

The role of waste to energy (WTE) as a renewable, sustainable, clean energy solution in the US: A review of the health impacts of WTE facilities

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Presentation to:



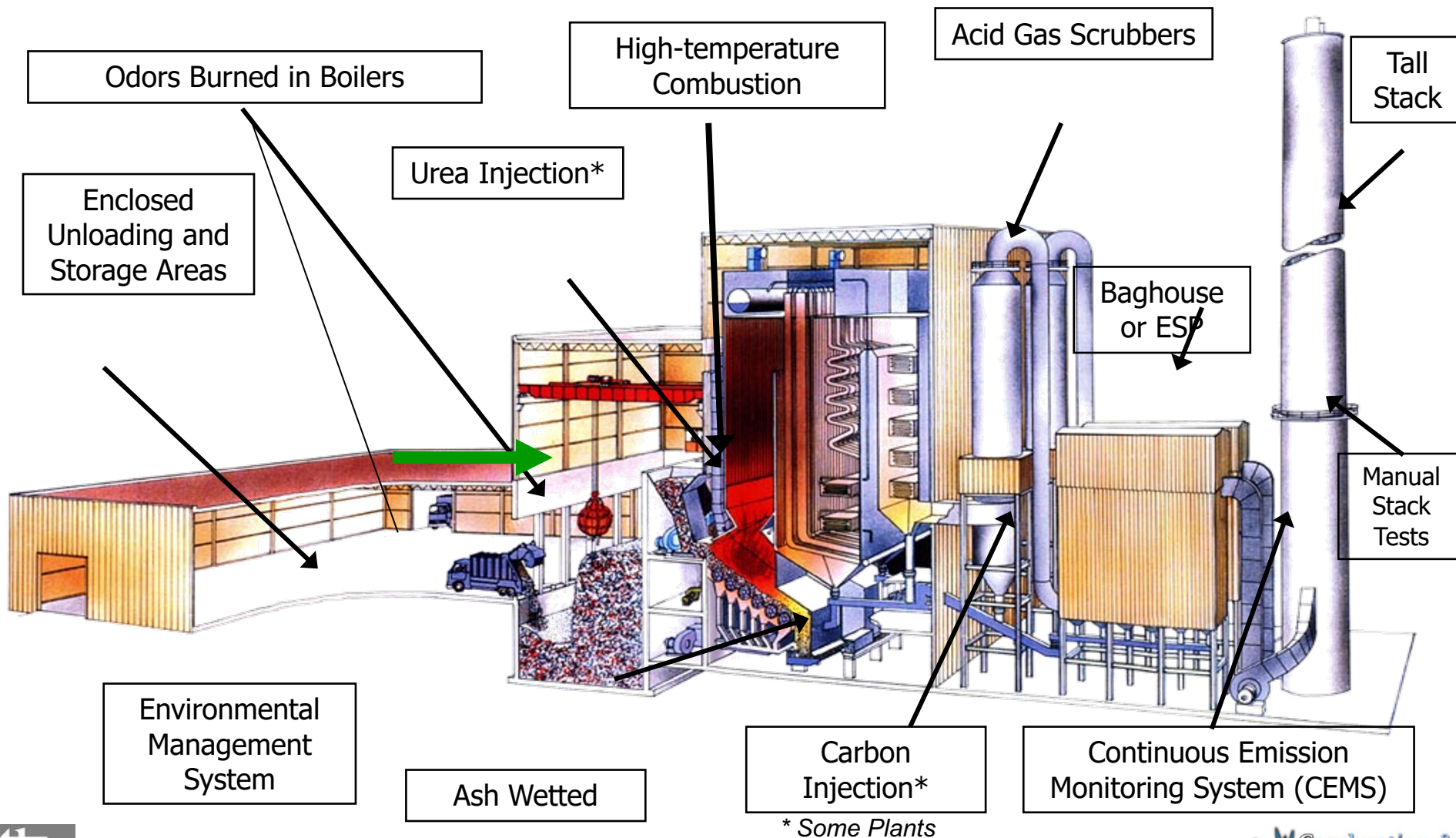
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Introduction

- **Only WTE & landfilling can match MSW generation**
 - Reduction, reuse and recycling need to continue and increase
- **Misinformation about WTE is counterproductive**
 - Main result is more landfilling, not more recycling
- **Decades of reliable, safe operation demonstrate WTE should be increased to avoid landfilling**
 - Global, Country & local data show those with more WTE correlate to less landfilling and more recycling.

