



Waste-to-Energy

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Overview

- The Debate Over Waste-to-Energy (WTE)
- EPA Regulations and Dramatic Reductions Achieved
- The Controls That Were Used to Achieve Those Reductions

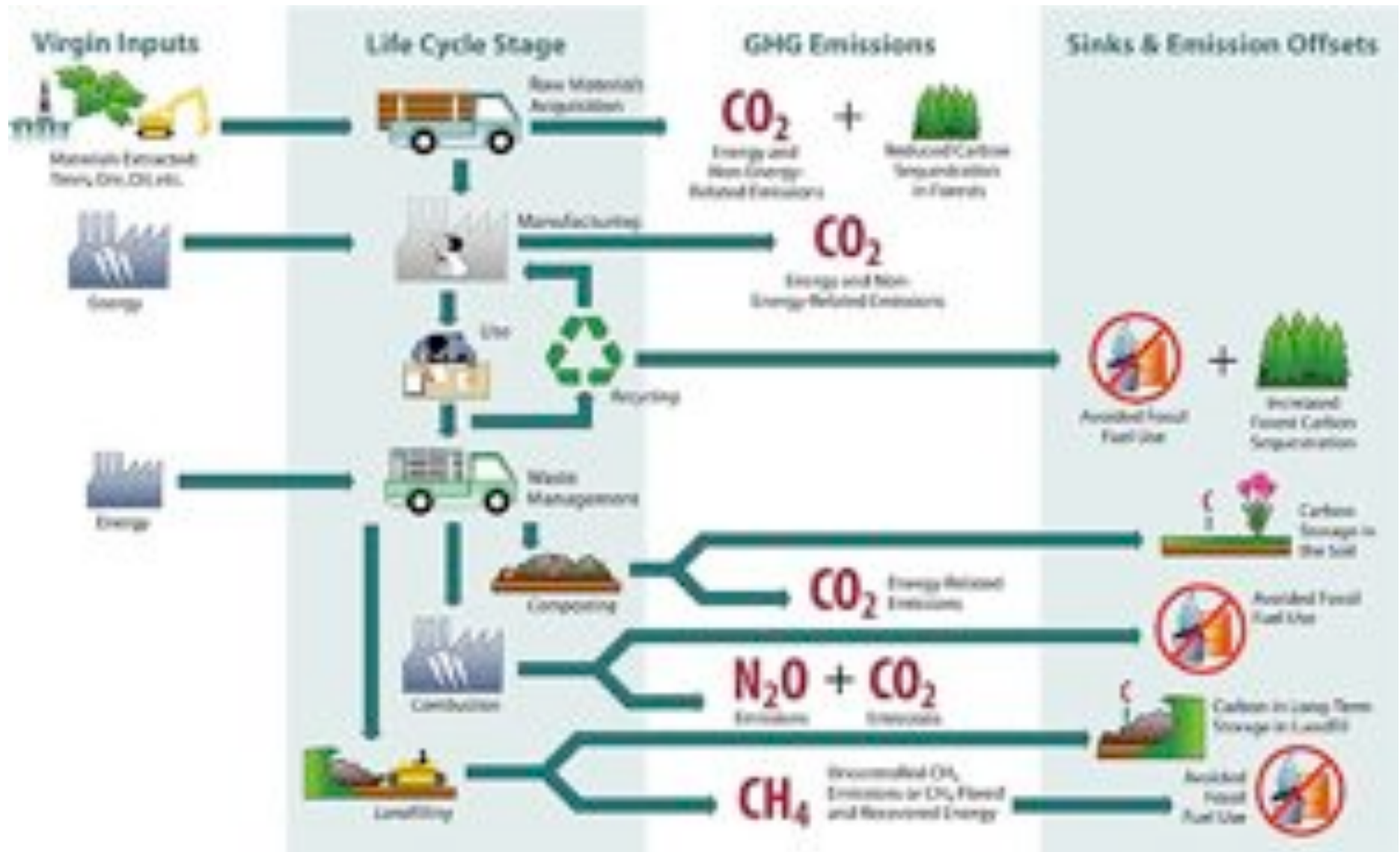
What to do with all of the waste?

