Comparison of GHG Emissions from Landfilling versus Energy-from-Waste (EfW)
Excerpts from Key Documents

Intergovernmental Panel on Climate Change (IPCC), 5th Assessment Report

EfW identified as an "important option for [GHG] mitigation in waste management."[1]

Intergovernmental Panel on Climate Change, 4th Assessment Report

The IPCC identified WTE a "key GHG mitigation technology."[2]

Berkeley Law (2016) Wasting Opportunities: How to Secure Environmental & Clean Energy Benefits from Municipal Solid Waste Energy Recovery

"Harvesting these leftover materials as solid waste energy sources could provide multiple environmental benefits:

- complementing intermittent renewable energy, such as wind and solar, to offset fossil fuel-based energy sources and associated greenhouse gas emissions;
- avoiding landfill emissions of methane (a potent greenhouse gas that is 28-34 times as strong as carbon dioxide over 100 years) by diverting wastes to energy, particularly organic wastes;" [3]

U.S. EPA Energy Recovery from the Combustion of Municipal Solid Waste (MSW) Webpage

"Energy recovery from the combustion of municipal solid waste is a key part of the non-hazardous waste management hierarchy, which ranks various management strategies from most to least environmentally preferred. Energy recovery ranks below source reduction and recycling/reuse but above treatment and disposal. Confined and controlled burning, known as combustion, can not only decrease the volume of solid waste destined for landfills, but can also recover energy from the waste burning process. This generates a renewable energy source and reduces carbon emissions by offsetting the need for energy from fossil sources and reduces methane generation from landfills."[4]

California Air Resources Board (2014)

"[C]ombusting waste in the three MSW Thermal facilities in California results in net negative GHG emissions, ranging from -0.16 to -0.45 MT CO_2e per ton of waste disposed, when considering that the waste would otherwise be deposited in landfills resulting in higher emissions."[5]

CalRecycle Review of Waste-to-Energy and Avoided Landfill Methane Emissions

"Published LCA studies and best available published direct measurement data support CalRecycle staff's general conclusions. CalRecycle staff concludes that the three existing California WtE facilities provide net avoided methane emissions over waste otherwise disposed in a California landfill. The net avoided emissions exceed non-biogenic emissions from burning of the fossil fuel based components such as plastic in the WtE facility."[6]

NREL (2013) Waste Not, Want Not: Analyzing the Economic and Environmental Viability of Waste-to-Energy (WTE) Technology for Site-Specific Optimization of Renewable Energy Options

"We find that MSW combustion is a better alternative than landfill disposal in terms of net energy impacts and carbon dioxide (CO_2)-equivalent GHG emissions. In this report, WTE leads to greater GHG reductions per kWh of electricity generated compared to landfill gas-to energy."

"Life cycle assessment studies published in the literature have generally been consistent in suggesting that MSW combustion is a better alternative to landfill disposal in terms of net energy impacts and CO_2- equivalent GHG emissions. The results from this study match that expectation. In this report, WTE leads to a higher reduction in emissions compared to landfill-to-energy disposal per kWh production." [7]

U.S. EPA Scientists: Kaplan et al. (2009) Is It Better to Burn or Bury for Clean Electricity Generation?

"One notable difference between LFGTE and WTE is that the latter is capable of producing an order of magnitude more electricity from the same mass of waste. In addition, as demonstrated in this paper, there are significant differences in emissions on a mass per unit energy basis from LFGTE and WTE. On the basis of the assumptions in this paper, WTE appears to be a better option than LFGTE. If the goal is greenhouse gas reduction, then WTE should be considered as an option under U.S. renewable energy policies. In addition, all LFTGE scenarios tested had on the average higher NOx, SOx, and PM emissions than WTE."[8]

Center for American Progress (2013) Energy from Waste Can Help Curb GHG Emissions

"According to the EPA, for every ton of garbage processed at an EfW facility, approximately one ton of emitted carbon-dioxide equivalent in the atmosphere is prevented. This is because the trash burned at an EfW facility doesn't generate methane, as it would at a landfill; the metals that would have been sent to the landfill are recycled instead of thrown out; and the electricity generated offsets the greenhouse gases that would otherwise have been generated from coal and natural gas plants."[9]