Study focused on conventional WTE





New Review Released

<https://ccnyeec.org/wp-content/uploads/2021/05/WTE-REPORT7603.pdf>

PREFACE

Our society's increasing focus on the interrelationship of energy and the environment, including in particular sustainable waste management, has prompted the need for a comprehensive review of generating energy from waste. While there is growing interest in a circular economy that facilitates productive reuse of municipal solid waste (MSW), there is also significant confusion and misinformation regarding sustainably managing MSW using thermal conversion – or “Waste-to-Energy” (WTE). But juxtaposed to that confusion and misinformation are the facts, which show that WTE plays a key role as part of an environmentally sound system that includes full protection of human health and where post-recycled MSW supplies the energy to serve residential, commercial and industrial needs.

That is the context for this study, which provides the most up-to-date information on WTE and the environment, and can serve as a comprehensive resource for policy makers and others interested in learning more about the quantifiable benefits of WTE. The study has been reviewed by the following experts who possess first-hand knowledge and experience with WTE and are recognized internationally for their research and other scientific and engineering contributions. Their review ensures that the information and data presented are accurate and up to date. Any opinions or interpretations are those of the author only.

Prof. Nickolas Themelis – Columbia University

Prof. Ashwani Gupta – University of Maryland

Prof. Frank Roethel – State University of New York, Stony Brook

Mr. Anthony Licata – ASME Fellow, Licata Energy & Environmental Consultants, Inc. (formerly of Babcock Engineering)

Institute of Energy and Resource Management (IERM)

Dr. Helmut Schnurer (Former Deputy Director

General at the Ministry for Environment, Germany – 40+ years in Waste Management, German & EU Policies)

Dr. Michael Weltzin (Senior Scientific

Advisor to German Green Party on Waste and Climate Policy – 20+ years in Waste Management and Climate)

Rene Moeller Rosendal (Danish Waste Solutions,

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Dr. Richard Honour (Executive Director

The Precautionary Group, Specialist in Environmental Toxicology, Infectious Diseases and Cancer – 50+ years)

Philipp Schmidt-Pathmann, MBA, MIS (Founder

and Executive Director, IERM – 20+ years in WTE and Waste Management US and Europe)

SCIENTIFIC TRUTH ABOUT WASTE-TO-ENERGY

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FURTHER READING

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- Waste to Energy Conversion Technology, 1st Edition, Editors: Naomi Klinghoffer and Marco J. Castaldi, Elsevier, ISBN: 9780857090119, 2013
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MATERIALS &
ENERGY RECOVERY
DIVISION

The Materials & Energy Recovery (MER) Division of ASME supports this document and is aligned with the findings.

Important Findings

The current performance of WTE facilities in the U.S., and globally, shows their emissions are more than 70% below MACT standards, except for NO_x, which operates at approximately 35% below emission standards.

Well-designed and well-operated WTE facilities will result in destruction and removal of viruses, enteric bacteria, fungi, human and animal parasites at an efficiency between 99.99 to 99.9999% (Ware, 1980).

US and International reports show human health effects cannot be directly connected to properly operating WTE facilities.

A recent review of 70 published studies concluded that a WTE facility's contribution to the overall daily air pollutant dose to the affected urban populations was negligible.

Main Findings

- **Longstanding & well-documented scientific consensus → human health is not adversely impacted by WTE.**
 - National Research Council report → WTE emissions contribute little to environmental concentrations or to health risks.
 - Epidemiological studies suggest there is no association between human health effects and the operation of WTE facilities.
 - A 2019 review → health benefits of modern, properly-managed WTE facilities may outweigh the health risks.
 - A 2003 to 2010 study → *“We found no evidence that exposure to PM_{10} from, or living near to, an [WTE] operating to current EU standards was associated with harm for any of the outcomes investigated. Results should be generalisable to other MWIs [i.e., WTE facilities] operating to similar standards.”*
 - A study from 1996 to 2012 found no evidence that WTE caused an increase in infant mortality when compared to control areas.



WTE-Recycling Correlation

UK's Department for Environment Food & Rural Affair (DEFRA) shows that recycling, and WTE are complementary. (Sara, 2016).

