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Solid Waste Alternatives Advisory Committee (SWAAC)
c/o Matt Korot
600 NE Grand Ave.
Portland, OR 9732-2736

Re: HDR Comparative Greenhouse Gas Analysis

Dear Committee Members:

We are pleased to see the evaluation of the potential GHG benefits of sending a portion of Metro Portland's municipal solid waste (MSW) to a possible expansion of the Marion County Energy-from-Waste (EfW) facility. The facility is an important part of Marion County's integrated waste management infrastructure, providing a more sustainable management option for 90% of the County's MSW remaining after recycling while generating 13 MW of electricity. EfW is also an important tool in reducing emissions of GHGs, recognized internationally as a source of GHG mitigation, including by the U.S. EPA, the European Union, CalRecycle, and the Intergovernmental Panel on Climate Change (IPCC).

The analysis completed by the HDR using the U.S. EPA's Office of Research & Development's MSW Decision Support Tool (MSW-DST) aligns with this international consensus: Each ton of MSW diverted from landfilling to EfW will reduce GHG emissions by 0.345 metric tonnes of CO_2 equivalents ($MTCO_2E$). The MSW-DST is a robust life cycle assessment (LCA) tool specifically tailored for waste management that has directly supported over 150 peer-reviewed papers.

In its analysis, HDR also presents data using the U.S. EPA's Waste Reduction Model (WARM), an easy to use, simple foot-printing tool, for evaluating different municipal solid waste management options. Its simplicity has made its use fairly commonplace, but this simplicity also begets significant limitations. In a recent U.S. EPA Board of Scientific Counselors meeting, an EPA LCA Center for Excellence scientist observed the following about the current version of WARM:

> "Documentation does exist for WARM, but the underlying data are not transparent. WARM is created in a spreadsheet platform. With complex models, the spreadsheet platform makes it difficult to follow and manage and it becomes easier for errors to occur. WARM has limited ability to configure scenarios or to modify embedded assumptions (e.g., carbon storage in the landfill)."[1]

This lack of transparency is a likely factor in HDR's analysis, using the WARM tool, which concluded landfilling is a better GHG option than EfW, contrary to significant scientific and policy consensus. After digging into the WARM analysis and its results, it became apparent that HDR's analysis was based on very low predictions for the methane generated in a landfill, well below published and peer reviewed ranges for MSW, and very high fossil CO_2 emissions for EfW (see Attachment 1). In fact, WARM's predicted fossil CO_2 emissions per ton of MSW combusted exceeded the emissions reported to the U.S. EPA since reporting began in 2010 for every MSW mass-burn EfW facility that Covanta operates. Covanta's June 28th letter to Metro Portland outlines other examples of where the WARM analysis doesn't match operating values and published data. Conversely, the USEPA's Decision Support Tool (DST) yields results that ***do*** match actual operating values and published data. We think that an objective analysis would prioritize to the model that matches.

Faced with two divergent models, HDR contends that there is "lack of consensus in scientific communities for estimating the GHG impacts of waste management options." This is false. While there is disparity with regard to the consideration and quantification of carbon storage, EfW has consistently been recognized as preferable to landfilling. For example, scientists at both the Joint Institute for Strategic Energy Analysis (JISEA)* and CalRecycle scientists in their own work concluding the benefits of EfW over landfilling, found agreement in published work:

> **Joint Institute for Strategic Energy Analysis**
> "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."[2]

* The Joint Institute for Strategic Energy Analysis (JISEA) is operated on behalf of the U.S. Department of Energy's National Renewable Energy Laboratory (NREL), the University of Colorado-Boulder, the Colorado School of Mines, the Colorado State University, the Massachusetts Institute of Technology, and Stanford University.

> **CalRecycle**
> "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."[3]

The failure of HDR's WARM analysis to match real world data and published peer reviewed ranges, the shortcomings of WARM noted by the U.S. EPA's LCA Center for Excellence, and the divergent result obtained by HDR relative to policy and scientific consensus that EfW is preferable to landfilling all support setting aside the WARM analysis. Fundamentally, if a model does not yield results that match reality – it is not appropriate for comparing waste management options.

