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DEPARTMENT OF ENVIRONMENTAL QUALITY
STATE AQ PROGRAM

DYNAMIS
ENERGY

Dynamis Energy, LLC
776 E. Riverside Drive, Suite 150
Eagle, ID 83616

October 24, 2012

Mr. Morrie Lewis, Permit Writer
Department of Environmental Quality
Air Quality Division
1410 North Hilton
Boise, Idaho 83706-1255

Re: Facility ID No. 001-00252, Dynamis Energy, LLC, Boise
Permit to Construct Application, Request for Additional Information for a Waste-to-Energy Project at Hidden Hollow Landfill

On April 25, 2012, Dynamis Energy, LLC (Dynamis) submitted to the Department of Environmental Quality a permit to construct application for a waste-to-energy project to be located at Hidden Hollow Landfill in Boise. DEQ has reviewed the application materials and determined that additional information is required. On October 19, Dynamis received a letter (via email) from DEQ requesting the following information in accordance with IDAPA 58.01.01.202.03:

Ambient Air Boundary

a) Signed lease agreement(s) that specify the leased boundary coordinates and provide authority for controlling access to the ambient air boundary used in the preconstruction modeling compliance demonstrations. The lease agreement submitted in May 2012 does not correspond to the boundary used in the modeling analyses.

The lease agreement was approved by Ada County on October 23, 2012. A copy of the lease agreement will be provided to DEQ as soon as possible.

Emission Inventories – Control Devices

b) Process diagram and description of the location of each air pollution control device in relationship to each emissions unit and process step. Will the selective non-catalytic reduction

system (SNCR) and caustic wet scrubber control equipment be situated downstream of the primary gasification chamber and upstream of the secondary combustion chamber, or downstream of the secondary combustion chamber at the end-of-pipe?

All control equipment will be situated downstream of the secondary combustion chamber. The SNCR will be situated between stages of the boiler and upstream of the caustic wet scrubber. The caustic wet scrubber control equipment will be immediately upstream of the exhaust stack. A process flow diagram showing the location of the SNCR and scrubber were included in Appendix D or the original permit application submitted to DEQ on April 25, 2012. A copy is also included as Attachment 1 to this letter.

c) Copies of the "various literature sources" cited concerning the estimated 70% reduction in mercury emissions from the Thermal Conversion Unit.

Copies of the literatures sources are included in Attachment 2 to this letter. The specific citations are included in the emission factor development spreadsheet submitted to DEQ via email (*email "Dynamis Emissions Factors Development," received 5/24/12 (8:38 am)*, and are also included in Attachment 2.

d) Documentation supporting the estimated 20% reduction in particulate metal emissions from the Thermal Conversion Unit.

The scrubber manufacturer guarantees 41% control of PM2.5 and smaller, with higher control efficiency expected for larger particulates. Metals emissions (with the exception of Mercury) from the thermal unit (including primary ignition system) will be in particulate form, therefore, by controlling particulate emissions, the scrubber will also control particulate metals. Although the control of metals by the scrubber is likely to be around 41% or higher, a conservative 20% control was assumed. In addition, AP-42 Section 2.1.3.2 states:

"The metals present in MSW are emitted from MWCs in association with PM (e.g., arsenic [As], Cd, chromium [Cr], and Pb) and as vapors, such as Hg. Due to the variability in MSW composition, metal concentrations are highly variable and are essentially independent of combustor type. If the vapor pressure of a metal is such that condensation onto particulates in the flue gas is possible, the metal can be effectively removed by the PM control device. With the exception of Hg, most metals have sufficiently low vapor pressures to result in almost all of the metals being condensed. Therefore, removal in the PM control device for these metals is generally greater than 98 percent."

e) Documentation supporting the manufacturer guarantee of 0.005 gr/dscf for the ash handling system baghouse.

Documentation of the ash handling system baghouse control guarantee is included in Appendix E of the original permit application submitted to DEQ on April 25, 2012 (the manufacturer is Donaldson Filtration Solutions). A copy is also included as Attachment 3 to this letter.

Modeling Analyses

f) Correction and resubmittal of the cumulative impact analyses. For the area external to the Hidden Hollow Landfill (HHLF) boundary, HHLF co-contributing sources were modeled accounting for 12 daytime hours per day of emissions from these sources. Because these sources are permitted for continuous operation, they should be modeled accordingly.

A revised modeling analysis is included as Attachment 4 to this letter. Increasing the run time from the HHLF two gas flares, chipper generator engine, and screen generator engine from 12 hrs/day to running continuously does cause an increase in ambient air impacts. However, impacts are still below the NAAQs and do not represent the maximum modeled impact (for all modeled scenarios).

- Scenario 1 NO_x "out" impact (receptors outside of HHLF boundary) – 108.18 ug/m3 including background (formerly 89.89 ug/m3 including background)
- Scenario 1 SO_2 "out" impact (receptors outside of HHLF boundary) – 46.04 ug/m3 including background (formerly 46.04 ug/m3 including background)
- Scenario 2 NO_x "out" impact (receptors outside of HHLF boundary) – 96.6 ug/m3 including background (formerly 75.77 ug/m3 including background)
- Scenario 2 SO_2 "out" impact (receptors outside of HHLF boundary) – 46.04 ug/m3 including background (formerly 46.04 ug/m3 including background)

Emission Inventories – Data

g) Certain regulated toxic air pollutant (TAP) emissions were not included in the emissions inventory, which might reasonably be expected to result from MSW syngas and/or diesel combustion. Please address whether the following substances will be emitted, and provide an estimate of the amount of emissions, including secondary emissions (if applicable):

- acid gases – sulfuric acid mist
- organic compounds – 1,3-butadiene, chlorobenzenes (1,4-dichlorobenzene, hexachlorobenzene, 1,2,4-trichlorobenzene), chlorophenols (2-chlorophenol, pentachlorophenol, 2,4,5-trichlorophenol, 2,4,6-trichlorophenol), cresols, ethylbenzene,

nitrobenzene, phenol, phthalates (diethylphthalate, bis(2-ethylhexyl) phthalate, dibutyl phthalate), polycyclic aromatic compounds (POM, PAH, fluorene, benzo(a)pyrene, anthracene, chrysene, naphthalene, phenanthrene, pyrene, etc.), etc.

- metals – beryllium, chromium (VI), etc.
- any regulated TAP listed in IDAPA 58.01.01.585-586

Diesel fuel will only be used in the emergency generator. HAPs associated with diesel fuel combustion were included in the emissions inventory; diesel PAH emissions were calculated as total PAH.

Reliable emission factors and information regarding emissions of sulfuric acid mist and organic compounds from MSW syngas combustion are not available. Only one of the source tests used to calculate emission factors for other pollutants, the April-May 1993 Entech test, includes analysis of the organic compounds listed above. Organics are discussed on page 26 of the report, and are summarized in Table 12. Table 12 indicates the units are g/dscm. The discussion on page 26 indicates the results were reported as total quantity of organic species collected in units of picograms (pg) or nanograms (ng). However, the lab reports contained in Appendix D state that the units are microgram (ug). Since there is a major discrepancy in the units listed in the report, we cannot rely on those results to be accurate enough to develop emissions estimates from.

In addition, AP-42 does not list emission factors or conversion factors for any organic compounds, other than Dioxin/Furan. In the background document for the AP-42 emission factors, it states "The Good Combustion Practice control strategy includes collectively applying a number of combustion conditions to achieve three broad goals: (1) Maximize in-furnace destruction of organics..." Also, Subpart Eb does not include any limits or monitoring requirements for any organics beside dioxin/furan. Because AP-42 and Subpart Eb are silent on organics emissions (with the exception of dioxin/furan), it is reasonable to assume emissions of organics from MSW combustion are negligible.

Emissions of MSW syngas combustion metals are included in the emissions inventory; any metal not included was either not included in the source tests used to develop emissions factors, or was not detected in the sample.

h) Discussion justifying the exclusion of source test runs from average emission factor calculations. What were the parameters adjusted and their values reported during the "Burn 1" test, and what process conditions lead to the upset condition reported on December 7?

Copies of the original source tests reports are included in Attachment 5. The December 7 upset condition discussion is highlighted in the text of the report.

i) Copies of the original source test data relied upon to establish emission factors and estimate emissions from the Thermal Conversion Unit. This includes, but is not limited to, the following source test reports:

Test Reference Number	Report Title	Author(s)	Additional Information	Data Included in Tests
1A	April - May 1993 Entech, Inc. Model TOS-80, Emissions Monitoring in Anchorage, Alaska. June 1993. For: NATCHIQ, Anchorage, Alaska	John Nordin, Steve Lindblom	Burn 1: 4/20/1993, 18 yd3 MSW	CO2, NOx, FH PM, BH PM, HCl, Metals, Dioxin/Furan, Ash
1B	April - May 1993 Entech, Inc. Model TOS-80 Emissions Monitoring in Anchorage, Alaska. June 1993. For: NATCHIQ, Anchorage, Alaska	John Nordin, Steve Lindblom	Burn 2: 4/22/1993, 16.5 yd3 MSW, 4 yd3 tires, oil waste	CO2, NOx, FH PM, BH PM, HCl, Metals, Dioxin/Furan, Ash
1C	April - May 1993 Entech, Inc. Model TOS-80 Emissions Monitoring in Anchorage, Alaska. June 1993. For: NATCHIQ, Anchorage, Alaska	John Nordin, Steve Lindblom	Burn 4: 4/26/1993, 23 Auto Tires, 2 truck tires, whole	CO2, NOx, FH PM, BH PM, HCl, Metals, Dioxin/Furan, Ash
1D	April - May 1993 Entech, Inc. Model TOS-80 Emissions Monitoring in Anchorage, Alaska. June 1993. For: NATCHIQ, Anchorage, Alaska	John Nordin, Steve Lindblom	Burn 5: 4/28/1993, 18 yd3 MSW, 200 lb wooden pallets	CO2, NOx, FH PM, BH PM, HCl, Metals, Dioxin/Furan, Ash
2	December 1990 Municipal Solid Waste Burn Test in an Entech Thermal Oxidation Demonstration Plant at Western Research Institute. February 1991, revised April 1991. For: Entech, Inc., Anchorage, Alaska	John Nordin, George Huntington	December 3 Burn	CO2, NOx, FH PM, BH PM, HCl, Metals, Dioxin/Furan, SO2, CO, Ash
3	December 1990 Tire Burn Test in an Entech Thermal Oxidation Demonstration Plant at Western Research Institute. February 1991. For: Entech, Inc., Anchorage, Alaska	John Nordin, George Huntington	December 5 and December 7 Burns	CO2, NOx, FH PM, BH PM, HCl, Metals, SO2, CO, Ash
4	September 1991 Tire Burn Test in an Entech Thermal Oxidation Demonstration Plant at Western Research Institute. January 1992. For: Entech, Inc., Anchorage, Alaska.	John Nordin	September 17 Burn	CO2, NOx, SO2, CO
n/a	Annual Report of Facility Performance. Operating Year 2010. Onondaga County Resource Recovery Facility Agency.	Onondaga County Resource Recovery Agency	NYSDEC Part 360 Permit ID No. 7-3142-00028/00011 and Title V Air Permit ID No. 7-3142-00028/00009	Hg

Copies of the first seven source tests listed in the table above are included as Attachment 5 to this letter. The "Annual Report of Facility Performance, Operating Year 2010, Onondaga County Resource Recovery Facility Agency" is included with Attachment 2.

j) Clarification of the following proposed Thermal Conversion Unit operating scenarios and throughput limits:

Source Description/ Operating Scenario	Scenario Definition	Tire Weight Percentage [a] tire wt/load wt	MSW Throughput [b] ton/hr	Tire Throughput [c] lb/24-hr	Total Throughput [d] ton/24-hr
Thermal Conversion Unit, Peak Operation	period from 7:00 am to 11:00 pm each calendar day	1.5%	21.38	12,240	367.2
Thermal Conversion Unit, Off-Peak Operation	period beginning at 11:00 pm each calendar day and ending at 7:00 am the subsequent calendar day (exclusive of "Peak Operation")	1.5%	3.15		

a) Maximum allowable weight percent in pounds of tires each load per total pounds each load, measured on a wet basis.
b) Tons per each period of Peak Operation, measured on a wet basis.
c) Pounds of tires per 24-hour period, calculated as the sum of the tire throughput during each Peak Operation and the preceding Off-Peak Operation period, measured on a wet basis.
d) Tons per 24-hour period, calculated as the sum of the throughput during each Peak Operation and the preceding Off-Peak Operation period, measured on a wet basis.

As limited in the table above, please confirm that each load input to the Thermal Conversion Unit will contain at least 85% MSW, and that no tire-only loads will be processed.

The throughput of the Dynamis Thermal Conversion Unit is 408 tpd on a wet basis. Of this, up to 1.5% will be tires (6.12 tpd). As described in the 'Response to Permit to Construct Application Incompleteness', received by DEQ June 11, 2012, because emission factors were developed using at least an equal number of tire test burns as MSW test burns, with each test burn given equal weight, the emission factors developed are appropriate for a waste stream of at least 50% tires. Because of this, and based on the calculations shown in the table below, Dynamis requests that the total 1.5% of tires may be processed during any hour of the day. In addition, NSPS Subpart Eb requires continuous monitoring of NO_x and SO_2 (the primary pollutant of concern from tire combustion) emissions with a CEMS. The use of the CEMS will ensure compliance with the 1-hr NO_x and SO_2 NAAQs standards.

Scenario	MSW Throughput, tpd (wet basis)	MSW Throughput, tph (wet basis)	If Total Requested Tire Throughput Processed in Either Peak or Off-peak Period (1.5% x 408 tpd = 6.12 tpd)		
			Amount of tires processed, tpd (wet basis)	Amount of tires processed per hour, tph (wet basis)	% of tires as amount of total waste stream processed
Peak Operating Hours	367.2	22.95	6.12	0.3825	2%
Off- Peak Operating Hours	40.8	5.1	6.12	0.765	15%

k) The proposed operating scenarios above and included in the development of the emission inventories do not account for emissions of uncontrolled syngas. Please clarify the following statement in response to incompleteness letter received on June 11, 2012 that "...emissions during startup will consist of emissions from natural gas combustion and **purging** of un-combusted syngas..." Identify whether any control devices are capable of bypass, and whether such devices will be bypassed under any anticipated operating scenario, including startup, shutdown, "Peak," and "Off-Peak" operation. Identify the control equipment (e.g., caustic scrubber, SNCR, flare) to be used during each of these operating scenarios and during malfunction events.

If uncontrolled venting during startup is necessary, please update the emissions inventory with an estimate of these emissions, and provide an estimate of the maximum number of startup and shutdown events expected annually.

DEQ may limit uncontrolled venting and bypassing of control devices if such scenarios are not addressed in the emission inventories.

The paragraph referenced above should be re-worded as follows: "During startup, the **primary** chamber and ducting **between primary and secondary combustion chambers** must be purged to remove any un-combusted gases. The un-combusted gases will be of the same composition as the syngas that is combusted during normal operations, therefore purging emissions are expected to be equivalent emission during normal peak operation. The turbulent air blowers and induced draft fans must run at 100% flow (150,000 scfm) for a minimum of 2 minutes. This airflow provides five air exchanges within the secondary chamber, boiler, scrubber and ducting. These air exchanges insure only ambient air is present in these chambers prior to ignition and prevents potential flare or explosion conditions. ~~After the purge sequence has been completed secondary chamber preheating can occur."~~

Control devices are only capable of bypass in the event of an extreme emergency, such as failure of the boiler or turbine. Under anticipated operating scenarios, including startup, shutdown, "Peak" and "Off-Peak" operation the SNCR and wet scrubber will be operated; there will not be any bypass of control equipment.

l) Discussion of the procedures for staging/staggering the loading of multiple chambers in the Thermal Conversion Unit to ensure compliance with the modeled emission rates during both "Peak" and "Off-Peak" operating scenarios. What is the time delay between charging an individual unit and complete combustion of the syngas generated from that unit?

Per the Power Purchase Agreement (PPA) between Dynamis and Idaho Power, one hour of ramp-up/startup and one hour of slowdown/shutdown are included within the 16 hour peak power delivery period. A primary operation time chart, reflecting the 1 hour shoulder period within the ends of the peak start and stop period, is included as Attachment 6.

Preconstruction Compliance Demonstrations

m) To verify non-applicability of mercury best available control technology requirements (MBACT) under IDAPA 58.01.01.215, provide calculations supporting the mercury emissions estimate of 19.4 pounds per year provided in the application. Alternatively, provide calculations estimating the level of mercury emissions from the Thermal Conversion Unit in pounds per hour corresponding to a concentration limit of 6.4 micrograms per dry standard cubic meter, corrected to 7 percent oxygen (NSPS Subpart Eb emission limit).

Mercury emissions were calculated as follows:

Hours	7am-11pm (Peak)	11pm -7 am (Off-Peak)
Throughput (tpd)	342	25.2
Throughput (ton/hr)	21.375	3.15
Flow Rate (dscm/min)	3532.88	918.11
Percent of day	0.67	0.33
Hg Emission Factor (lb/ton)	1.45E-04	1.45E-04

Emission Calculation

Peak Hg Emissions: 1.45E-04 lb/ton x 21.375 ton/hr = 3.1E-03 lb/hr
Off-Peak Hg Emissions: 1.45E-04 lb/ton x 3.15 ton/hr = 4.57E-04 lb/hr
Average Hg Emissions: 3.1E-03 lb/hr *0.67 + 4.57E-04 lb/hr *0.33 = 2.22E-03 lb/hr
Yearly Hg Emissions: 2.22E-03 lb/hr *8760 hr/yr = 19.4 lb/yr

Alternative Calculation:

NSPS Subpart Eb Hg Emission Limit = 6.4 ug/dscm
Average Exhaust Flow Rate = 2670 dscm/min
Yearly Hg Emissions: 6.4 ug/dscm x 2670 dscm/min x 60 min/hr x 1 lb/453.6g x 1g/10^6ug x 8760 hr/yr= 19.79 lb/yr

Applicable Requirements

n) Address the applicability of the following definitions and rules:

- Definitions of "incinerator" under IDAPA 58.01.01.006.58 and "Designated Facility" under IDAPA 58.01.01.006.30.i.

IDAPA 58.01.01.006.58 defines incinerator as the following:
Incinerator. Any source consisting of a furnace and all appurtenances thereto designed for the destruction of refuse by burning. "Open Burning" is not considered incineration. For purposes of these rules, the destruction of any combustible liquid or gaseous material by burning in a flare stack shall be considered incineration.

Dynamis asserts that the Ada County Waste-To-Energy thermal conversion unit does not meet the definition of incinerator as given above for the following reason:

The Dynamis thermal conversion unit does not burn the refuse; the refuse is gasified. Dynamis' technology utilizes a controlled (starved) air gasification process which thermally converts waste products to combustible gas. The two-stage process provides complete conversion of carbon to an inert ash and a controlled heat output for efficient energy recovery. According to the Gasification Technologies Council (http://www.gasification.org/page_1.asp?a=87&b=85):

> "Incineration uses MSW as a fuel, burning it with high volumes of air to form carbon dioxide and heat. Gasification converts MSW to a usable synthesis gas, or syngas. It is the production of this syngas which makes gasification so different from incineration. In the gasification process, the MSW is not a fuel, but a feedstock for a high temperature chemical conversion process. In the gasifier, the MSW reacts with little or no oxygen, breaking down the feedstock into simple molecules and converting them into syngas."

Therefore, because it is the syngas that is being combusted (burned) by the Dynamis thermal conversion unit, and not the refuse, the unit does not meet the definition of incinerator.

IDAPA 58.01.01.006.30.i defines Designated Facility as the following:
Municipal incinerators capable of charging more than two hundred and fifty (250) tons of refuse per day.

Because Dynamis does not meet the IDAPA 58.01.01.006.58 definition of incinerator, as described above, the facility is not a 'Designated Facility' as described in IDAPA 58.01.01.006.30.

- Rules for Control of Incinerators, IDAPA 58.01.01.785-788.

  Because Dynamis does not meet the IDAPA 58.01.01.006.58 definition of incinerator, as described above, IDAPA 58.01.01.785-788 does not apply to the facility.

- Air Pollution Emergency Rule, IDAPA 58.01.01.550-562.

  The Dynamis facility will not burn or incinerate solid waste; therefore IDAPA 58.01.01.550-562 does not apply to the facility.

- Polychlorinated Biphenyls (PCB), IDAPA 58.01.01.164.

  The Dynamis thermal conversion unit is not an incinerator and will not burning any material containing greater than five (5) parts per million of polychlorinated biphenyls (PCBs) nor will the unit be used for incineration of PCBs for the purpose of disposal.

- Standards of Performance for Hospital/Medical/Infectious Waste Incinerators, IDAPA58.01.01.861.

  IDAPA 58.01.01.861.02.d. states "Any combustor which meets the applicability requirements under 40 CFR Part 60, Subparts Cb, Ea or Eb (relates to certain municipal waste combustors) is not subject to Section 861.

  Since the Dynamis facility is subject to 40 CFR Part 60, Subpart Eb, the facility is exempt from IDAPA 58.01.01.861.

Pursuant to IDAPA 58.01.01.123, I hereby certify that, based on information and belief formed after reasonable inquiry, the statements and information in this application are true, accurate, and complete.

Please feel free to me at 208.938.2680 if you have any questions or need additional information.

Sincerely,

C. Lloyd Mahaffey
Chairman & CEO, Dynamis Energy, LLC

Enclosures

Cc: JBR Environmental Consultants, Inc.