*Austria: 70% recycling, 30% WTE;
Germany: 62% recycling, 38% WTE;
Belgium: 62% recycling, 37% WTE
Korea: 60% recyc/comp, 20% WTE*

Municipal waste treatment in 2015 EU 28 + Switzerland, Norway and Iceland

Graph by CEWEP,
Source: EUROSTAT 2017

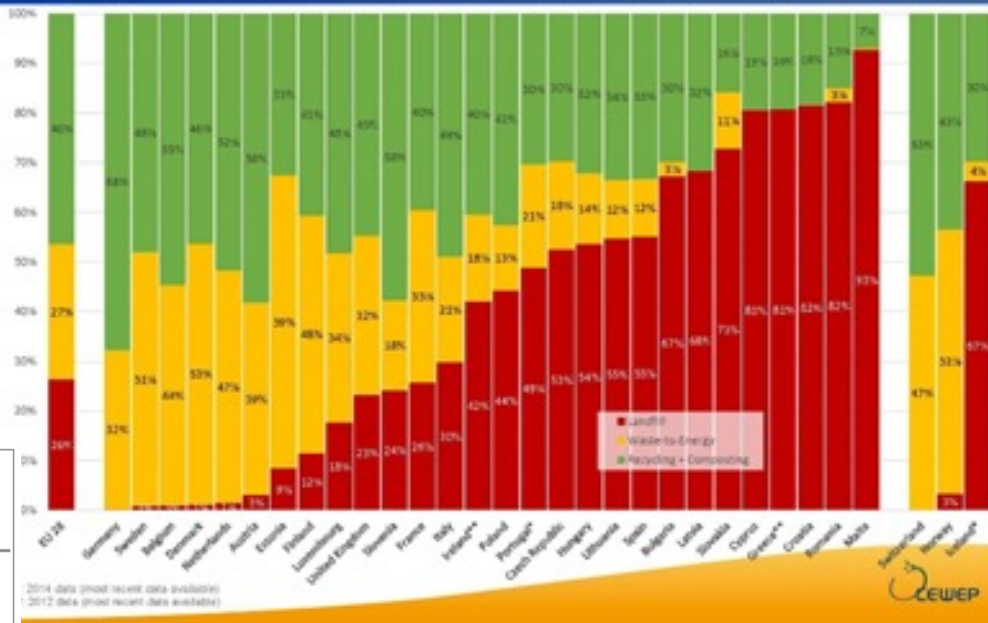
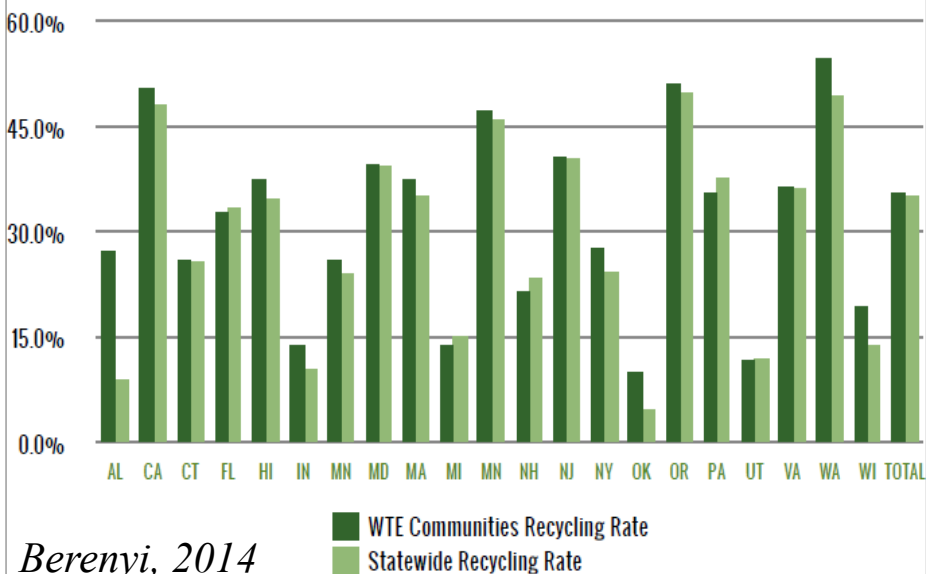


