. Lonati G, Cambiaghi A, Cernuschi S. The actual impact of Waste-to-Energy plant emissions on air quality: a case study from Northern Italy. Detritus 2019;6:77–84. doi: 10.31025/2611-4135/2019.13817
12. Lonati G, Cernuschi S, Giani P. Air quality impact assessment of a Waste-to-Energy plant: modelling results vs. monitored data. Atmosphere 2022;13(4):516. doi: 10.3390/atmos13040516
13. Kyei-Gyamfi S. Efficacy of HIV and AIDS education programs in the Elmina fishing community in Ghana. Humanit Soc Sci Commun 2023;10:42. doi: 10.1057/s41599-023-01535-y
14. Friedman SR, Downing MJ, Smyrnov P, Nikolopoulos G, Schneider JA, Livak B, Magiorkinis G, Slobodianyk L, Vasylyeva TI, Paraskevis D, Psichogiou M, Sypsa V, Malliori MM, Hatzakis A. Socially-integrated transdisciplinary HIV prevention. AIDS Behav 2014;18:1821–34. doi: 10.1007/s10461-013-0643-5
15. Srivastava S, Chauhan S, Patel R, Kumar P. A study of awareness on HIV/AIDS among adolescents: A Longitudinal Study on UDAYA data. Sci Rep 2021;11:22841. doi: 10.1038/s41598-021-02090-9