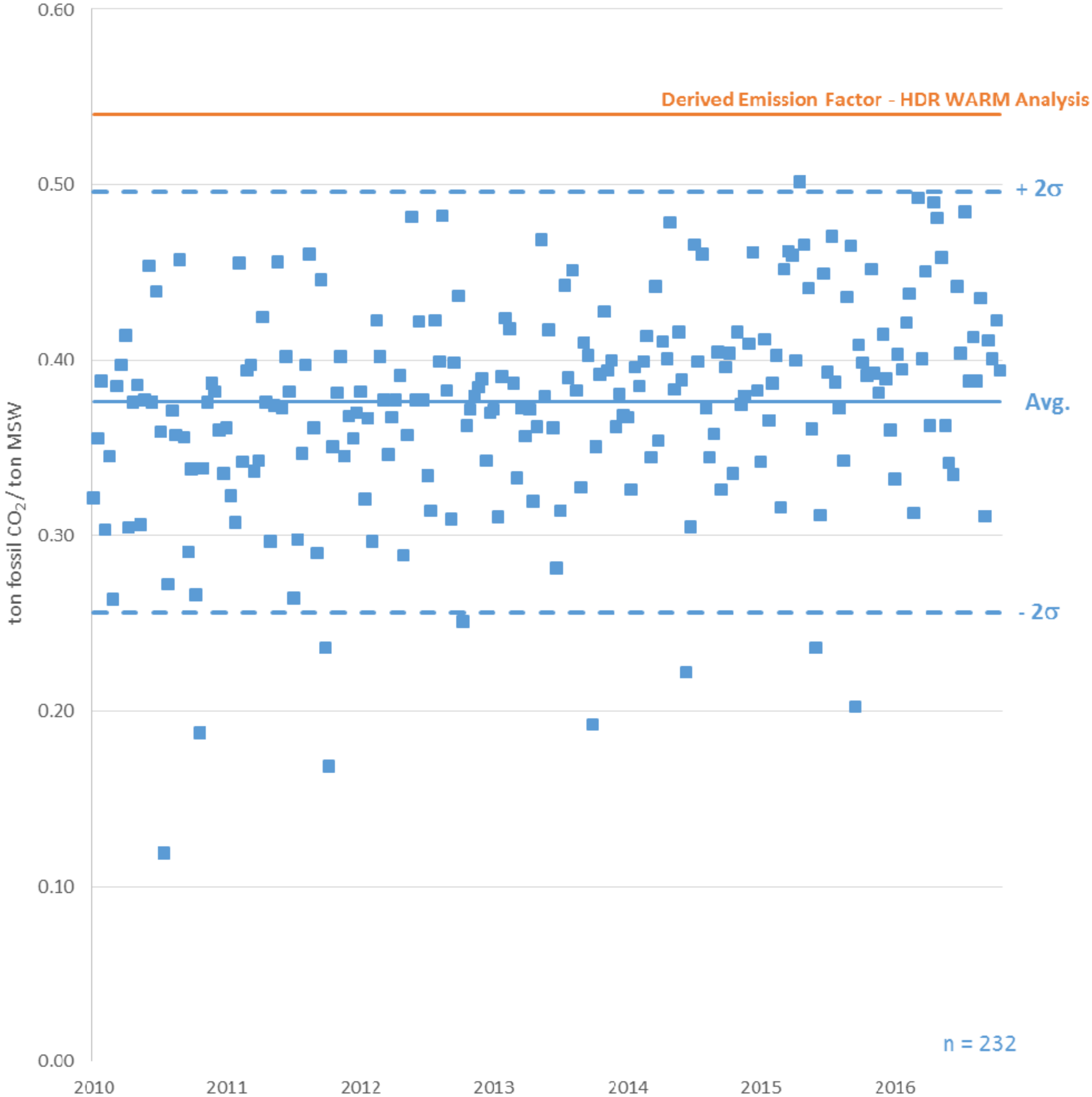
We recommend that the members therefore focus on the results of the MSW-DST analysis. The MSW-DST is a robust life cycle assessment (LCA) tool that has directly supported over 150 peer-reviewed papers. The DST analysis is supported by a significant body of research completed to date that has found EfW preferable to landfilling, and most importantly, the DST analysis closely aligns with actual operating values, real-world measurements, and published data.