FIGURE ES-2: RECYCLING RATES
FOR WTE COMMUNITIES AND STATES

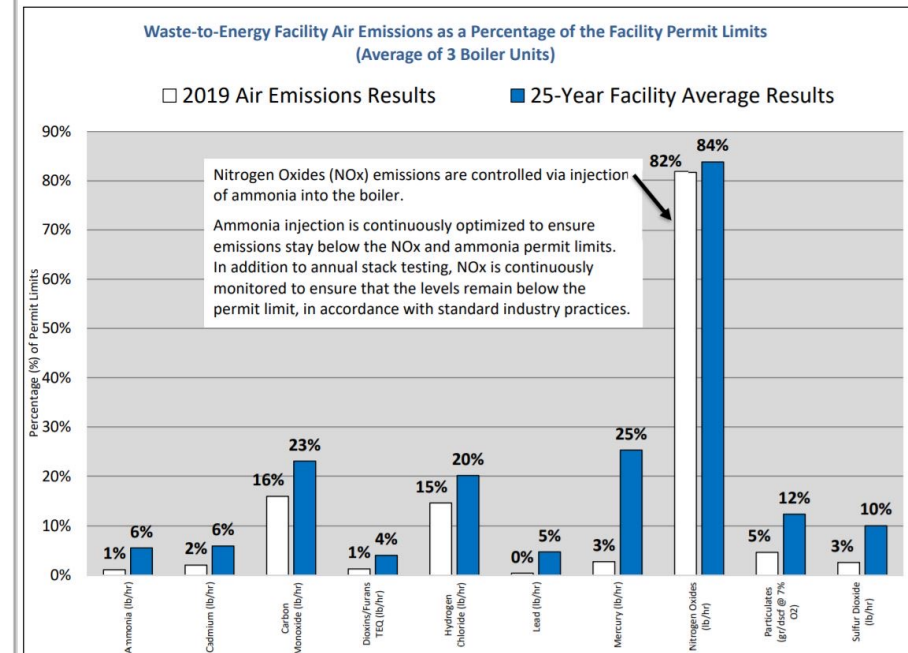
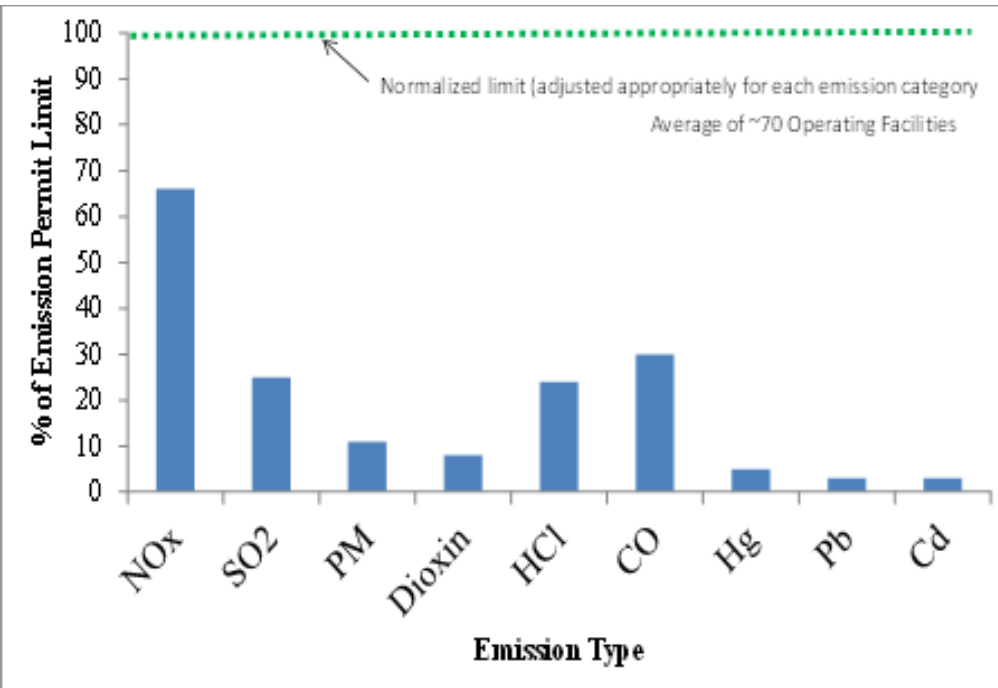


*Use of WTE correlates to higher recycling rates
at all scales from municipality to country level*

WTE & Health

- **WTE is primarily a sustainable waste management solution.**
 - Disposes MSW, and other wastes, safely through combustion.
 - Extracts value from MSW (power, heat and materials).
 - Flue gas and ash emissions are well regulated.
 - All MSW management has emissions

WTE Emissions are lower than EPA limits



Emissions compared to federal and state limits. **Left**; results of an average of 70 operating facilities in the U.S. **Right**; Average stack emissions for 2019 and 25 years of operation for one facility

- Although already well below regulatory limits, emission reduction efforts continue
- Many facilities implement upgrades to APC systems & better feedback controls