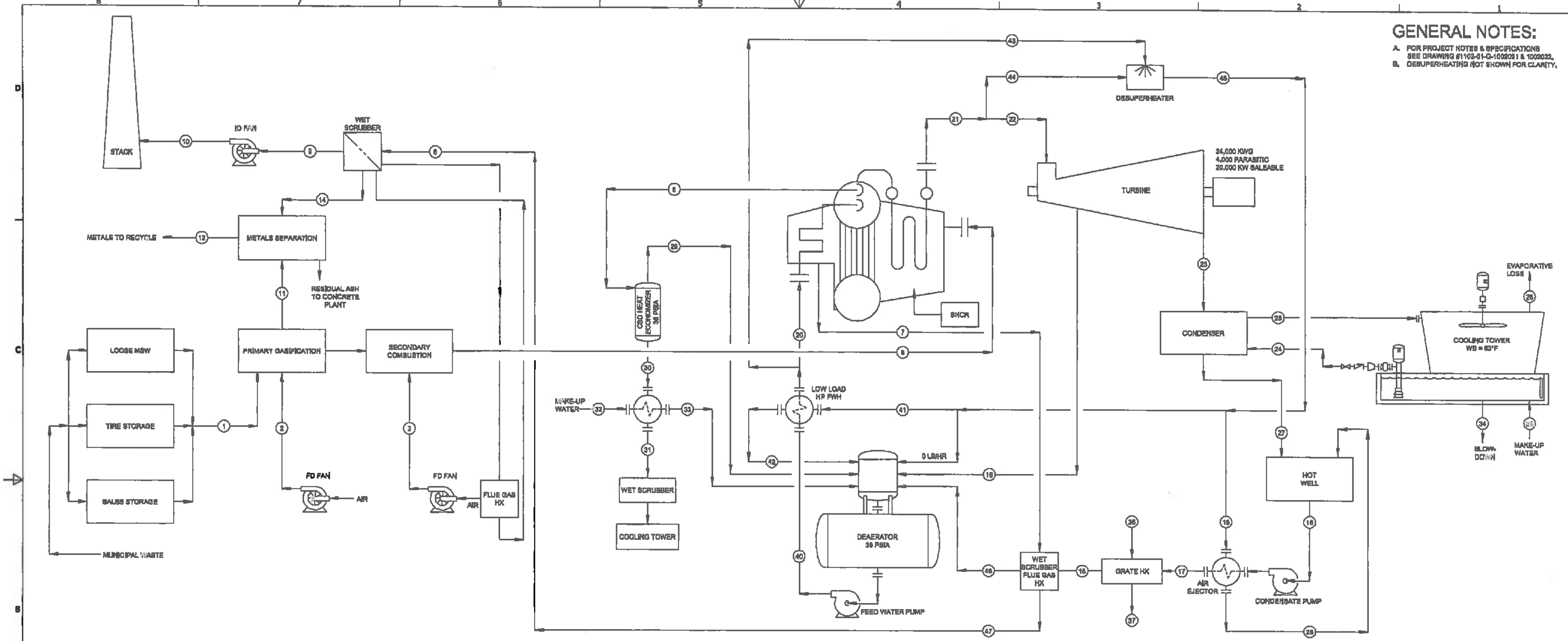
ATTACHMENT 1

Process Flow Diagram

Dynamis Energy, LLC
776 E Riverside Dr. Ste.150
Eagle, ID 83616

GENERAL NOTES:

A. FOR PROJECT NOTES & SPECIFICATIONS SEE DRAWING #1102-01-G-1002021 & 1002022.
B. DESUPERHEATING NOT SHOWN FOR CLARITY.



STREAM NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
DESCRIPTION	PLANT FEED	PRIMARY AIR	SECONDARY AIR	NOT USED	BOILER BLOWDOWN	COMBUSTION GAS	FLUE GAS HOT	AIR FILTER INLET	AIR FILTER OUTLET	EXHAUST GAS	PRIMARY ASH	SEPARATED METALS	NOT USED	AIR PARTICULATES	AIR EJECTOR STEAM	CONDENSATE	GRATE HEAT FEED	FLUE GAS HX FEED	EXTRACTION STEAM
PHASE (S,L,V)	S	V	V	-	L	V	V	V	V	V	S	S	-	S	V	L	L	L	V
TEMP (°F)	60	60	60	-	536	X	350	-	-	-	X	-	-	-	385	103	105	118	306
PRESS (PSIA)	14,7	14,7	14,7	-	940	-	-	-	-	-	-	-	-	-	165	14,7	-	-	36
ENTHALPY (BTU/LBM)	5600	-	-	-	533	-	-	-	-	-	-	-	-	-	1196	71	74	84	1189
MASS FLOW (LBM/HR)	51,013	-	-	-	4117	X	460,000	-	-	-	X	-	-	-	600	200,774	200,774	200,774	5,205
VOLUME FLOW (ACFM)	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
VOLUME FLOW (SCFM)	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-

STREAM NUMBER	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
DESCRIPTION	BOILER FEED	BOILER STEAM	STEAM TO TURBINE THROTTLE	TURBINE EXHAUST	COOLING WATER SUPPLY (GPM)	COOLING WATER RETURN (GPM)	EVAPORATIVE LOSS (GPM)	CONDENSER OUTLET	AIR EJECTOR CONDENSATE	FLASH STEAM	BLOW-DOWN HOT	BLOW-DOWN COLD	BOILER MAKE-UP COLD	BOILER MAKE-UP HOT	CT BLOW-DOWN (GPM)	CT MAKE-UP (GPM)	GRATE WATER SUPPLY (GPM)	GRATE WATER RETURN (GPM)	SNCR	
PHASE (S,L,V)	L	V	V	V	L	L	V	L	L	V	L	L	L	L	L	L	L	L	S	-
TEMP (°F)	261	825	823	102	71	86	-	102	385	305	262	121	60	201	-	-	260	129	-	-
PRESS (PSIA)	1140	916	915	1	-	-	-	1	165	36	36	-	-	-	-	-	-	-	-	-
ENTHALPY (BTU/LBM)	230	1414	1414	1004	-	-	-	70	339	1168	230	89	28	169	-	-	-	-	-	-
MASS FLOW (LBM/HR)	209,849	205,832	205,179	199,674	-	-	-	199,674	600	1330	2787	2787	2787	2787	-	-	-	-	-	-
VOLUME FLOW (ACFM)	-	-	-	-	15,303		301	-	-	-	-	-	-	-	72	373	34		-	-
VOLUME FLOW (SCFM)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

STREAM NUMBER	40	41	42	43	44	45	46	47
DESCRIPTION	DEAERATOR OUTLET	STEAM TO FWH	FWH CONDENSATE	WATER TO DESUPERHEATER	STEAM TO DESUPERHEATER	DESUPERHEATER OUTLET	DEAERATOR FEED	FLUE GAS COLD
PHASE (S,L,V)	L	V	L	L	V	V	L	V
TEMP (°F)	261	385	365	261	825	385	232	142
PRESS (PSIA)	1140	165	165	1140	915	156	-	-
ENTHALPY (BTU/LBM)	230	1196	339	230	1414	1196	200	-
MASS FLOW (LBM/HR)	210,098	0	0	147	853	800	200,774	460,000
VOLUME FLOW (ACFM)	-	-	-	-	-	-	-	-
VOLUME FLOW (SCFM)	-	-	-	-	-	-	-	-

REVISION IN PROGRESS
05 Apr 12 – 01:31 pm

NO.	REVISIONS	BY	DATE
D	RENUMBERED AND UPDATED	JRM	4/5/12
C	ISSUED FOR NOT TO EXCEED BUDGET	BEH	3/23/12
B	FOR REFERENCE ONLY	DTS	1/3/12
A	FOR REFERENCE ONLY	NGJ	12/29/11

ADA COUNTY, IDAHO

EVERGREEN ENGINEERING
Engineering and Construction Services
EUGENE, OREGON

EE JOB NUMBER 2540.1

EE DRAWING NUMBER 1102-04-F-1002047 — CAD FILE 1102-04-F-1002047 dwg

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMAL .X ±.1 .XX ±.01 .XXX ±.005; WELD ± 1/32; CHAMFERS ±5°; ANGLES ±1°; CAST ±1/8; FRACTIONS ±1/16; THIRD ANGLE PROJECTION

DRAWN DS 12/05/11
CHECKED
QA
MFG
APPROVED JP
MATERIAL SEE TABLE
FINISH N/A

Dynamis Energy LLC,
776 E. Riverside Dr. Ste. 150
Eagle, ID 83616

TITLE
408T WASTE TO ENERGY FACILITY
HEAT BALANCE FLOW DIAGRAM
32 MMBTU/HR FLUE GAS HX

SIZE D — DWG NO 1102-04-F-1002047 — REV D
SCALE NONE — SHEET 1 OF 1

ATTACHMENT 2

Mercury Emissions Information

Dynamis Energy, LLC
776 E Riverside Dr. Ste.150
Eagle, ID 83616

Report

OCRRA

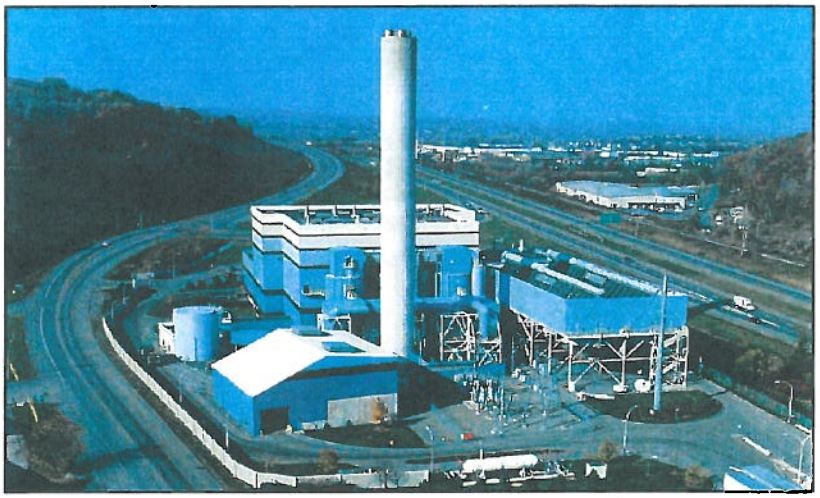
Onondaga County
Resource Recovery Facility

NYSDEC Part 360 Permit ID No. 7-3142-00028/00011
Title V Air Permit ID No. 7-3142-00028/00009

Annual Report of Facility Performance
Operating Year 2010

Onondaga County
Resource Recovery Agency
WWW.OCRRA.ORG

May 2011



Prepared by: ***Amy K. Miller, P.E.***
Agency Engineer, OCRRA

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Section 1 – Introduction

In the 1980s, the Onondaga County Solid Waste Management Program developed a plan to deal with the community's mounting garbage crisis. Realizing that there were no easy answers, they set out to design a safe, reliable, and cost-effective program that would serve the community's needs, at that time and into the future. They carefully analyzed the environmental impacts of different trash disposal alternatives and determined that no single method of disposal would solve the trash dilemma. Ultimately, a comprehensive, finely balanced, and integrated solid waste management system was required to manage the County's waste. The final plan consisted of four parts:

1) a waste reduction program,
2) an aggressive recycling program,
3) a state-of-the-art mass burn waste-to-energy (WTE) facility, and
4) a modern, lined landfill.

To manage this new County-wide waste management system, the County created a public authority – the Onondaga County Resource Recovery Agency (OCRRA). OCRRA would administer the County's solid waste management with a prioritization of management methods that exactly mirrored New York State's Solid Waste Management Plan: 1) waste reduction, 2) recycling, 3) recovery of useful energy through solid waste combustion (i.e., modern waste-to-energy facilities), and 4) use of permitted landfill facilities.

After a rigorous procurement process in 1988 and 1989, Ogden Martin Systems was selected to design, build, and operate the Onondaga County Resource Recovery Facility (Onondaga County WTE Facility). OCRRA entered into a service agreement with Ogden Martin Systems of Onondaga (currently Covanta Onondaga) in 1990. On December 18, 1992, with environmental permits in place and project revenue bonds totaling $178 million, formal groundbreaking ceremonies were held for the construction of the waste-to-energy facility. By late 1994 the Facility had its first official burn and by early 1995 the Facility was commercially operational.

Today, the Onondaga County WTE Facility continues to be an integral part of OCRRA's solid waste management system, or perhaps more aptly termed, OCRRA's resource recovery system. About 47% of materials that could otherwise go to the WTE Facility are source separated for recycling. The remaining non-recyclable portion goes to the WTE Facility, which uses a mass burn combustion system (and temperatures of 1800° - 2000° F) to safely and efficiently convert non-hazardous, non-recyclable trash into steam.

The steam is then used to generate electricity that is sold to National Grid, providing enough electricity for approximately 30,000 households and the Facility itself. Ferrous and non-ferrous metals that would otherwise have gone to a landfill are recovered at the WTE Facility for recycling. The by-product of the combustion process is a non-hazardous ash residue, which is about 10% of the original volume of the trash processed at the Facility. The ash residue is sent to a landfill for use as alternative daily cover.

Incorporated into the operations of the Facility is an air pollution control system, which helps the Facility comply with one of the strictest air permits in the nation, meeting federal and state emissions requirements. Emissions from the Facility are carefully monitored through continuous emissions monitors (CEMs) and annual stack testing.

Since its start-up in 1994 the facility's operational and environmental performance has exceeded expectations. In fact, the Facility has received several national awards and, in 2008, POWER Magazine ranked the Onondaga WTE Facility as one of the top five renewable energy facilities. By generating power for use by homes and businesses, the Onondaga County WTE Facility offsets the burning of fossil fuels by using an alternative, domestically-generated fuel: non-recyclable solid waste.

This report presents a summary of operational, environmental, and financial performance of the Onondaga County WTE Facility, located at 5801 Rock Cut Road (Town of Onondaga), Jamesville, New York for calendar year 2010. The Facility operates in accordance with NYSDEC Part 360 Permit ID No. 7-3142-00028/00011 (issued 11/16/01) and USEPA Title V Air Permit ID No. 7-3142-00028/00009 (issued 1/8/02). 2010 was the 16th full year of Facility operation since initial start-up on November 10, 1994. Commercial operation began on February 25, 1995.

The report is organized as follows:

- Section 2 of the report presents an Executive Summary.
- Section 3 presents a summary of the Facility's operational performance.
- Section 4 presents a summary of the Facility's environmental performance.
- Section 5 presents a summary of the Facility's financial performance.
- Section 6 provides a list of references.

Section 2 – 2010 Highlights

2010 Overview

- OCRRA's system is exceptionally consistent with the New York State and U.S. Environmental Protection Agency waste management hierarchy, which includes (in order of preference): 1) waste reduction, 2) recycling, 3) recovery of useful energy through solid waste combustion (i.e., modern waste-to-energy facilities), and 4) use of permitted landfill facilities.

- 2010 was another year of low trash tonnage due to the continuing recession. Trash tonnage was about 9% below historical levels. Electricity rates averaged 4.5¢ per kilowatt hour (kWh); better than 2009's average rate of 3.7¢ per kWh, but still much less than the rate of about 6¢ per kWh for the previous few years. On a positive note, the Facility's operational and environmental performance remained strong and consistent with historical performance.

2010 Operational Performance

- The Facility has been for the past 16 years, and continues to be, well operated and maintained by Covanta Onondaga.

- The Facility processed 315,385 tons of non-hazardous, non-recyclable trash (enough to overfill the Syracuse Carrier Dome) or 87% of capacity and, in doing so, generated 218,118 megawatt hours (MWh) – enough electricity to power approximately 30,000 homes, as well as the Facility itself. As mentioned above, the amount of trash processed was down about 9% due to the ongoing recession, and therefore, the total amount of electricity generated was also down from historical generation.

- The Facility had a net electricity production of 605 kWh per ton of refuse processed. This rate is below the Facility's 16-year average of 628 kWh/ton; however the difference is primarily due to the turbine-generator system being out of service during the 21-day major maintenance overhaul.

- In 2010, the Facility's metal recovery systems recovered 8,932 tons of metal for recycling.

- Overall boiler availability for 2010 was 93.3%. This value reflects less downtime for scheduled maintenance and equipment malfunctions than the historical Facility average.

- Turbine-generator availability was at a Facility-low of 94.4% due to a thorough and detailed inspection of the turbine-generator system; the second major overall since Facility start-up.

2010 Environmental Performance

- The 2010 annual stack testing results indicate that the Facility is performing strongly. All parameters met the corresponding air permit limits, and most were significantly below the permit limit.

- Levels of mercury in the incoming waste stream continue to trend downward, indicating that OCRRA's mercury removal programs are effective. Furthermore, the Facility demonstrates high mercury removal efficiency. Mercury emissions from the Facility were 5% of the permit limit.

- In 2010, the estimated annual total dioxin toxic equivalence (TEQ) emissions were 0.00009 lbs (90 millionths of a pound) – an amount equivalent to 3% of the weight of a standard paper clip. Dioxin/furan emissions from the Facility were less than 5% of the permit limit.

- By sending the community's non-recyclable trash to the WTE Facility, rather than to a landfill, greenhouse gas emissions are avoided. As a general rule of thumb, approximately 1 ton of trash processed prevents 1 ton of carbon dioxide emissions. So in 2010, the WTE Facility avoided 315,385 tons of carbon dioxide emissions, which is the equivalent of taking about 50,000 passenger vehicles off the road.

- The WTE Facility utilizes a locally-generated feedstock – the community's non-recyclable trash to generate a significant amount of electricity; this not only reduces dependence on fossil fuels, it also achieves goals of energy independence. In 2010, the WTE Facility generated enough energy to displace nearly 400,000 barrels of oil or 80,000 tons of coal – enough energy to satisfy the needs of approximately 30,000 homes in OCRRA's service area.

- With one of the highest recycling rates in New York State, Onondaga County demonstrates that WTE and recycling are highly compatible; it also supports many studies that have concluded communities with WTE facilities often have higher rates of recycling.

- In 2010, all ash residue from the Facility was used as alternative daily cover at the landfill. This beneficial use of the ash ultimately means that other materials, such as clean soil, do not need to be used for daily cover at the landfill.

2010 Financial Performance

- Due to the continuing recession, trash tonnage were still down about 9% and electricity rates remained relatively low. As a result, OCRRA's 2010 Facility-related expenses were $1.57 million more than Facility revenues. Total operating revenues were approximately $24.29 million and total (operating and bond) expenses were $25.86 million. As evident, WTE facilities like the local Facility have tremendous fixed costs. If those fixed costs are not offset by sufficient electricity revenue and tipping fees, there may be facility-related net losses, as in 2009 and 2010.

Section 3 – Operational Performance

3.1 Summary of Operations

Based on the 2010 operating data, overall Facility operations continued at high levels for the 16th year of continuous operation despite a second year of relatively low trash levels. The Facility processed 315,385 tons of municipal solid waste (MSW), 87% of the Facility's permitted throughput limit of 361,350 tons. Overall boiler availability for 2010 was 93.3%, which is higher than the 16-year Facility average of 91.4%. Turbine-generator availability was at a Facility-low of 94.4% due to a thorough and detailed inspection of the turbine-generator system; the second major overall since Facility start-up.

The average higher heating value (HHV) of waste processed in 2010 was 5,399 British thermal units per pound (Btu/lb). The 2010 HHV, which indicates the energy embodied in the incoming waste stream, was slightly above the Facility's 16-year average (1995-2010) average HHV of 5,377 Btu/lb. The Facility had a net electricity production of 605 kilowatt-hours per ton of refuse processed (kWh/ton). This rate is lower than the Facility's 16-year average of 628 kWh/ton, however the difference is primarily due to the turbine-generator system being out of service during the 21-day major overhaul.

In 2010, the WTE Facility generated 77,534 tons of combined ash residue, which were hauled by OCRRA to Seneca Meadows Landfill in Waterloo, NY. Based on the waste tonnage processed, this amount of ash was 24.6%; therefore the Facility reduced the weight of the refuse by over 75%. The 2010 ash ratio is a percentage less than the 16-year Facility average of 25.7%. For all of 2010, ash residue from the Facility was used as alternative daily cover at the landfill. This beneficial use of the ash ultimately means that other materials, such as clean soil, do not need to be used for daily cover at the landfill.