Sincerely,

Paul Gilman
SVP, Chief Sustainability Officer

cc: Rob Smoot
Paul Slyman

Attachment 1. Comparison of MSW Combustion Emission Factor HDR WARM Analysis for Metro Portland v. Covanta Data for MSW Reported to U.S. EPA



Source Information:

- Data from annual fossil CO_2 reported to U.S. EPA under the Mandatory GHG Reporting Rule (40 CFR 98) for Covanta mass burn EfW facilities . Excludes data from those facilities combusting significant amounts of non-hazardous industrial waste and RDF facilities. Non-hazardous industrial wastes are not representative of municipal MSW. RDF facilities include several pre-processing steps which may materially impact the properties of the waste combusted relative to the MSW received from municipalities.
- The emission factor presented from the WARM analysis was calculated based on the waste composition used for WARM and the underlying emission factors in Exhibit 5-1 of the 2016 WARM Documentation.

Attachment 2. Comparison of Methane Generation Potentials, HDR's WARM and MSW-DST versus peer-reviewed, published values

	Value (m^3 / Mg)	Reference
WARM & DST Analysis	59	HDR WARM analysis
	78	HDR MSW-DST analysis
	92	MSW-DST: Reclassification of "other" and "mixed paper" fractions of the waste composition analysis from "combustible compostable recyclables (commercial stream)" into an appropriate paper category "paper, non-recyclable"
Published ranges	100	U.S. EPA's emission factor database, AP-42, based on data from at 40 landfills[4]
	100	U.S. EPA Landfill Gas Emission Model ("LandGEM") default L_0 for inventory purposes[5]
	100	U.S. EPA Waste Reduction Model (WARM)[6]
	170	Potential-to-emit value, U.S. EPA Clean Air Act regulations[7]
	168	U.S. EPA's 2006 solid waste greenhouse gas life cycle report[8]
	74 - 140	Peer-reviewed studies predicting landfill methane generation based on landfill emissions & gas collection data.[9,10]
	89	CalRecycle analysis of avoided landfill methane emissions through WTE [11]

[1] U.S. EPA Board of Scientific Counselors (BOSC) Sustainable and Healthy Communities Subcommittee Face-to-Face Meeting Minutes, November 2–4, 2016 DRAFT https://www.epa.gov/sites/production/files/2017-02/documents/bosc_shc_f2f-2_mtg_minutes.pdf

[2] 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

[3] CalRecycle (2012) CalRecycle Review of Waste-to-Energy and Avoided Landfill Methane Emissions. Available at: http://www.calrecycle.ca.gov/Actions/PublicNoticeDetail.aspx?id=735&aiid=689

[4] U.S. EPA (1997) *Section 2.4: Emission factor documentation for AP-42. Municipal solid waste landfills revised*, Research Triangle Park, N.C. http://www.epa.gov/ttn/chief/ap42/ch02/bgdocs/b02s04.pdf

[5] U.S. EPA (2005) Landfill gas emissions model LandGEM Version 3.02 user's guide, EPA-600/R-05/047, Research Triangle Park, N.C. http://www.epa.gov/ttncatc1/dir1/landgem-v302-guide.pdf

[6] Converted from value of 1.62 t CO_2E ($MTCO_2E$) / ton MSW from U.S. EPA (2016) Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM): Management Practice Chapters. https://www.epa.gov/sites/production/files/2016-03/documents/warm_v14_management_practices.pdf

$$\left(\frac{1.62\ t\ CO_2e}{ton\ MSW}\right) \times \left(\frac{1\ t\ CH_4}{25\ t\ CO_2e}\right) \times \left(\frac{1m^3}{0.714\ kg\ CH_4}\right) \times \left(\frac{1000\ kg}{1\ t}\right) \times \left(\frac{1\ ton}{0.907\ Mg}\right) = \frac{100m^3}{Mg\ MSW}$$

[7] 40 CFR §60.754(a)(1)

[8] Exhibit 6-3 of U.S. EPA (2006) *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*, 3rd edition, Available at: http://www.epa.gov/climatechange/wycd/waste/SWMGHGreport.html)

[9] Amini, H.R., D. R. Reinhart, A. Miskanen (2013) Comparison of first-order-decay modelled and actual field measured municipal solid waste landfill methane data, *Waste Management* 33 (12) 2720-2728. http://dx.doi.org/10.1016/j.wasman.2013.07.025

[10] Wang, X. *et al.* (2013) Using Observed Data To Improve Estimated Methane Collection from Select U.S. Landfills, *Environ. Sci. Technol.* 2013, 47, 3251-3257. http://pubs.acs.org/doi/abs/10.1021/es304565m

[11] CalRecycle (2012)