- Despite the increase in recycling and composting, the amount of waste to be disposed is still great and expected to increase.
- In 2005 a total of somewhere between 245 - 387 million tons of municipal solid waste (MSW) was generated
- All agree that it must be stressed that Reduce, Reuse, and Recycle continue to be the highest priorities in waste management.
- We should only combust or landfill what can not be recycled. And combustion with energy recovery is preferred over landfilling.

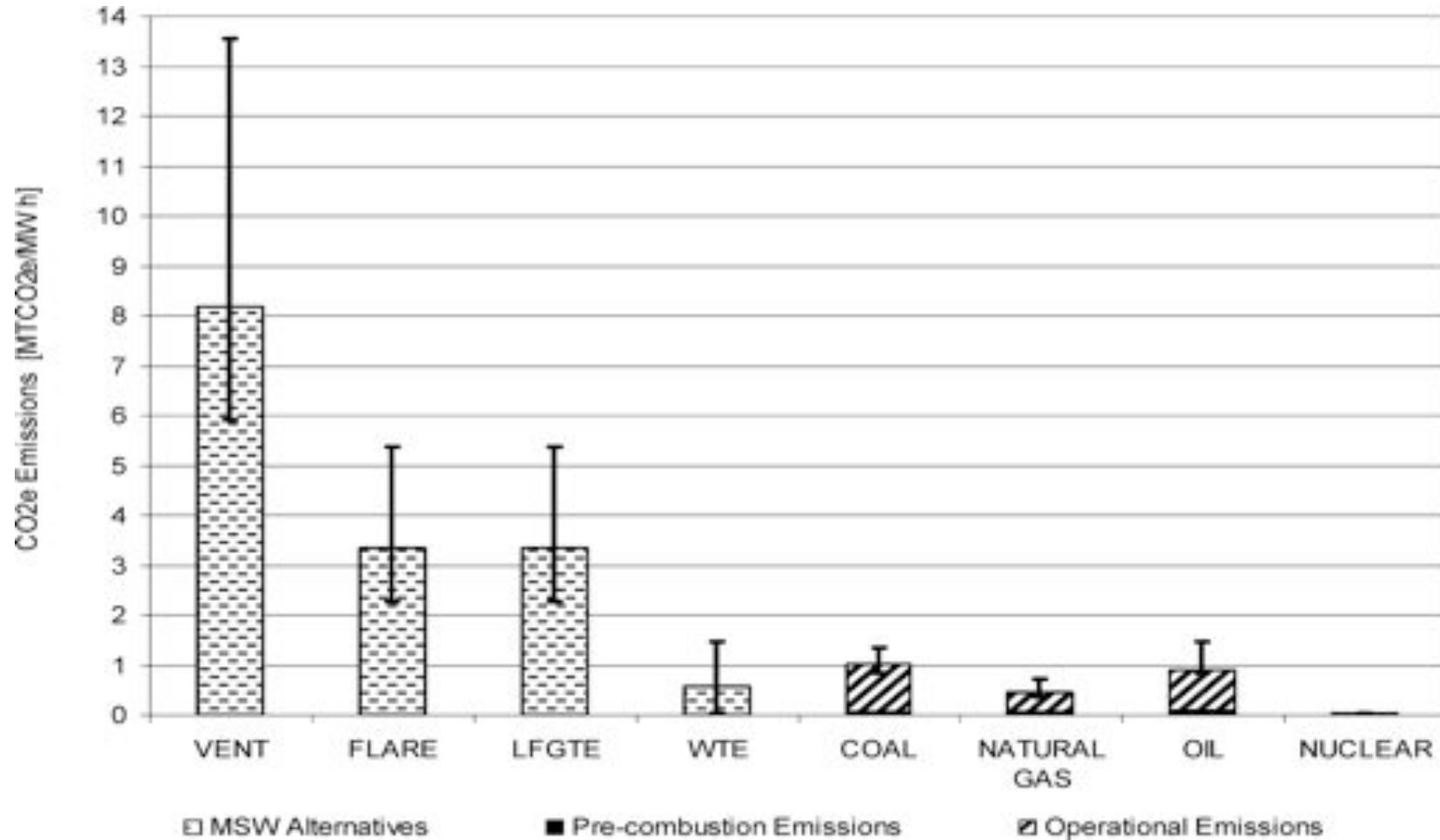
Arguments Against WTE

- Building expensive large Municipal Waste Combustion (MWC) facilities may provide less incentive to reduce the amount of waste we produce or improve recycling technology
- WTE seems counter intuitive to sustainability goals
 - in order to be profitable you should have a waste stream to provide the combustor with fuel.
- Many do not consider WTE to be renewable when it is burning a non-renewable source such as fossil-fuel derived products
 - Burning something to produce energy could detract from efforts to develop truly renewable energy sources such as wind, solar and tidal energy.