Concentration Ratio Results

Emissions data for four WTE plants operating in North America

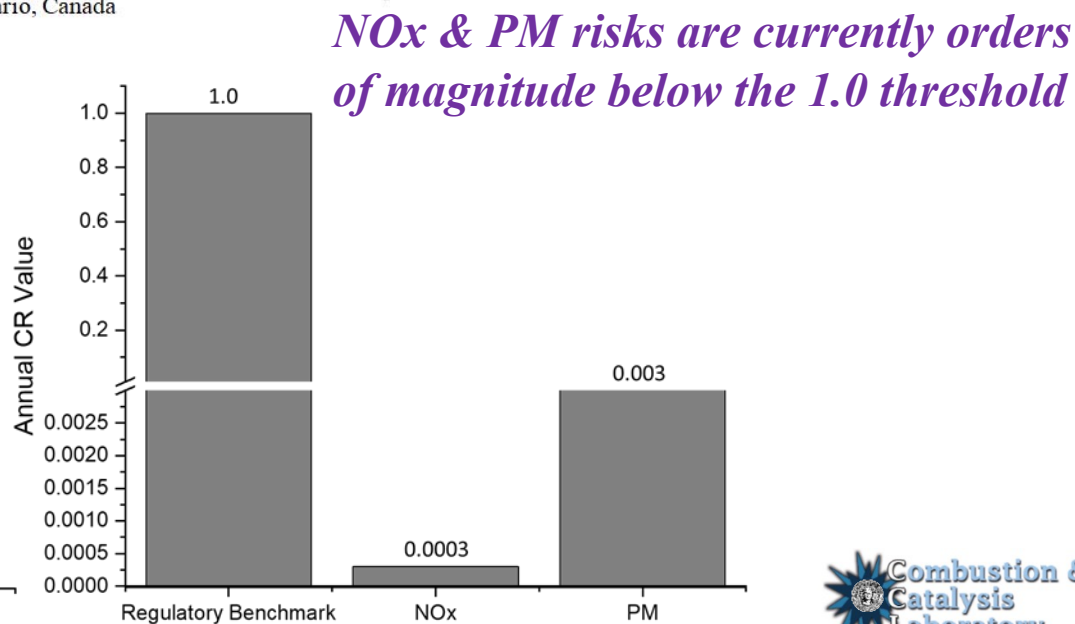
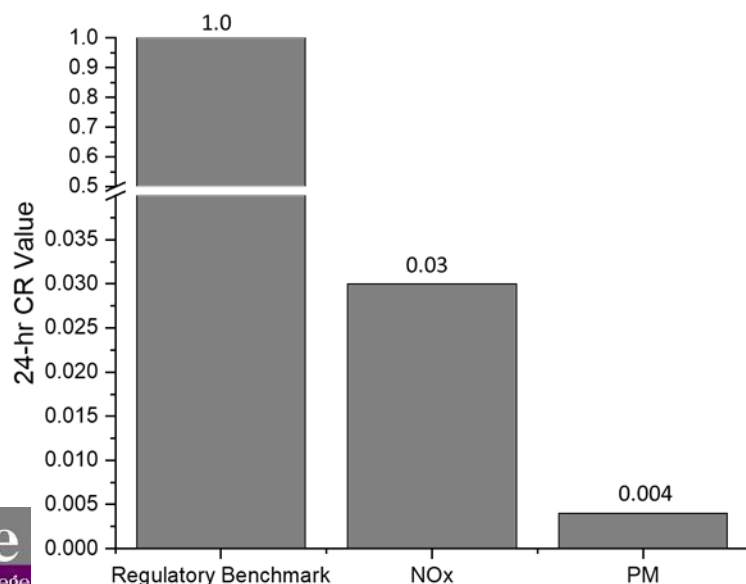
MWC Features	Combustion Technology	Plant 1	Plant 2	Plant 3	Plant 4
	Combustion Units	3	2	3	2
	Facility Capacity t/day	1800	3000	3000	480
NOx	In-stack emissions, 24-hr average	88 ppmv	142.8 ppmv	30 ppmv	94 ppmv
	MACT ruling limit	180 ppmv	230 ppmv	180 ppmv	121 ppmv ^(a)
	% Below EPA limit	48%	38%	83%	22%
PM _{total}	In-stack emissions, annual concentrations	4.92 mg/dscm	8.05 mg/dscm	3.29 mg/dscm	0.33 mg/dscm
	MACT ruling limit	20 mg/dscm	20 mg/dscm	20 mg/dscm	9 mg/Rm ^(a)
	% Below limit	75%	60%	84%	96%
Year facility began operation		1995	1989	2016	2016