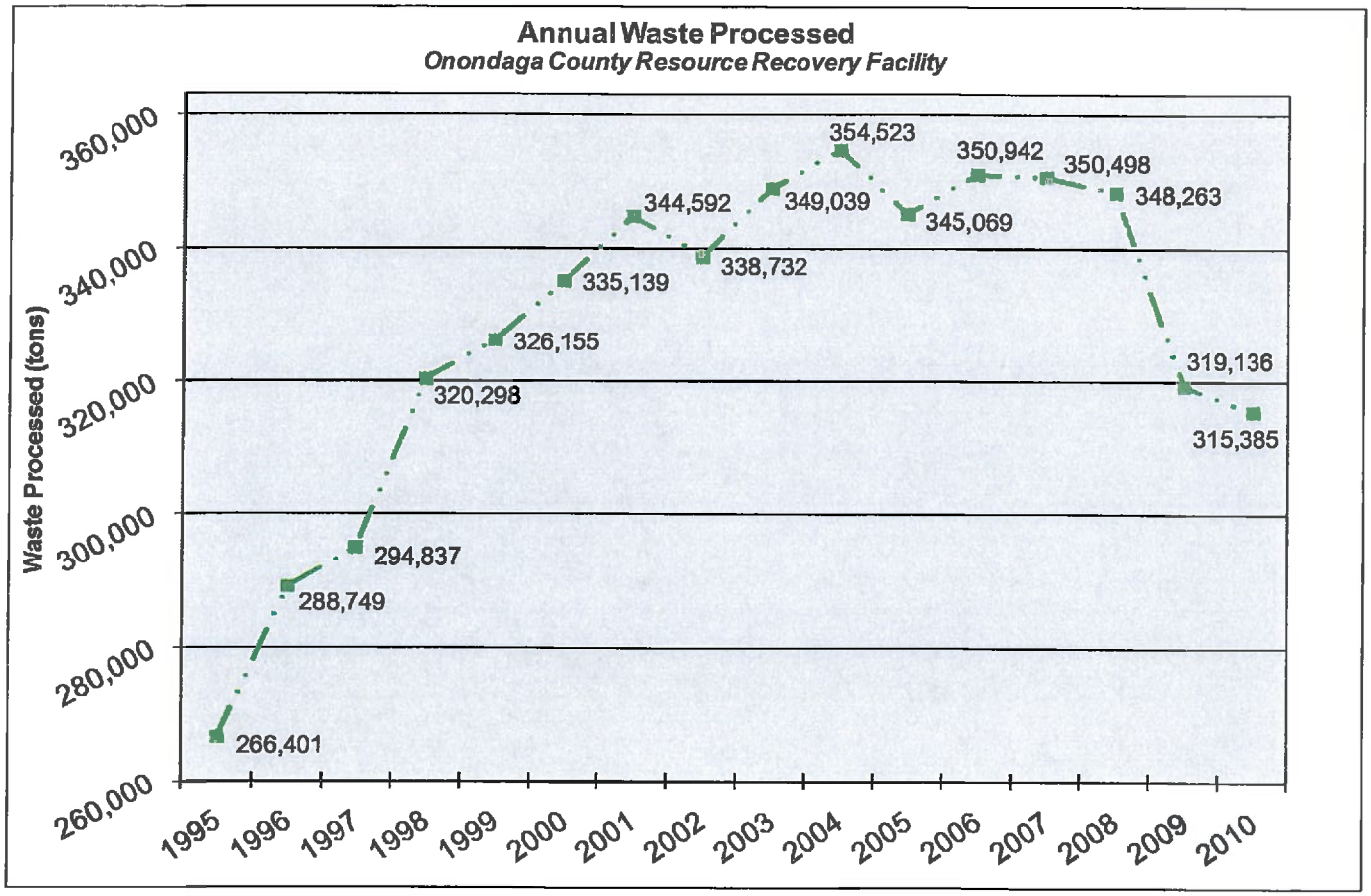
In 2010, the Facility recovered approximately 8,599 tons of ferrous metal, or 2.7% of the refuse processed, for shipment to recycling markets. The non-ferrous metal recovery system, which uses an eddy-current separator, recovered 403 tons of material, of which 333 tons were deemed to be non-ferrous metal – about 0.11% of the refuse processed.

In 2010, the average boiler utilization was 95.8%, indicating that while the boilers were operational, they operated at slightly less than full design levels (due to low trash tonnage). Whenever the boilers are operated at less than full capacity, their efficiency and, therefore steam production, drops. Often times, when there is not enough trash to run all three units at full capacity, one unit is taken offline so that the other units may be operated at full capacity, thereby still maximizing boiler utilization. However, it is not ideal to bring units online and offline too frequently. Another term, steam capacity, is also used to compare boiler utilization, and is defined as the ratio of actual steam to the maximum amount of steam that could be generated if the unit were running full time. For 2010, the Facility's average steam capacity was 78.5%.

3.2 Refuse Processed

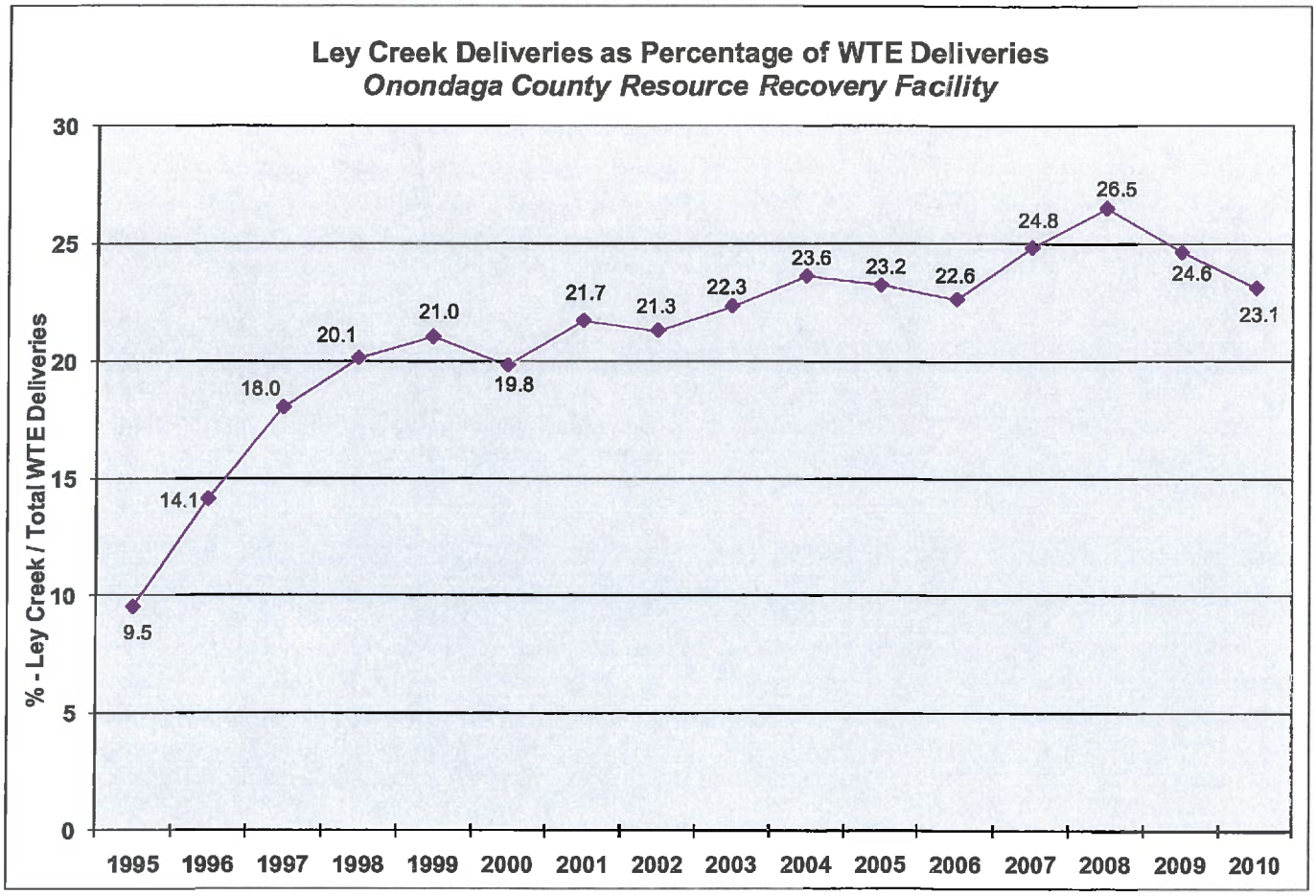
The WTE Facility received 314,474 tons of refuse during 2010, or 95% of OCRRA's total non-recyclable waste tonnage. Only 7 tons, or less than 0.002% of the incoming waste stream, were rejected from the Facility as non-processable waste. Taking into consideration the refuse received and the beginning and ending refuse pit inventory, 315,385 tons of solid waste were processed in 2010. This represents 87.3% of the Facility's permitted throughput limit of 361,350 tons, leaving 45,965 tons of unused processing capacity.

Due to the continuance of the recession from 2009, waste received and processed in 2010 was 1.2% less than the tonnage processed in 2009 and 9.4% less than the tonnage processed in 2008. The figure below shows the historical annual waste processed at the Facility.

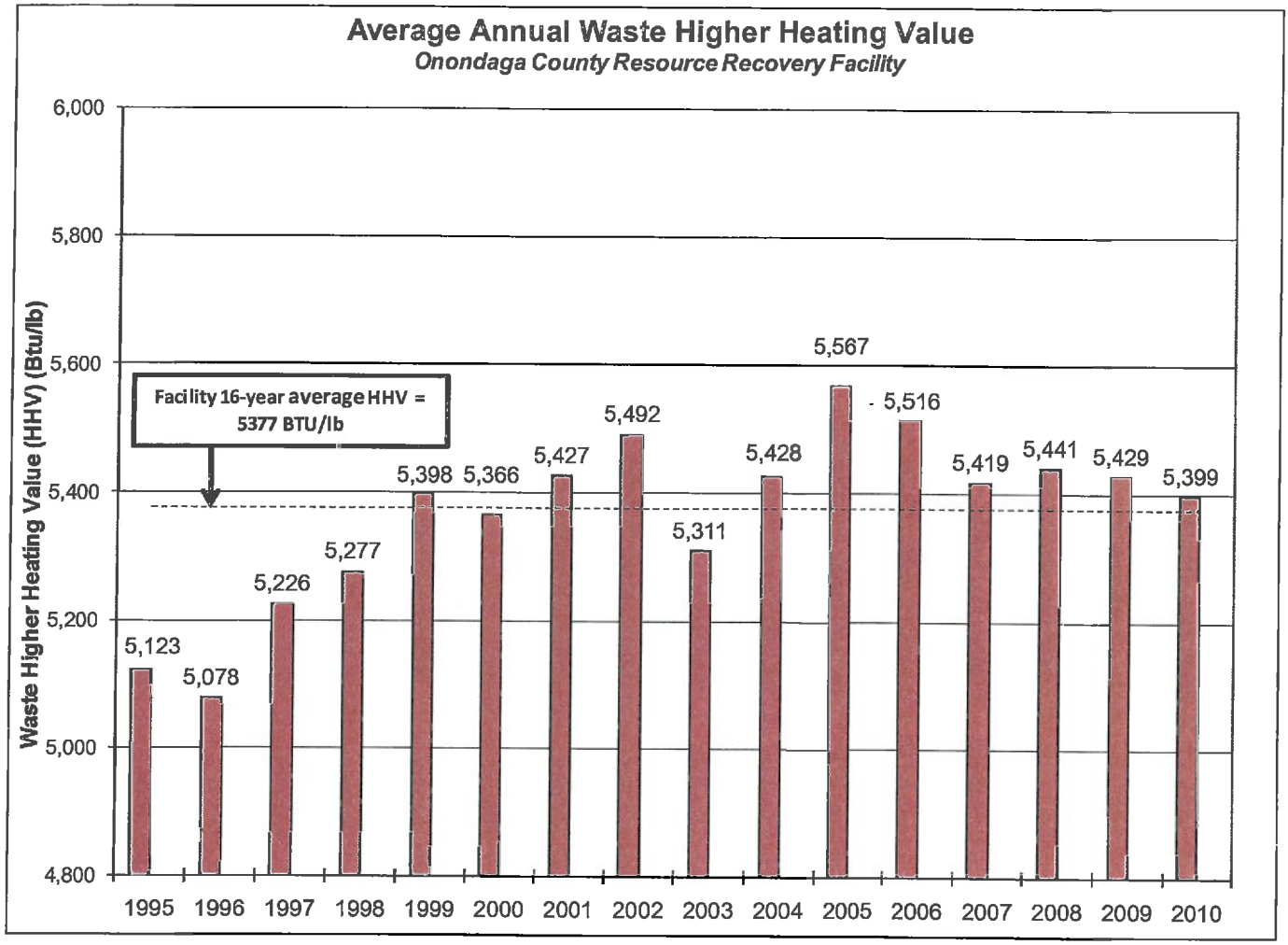


The refuse delivered to the Facility consists primarily of MSW and processable construction and demolition debris (C&D), including roofing. Licensed haulers collect Onondaga County (with the exception of the Town and Village of Skaneateles) MSW and deliver it directly to the Facility. Direct hauler deliveries generally account for about 75% of the tonnage processed. Direct hauler deliveries accounted for 75.6% of the tonnage delivered to the plant in 2010.

In addition to direct hauler MSW deliveries, OCRRA delivers MSW and processable C&D to the Facility from the Ley Creek and Rock Cut Road transfer stations (with the majority from Ley Creek). These deliveries generally account for about 25% of the tonnage processed at the Facility. The 2010 MSW and C&D tonnage delivered to the Facility from OCRRA's transfer stations was 24.4% of the total material delivered to the plant. Ley Creek deliveries as a percentage of total deliveries are shown below.



The average higher heating value (HHV) of waste processed in 2010 was 5,399 British thermal units per pound (Btu/lb). The 2010 average HHV was slightly above the Facility's 16-year average (1995-2010) average HHV of 5,377 Btu/lb (see figure on next page). HHV, which is mainly determined by waste composition and moisture content, is a measure of the amount of energy contained in the waste being combusted. If other boiler operating parameters remain the same, the net effect of a greater waste HHV is increased steam production and, in turn, increased electricity generation.



For 2010, Covanta Energy reported an average HHV of 5,024 Btu/lb for all of its domestic WTE facilities (Covanta, 2011). According to a study of 13 mass burn facilities (including the Onondaga Facility), the average HHV was about 5,200 Btu/lb for years 2003-2008 (LoRe and Oswald, 2009).

OCRRA's average HHV is likely higher than the other averages for two main reasons – 1) the proportion of processable C&D materials and 2) OCRRA's high recycling rate. Other facilities may not process C&D materials, which generally have a higher heating value than MSW, and therefore, if present, tend to increase a facility's average HHV. In contrast, some recyclable materials, such as glass and metal, tend to have a low heating value. By removing these materials from the waste stream, a facility's average HHV will increase. Therefore, OCRRA's highly effective recycling program also plays a role in the Facility's higher-than-average HHV.

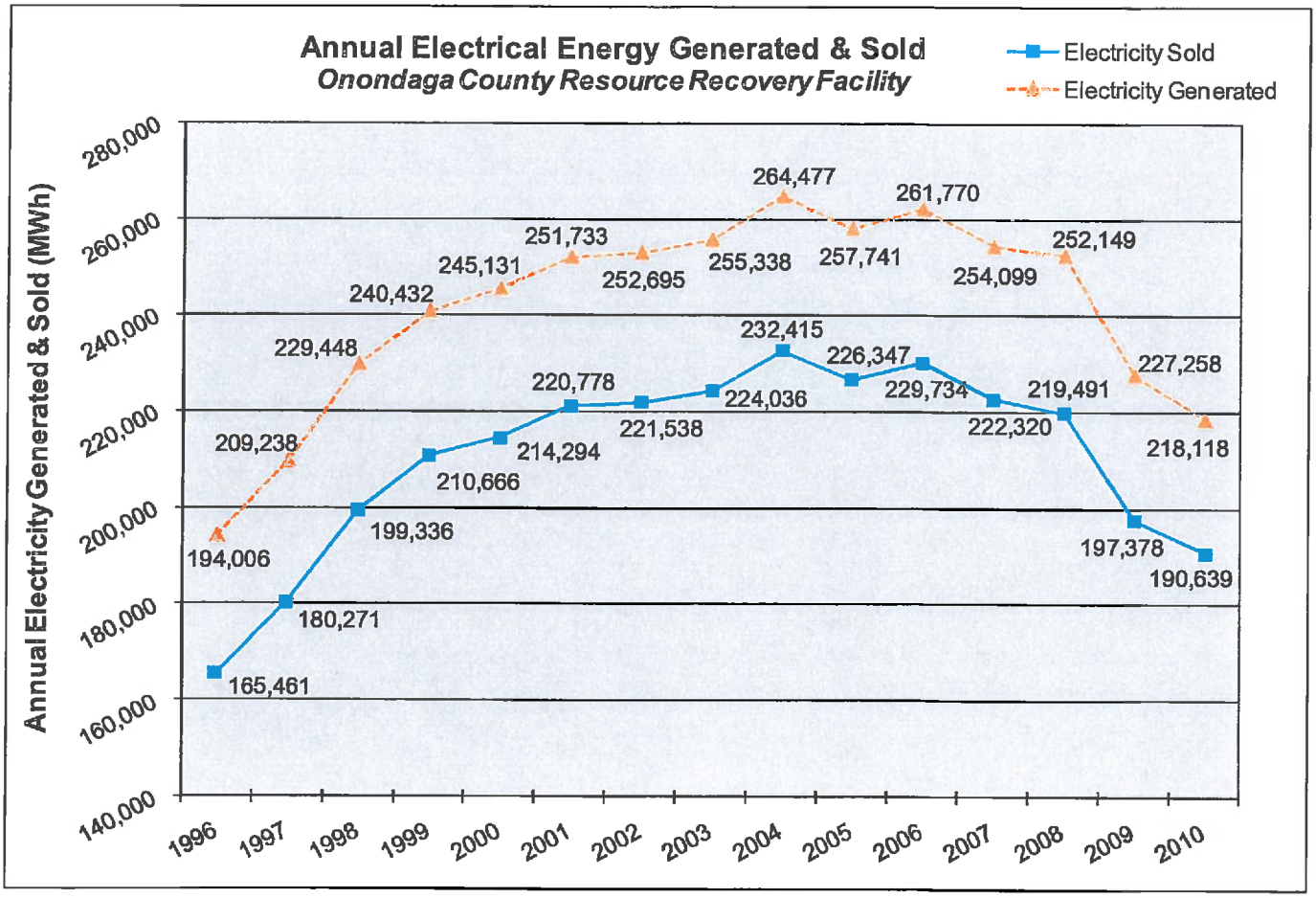
3.3 Steam Generated

Steam generated in 2010 was 2,145,735 kilopounds (klb), or 3.4 pounds of steam per pound of refuse processed. The amount of steam generated depends on the boiler efficiency and HHV of the waste being combusted. Of the total amount of steam generated, 1,981,043 klb were used by the Facility's turbine-generator for electricity production. About 5% is generally consumed for the Facility's internal needs, such as preheating combustion air and heating boiler feedwater. Also, during the 2010 major maintenance event for the turbine-generator, steam bypassed the turbine and was shed to the steam desuperheater and then the air cooled condenser.

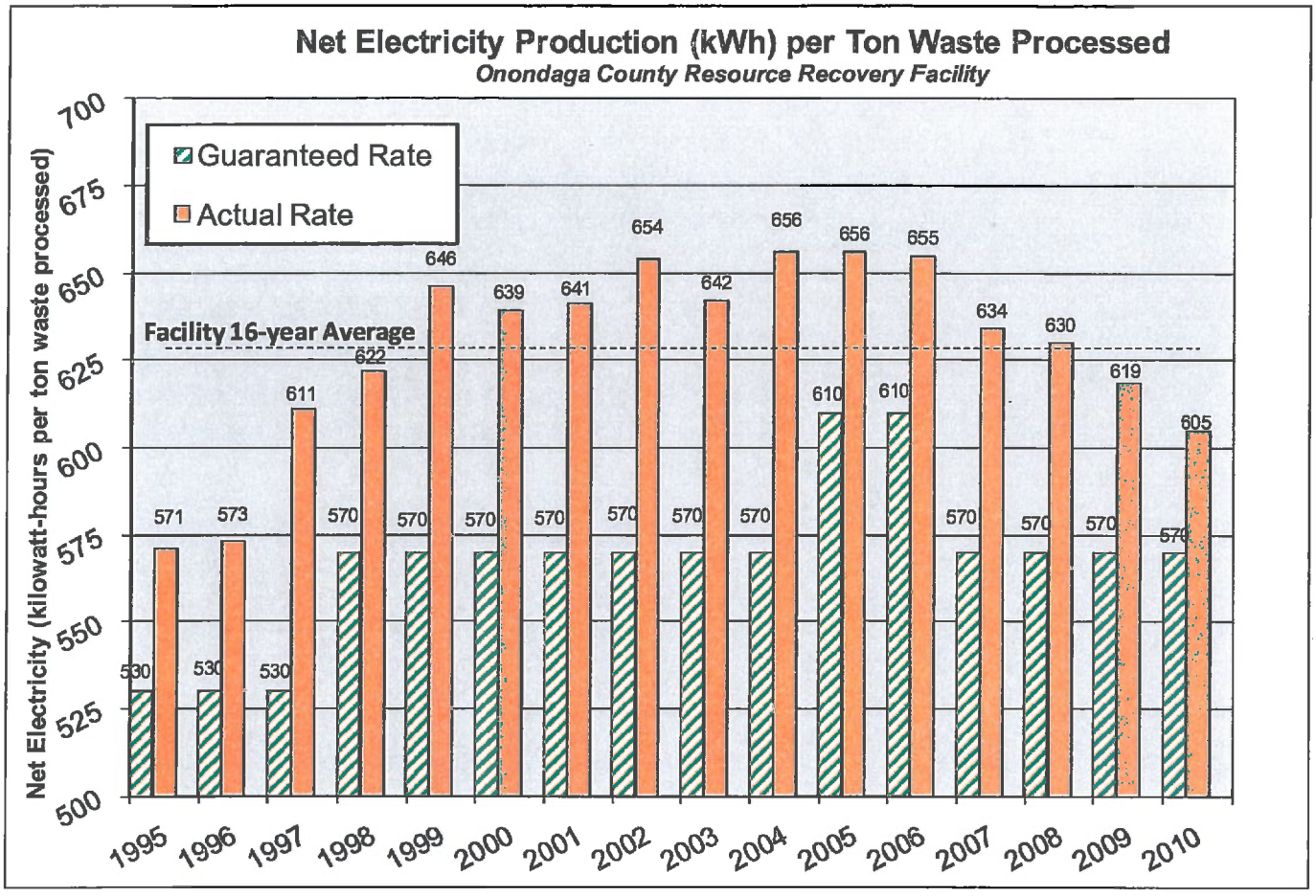
Boiler efficiency, in simplest terms, is the difference between the energy input (HHV of waste being combusted) and energy output (quantity of steam generated). Using monthly data, the 2010 overall boiler efficiency was 71.2%, a value consistent with historical levels and reported literature values.