Davos World Economic Forum (2009)

Municipal solid waste to energy identified as one of eight technologies likely to make a meaningful contribution to a future low-carbon energy system.[10]

EEA Briefing (2008) Better management of municipal waste will reduce greenhouse gas emissions

"As recycling and incineration with energy recovery are increasingly used, net greenhouse gas emissions from municipal waste management are expected to drop considerably by 2020."[11]

U.S. EPA Clean Power Plan, Obama Administration

Under the plan promulgated in 2015, new EfW facilities were eligible to generate Emission Rate Credits (ERCs).[12] Existing facilities were not a covered source and were considered a source of no carbon energy under the program.[13]

United Nations Conference on Sustainable Development

"We therefore commit to further reduce, reuse, and recycle waste (3Rs), and to increase energy recovery from waste..."[14]

References

[1] See p.102 of IPCC (2014) *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp. Available at: https://www.ipcc.ch/report/ar5/syr/

[2] See Table 4.2 (p.60) of IPCC (2007) *Climate Change 2007: Synthesis Report. Contribution of Work Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp. Available at: https://www.ipcc.ch/report/ar4/syr/

[3] Berkeley Law Center for Law, Energy & the Environment (2016) *Wasting Opportunities: How to Secure Environmental & Clean Energy Benefits from Municipal Solid Waste Energy Recovery*. https://www.law.berkeley.edu/research/clee/research/climate/waste-to-energy/

[4] U.S. EPA (2018) *Energy Recovery from the Combustion of Municipal Solid Waste (MSW)* webpage, last updated 11/27/2018, accessed 1/10/2019. https://www.epa.gov/smm/energy-recovery-combustion-municipal-solid-waste-msw

[5] See p90 of California Air Resources Board (2014) *Proposed First Update to the Climate Change Scoping Plan: Building on the Framework, Appendix C – Focus Group Working Papers, Waste Sector Working Paper* https://www.arb.ca.gov/cc/scopingplan/2013_update/waste.pdf

[6] CalRecycle (2012) *CalRecycle Review of Waste-to-Energy and Avoided Landfill Methane Emissions*. Available at: http://dpw.lacounty.gov/epd/conversiontechnology/download/CalRecycle_Review_of_WtE_Avoided_Emissions_07032012.pdf

[7] Joint Institute for Strategic Energy Analysis (2013) *Waste Not, Want Not: Analyzing the Economic and Environmental Viability of Waste-to-Energy (WTE) Technology for Site-Specific Optimization of Renewable Energy Options*. http://www.nrel.gov/docs/fy13osti/52829.pdf

[8] Kaplan, P.O., J. DeCarolis, S. Thorneloe (2009) Is It Better to Burn or Bury Waste for Clean Electricity Generation? *Environ. Sci. Technol.* **2009**, 43, 1711-1717. http://pubs.acs.org/doi/abs/10.1021/es802395e

[9] Center for American Progress (2013) *Energy from Waste Can Help Curb Greenhouse Gas Emissions* https://www.americanprogress.org/issues/green/report/2013/04/17/60712/energy-from-waste-can-help-curb-greenhouse-gas-emissions/

[10] WTE identified as a key technology for a future low carbon energy system in World Economic Forum. *Green Investing: Towards a Clean Energy Infrastructure.* January 2009. Available at: https://about.bnef.com/blog/green-investing-towards-a-clean-energy-infrastructure/

[11] European Environmental Agency (2008) Better management of municipal waste will reduce greenhouse gas emissions. Available at: http://www.eea.europa.eu/publications/briefing_2008_1

[12] See p.64950, §60.5800(a)(4)(iii) of U.S. EPA (2015) Carbon Pollution Guidelines for Existing Stationary Sources: Electric Utility Generating Units, *Federal Register*, **80**, 205, 64662-64964 (October 23, 2015)

[13] See p64953 of §60.5845 of U.S. EPA (2015) Carbon Pollution Guidelines for Existing Stationary Sources: Electric Utility Generating Units, *Federal Register*, **80**, 205, 64662-64964 (October 23, 2015)

[14] See para. 218 on p42 of United Nations (2012) Resolution adopted by the General Assembly on 27 July 2012. http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang=E