Greenhouse Gas Considerations of Waste Management



Comparison of carbon dioxide equivalents for LFGTE, WTE, and conventional electricity-generating technologies



Arguments for WTE

- Studies show that for each ton of waste burned in waste-to-energy units, more than 0.55 – 1.01 ton of CO₂ equivalent emissions are avoided (for example, from landfills and combustion of fossil fuels).
- Recent studies show that recycling rates actually increase in areas where a Waste-to-Energy (WTE) facility is located.
- WTE is capable of producing an order of magnitude more electricity from the same mass of waste than combustion of landfill gas.
- WTE systems provide reliable base load electricity at a known cost.
 - But this assumes a reliable waste stream, which is a concern for those who believe WTE will detract from Reduce, Reuse, & Recycle.
- The volume of solid waste sent to landfill is reduced by > 90 percent.
- Countries in Europe such as Germany have used WTE to reduce their greenhouse gas emissions while continuing to focus on recycling and product producer responsibility.
 - They have had government regulations that were able to drive the recycling and producer responsibility.

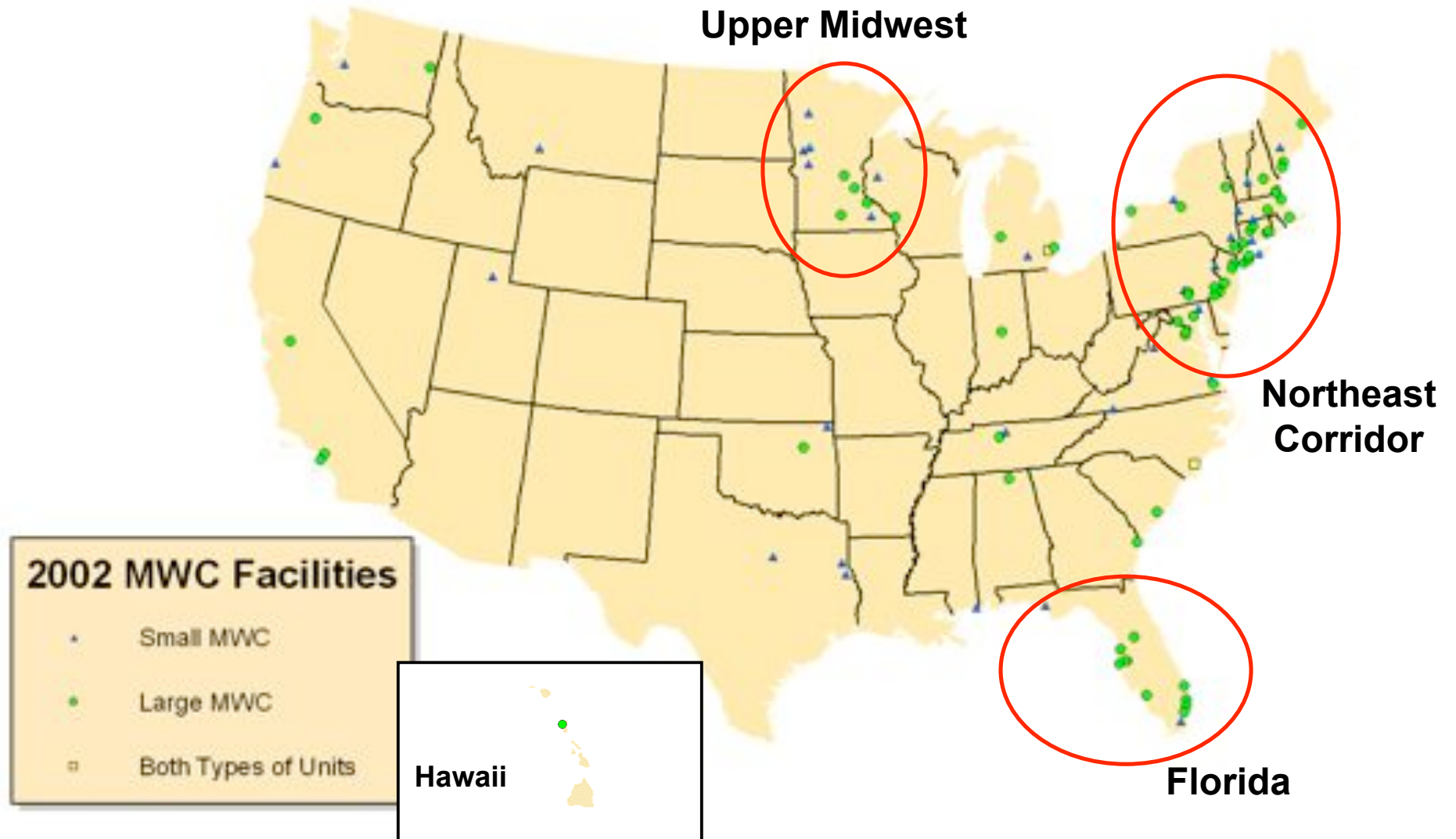
Some Recent News in Support of Waste-to-Energy