3.4 Electricity Production

Total (gross) electricity generated for 2010 was 218,118 megawatt-hours (MWh). Of this amount, 190,639 MWh, or 87%, was sold to National Grid (net electricity). The balance, or 13%, was used for the Facility's electrical needs. The amount of electricity sold in 2010 decreased by 3.4% from 2009.



The Facility had a net electricity production of 605 kilowatt-hours per ton of refuse processed (kWh/ton). This rate is below the Facility's 16-year average of 628 kWh/ton; however the difference is primarily due to the turbine-generator system being out of service during the 21-day major overhaul. Furthermore, this rate exceeds the net electricity production guarantee of 570 kWh/ton (based on the average annual HHV of the waste processed, which was 5,399 Btu/lb for 2010). In their benchmarking report, LoRe and Oswald (2009) suggest an average 14-facility (including Onondaga County) net electricity production of 500 kWh/ton.

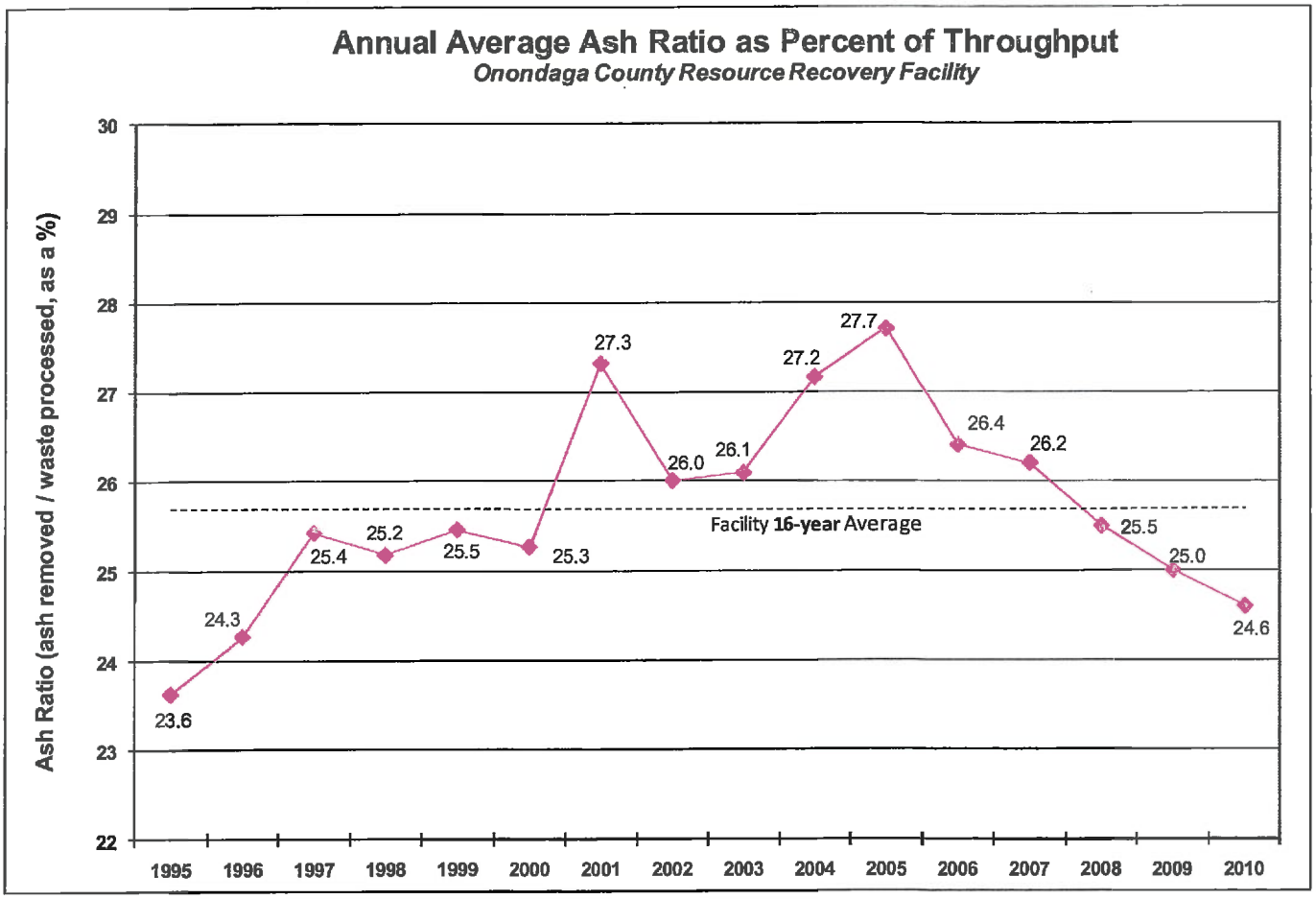


During normal Facility operation, the Facility's electrical demand is satisfied by the Facility's turbine-generator system, with the excess electricity being exported to the grid. Thus, the difference between the gross electricity produced by the turbine-generator and the net electricity sold to the grid is the Facility's electrical demand. In 2010 the Facility used an average of 93 kWh per ton of refuse. This is consistent with the Facility's long-term average, as well as that for other similar facilities. Lore and Oswald (2009) suggest a 14-facility average electricity usage of 90.4 kWh per ton.

3.5 Ash Residue Generation

In 2010, the WTE Facility generated 77,534 tons of combined ash residue, which were hauled by OCRRA to Seneca Meadows Landfill in Waterloo, NY. Based on the waste tonnage processed, this amount of ash was 24.6%; therefore the Facility reduced the weight of the refuse by 75.4%. The 2010 ash ratio (weight basis) is less than the 16-year Facility average of 25.7% and well below the annual contractual limit of 32% (see figure below).

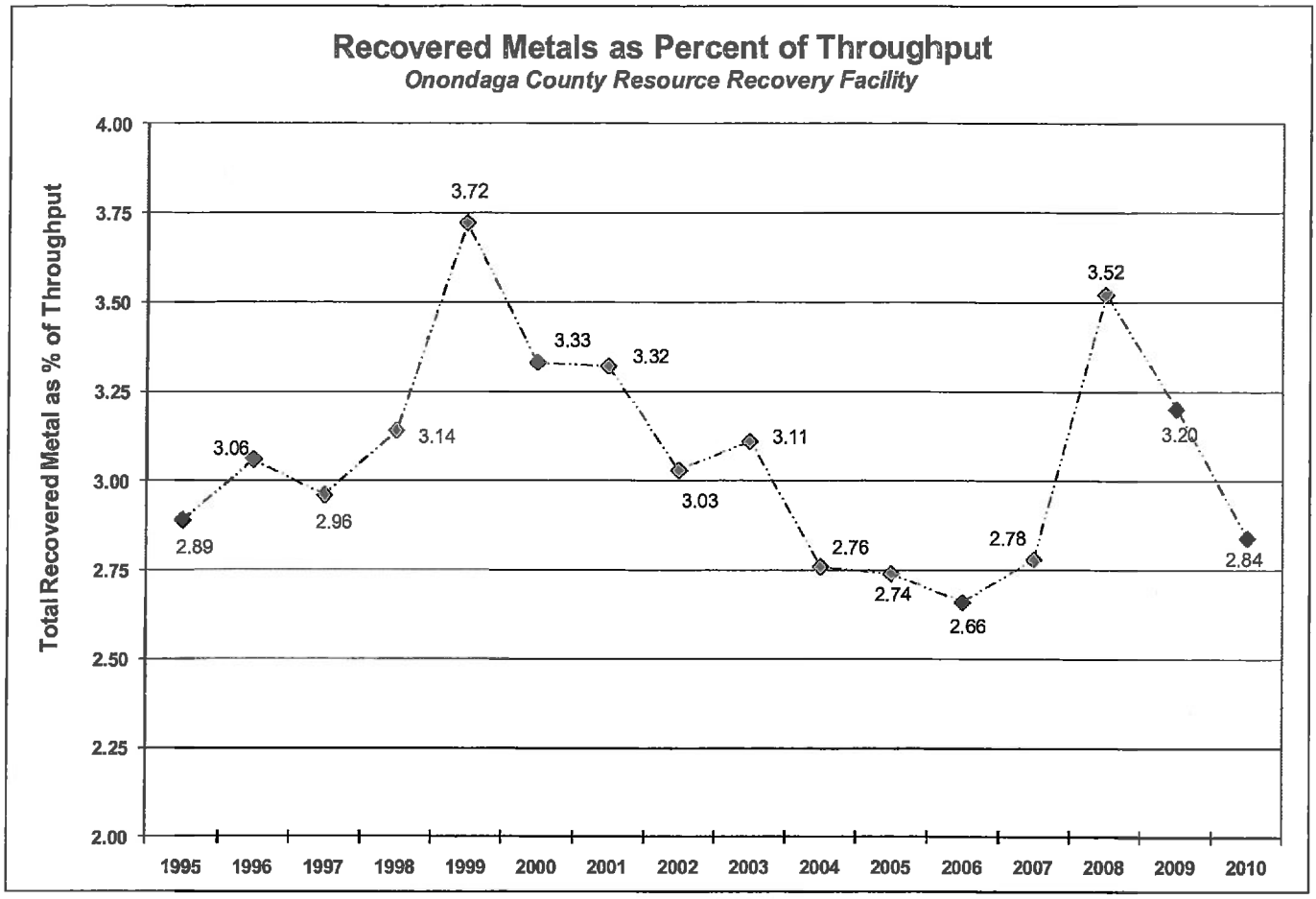
For all of 2010, ash residue from the Facility was used as alternative daily cover at the landfill. This beneficial use of the ash ultimately means that other materials, such as clean soil, do not need to be used for daily cover at the landfill.



3.6 Metal Recovery

In 2010, the Facility recovered approximately 8,599 tons of ferrous metal, or 2.7% of the refuse processed, for shipment to recycling markets. The non-ferrous metal recovery system, which uses an eddy-current separator, recovered 403 tons of material, of which 333 tons were deemed to be non-ferrous metal – about 0.11% of the refuse processed.

The graph below shows the metal recovery over the life of the Facility.



As shown, the annual quantity of recovered metal has varied over time. Recovery of metal is dependent upon the amount of metals in the incoming waste stream, as well as on the effectiveness of the Facility's metal recovery systems.

3.7 Boiler and Turbine-Generator Availability

Though the boilers and turbine-generator are designed to operate 24 hours a day, 365 days per year, a WTE facility cannot realistically achieve 100% boiler availability because of necessary routine and periodic maintenance. Boiler and turbine-generator availability are generally defined as the percentage of hours that the boiler/turbine-generator is available for operation, taking into account downtime related to scheduled and unscheduled maintenance. Downtime related to low refuse deliveries is not generally counted against availability. This is consistent with industry standards (LoRe and Oswald, 2009).

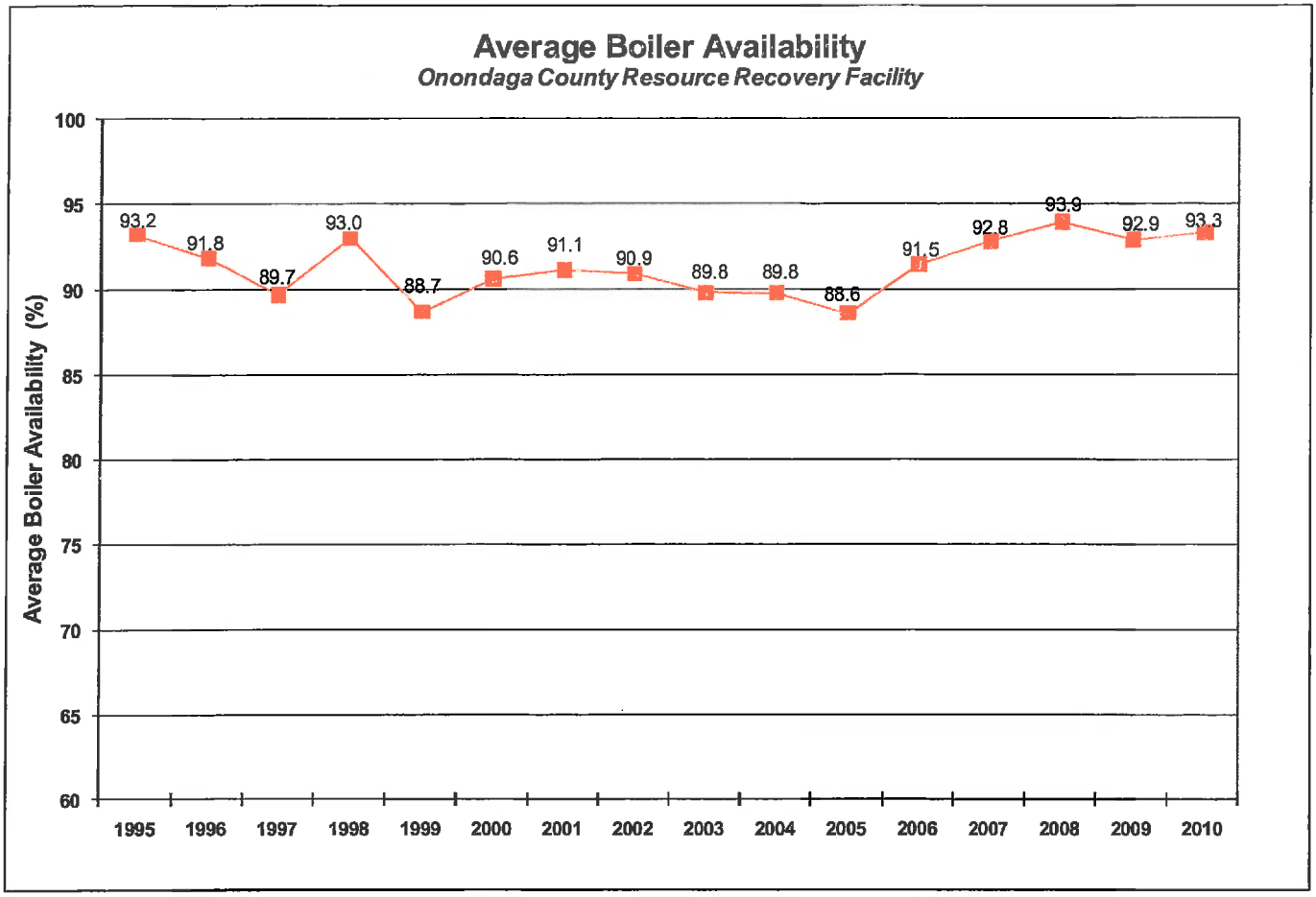
Facility boiler and turbine-generator availability are reported monthly and annually. 2010 availability information is presented below:

	Boiler Unit #1	Boiler Unit #2	Boiler Unit #3	Turbine/Generator
Total Scheduled Downtime (hr)	463.2	515.1	475.1	445.4
Total Unscheduled Downtime (hr)	172.9	42.4	83.6	41.6
Total Downtime (hr)	636.1	557.5	558.7	487.0
Total Downtime (days)	26.5	23.2	23.3	20.3
Availability (%)	92.7	93.6	93.6	94.4

Overall average boiler availability for 2010 was 93.3%, a fair bit higher than the Facility's 16-year (1995-2010) average of 91.4%. The 2010 average boiler availability reflects less downtime for scheduled boiler maintenance and equipment malfunctions. For comparative purposes, Covanta reported that their domestic WTE facilities had an average boiler availability of 91.2% for 2010 (Covanta, 2011) and LoRe and Oswald (2009) suggest a 15-facility average (including Onondaga County) of 90.3%.

Covanta has historically performed, and continues to perform, necessary boiler maintenance consistent with industry standards. Performing preventative maintenance remains critically important in prolonging the useful life of the boiler; replacing and repairing worn components prevents unscheduled downtime, thereby increasing boiler availability. Scheduled maintenance accounted for 73%, 92%, and 85% of downtime for Unit 1, 2, and 3, respectively. Unscheduled boiler downtime in 2010 resulted mainly from waterwall and superheater tube leaks.

The figure on the next page shows the Facility's historical average boiler availability.



The table below presents a summary of historical scheduled and unscheduled total boiler downtime.

Historical Boiler Operating Data (total hours for three boilers)

Year	Scheduled Maintenance (hours)	Unscheduled Maintenance (hours)	Total Maintenance (hours)	Total Maintenance Downtime* (%)	Downtime due to low trash deliveries (hours)	Low Trash Downtime* (%)	Total Downtime (hours)	Total Downtime* (%)
1996	1,964	196	2,160	8.2	6,954	26.5	9,114	34.7
1997	2,124	586	2710	10.3	5,985	22.7	8,695	33.0
1998	1,262	588	1850	7.0	3,541	13.5	5,391	20.5
1999	1,873	1,101	2974	11.3	3,585	13.6	6,559	25.0
2000	1,728	745	2473	9.4	1,652	6.3	4,125	15.7
2001	1,991	338	2329	8.9	2,011	7.6	4,340	16.5
2002	1,998	383	2381	9.1	1,052	4.0	3,433	13.1
2003	1,958	714	2672	10.2	1,034	3.9	3,706	14.1
2004	1,954	738	2692	10.2	777	3.0	3,469	13.2
2005	2,373	790	3163	12.0	218	0.8	3,381	12.8
2006	1,688	551	2239	8.5	171	0.7	2,410	9.2
2007	1,321	565	1886	7.2	151	0.6	2,037	7.8
2008	1,337	264	1,601	6.1	920	3.5	2,521	9.6
2009	1,546	318	1,864	7.1	1,859	7.1	3,723	14.2
2010	1,453	299	1,752	6.7	2,978	11.3	4,730	18.0

* Total Maintenance Downtime, Low Trash Downtime, and Total Downtime computed as a percentage of total unit-hours in calendar year.

The 2010 unscheduled and scheduled downtime represented 6.7% of total annual hours. The downtime due to low trash levels represents an additional 11.3%. Total boiler downtime, including downtime due to low trash deliveries, for 2010 was 4,730 hours, or 18% of the unit-hours in the calendar year.

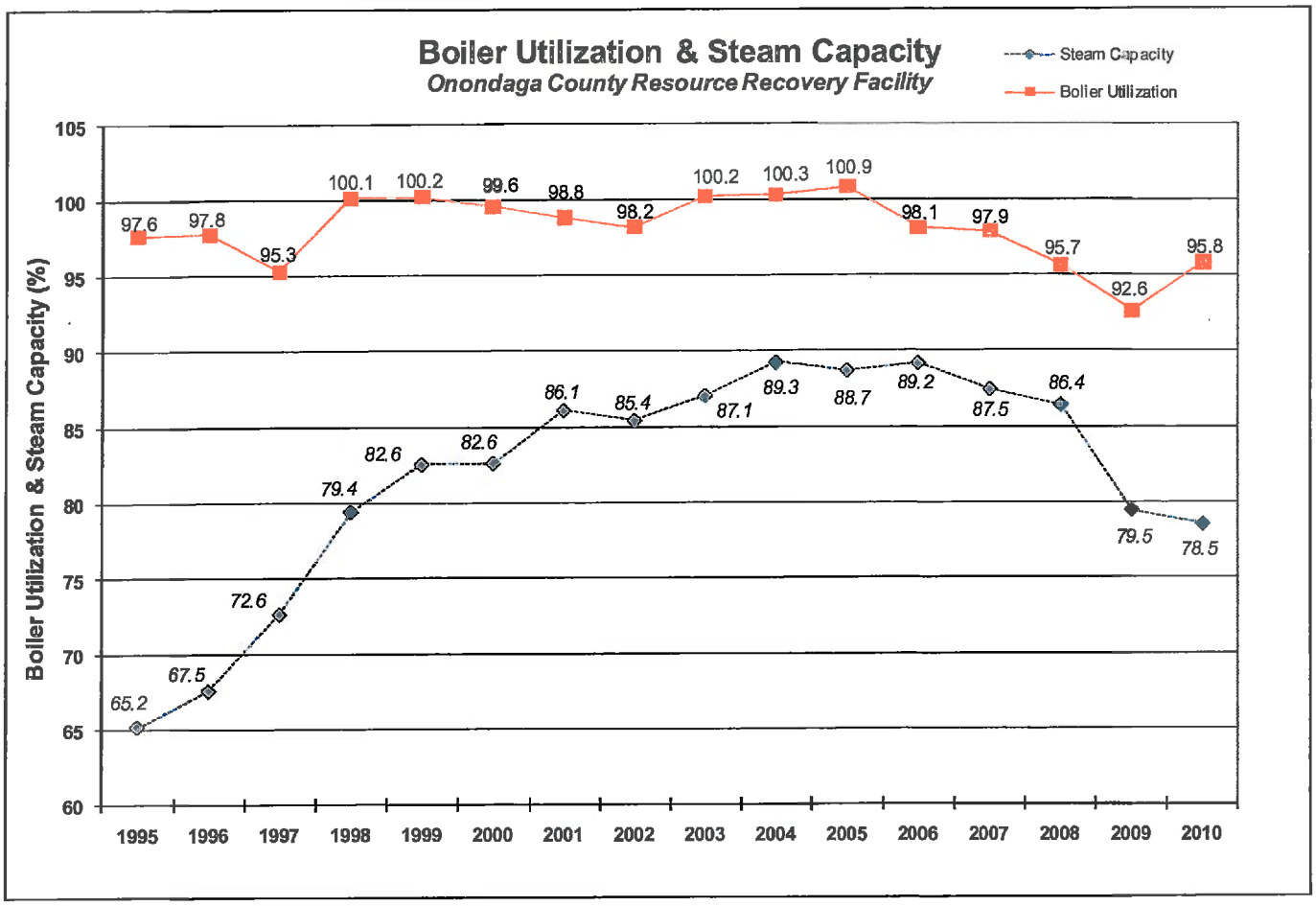
Turbine-generator availability for 2010 was 94.4% with 487 hours of downtime. Unscheduled outages accounted for only 8.5% of the downtime, while the the major turbine-generator outage accounted for the rest. For comparative purposes, LoRe and Oswald (2009) suggest a 14-facility average (including Onondaga County) of 96.6%.