(a) In stack Environmental Compliance Approval Limits in Ontario, Canada

CR = pollutant's modeled ambient air concentration divided by its corresponding health-based benchmark or ambient air quality criteria

CR > 1.0 → health risk expected

CR < 1.0 → health risk NOT expected



NOx & PM risks are currently orders of magnitude below the 1.0 threshold



GHGs are reduced with Energy from MSW

California Air Resources Board analysis showing specific WTE facilities' ability to reduce GHG emissions((CARB), 2013)

(MTCO₂e/Short Ton Waste)

Facility	Waste (TPD)	Non-biogenic MT CO ₂ E Emissions	Energy Credit MT CO ₂ E ¹	Metal Recycled (Tons)	Metal Recycling Credit MT CO ₂ E ²	Avoided Landfill Methane Emissions MTCO ₂ e ³	Net MT CO ₂ E per Ton Waste
Covanta Stanislaus	800	79,590	-49,740	5,690	-10,240	-70,080 to -154,760	-0.17 to -0.46
Commerce Refuse to Energy	360	53,760	-26,000	920	-1,660	-31,540 to -69,640	-0.04 to -0.33
Long Beach SERRF	1380	115,790	-81,390	6,500	-11,700	-120,890 to -266,960	-0.19 to -0.48
Total	2,540	249,150	-153,740	13,110	-23,600	-222,500 to -491,360	-0.16 to -0.45

1 Uses 2009-2010 average CA grid emission factor of 668 lb. CO₂e per MWh, and assumes facilities produce 85% of rated power capacity per Table 1.

2 Uses a metal recycling credit of 1.8 MT CO₂e per short ton of ferrous metal.

3 Estimated avoided landfill methane emission 0.24 to 0.53 MTCO₂e/MT

- *Nation-wide use of the WTE technology can become one of the big contributors to North America's carbon dioxide reductions, accounting for as much as 325 million tons of CO₂.*
- *The USEPA concluded WTE produces electricity with less environmental impact than almost any other source(Horinko and Holmstead, 2003).*

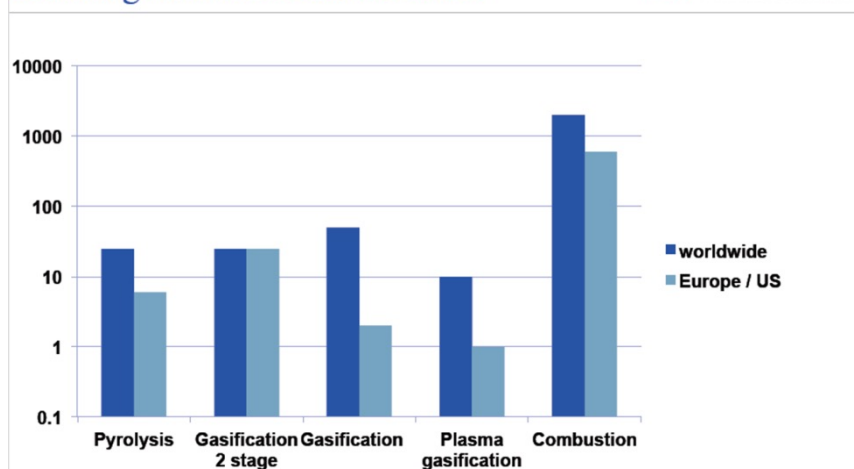
UNEP report "District Energy in Cities: Unlocking the Potential of Energy Efficiency and Renewable Energy" states that Paris currently meets 50% of its heating needs by three WTE plant that results in avoidance of 800,000 tons of CO₂ emissions each year.