- Waste-to-energy was identified as one of eight emerging green technologies according to a report released Jan. 29, 2009 at the World Economic Forum in Davos, Switzerland.
- On February 17, President Obama signed into law the American Recovery and Reinvestment Act otherwise known as the “stimulus bill”. Approximately \$20 billion is aimed at investing directed toward renewable energy projects, and waste-to-energy was included.

How Prevalent is WTE

- In the U.S. Municipal Waste Combustors (MWCs) combust about 17% of domestic municipal solid waste and produce roughly 14% of the U.S. non-hydro renewable electricity generation.
- Some countries use WTE to combust as much as 80% of municipal solid waste.
- There are currently 91 facilities in the US. They generate 2,500 megawatts of electricity (MWe), enough to power 2.3 million homes.

Where are Large and Small MWCs Currently Located in the U.S.?





WTE facility: combusts 2,500 tons/day waste (generated by about 1.3 million people) and generates 72 MWe

Large Municipal Waste Combustor Regulations

- Federal Regulations were finalized in 1995, and large MWC units were required to comply by December 2000.
- Regulations were revised in 2006 to reflect current performance.
- And currently, the entire Clean Air Act Section 129 waste combustion program is being evaluated to strengthen the regulations where needed.
- Standards for new large MWC are based on good combustion practices and add-on controls including:
 - spray dryer, fabric filter (FF), electrostatic precipitator (ESP), activated carbon injection (ACI), and selective non-catalytic reduction (SNCR).

Dramatic Reductions Achieved After Regulation of MWC

Pollutant	Total			Percent Reduction
	1990	2005	Reductions	
Dioxins, total mass, kg/yr	226	0.706	226.0	99.7%
Dioxins TEQ, kg/yr	4.42	0.0138	4.4	99.7%
Hg, tons/yr	56.7	3.72	53.0	93.4%
PM, tons/yr	18,630	1,066	17,564.0	94.3%
SO ₂ , tons/yr	38,270	6,118	32,152.0	84.0%
NO _x , tons/yr	64,900	49,500	15,400.0	23.7%
Cd, tons/yr	9.61	0.550	9.1	94.3%
Pb, tons/yr	172	8.70	163.0	94.9%
HCl, tons/yr	57,400	2,538	54,862.0	95.6%