3.8 Boiler Utilization and Steam Capacity

Another metric used to evaluate Facility efficiency is boiler utilization. Each boiler is designed with a maximum steam rate (pounds per hour) at which the unit is intended to be operated. This is referred to as the "maximum continuous rating" (MCR). The maximum design steam rating for the Onondaga Facility is 103,950 lb of steam per hour per boiler, or 311,850 lb of steam per hour for all three boiler units. Boiler utilization is the ratio of actual steam generated by the boilers to the MCR. It is important to note that boiler utilization only takes into account boiler operating time; that is, it does not include boiler downtime. Another term, steam capacity, is also used to evaluate Facility efficiency, and is defined as the ratio of actual steam to the maximum amount of steam that could be generated if the unit were running full time.

For 2010, the average boiler utilization was 95.8%. Boiler utilization of 100% represents the most efficient mode of Facility operation, and will maximize steam production and thus electrical energy generation. Anything less than 100% indicates that while the boilers were operational, they were being utilized at less than their full steaming capacity. It is not optimal to frequently bring boilers on- and off-line, so an alternative for dealing with low trash levels is to run the boilers at less than full capacity. This was the case for 2010. For comparative purposes, LoRe and Oswald (2009) suggest a 14-facility average (including Onondaga County) boiler utilization of 96.0%. Steaming capacity, which also takes into consideration steam "lost" from boiler downtime, for 2010 was 78.5%. Due to low trash tonnage, the steaming capacity was at the lowest level since 1998 (at which point the permitted throughput capacity of the Facility was significantly lower).

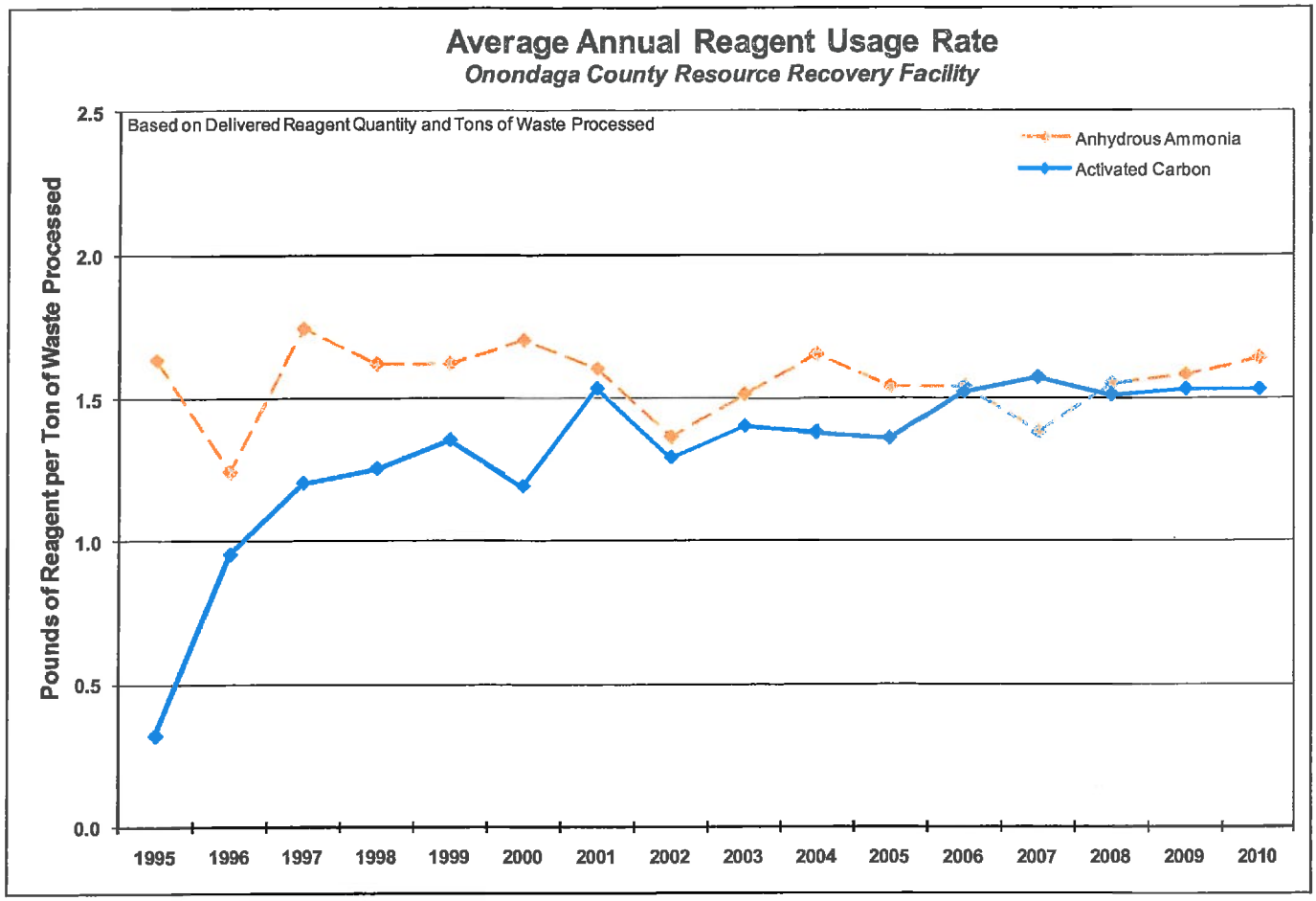
Historical data for boiler utilization and steam capacity are shown in the figure on the next page.



3.9 Pollution Control Reagent Consumption

The Facility uses several reagents for pollution control including anhydrous ammonia for control of nitrogen oxides (NO_x), activated carbon for mercury and dioxin/furan control, and lime for control of acid gases (as well as ash conditioning).

To control NO_x emissions, anhydrous ammonia is injected into the combustion chamber of each boiler unit. To control mercury emissions, as well as dioxin and furan emissions, powdered activated carbon is mixed into slurry and injected into the spray-dry scrubbers through the rotary atomizer. The rotary atomizer creates tiny droplets for optimal reaction. The average annual 2010 reagent usage rates for ammonia and carbon were 1.64 lb and 1.53 lb per ton of waste processed, respectively. As evident in the chart below, anhydrous ammonia and carbon usage rates have been consistent with historical rates. According to Lore and Oswald (2009), the Facility's anhydrous ammonia usage rate is consistent with other facilities that use anhydrous ammonia and the carbon usage is a bit higher than a 12-facility average (including Onondaga County) of 1.01 lb per ton.



To neutralize acid gases, namely sulfur dioxide (SO_2), hydrogen chloride (HCl), hydrogen fluoride (HF), and sulfuric acid (H_2SO_4), a calcium-based lime, referred to as pebble lime, is injected into the spray-dry scrubbers through the rotary atomizer. In 2010, the average reagent application rate was 29.4 lb of pebble lime per ton of waste processed. This is consistent with 2002 (31.0 lb of pebble lime per ton of waste processed) and 2007–2009 (29.2, 28.4, and 30.3 lb of pebble lime per ton of waste processed, respectively) when pebble lime was the only form of lime used.

Prior to making the decision to solely use pebble lime, dolomitic lime, a lime with a higher magnesium content than pebble lime, was added to the fly ash prior to combining with the bottom ash to provide additional conditioning of the fly ash. In August 2006, dolomitic lime use was discontinued and the reagent application rate for pebble lime increased above that needed for acid gas control. While still providing satisfactory ash conditioning, this change was implemented to improve housekeeping conditions, reduce OCRRA's overall ash conditioning costs, and produce a drier, more manageable combined ash residue for disposal. In 2009, Covanta also experimented with another type of lime (in conjunction with pebble lime) called carbide lime but found it to be too abrasive.

3.10 Electricity, Natural Gas, and Water Utilization

During normal Facility operation, the Facility's electrical demand is satisfied by the Facility's turbine-generator system, with the excess electricity being exported to the grid. During those times when the turbine-generator is off-line due to maintenance or malfunction, electricity is purchased from National Grid to operate the Facility and continue combusting the incoming MSW. In 2010, 1,239,156 kWh of electricity was purchased from National Grid for in-plant needs, with the majority of the usage occurring during the planned major turbine-generator outage. The amount of electricity purchased during 2010 is significantly more than the Facility average, due to the relatively long maintenance period that the turbine-generator was offline. The Service Agreement allows for 3,348,000 kWh over a three-year rolling period and at the end of 2010 the Facility had used 2,035,350 kWh for 2008-2010.

Natural gas is an auxiliary fuel used for boiler start-ups and shutdowns, and for maintaining minimum furnace temperatures when processing overly wet waste. 2010 natural gas usage was 137,520 therms, which is consistent with historical consumption. Under the Service Agreement, OCRRA is responsible for the first 110,000 therms and Covanta pays for usage in excess of 110,000 therms.

City water satisfies all potable and process needs of the Facility, with the majority being for process use. However, the Facility is a zero discharge plant relative to process wastewater; meaning that only sanitary sewage is discharged off-site. 30,360,000 gallons were used in 2010. This amount of water translates into about 96 gallons per ton of waste combusted or approximately 58 gallons per minute. 2010 water usage remained consistent with historical levels and design parameters following initial start-up. The Onondaga Facility's water use is much lower than that of similar facilities because it is a zero-process water discharge Facility, meaning that all process water gets treated and reused thereby requiring less potable water. According to LoRe and Oswald (2009), a ten-facility average water consumption rate is 422 gallons per ton of waste processed.

3.11 Facility Inspections

In accordance with NYSDEC Part 360 regulations, an annual general Facility inspection must be undertaken to determine the operating condition of the safety, emergency, security, process, and control equipment. Covanta must have this inspection performed under the direction of a New York State licensed professional engineer. With the approval of the NYSDEC, Covanta performed the required Facility annual inspection on November 19, 2010. Covanta's Regional Vice President, Steven J. Bossotti, P.E., certified: "*Based upon the above inspections and information, the safety, emergency, security, process and control equipment at the Onondaga County Resource Recovery Facility operated by Covanta Onondaga at 5801 Rock Cut Road, Jamesville, NY 13078 are considered to be in acceptable operating condition.*" This annual inspection report was submitted to the NYSDEC on February 25, 2011 as part of the Facility's 2010, 4th Quarter & Annual Solid Waste Report.

NYSDEC also conducted several facility inspections in 2010. The Division of Air Resources was on site for the annual stack testing activities. On July 22, 2010 the Division of Solid and Hazardous Materials visited the Facility for an inspection.

In 2010, OCRRA had its independent consultant, CDM, conduct a comprehensive 2-day site inspection. This visit focused on all various aspects of plant operations and maintenance, and coincided with the Unit #2 spring boiler outage. Based on the results of their visual inspection and experience at other WTE facilities, CDM opined that the Onondaga Facility continues to be well maintained, and is in overall good operating condition. The routine preventative maintenance and major repairs performed are consistent with the type and level of repairs observed at other facilities. The systems inspected were in good operating condition, and all equipment appeared to be operating properly. The level of daily repair and preventative maintenance observed was considered normal for facilities of the same type and age.

CDM also conducted a comprehensive 2-day site inspection during the major turbine-generator outage. The purpose of this site visit was to inspect the condition of the steam turbine and electrical generator and to observe the maintenance activities that were being undertaken during the outage. Based on this inspection, CDM concluded that the turbine-generator was in good overall condition, with no major problems reported. They also concluded that the type and level of maintenance work performed during this major outage was consistent with the age of the equipment and similar work observed at other facilities.

In addition to Facility inspections, CDM performed oversight for the annual air emissions stack testing and semi-annual ash residue testing. CDM concluded that testing was conducted in accordance with required procedures and protocols.

Section 4 – Environmental Performance

4.1 Summary of Environmental Performance

Operating under one of the strictest WTE air permits in the country, the Onondaga County WTE Facility turns the County's non-recyclable trash into energy. Over 15 million dollars worth of air pollution control equipment is in place to make sure this is done safely. Results of the Facility's annual air emissions and ash residue test results consistently demonstrate the Facility's exemplary environmental track record. Coupled with Onondaga County's nationally high recycling rate of 60% in 2010 (nearly double the national average), the Onondaga County WTE Facility generates enough renewable energy to satisfy the needs of approximately 30,000 homes in OCRRA's service area while also reducing the volume of trash that needs to be landfilled by 90%.

4.2 2010 Stack Test Results

Stack testing is an important tool that measures the amount of regulated pollutants being emitted from the Facility. Stack testing consists of a series of sampling events, in which a probe is inserted into the stack gases to collect a representative sample, over a defined amount of time. Sampling and laboratory analysis are conducted in accordance with NYSDEC and USEPA protocols. NYSDEC oversees stack testing at the WTE Facility.

In addition to annual stack testing, the Facility has a continuous emission monitoring system (CEMS) that measures equipment performance and stack emissions in order to constantly track Facility performance. The CEMS tracks carbon monoxide, carbon dioxide, oxygen, sulfur dioxide, and NOx as well as ammonia, opacity, and combustion temperatures.

The 2010 stack testing consisted of the 10 parameters that are tested annually. The results from the 2010 stack testing indicate that the Facility is operating acceptably and that the air pollution control devices are functioning properly. As shown by the summary data on the next page, many of the parameters were considerably below the permit limit.

2010 ANNUAL STACK TEST RESULTS

		Constituent	Average Measured Emissions[1] Unit 1	Unit 2	Unit 3	Permit Limit[2]	Pass/Fail? P/F
TESTED ANNUALLY	FEDERAL	Cadmium (mg/dscm @ 7% O_2)	5.50E-04	6.51E-03	1.26E-03	3.50E-02	P
		Cadmium (lb/hr)	8.41E-05	1.06E-03	2.05E-04	1.90E-03	P
		Carbon Monoxide (lb/hr)	1.01E+00	1.09E+00	1.01E+00	8.04E+00	P
		Dioxins/Furans (ng/dscm @ 7% O_2)	2.42E+00	1.03E+00	1.30E+00	3.00E+01	P
		Hydrogen Chloride (ppmdv @ 7% O_2)	3.11E+00	2.37E+00	2.53E+00	2.50E+01	P
		Hydrogen Chloride (lb/hr)	7.14E-01	5.94E-01	6.39E-01	5.24E+00	P
		Hydrogen Chloride Removal Efficiency (%)	99.5	99.7	99.7	>=95	P
		Lead (mg/dscm @ 7% O_2)	1.44E-02	1.13E-01	2.36E-02	4.00E-01	P
		Lead (lb/hr)	2.22E-03	1.84E-02	3.84E-03	3.81E-02	P
		Mercury (lb/hr)	< 9.49E-05	4.21E-04	1.35E-04	4.00E-03	P
		Nitrogen Oxides (lb/hr)	5.44E+01	5.25E+01	5.32E+01	5.80E+01	P
		Particulates (gr/dscf @ 7% O_2)	2.99E-04	6.81E-03	1.52E-03	1.00E-02	P
		PM_{10} (gr/dscf @ 7% O_2)	4.65E-04	3.18E-03	5.33E-04	1.00E-02	P
		PM_{10} (lb/hr)	1.87E-01	1.29E+00	2.17E-01	3.16E+00	P
		Sulfur Dioxide (lb/hr)	3.47E+00	6.91E+00	4.50E-01	1.62E+01	P
	STATE	Ammonia (ppmdv @ 7% O_2)	< 8.90E-01	< 8.44E-01	1.47E+00	5.00E+01	P
		Ammonia (lb/hr)	< 9.55E-02	< 9.87E-02	1.73E-01	4.88E+00	P
		Dioxins/Furans-2,3,7,8 TCDD TEQ (ng/dscm @ 7% O_2)	2.79E-02	2.27E-02	1.58E-02	4.00E-01	P
		Dioxins/Furans-2,3,7,8 TCDD TEQ (lb/hr)	4.47E-09	3.38E-09	2.61E-09	1.29E-07	P
		Mercury (µg/dscm @ 7% O_2)	< 6.20E-01	2.59E+00	8.20E-01	2.80E+01	P
		Mercury Removal Efficiency (%)	> 99.5	98.2	99.1	>=85	P
		Zinc (lb/hr)	6.73E-03	6.97E-02	4.21E-02	1.42E-01	P

NOTES:

[1] Based on three test runs

[2] NYSDEC Title V Permit #7-3142-00028/00009 - Draft Renewal

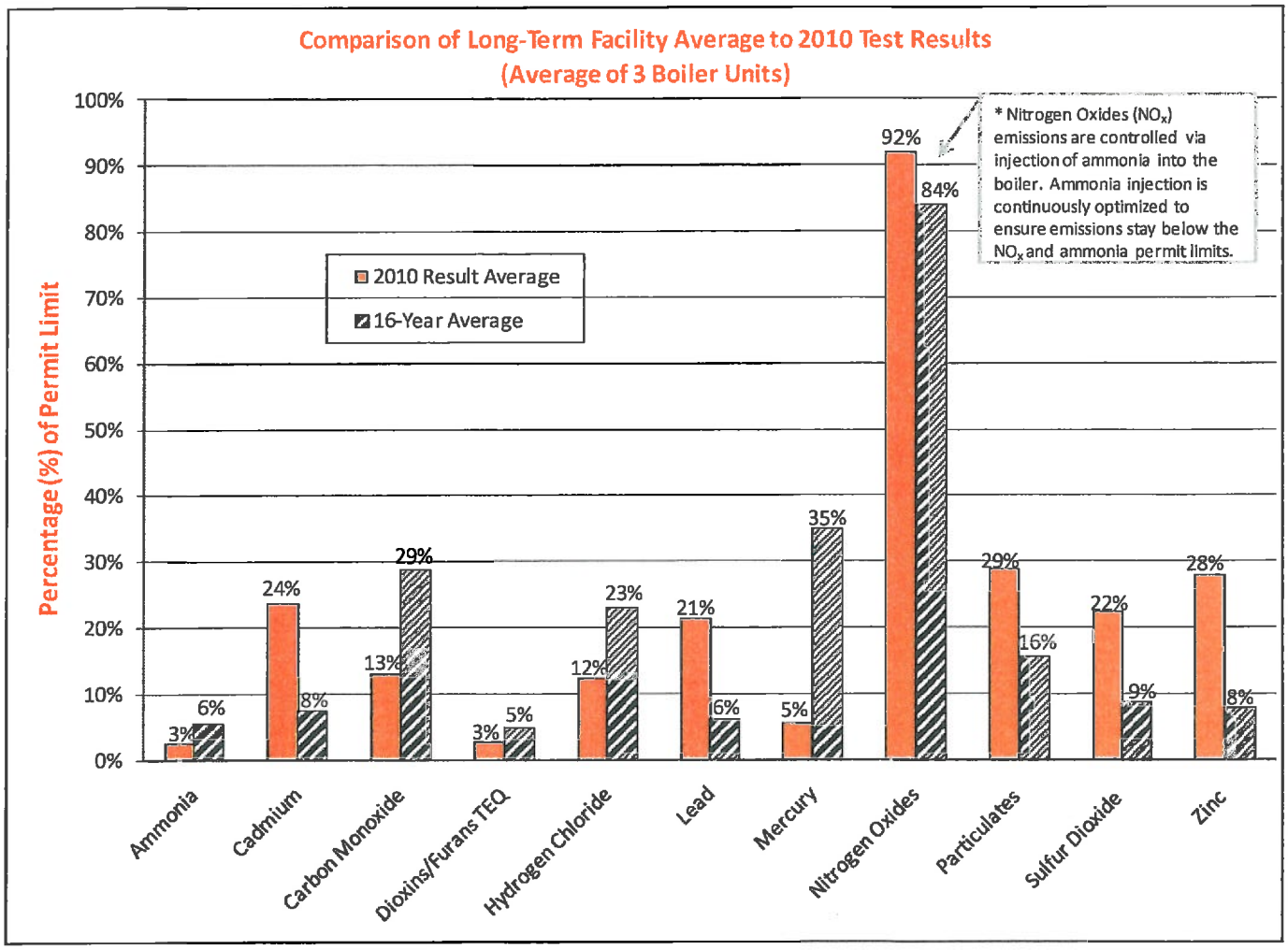
UNITS:

gr/dscf = grains per dry standard cubic foot
ppmdv = parts per million dry volume
lb/hr = pounds per hour
ng/dscm = nanograms per dry standard cubic meter
µg/dscm = micrograms per dry standard cubic meter
mg/dscm = milligrams per dry standard cubic meter
@ 7% O_2 = concentration corrected to 7% oxygen

4.2.1 Parameters Tested Annually

The figure below presents a comparison of the 2010 stack test results with their respective long-term (16-year) Facility averages (1995 through 2010) for the parameters tested annually. The results are graphed as a percentage of their respective permit limits. The graph shows that the 2010 results continue to be well below regulatory limits. These results indicate that the Facility's air pollution control system continues to operate effectively, and that OCRRA's efforts in screening the incoming waste continue to be effective.