WTE is a proven GHG emissions reduction technology

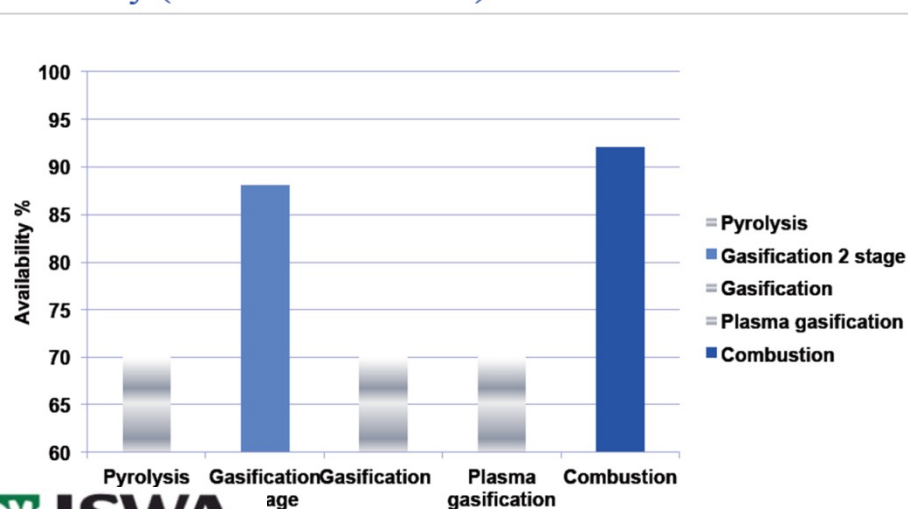


Non-conventional technology Emissions

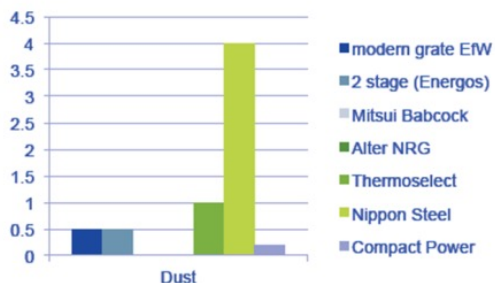
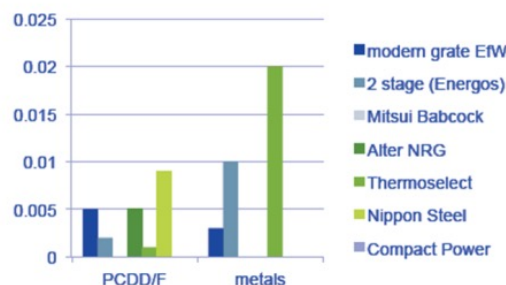
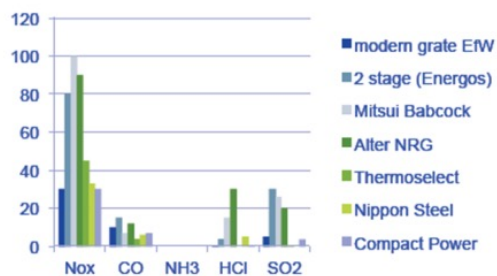
Running installations worldwide



Availability (known or unknown) %



Emission levels ATT's



Emissions are similar for all thermal treatment systems

- Extensive studies do not exist for these like for WTE
- Similar concentration levels
- Similar pollutant categories
- Feedstock dependent

- Review of 21 peer-reviewed for Vancouver
 - Modern WTE facility would not pose unacceptable health risks to local residents (Sciences, 2014).
- England's Ministry of Public Health determined that it is not able to connect any negative health impacts associated with well-regulated WTE facilities (Freni-Sterrantino *et al.*, 2019; Parkes *et al.*, 2020).
- WTE facility in Italy found the excess risk of lung cancer for people living or working nearby the plant is below the WHO target (1×10^{-5}) (Scungio *et al.*, 2016).
- Biomonitoring studies showed no potential risks to humans or crops in the vicinity of three (3) WTE facilities in The Netherlands (Van Dijk, van Doorn and van Alfen, 2015)
- No correlation to dioxin levels in blood for residents near a Portugal WTE facility (Reis *et al.*, 2007). A similar conclusion related to heavy metals was obtained for a WTE facility built in 2005 in Bilbao, Spain.
 - Blood and urine samples over a two-year period from residents 2 to 20 km did not find increased levels of heavy metals for the residents that lived near the plant (Zubero *et al.*, 2010).
- 2004 study for Montgomery County, Maryland WTE tested polychlorinated dioxins/furans and selected toxic metals (arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel). Sites ranged from 2.5 to 25 miles away from the facility.
 - No measurable difference compared to pre-operational ambient levels and no expectation of non-carcinogenic health effects as a result of facility emissions (Rao *et al.*, 2004).
 - Health risk assessment found a 1.0×10^{-6} (1/1,000,000) potential carcinogenic health effects (i.e. 99% below acceptable risk).
 - The facility is unlikely to pose undue risk (Ollson, Aslund, *et al.*, 2014; Ollson, Knopper, *et al.*, 2014).