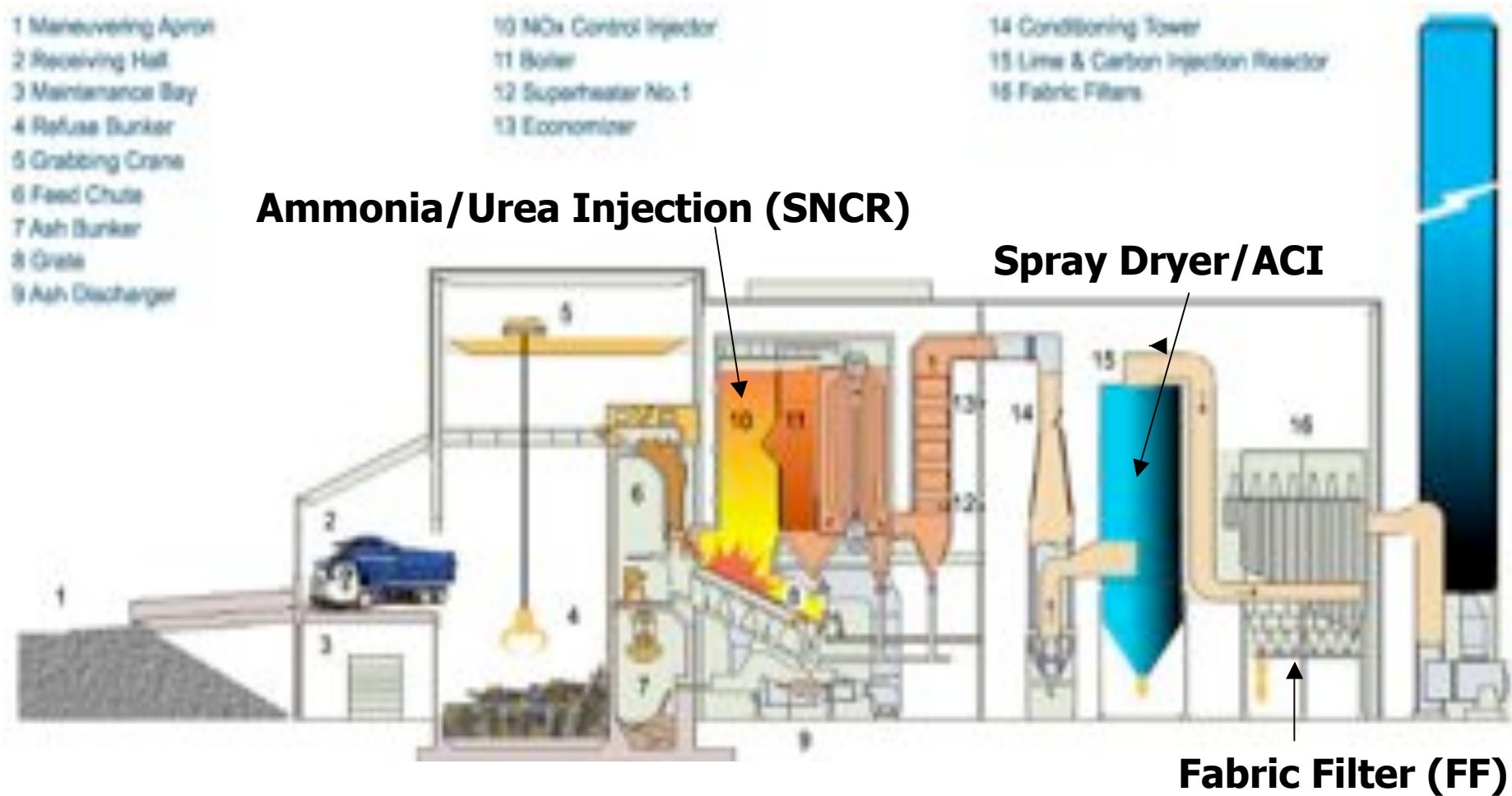
Public Concern Over Mercury and Dioxins/Furans

- Sulfur impregnated activated carbon is used to control mercury. It works by reacting with the mercury to form mercury sulfide (HgS), that is analogous to stable HgS found in nature.
- Tests done at Idaho National Laboratory, published in May 2007, show that the optimized use of sulfur impregnated activated carbon could achieve mercury control efficiencies up to 99.999%.
- Recent risk assessment studies done near facilities in Dickerson, Maryland and in Italy show that findings do not lend support to the hypothesis that the contamination that occurring around the plant induced health effects or that the facility had noticeable impacts upon the presence of chemicals in various sample types.
- When speaking about current non-renewable practices, EPA has concluded that WTE power plants produce electricity “with less environmental impact than almost any other source of electricity.”

Some Comparisons of Current Mercury and Dioxins/Furans Emissions for Scale

- The 1999 EPA National Emission Inventory estimated emissions of Mercury from Utility Boilers to be 42% of the inventory while Municipal Waste Combustors accounted for 4% of National Mercury emissions
- In 2002, EPA estimated that the total annual dioxin emission rate from all waste-to-energy facilities in the U.S. was less than 12 grams of dioxin (as Toxic Equivalent or TEQ), in comparison to the largest source, backyard barrel burning, with 550 grams dioxin TEQ emitted per year

WTE Flow Diagram



Source: Montenay Power Corp.