Compared to the other parameters, NO_x emissions are much closer to the permit limit. This is because NO_x emissions are controlled via injection of ammonia into the boiler. Ammonia injection is continuously optimized to ensure emissions stay below the NO_x and ammonia permit limits.



WTE facilities have significantly reduced emissions over the past decade. In 1997 a memorandum by the United States Environmental Protection Agency (USEPA) documented this progress. The table from USEPA's memorandum is provided on the following page.

Emissions From Large and Small MWC Units

Pollutant	*1990 Emissions (tpy)*	*2005 Emissions (tpy)*	*Percent Reduction*
CDD/CDF, TEQ basis*	4400	15	99+ %
Mercury	57	2.3	96 %
Cadmium	9.6	0.4	96 %
Lead	170	5.5	97 %
Particulate Matter	18,600	780	96 %
HCl	57,400	3,200	94 %
SO_2	38,300	4,600	88 %
NO_x	64,900	49,500	24 %

(*) dioxin/furan emissions are in units of grams per year toxic equivalent quantity (TEQ), using 1989 NATO toxicity factors; all other pollutant emissions are in units of tons per year.

Source: USEPA Memorandum dated 1997

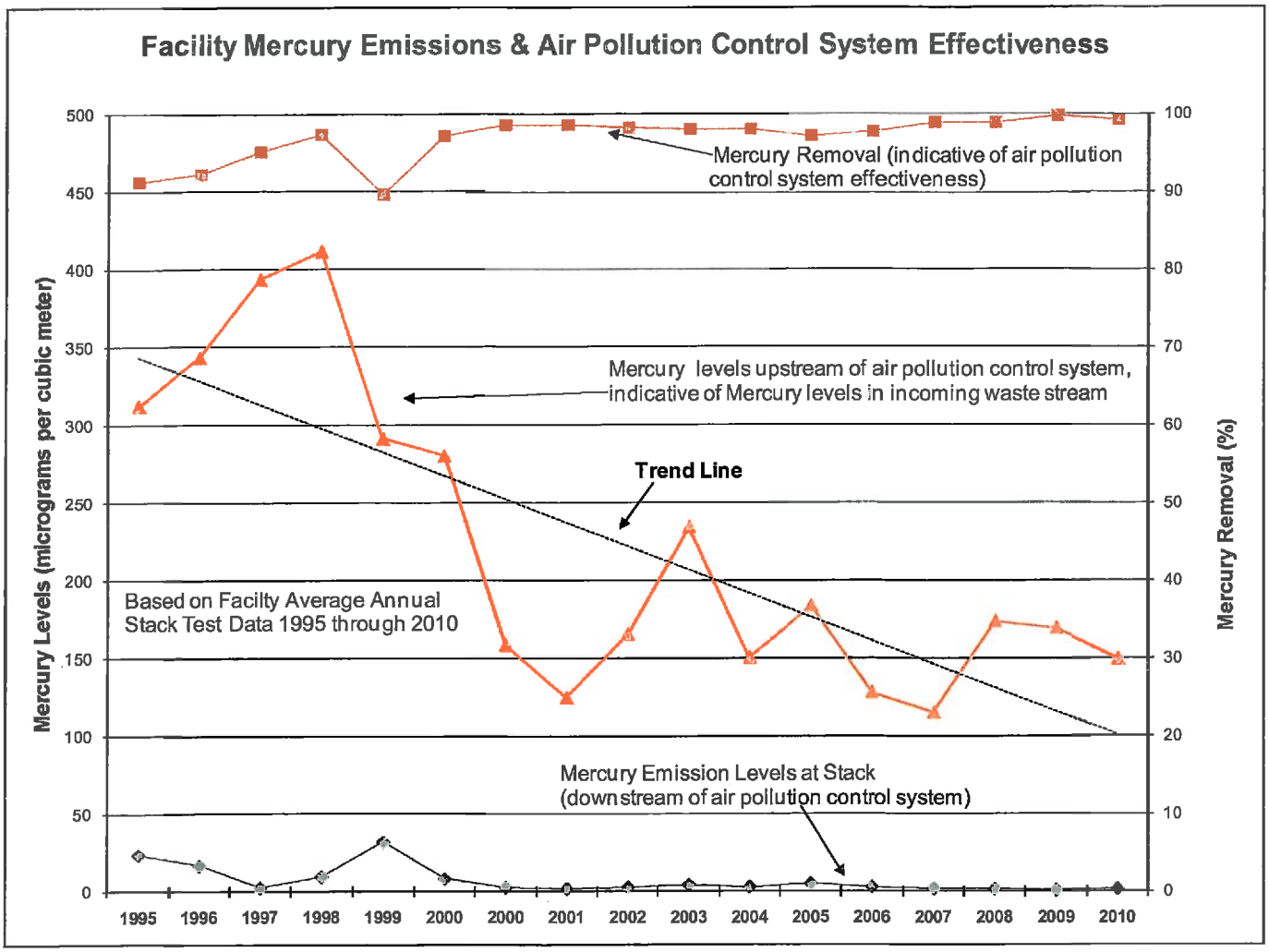
Some of these parameters will be discussed in further detail the following sections.

4.2.2 Mercury

To control mercury emissions, powdered activated carbon is mixed into slurry and injected into the spray-dry scrubbers through a rotary atomizer, which creates tiny droplets. The activated carbon reacts with the mercury in the gas exiting the boiler and forms particles that are captured in the baghouse. Still considered the most highly advanced control technology, activated carbon injection has been used at WTE facilities for the past decade; however activated carbon injection is just beginning to be used at coal-fired power plants.

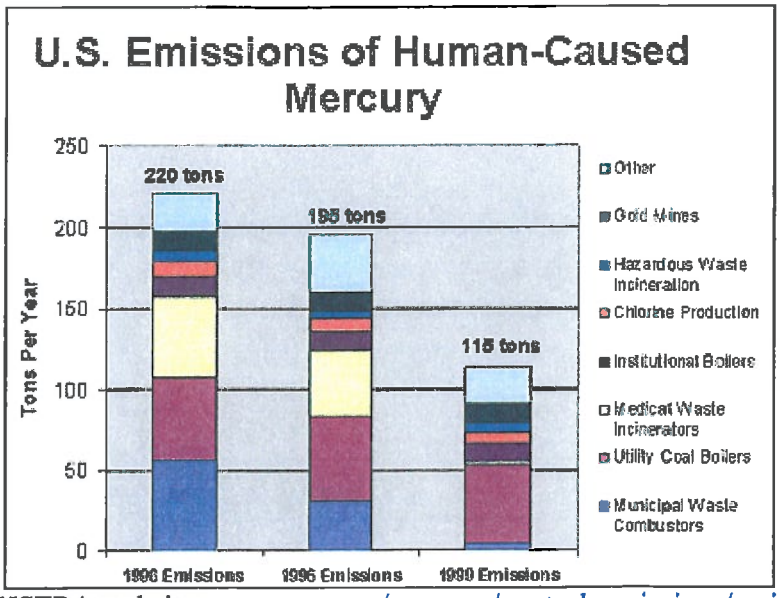
In addition to advanced control technologies, it's important to limit the amount of mercury in the incoming waste stream. OCRRA has multiple programs in place to do just that. These programs include household hazardous waste collection events, an ongoing mercury-containing thermostats and thermometer exchange at OCRRA's Rock Cut Road Transfer Station (a joint program with Covanta), partnerships with local businesses for electronic waste and household fluorescent collections, active daily sorting activities at OCRRA's transfer stations, and active daily screening at the Facility itself. Coupled with extensive public education efforts, these programs have had a significant impact.

The figure on the following page shows the effectiveness of the Facility's mercury control system, as well as the inlet and outlet (stack) average mercury concentrations. Inlet concentrations indicate the level of mercury in the incoming waste stream. As shown, inlet mercury levels since 1995 have exhibited a dramatic decrease, which has been the result of OCRRA's programs to remove mercury from the local waste stream, as well as restrictions on the mercury content of many products, most notably, alkaline batteries.



Average mercury emissions measured during 2010 annual stack testing event were 5% of the Facility's current permit limit of 28 micrograms per dry standard cubic meter and the average effectiveness of the Facility's carbon injection system for removing mercury was 99.1 % (85% removal efficiency is required).

In 1990, the contribution of atmospheric mercury from coal-fired power plants and WTE facilities were similar and substantial. During the following decade, Maximum Achievable Control Technology (MACT) emission standards were imposed on municipal waste combustors (MWCs) and the contribution to atmospheric mercury from MWCs relative to coal-fired power plants dropped dramatically. According to the USEPA Memorandum mentioned previously, mercury emissions from MWCs were reduced by 96% from 1990 to 2005. While coal-fired plants still contribute over 40% of all domestic human-caused mercury emissions in the U.S., according to the USEPA, mercury emissions from WTE plants have decreased to about 4% of the total. The following chart has been provided from USEPA's website.



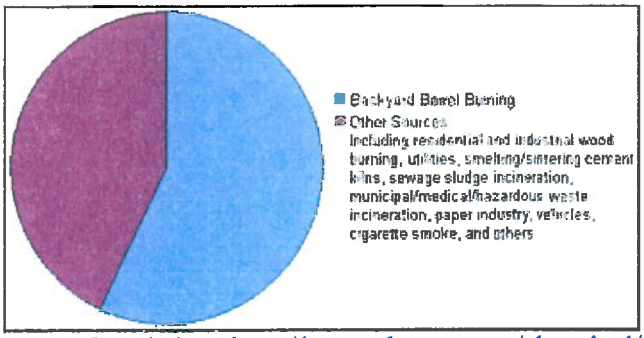
Source: USEPA website: www.epa.gov/mercury/control_emissions/emissions.htm

4.2.3 Dioxin/Furan

Like mercury emissions, dioxin and furan emissions constitute considerable environmental concern. The Onondaga County WTE Facility has several permit limits associated with dioxin/furan emissions. The 2010 results were all at least 95% below the associated permit limits. These levels are exceptionally small and indicative of effective combustion and air pollution controls.

2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is the most toxic congener of dioxin. The total dioxin toxic equivalence (TEQ) value expresses the toxicity as if the mixture were pure TCDD. In 2010, the estimated annual TEQ dioxin/furan emissions are 0.00009 lbs (90 millionths of a pound); or 3% of the weight of a standard paper clip.

Over the past 20 years, the WTE industry has drastically reduced dioxin/furan emissions – by more than 99% (see table from referenced EPA memo). Today, backyard burn barrels emit more dioxins and furans than all other sources combined. The pie chart below is from NYSDEC's website and it provides data from an EPA study during 2002 to 2004.



Source: NYSDEC website - http://www.dec.ny.gov/chemical/32065.html

Fortunately, in 2009, NYSDEC passed and enacted new open burning regulations that prohibit burning household trash in burn barrels or piles statewide.

4.3 2010 Ash Testing Results

Semi-annual ash testing determines whether residual ash, the byproduct of turning non-recyclable trash into energy, should be managed as a non-hazardous or hazardous material. A representative sample of residual ash is collected according to NYSDEC and USEPA protocols. The sample is then analyzed by an independent laboratory for leachable metals, according to USEPA's Toxicity Characteristic Leaching Procedure (TCLP). TCLP analysis simulates landfill conditions (the final disposal site for the ash) and determines whether the ash exhibits hazardous characteristics. Over the life of the Facility (including 2010 results), TCLP analysis has always indicated that the ash is non-hazardous. A summary of the ash residue test results for 2010 is provided below.

2010 ASH RESIDUE CHARACTERIZATION TEST RESULTS

Semi-Annual Test Results - May 2010

Constituent	*Test Result*	*Permit Limit*	*Pass or Fail*
Cadmium	0.12 mg/L	1 mg/L	Pass
Lead	0.25 mg/L	5 mg/L	Pass

Semi-Annual Test Results - Sept./Oct. 2010

Constituent	*Test Result*	*Permit Limit*	*Pass or Fail*
Cadmium	0.60 mg/L	1 mg/L	Pass
Lead	0.25 mg/L	5 mg/L	Pass

CONCLUSION

Ash residue does NOT exhibit a hazardous characteristic. As such, it should continue to be managed as a non-hazardous solid waste.

In 2010, 77,534 tons of combined ash residue (consisting of mixed fly and bottom ash) were sent to Seneca Meadows Landfill in Waterloo, NY. Based on waste processed, this amount of ash was 24.6% of the waste tonnage combusted; therefore the Facility reduced the weight of the refuse by more than 75%. Since October 2009, ash residue from the Facility has been used as alternative daily cover at the landfill. This beneficial use of the ash ultimately means that other materials, such as clean soil, do not need to be used for daily cover at the landfill.

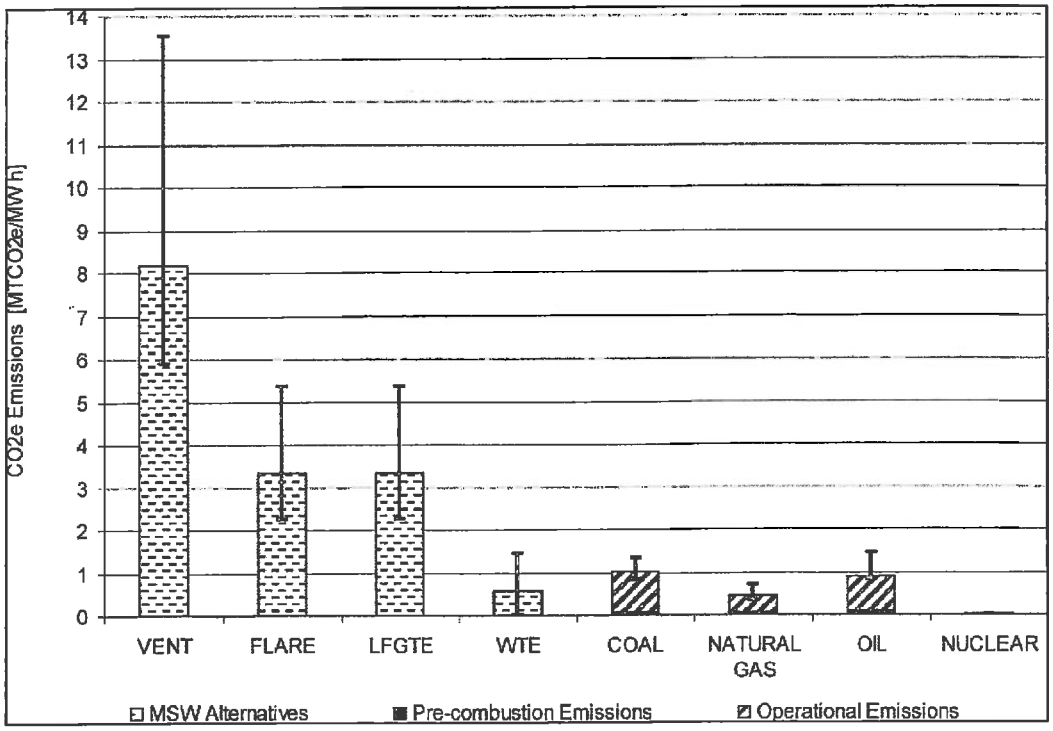
4.4 Combustion versus Landfilling

A recent USEPA-authored journal article published in Environmental Science and Technology applies a life-cycle analysis model to evaluate whether it's better to burn or bury MSW. The article is titled, "Is It Better to Burn or Bury Waste for Clean Energy Generation?" and the analysis compares greenhouse gas emissions and emissions of other pollutants for WTE and landfill gas-to-energy (LFGTE), using a life-cycle analysis model. The study states that MSW is a viable source for electricity generation and finds that WTE is a better option than LFGTE because WTE generates significantly more electricity from the same amount of waste, with fewer emissions. Though not immediately intuitive, emissions from LFGTE are due to fugitive methane emissions in a landfill, as well as emissions from combusting landfill gas in an internal combustion engine. The last paragraph of the article provides a good summary (Kaplan, Decarolis, and Thornloe, 2009):

"Despite increased recycling efforts, U.S. population growth will ensure that the portion of MSW discarded in landfills will remain significant and growing. Discarded MSW is a viable energy source for electricity generation in a carbon constrained world. 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. However, HCl emissions from WTE are significantly higher than the LFGTE scenarios."

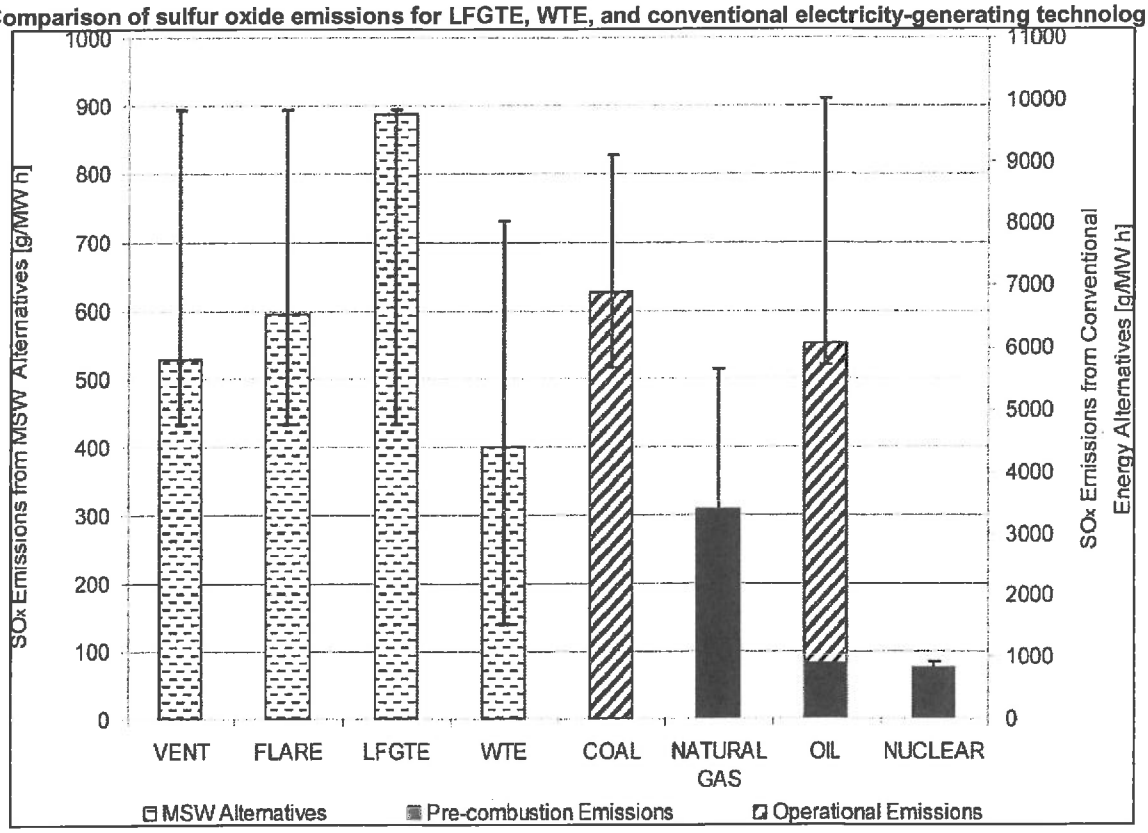
Several graphs from the article are provided below and on the next page. These graphs compare the relative emissions of greenhouse gas emissions, NO_x, and sulfur oxide (SO_x) for WTE, LFGTE, and several conventional electricity generating technologies.