Peer-Reviewed Scientific Studies

- 7-year (2003-10) Great Britain WTE study
 - modeled ground-level PM₁₀ within 4.5 miles found there was no excess risk for people living in close proximity to WTE facilities (Ghosh *et al.*, 2019). “We found no evidence that exposure to PM₁₀ from, or living near to, an [WTE] operating to current EU standards was associated with harm for any of the outcomes investigated. Results should be generalisable to other MWIs [i.e., WTE facilities] operating to similar standards.”
- Long-term study from 1996-2012 Great Britain WTE study
 - Interrupted Time Series (ITS) methodology found no evidence of an increase in infant mortality when compared to control areas (Freni-Sterrantino *et al.*, 2019).
- 2011 study to quantify attributable burden of disease from four (4) WTE facilities near Seoul
 - Combination of air modeling and the fraction associated with the emissions.
 - Projected 30-year operation $\approx 446 \pm 59\%$ deaths may occur and could be as low as $126 \pm 59\%$.
 - Calculations were completed **assumed** emissions equal to the regulatory limit values.
 - **Actual** emissions were about **10x lower than regulatory limits** and the study did not account for residual risk factors (Kim, Kim and Lee, 2011).

References to above bullets

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Summary

- **Vast scientific, peer-reviewed literature demonstrates negligible to no health risk impact of operating WTE facilities worldwide**
 - Includes asthma, infant mortality, blood-dioxin levels, carcinogenic effects, etc
 - Proximity to WTE does not change findings
 - Performance is constantly improving → cannot rely on outdated studies
- **More health risk impacts from many other sources**
 - Local traffic contributes more to NO_x & PM compared to WTE
- **Until reduce, reuse & recycle treat all waste – WTE must be used**

Peer-reviewed summary of literature published by Earth Engineering Center|CCNY
<https://ccnyeec.org/wp-content/uploads/2021/05/WTE-REPORT7603.pdf>

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WTERT Efforts

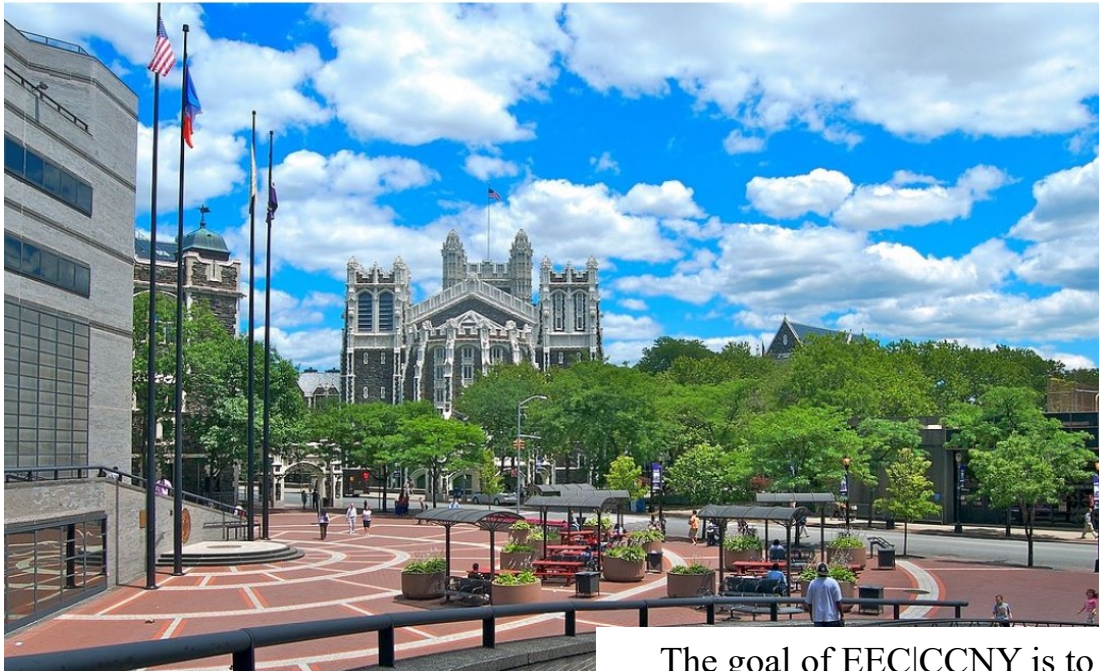
Research

People

Sponsors

Publications

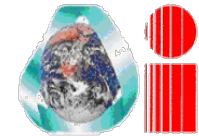
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Engineering of Earth's energy and
material resources for responsible
utilization and preservation

WTERT



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Appendix