Add-On Emission Controls - Spray Dryer

- Lime and water slurry injected into reaction chamber to remove acid gases
 - Control device achieves >95% hydrochloric acid (HCl) control and >80% sulfur dioxide (SO₂) control



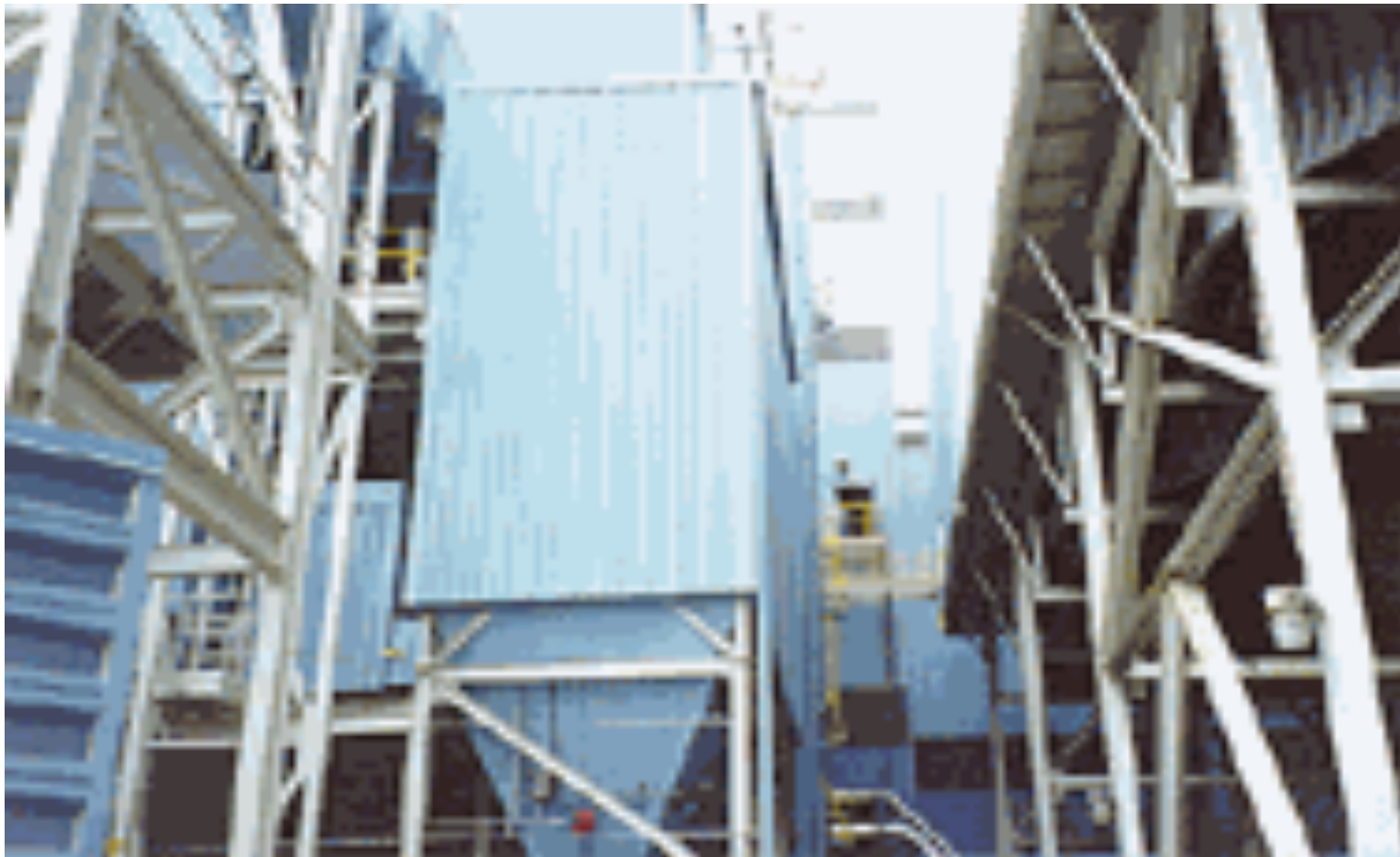
Add-On Emission Controls- Selective Non-Catalytic Reduction (SNCR)

- SNCR reduces NO_x emissions, which lead to urban smog, by injecting ammonia or urea into flue gas to convert NO_x to nitrogen and water.