Comparison of greenhouse gas emissions for LFGTE, WTE, and conventional electricity-generating technologies



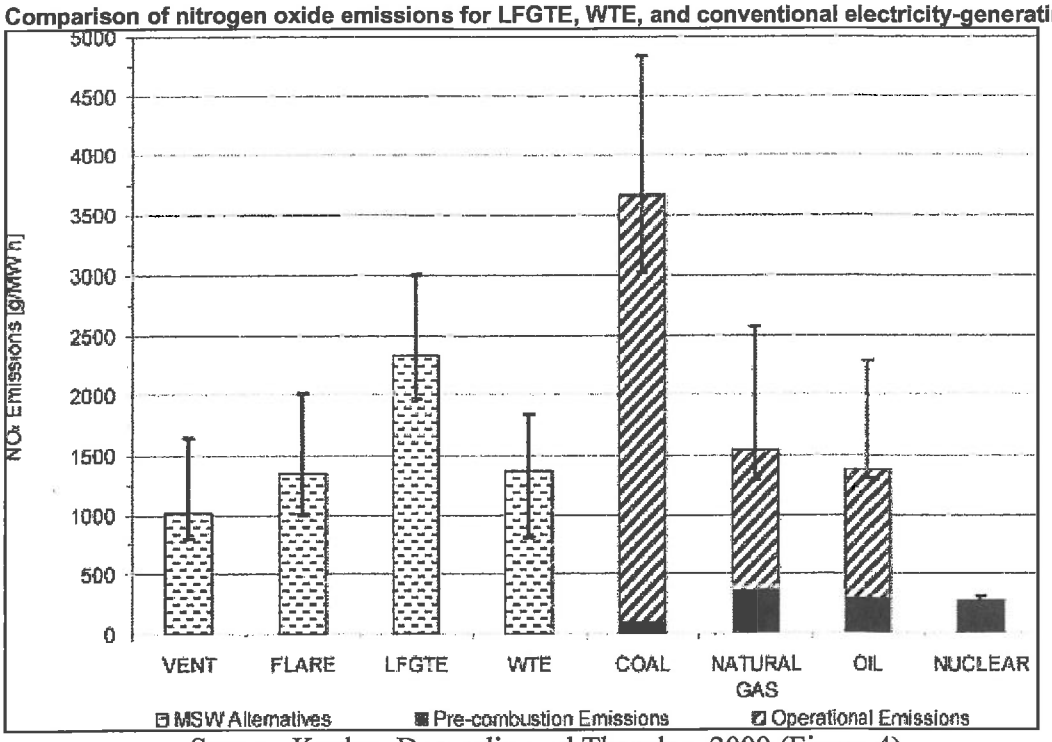
Source: Kaplan, Decarolis, and Thornloe, 2009 (Figure 2)

Comparison of sulfur oxide emissions for LFGTE, WTE, and conventional electricity-generating technologies



Source: Kaplan, Decarolis, and Thornloe, 2009 (Figure 3)

Comparison of nitrogen oxide emissions for LFGTE, WTE, and conventional electricity-generating technologies



Source: Kaplan, Decarolis, and Thornloe, 2009 (Figure 4)

4.5 Greenhouse Gas Emissions

Managing what happens to the County's non-recyclable trash is about choices. If Onondaga County did not have a WTE Facility, the County's non-recyclable trash would be destined for a landfill. Landfills generate methane (a potent greenhouse gas) as the trash degrades anaerobically. Although many landfills now have landfill gas collection systems and, ultimately, flare the landfill gas (and convert the methane to carbon dioxide), or preferably, generate electricity from the gas (landfill gas-to-energy), there are still fugitive landfill gas emissions because the landfill gas collection systems are not 100% effective. Although the Onondaga County WTE Facility generates carbon dioxide as a result of the complete combustion processes, when compared to emissions associated with landfilling, the emissions from the WTE Facility are significantly less.

In addition to having lower emissions (in terms of carbon dioxide equivalents), the WTE Facility offsets electricity that would have otherwise been generated using coal, natural gas, or nuclear fuels. According to the latest 2010 USEPA eGRID data (for 2007), New York's electricity generation resources (with associated percentages) are natural gas (30.6%), nuclear (29.4%), hydropower (16.9%), coal (14.8%), oil (5.7%), biomass (1.3%), other fossil (0.7%), and wind (0.6%). The carbon dioxide equivalent emissions associated with this profile are 755 lb/MWh. Assuming a given energy demand, the WTE Facility generates electricity that would have otherwise by generated by an alternative source.

Lastly, every year the WTE Facility recovers roughly 9,000 - 10,000 tons of metals that would have otherwise gone to a landfill. The recovered metal is then recycled, which saves considerable energy and prevents greenhouse emissions that would have resulted from virgin metal production.

When all of these factors are considered, the Onondaga County WTE Facility reduces greenhouse gas emissions (in carbon dioxide equivalents) by one ton for every ton of waste processed. Thus, in 2010, the Facility prevented 315,385 tons of carbon dioxide equivalent greenhouse gas emissions, which is the equivalent of taking nearly 50,000 cars off the road!

USEPA recently released a study entitled, "Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices" (September 2009). The study highlights several waste management practices, including waste prevention (source reduction), reuse/recycling, and WTE (energy recovery), that can lead to significant reduction in the country's greenhouse gas emissions. The study indicates there is significant GHG reduction potential associated with WTE facilities (*i.e.*, energy recovery).

4.6 Renewable Energy and Energy Independence

The Facility utilizes a locally-generated feedstock – the community's non-recyclable trash to generate a significant amount of electricity. This not only reduces dependence on fossil fuels, it also achieves goals of energy independence. In 2010 alone, the WTE Facility generated enough energy to displace nearly 400,000 barrels of oil or 80,000 tons of coal – enough energy to satisfy the needs of approximately 30,000 homes in OCRRA's service area. That is in addition to reducing the volume of non-recyclable trash by 90% and recovering ferrous and non-ferrous metal for recycling.

In many European countries and about half of the U.S. states, WTE (or energy from waste, as it is referred in Europe), is considered a renewable energy source. Most recently, Maryland Governor Martin O'Malley signed into law a bill elevating waste-to-energy to a Tier 1 renewable status in Maryland's Renewable Portfolio Standard. WTE was also highlighted as one of eight "key renewable energy sectors" by the World Economic Forum's recent (January 2009) report, "Green Investing – Towards a Clean Energy Infrastructure."

In a February 2003 letter to the Integrated Waste Services Association (IWSA) (currently the Energy Recovery Council), USEPA assessed WTE as "...clean, reliable, renewable power..."; "These plants produce 2,800 megawatts of electricity with less environmental impact than almost any other source of electricity." The Onondaga County Resource Recovery Facility is leading the way in providing an environmentally sound and cost-effective method of solid waste disposal while partially providing the energy needs of a community of 450,000 people.

4.7 Preservation of Landfill Capacity and Greenfields

In the United States, landfills are the predominant disposal alternative for MSW, with 54.3% of MSW ending up in landfills, 11.9% going to WTE facilities, and 33.8% being recycled or composted (Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts and Figures for 2009, USEPA). Over the past couple of decades, the number of landfills has decreased dramatically, however the size of the remaining landfills is substantially larger. Due to economies of scale, these "mega-landfills" are becoming the norm. However, as you can imagine, "mega-landfills" take up massive amounts of open space.

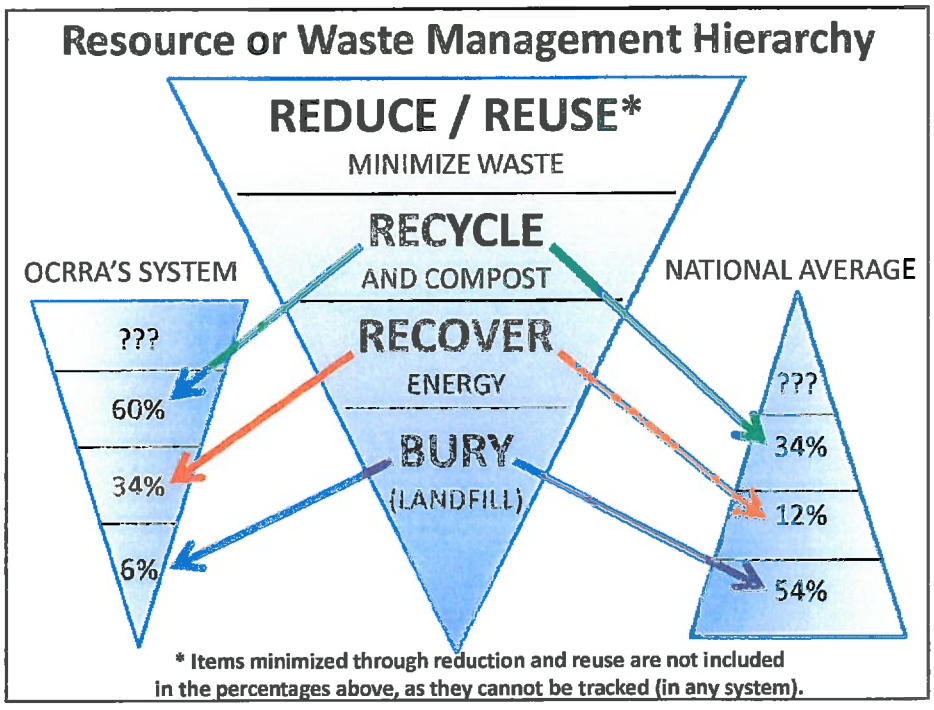
WTE facilities preserve existing landfill capacity by reducing the volume of MSW by 90%. This means that the current landfill capacity will last longer, and that "greenfields" will not be utilized for landfill expansion projects. Had the 315,385 tons of waste processed at the Facility in 2010 been landfilled, it would have utilized close to a million cubic yards of landfill space. To put this into perspective, if the waste was compacted to a 20-foot height, the landfilled waste would consume about 31 acres of land.

4.8 Compatibility with Recycling

In Onondaga County, which has one of the highest recycling rates in the State and perhaps in the nation, it seems trivial to question the compatibility of WTE and recycling. However, WTE facilities are often thought to compete with recycling. Interestingly, study after study, it has been shown that communities with WTE facilities often have higher recycling rates than communities that landfill their non-recyclable trash, both in Europe and the United States. A recent study (June 2009) entitled "A Compatibility Study: Recycling and Waste-to-Energy Work in Concert, A 2009 Update" again indicates the same conclusion.

4.9 Consistency with Waste Management Hierarchy

The waste management hierarchy set forth in New York State's 2010 "Beyond Waste" Solid Waste Management Plan, as well as in USEPA guidelines, includes (in order of preference): 1) waste reduction, 2) recycling, 3) recovery of useful energy through solid waste combustion (i.e., modern waste-to-energy facilities), and 4) use of permitted landfill facilities. This hierarchy, supported by our state and the nation, considers the environmental impacts of each level and prioritizes them accordingly, with the most preferred option being waste reduction/reuse and the least preferred option being landfilling. It also provides a good measuring stick for evaluating OCRRA's system. As indicated in the figure below, OCRRA's system is extremely consistent with the hierarchy. On the other hand, the national average doesn't do nearly as good a job with its low recycling rate and heavy reliance on landfilling. In fact, the national numbers are upside down.



National data from USEPA Report, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2009."

Section 5 – Financial Performance

5.1 Waste-to-Energy Facility Financial Summary

A simplified financial summary of OCRRA's revenues and expenses associated with the WTE Facility for 2010 is provided below. Please note that the presentation of information in this report is different from the presentation in OCRRA's financial statements. The information in this report should not be used for financial accounting purposes and is only intended to provide a simplified perspective on OCRRA's costs and expenses associated with the WTE Facility. It should be emphasized that the revenues and expenses described in this report pertain specifically to OCRRA; Covanta Onondaga also has Facility-related operating revenues and expenses that are not described in this report.

Waste-to-Energy Financial Summary for 2010

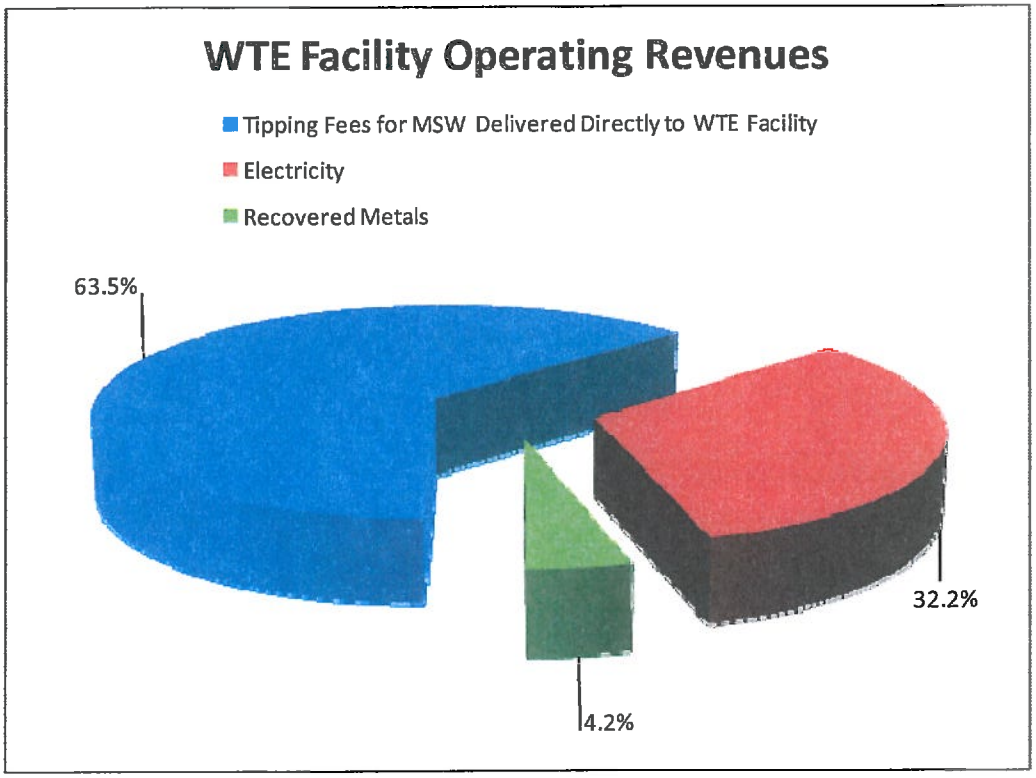
Operating Revenues	
Tip Fee for MSW Delivered Directly to Facility	$15,427,490
OCRRA's Electricity Share	$7,832,026
OCRRA's Recovered Metals Share	$1,031,263
Supplemental Waste Tip Fee	$4,100
Total	**$24,294,879**
Operating Expenses	
Operations and Maintenance Service Fee	$11,137,824
Ash Transportation and Disposal	$3,485,172
Excess Waste Fee	$110,594
Pollution Control Reagents	$719,728
Taxes/Fees	$331,674
Utilities	$414,833
Other Expenses (Mainly insurance)	$340,371
Total	**$16,540,197**
Bond Expenses	**$9,320,217**
Total Expenses	**$25,860,414**

As evident, OCRRA's 2010 WTE-related expenses exceeded the WTE-related revenues (net loss of $1.6 million). These Facility-related revenues and expenses constitute a significant portion of OCRRA's total Agency revenues and expenses. To provide some perspective, in the 2010 budget, WTE Facility-related operating and bond expenses accounted for about two thirds of OCRRA's total Agency expenses. Similarly, WTE Facility-related operating revenues accounted for roughly two thirds of OCRRA's total Agency revenues.

In 2010, total cost per ton of MSW processed was approximately $82 and total revenue per ton of MSW processed was approximately $77. As evident, WTE facilities like the local Facility have tremendous fixed costs. If those fixed costs are not offset by sufficient electricity revenue and tipping fees, there may be facility-related net losses, as in 2010. In 2010, the average electricity rate (including the capacity factor) was 4.5¢ per kWh; better than 2009's average rate of 3.7¢ per kWh, but still much less than the rate of about 6¢ per kWh for the previous few years. The low electricity rate, compounded by low trash tonnage, resulted in a net loss.

5.2 Waste-to-Energy Facility Operating Revenues

OCRRA's operating revenues associated with the WTE Facility include tipping fees for waste delivered *directly* to the Facility (not including tipping fees for waste delivered to OCRRA's transfer stations), sale of electricity generated by the Facility, the sale of metals recovered by the Facility, and revenue derived from the supplemental waste program, which was negligible for 2010. A summary of the relative contribution of these revenues is provided in the pie chart below. It should be emphasized that the revenues described in this report are revenues that pertain to OCRRA. Covanta Onondaga also receives Facility-related operating revenues that are not described in this report.



Although MSW and C&D from OCRRA's transfer stations are delivered to the WTE Facility, tipping fees are collected at the transfer stations and are therefore not included in this financial summary. Similarly, the cost of processing MSW and C&D at the transfer stations is not included in this report. However, it should be noted that electricity generated from the transfer station MSW and C&D is included in the electricity revenue.

5.2.1 Tip Fee for MSW Delivered Directly to Facility

In 2010, tipping fees for MSW delivered directly to the Facility accounted for just under two thirds of the revenues associated with the WTE Facility. In previous years, when electricity rates had been higher, tipping fees generally accounted for about half of the Facility-related revenues.

OCRRA receives the full tipping fee for MSW delivered directly to the Facility. In 2010, tipping fees were $69 per ton, with a $4 prompt payment discount. Most haulers take advantage of the prompt payment discount; therefore OCRRA generally received revenues of $65 per ton. OCRRA's office staff is responsible for billing and collecting payments from haulers.

5.2.2 OCRRA's Electricity Share

Electricity sales represent the other major revenue component associated with the WTE Facility. Historically, electricity had accounted for about 40-45% of Facility-related revenues. However, due to the low electricity rates in 2010, electricity sales accounted for 32% of Facility-related revenues. OCRRA receives 90% of the electricity revenues, with Covanta Onondaga receiving the remaining 10%.

For 2010, the total amount of electricity sold was 190,639 MWh, with an average electricity rate (including the capacity factor) of 4.5¢ per kWh. While this was better than the average rate of 3.7¢ per kWh in 2009, prior to 2009, a contract between OCRRA/National Grid (formerly Niagara Mohawk), provided minimum floor pricing of 6¢ per kWh. Ironically, the historical annual average electricity rate had generally exceeded the floor pricing. Unfortunately, in 2009, when electricity prices took a sharp decline, the minimum floor pricing had expired. In 2010, total energy revenues were $8,575,583, with OCRRA's share generating $7,832,026 in revenue. For comparison, 2008 energy revenues were $15,006,122, with OCRRA's 90% share generating $13,505,512 in revenue.

5.2.3 OCRRA's Recovered Metal Share

In 2010, recovered metal revenue accounted for 4% of Facility-related revenues. Unlike electricity rates, metal prices rebounded in 2010. OCRRA and Covanta Onondaga evenly split metal recovery revenues, each receiving 50%. A breakdown of 2010 tonnage and revenues for the non-ferrous and ferrous recovery systems is provided below.

	Tonnage	*OCRRA's Revenue*
Ferrous Metal	8,599	$816,087
Non-Ferrous Metal	333	$215,176

In 2010, average ferrous and non-ferrous prices were about $190 and $1,290 per ton, respectively. In comparison, average ferrous and non-ferrous pricing for 2008 were about $250 and $1000 per ton, respectively. In 2009, average ferrous and non-ferrous pricing were about $90 and $550 per ton, respectively.

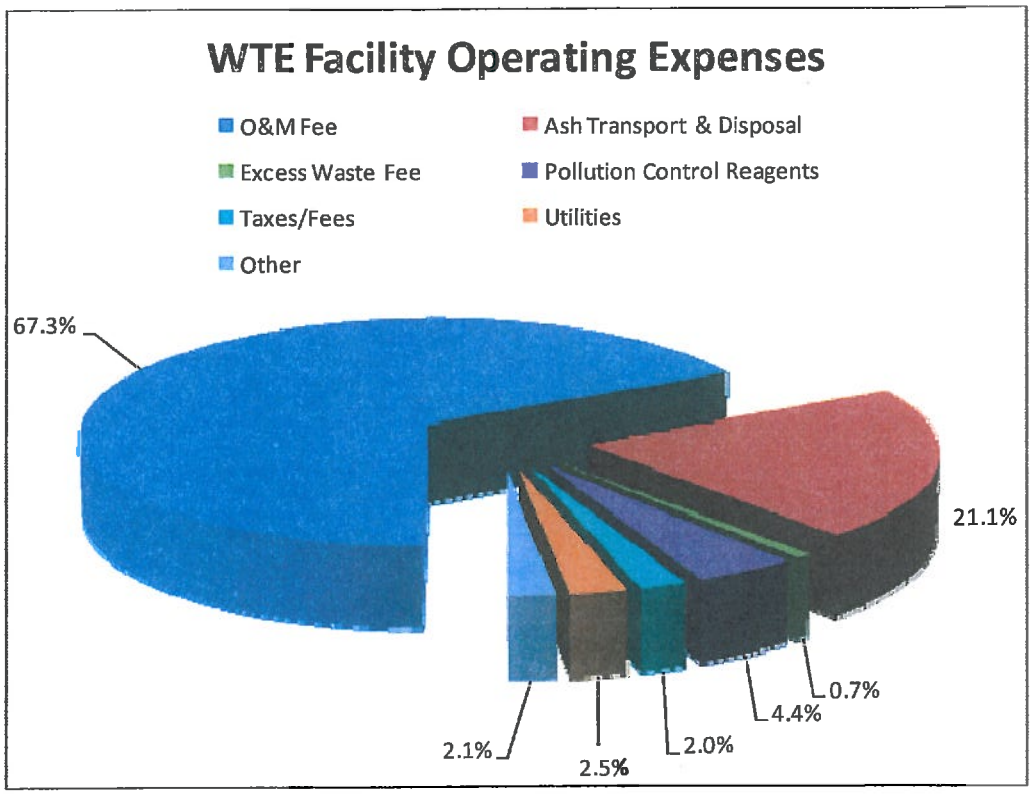
5.2.4 Supplemental Waste Tip Fee

The supplemental waste program is in place to provide proper disposal for waste streams other than MSW that may need special handling, secure destruction, or other special provisions. These wastes are carefully screened and evaluated to ensure that they will not impact Facility operations, including air emissions and ash residue characteristics. Covanta Onondaga administers the supplemental waste program with oversight from NYSDEC and OCRRA. As such, Covanta receives the established tipping fee less $10 (which OCRRA receives) for the first 500 tons of waste and thereafter Covanta receives the established tipping fee less OCRRA's tipping fee, which OCRRA receives.

In 2010, 544 tons of supplemental waste were processed, generating $4,100 in revenue for OCRRA. The types of waste processed in 2010 include pill bottles with labels (which under the HIPAA regulations require secure destruction); confiscated drugs, uniforms, and other paraphernalia from drug enforcement agencies; and pharmaceutical laboratory debris.