Add-On Emission Controls-Fabric Filter

- Fabric Filter Achieves >94% control of particulate matter and heavy metals (e.g. lead (Pb), cadmium (Cd), arsenic (As))



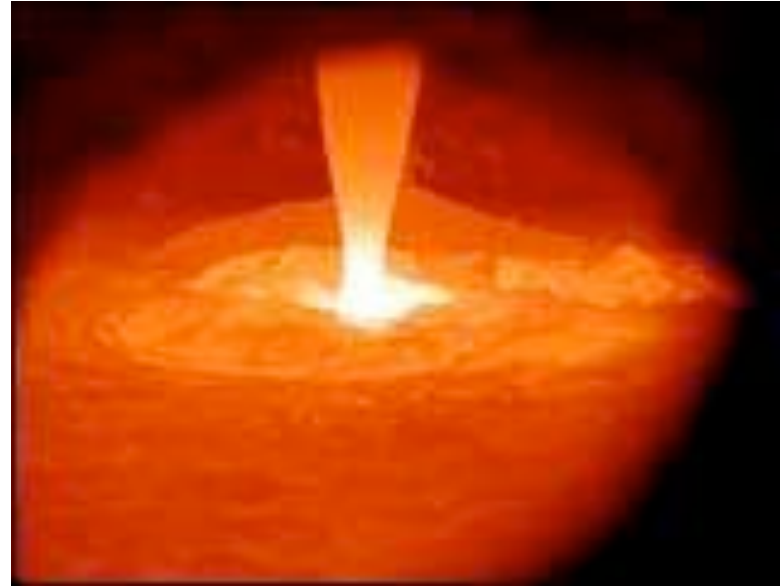
Add-On Emission Controls- Activated Carbon Injection (ACI)

- ACI, in combination with other factors, controls mercury and dioxin emissions.
- Overall mercury reductions of >93% due to ACI, fabric filter, and removal of mercury from waste stream.
- Overall dioxin reductions of 99.7% due to ACI, good combustion, and other factors.



New WTE Technologies?

- EPA is examining the potential for new technologies in the waste-to-energy area
 - Gasification
 - Plasma Arc
 - Other technologies
- EPA is considering how these types of sources could fit within the established regulatory framework of section 129 and sections 111 and 112 of the CAA.



Links For Your Information

- Columbia University - Waste to Energy Research and Technology Council <http://www.seas.columbia.edu/earth/wtert/>
- Integrated Waste Services Association <http://www.wte.org/>
- Solid Waste Association of North America <http://www.swana.org/>
- Report:<http://epa.gov/climatechange/wycd/waste/SWMGHGreport.html>
- WARM (Waste Reduction Model) and other tools:
<http://epa.gov/climatechange/wycd/waste/tools.html>

* Views presented are not necessarily those of EPA, these are just provided for your information

Recent Reports

- P. Ozge Kaplan, Decarolis, and Thorneloe (Feb 10, 2009) Is It Better To Burn or Bury Waste for Clean Electricity Generation? *Environmental Science & Technology*.
- Jonathan V.L. Kiser (2003) Recycling and Waste-to-Energy: The ongoing compatibility success story. *MSW Management*.
- Third Operational Phase Non-Air Media Monitoring for the Montgomery County Solid Waste Resource Recovery Facility near Dickerson, Maryland, July 2006. Prepared by ENSR Corporation for Montgomery County Government Maryland, Document No.: 04739-002-500
- Vinceti, Malagoli, Fabbi, Teggi, Rodolfi, Garavelli, Astolfi, and Rivieri (Feb 2009) Risk of congenital anomalies around a municipal solid waste incinerator, *International Journal of Health Geographics*,
- Thorneloe, Weitz, Nishtala, Yarkosky, and Zannes (2002) The Impact of Municipal Solid Waste Management on Greenhouse Gas Emissions in the United States, *Journal of the Air & Waste Management Association* 52:1000-1011.
- Soelberg, Olson, Boardman, Ryan, and Mason (May 2007) Off-Gas Mercury Control Using Sulfur- Impregnated Activated Carbon – Test Results, *IT3' 07 Conference, May 14-18, 2007, Phoenix, AZ*.

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