5.3 Waste-to-Energy Facility Operating Expenses

The operating expenses associated with the WTE Facility include an operations and maintenance (O&M) service fee paid to Covanta to maintain the Facility, the costs to transport and dispose of ash generated by the Facility, an excess waste fee payment to Covanta if more than 310,000 tons of MSW is processed at the Facility, costs associated with pollution control reagents, taxes/fees, utilities, and other miscellaneous expenses (described further below). A summary of the relative contribution of these expenses is provided in the pie chart below. It should be emphasized that the operating expenses described in this report are expenses that pertain to OCRRA. Covanta Onondaga also has Facility-related operating expenses that are not described in this report.



5.3.1 Operations and Maintenance Service Fee

OCRRA pays an operations and maintenance (O&M) service fee for Covanta Onondaga to operate, repair, and maintain the Facility in accordance with the 2003 Service Agreement between OCRRA and Covanta Onondaga. This is, by far, the largest Facility-related expense. Each calendar year the O&M fees are adjusted according to several indices (skilled labor index, producer price index, and employment cost index) and OCRRA's annual tipping fee. In 2010, the base O&M service fee was $11,097,888 and the non-ferrous O&M fee was $39,936, for a total of $11,137,824.

5.3.2 Ash Transportation and Disposal

OCRRA is responsible for transporting and disposing of ash residue generated at the Facility. The associated costs were estimated from a unit cost report and include all costs associated with handling and disposal of ash residue (salaries, fuel, tolls, tip fees, social security, insurance, and maintenance). The average unit cost for 2010 was approximately $44.95 per ton, with 77,534 tons of ash being managed. Therefore, the total ash transportation and disposal costs for 2010 were approximately $3,485,172.

5.3.3 Excess Waste Fee

According to the 2003 Service Agreement between OCRRA and Covanta, OCRRA is required to pay Covanta an excess waste fee if the Facility processes more than 310,000 tons of material in the calendar year. The unit fee per ton of waste greater than 310,000 is adjusted annually, based on the same indices as the O&M Service Fee adjustment. For 2010, the unit fee was $22.85. The excess waste fee is not applicable for supplemental waste; therefore the quantity of supplemental waste is subtracted from the amount of waste processed in excess of 310,000 tons. In 2010 the Facility processed 4,840 tons of excess waste, resulting in an excess waste fee payment to Covanta of $110,594. Historically, the excess waste fee has been between $500,000 and $800,000. The 2010 fee was significantly less because of the low waste tonnage in 2010.

5.3.4 Pollution Control Reagents

The Facility uses several reagents for pollution control including anhydrous ammonia for control of NO_x, carbon for mercury and dioxin/furan control, and lime for control of acid gases. The cost of these reagents is generally a pass-through cost to OCRRA, with the exception of lime for which OCRRA only pays a portion of the cost.

To control NO_x emissions, anhydrous ammonia is injected into the combustion chamber of each boiler unit. There are no contractual maximum levels for ammonia usage, so OCRRA is solely responsible for the expense of all ammonia used. In 2010, the cost for ammonia reagent was $188,527 for 259 tons of anhydrous ammonia at an average cost of about $725/ton. Given the 2010 waste tonnage processed, these figures translate into an application rate of 1.64 lb per ton of waste processed and a unit cost of $0.60 per ton of waste processed.

To control mercury emissions, as well as dioxin and furan emissions, powdered activated carbon is mixed into slurry and injected into the spray-dry scrubbers through the rotary atomizer. The rotary atomizer creates tiny droplets for optimal reaction. There are no contractual maximum levels for carbon usage, so OCRRA is solely responsible for the expense of all carbon used. In 2010, the cost for activated carbon was $339,033 for 241 tons of activated carbon at an average cost of $1,406 per ton. The average carbon reagent application rate for 2010 was 1.53 lb per ton of waste processed, a rate within the historical range, and the unit cost was $1.07 per ton of waste processed. In 2009 and 2010, the average unit cost for activated carbon was nearly 23% over the 2008 unit cost.

To neutralize acid gases, namely sulfur dioxide (SO_2), hydrogen chloride (HCl), hydrogen fluoride (HF), and sulfuric acid (H_2SO_4), a calcium-based lime, commonly referred to as pebble lime, is injected into the spray-dry scrubbers through the rotary atomizer. According to an agreement between OCRRA and Covanta, OCRRA is responsible for the cost associated with the pebble lime usage in excess of 21 pounds of pebble lime per ton of waste processed, up to a maximum of 32 lb per ton of waste processed. Covanta is responsible for pebble lime reagent costs up to 21 lb per ton of waste processed and above 32 lb per ton of waste processed. In 2010, OCRRA's cost for lime was $192,168 and the average reagent application rate was 29.4 lb of lime per ton of waste processed. The cost of the lime reagent for 2010 was about $137 per ton.

5.3.5 Taxes/Fees

OCRRA is contractually responsible for the cost of the following taxes/fees:

- State and local sales taxes on Facility-related purchases – $34,496 in 2010
- Regulatory operating permit annual fees – $26,733 in 2010
- Host Community Agreement payments to the Town of Onondaga – $144,747 in 2010
- Special fire district tax assessments – $119,433 in 2010
- Special water district tax assessments – $6,265 in 2010

5.3.6 Utilities

During normal Facility operation, the Facility's electrical demand is satisfied by the Facility's turbine-generator system, with the excess electricity being exported to the grid. During those times when the turbine-generator is offline due to maintenance or malfunction, electricity is purchased from National Grid (NG) to operate the Facility and continue combusting the incoming MSW. OCRRA is financially responsible for paying for the electricity purchased during these periods. The contractual threshold levels beyond which Covanta is responsible for such costs are as follows:

Electrical Energy	3,348,000 kWh/rolling 3-year period (maximum)
Electrical Demand	4,400 kW (maximum per billing period)

In 2010, 1,239,156 kWh of electricity was purchased from National Grid for in-plant needs during turbine-generator outages. The amount of electricity purchased during 2010 is significantly more than the average annual electricity purchased and is mainly due to the occurrence of the second major turbine-generator overall since Facility start-up. The 3-year rolling period total for 2008-2010 was 2,035,350 kWh, significantly less than the contractual maximum amount stated above. For 2010, the maximum monthly metered electrical demand was 3,888 kW. The cost of purchased power paid by OCRRA for 2010, including electrical usage and demand charges, was $231,010.

City water satisfies all potable and process needs of the Facility, with the majority being for process use. 30,360,000 gallons, representing 76% of the contractual maximum (40 million gallons per year) for which the Agency is financially responsible, were purchased in 2010. This amount of water translates into about 96 gallons per ton of waste combusted or approximately 58 gallons per minute. 2010 water usage remained consistent with historical levels and design parameters following initial start-up. Total 2010 water costs were $63,805, or $2.10 per thousand gallons, a 10% increase from 2009.

Natural gas is an auxiliary fuel used for boiler start-ups and shutdowns, and for maintaining minimum furnace temperatures when processing overly wet waste. 2010 natural gas usage was 137,520 therms, which is consistent with historical usage. The contractual maximum amount of natural gas OCRRA is financially responsible for is 110,000 therms per year, with Covanta being responsible for usage over 110,000 therms. Covanta exceeded the usage threshold in October 2010, at which point OCRRA was no longer responsible for natural gas costs. OCRRA's total annual natural gas costs were $120,019.

5.3.7 Other Expenses

In 2010, OCRRA was financially responsible for several other Facility-related expenses totaling $340,371, which consisted of:

- Facility-related insurance premiums ($290,024);
- System telecommunications between Facility and National Grid ($6,355);
- Traffic signalization for the hauler entrance to the Facility ($1,585);
- OCRRA's WTE engineering consulting services related to providing technical assistance and annual stack and ash testing on-site observations ($34,742);
- Trustee fees ($8,620); and
- Other miscellaneous (-$955).

5.4 Bond Expenses

Until May 2015, OCRRA is responsible for paying debt service on the bonds for the Facility. At that point, the Series A bonds will have been paid off and the responsibility of the Series B bonds will be transferred to Covanta Onondaga. OCRRA pays a set amount for the principal and interest on the Series A bonds; however the amount paid on the Series B bonds depends on the profitability of OCRRA in any given year. OCRRA did not have a profitable year in 2010 (similar to 2009); therefore, OCRRA did not make payments on the principal of the Series B bonds. The total payment on the Series A bonds in 2010 was $9,320,217.

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An overview of the global waste-to-energy industry

Article by Nickolas J. Themelis in Waste Management World (www.iswa.org), 2003-2004 Review Issue, July-August 2003, p. 40-47

Nickolas J. Themelis

Despite the expansion of the global waste-to-energy (WTE) industry in the past decade, hundreds of millions of tonnes of municipal solid wastes still end up in landfills. For every tonne of waste landfilled, greenhouse gas emissions in the form of carbon dioxide increase by at least 1.3 tonnes. This article provides an overview of the WTE industry, and reviews recent advances made in the US in decreasing dioxin and mercury emissions. The recently established Waste-to-Energy Research and Technology Council hopes to bring together global academic and industrial expertise with the aim of improving WTE technologies.

Worldwide, about 130 million tonnes of municipal solid waste (MSW) are combusted annually in over 600 waste-to-energy (WTE) facilities that produce electricity and steam for district heating and recovered metals for recycling. Since 1995, the global WTE industry increased by more than 16 million tonnes of MSW. Currently, there are WTE facilities in 35 nations, including large countries such as China and small ones such as Bermuda. Some of the newest plants are located in Asia.

According to a directive from the European Union,[1] landfilling of combustible materials must be phased out within the decade. However, it is not clear that the capital investments required will be made by all of the member countries. Some of them have little WTE capacity and some - for example, Greece - none at all. The current EU installed capacity and per-capita use of WTE for the disposal of municipal solid waste is shown in Table 1.[2] For comparison, the use of WTE amounts to 314 kg per capita in Japan, 252 kg in Singapore, and 105 kg in the US. One of the newcomers to WTE is China, with seven plants in operation and an estimated annual capacity of 1.6 million metric tonnes per year.

Current state of the global WTE industry

A 2002 review of the European WTE industry by the International Solid Waste Association showed that the total installed capacity was more than 40 million tonnes per year and the generation of electrical and thermal energy was 41 million GJ and 110 GJ, respectively (Table 1). It should be noted that, in contrast to Europe, the US makes very little use of the exhaust steam from the power-generating turbines for either district or industrial heating. A good example of cogeneration of thermal and electric energies is the Brescia WTE facility in Italy (see page 45) that provides an estimated 650 kWh of electricity per tonne of MSW combusted. In the cold season, it supplies at least as much energy as for district heating.[3]

TABLE 1. Reported WTE capacity in Europe[2]

Country	Tonnes/year (in 1999)	Kilograms/capita	Thermal energy (gigajoules)	Electric energy (gigajoules)
Austria	450,000	56	3,053,000	131,000
Denmark	2,562,000	477	10,543,000	3,472,000
France	10,984,000	180	32,303,000	2,164,000
Germany	12,853,000	157	27,190,000	12,042,000
Hungary	352,000	6	2,000	399,000
Italy	2,169,000	137	3,354,000	2,338,000
Netherlands	4,818,000	482		9,130,000
Norway	220,000	49	1,409,000	27,000
Portugal	322,000	32	1,000	558,000
Spain	1,039,000	26		1,934,000
Sweden	2,005,000	225	22,996,000	4,360,000
Switzerland	1,636,000	164	8,698,000	2,311,000
UK	1,074,000	18	1,000	1,895,000
Total reported	40,484,000	154.5 (average)	109,550,000	40,761,000

The US WTE industry represents about 23% of the global capacity; 66% of that is concentrated in seven states on the East Coast (Table 2).

TABLE 2. Major users of WTE in the US[4]

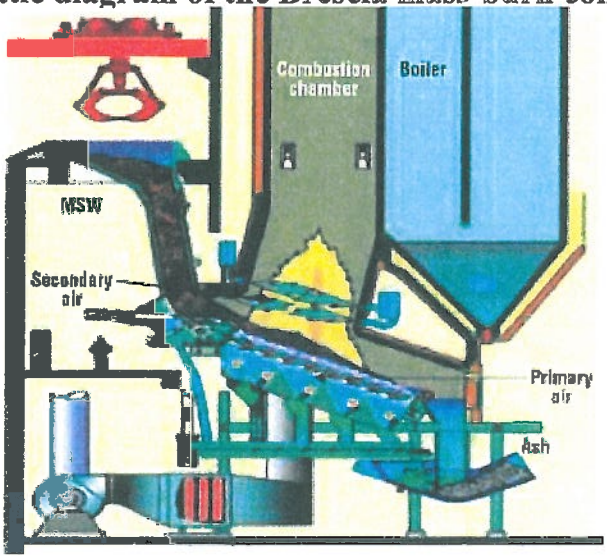
State	Number of plants	Capacity (short US tons/day)
Connecticut	6	6,500
New York	10	11,100
New Jersey	5	6,200
Pennsylvania	6	8,400
Virginia	6	8,300
Florida	13	19,300
Total	53	69,600

Current state of WTE technology

The dominant WTE technology is mass burning, because of its simplicity and relatively low capital

cost. The most common grate technology, developed by Martin GmbH (Munich, Germany), has an annual installed capacity of about 59 million metric tonnes. The Martin grate at the Brescia (Italy) plant is one of the newest WTE facilities in Europe. Figure 1 shows a schematic diagram of its mass-burn combustion chamber. The Von Roll (Zurich, Switzerland) mass-burning process follows with 32 million tonnes worldwide. All other mass-burning and refuse-derived- fuel (RDF) processes together have a total estimated capacity of more than 40 million tonnes.

FIGURE 1. Schematic diagram of the Brescia mass-burn combustion chamber [3]



The SEMASS facility in Rochester, Massachusetts, USA, developed by Energy Answers Corp. and now operated by American Ref-Fuel, has a capacity of 0.9 million tonnes/year and is one of the most successful RDF-type processes. The MSW is first pre-shredded, ferrous metals are separated magnetically, and combustion is carried out partly by suspension firing and partly on the horizontal moving grate (Figure 2).

FIGURE 2. Schematic diagram of the SEMASS process at Rochester, Massachusetts, USA

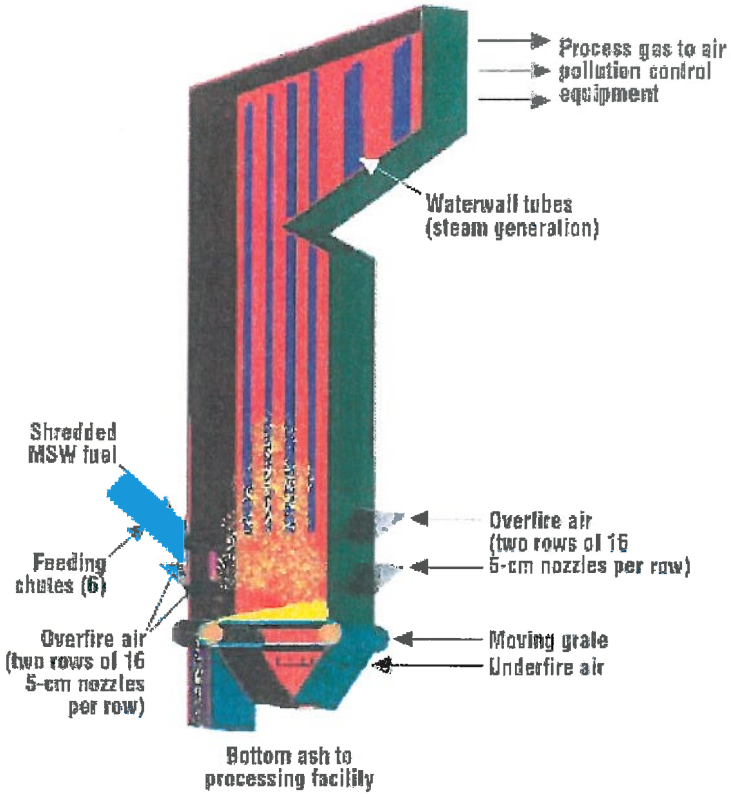


Table 3 shows the enormous expansion in global WTE capacity, in terms of new Martin and Von Roll plants, that has taken place since 1995.A total of 154 WTE facilities have been constructed or are currently under construction, totalling to a capacity of 16.5 million tonnes.

TABLE 3. Martin and Von Roll new facilities since 1995

Major trends in new WTE construction, 1996-2003	Martin plants[a]		Von Roll plants[b]
	Reverse grate	Horizontal grate	
Number of new plants, 1996-2001	41	21	55
Installed total new capacity, 1996-2001, tonnes/year	7,800,000	3,100,000	3,500,000
Average plant capacity, 1996-2001, tonnes/year	182,000	148,000	64,000
Number of new plants, since 2001 (plus those under construction)	27	6	14
Total new capacity since 2001, tonnes/year	4,100,000	740,000	1,150,000
Average plant capacity since 2001, tonnes/year	151,000	134,000	82,000
Largest plant built in 1996-2003, tonnes/year	1,400,000	480,000	250,000

[a] Martin capacities were obtained by multiplying reported daily capacities by 330.[5]
[b] Von Roll capacities were calculated by multiplying reported hourly capacities by 24 x 330.[6]

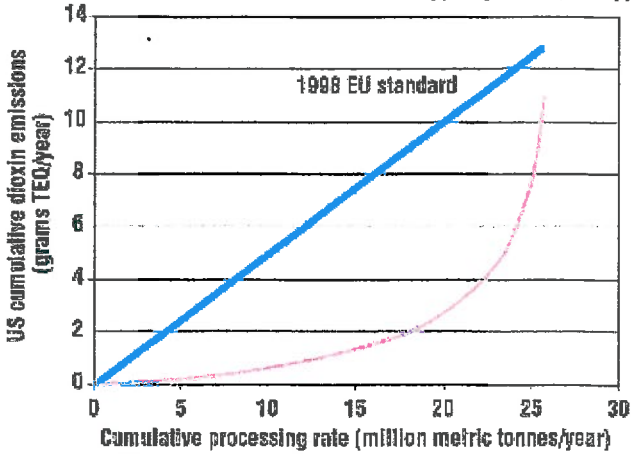
WTE emissions

In the late 1980s, WTE plants were listed by the US Environmental Protection Agency (EPA) as major sources of mercury and dioxin/furan emissions. However, in response to the Maximum Available Technology (MACT) regulations promulgated in 1995 by the US EPA, the US WTE industry spent more than one billion dollars in retrofitting pollution control systems and becoming one of the lowest emitters of high temperature processes. The US EPA recently affirmed that WTE plants in the US 'produce 2800 MW of electricity with less environmental impact that almost any other source of electricity'.[7]

Dioxins

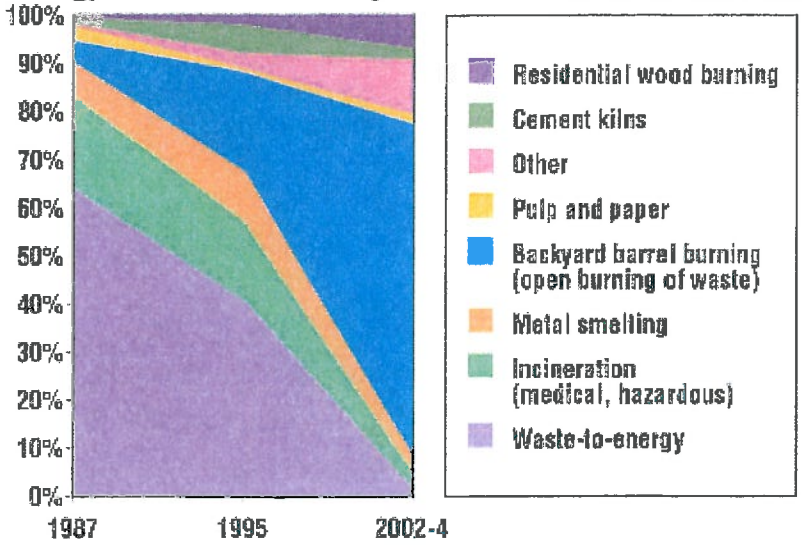
A memorandum by Walt Stevenson of the US EPA summarizing EPA data8 showed that the emissions of the large US WTE plants (about 89% of total US capacity) decreased from 4260 grams TEQ (toxic equivalent) in 1990 to 12 grams TEQ in 2000. Figure 3 shows the post-MACT cumulative dioxin emissions of the US WTE facilities, plant by plant.[8,9] The diagonal straight line shows the allowable limit of toxic dioxins (in grams TEQ) using the present EU limit of 0.1 ng/m^3 and the cumulative processing rate of MSW (x-axis). It can be seen that the total emissions in the US are well below the EU limit. The fact that WTEs stopped being the major emitters of dioxins in the US is illustrated in Figure 4 that depicts the distribution of dioxin sources in recent years;[8,9] it should be noted that in the same period, the total dioxin emissions in the US decreased tenfold, from 14,000 to 1100 grams TEQ.[8]

FIGURE 3. Post-MACT cumulative dioxin emissions from US WTE plants in 2000; each point represents the emissions of a single plant, in grams TEQ [8,9]



The current WTE industry in the US, and also those in other developed nations, are an insignificant source of dioxins. Modern WTE facilities in Europe have dioxin emissions that are much lower than the EU limit. For example, the level of dioxin emissions of the state-of-the-art Brescia (Italy) plant is only 0.01 ng TEQ/m^3.[3]

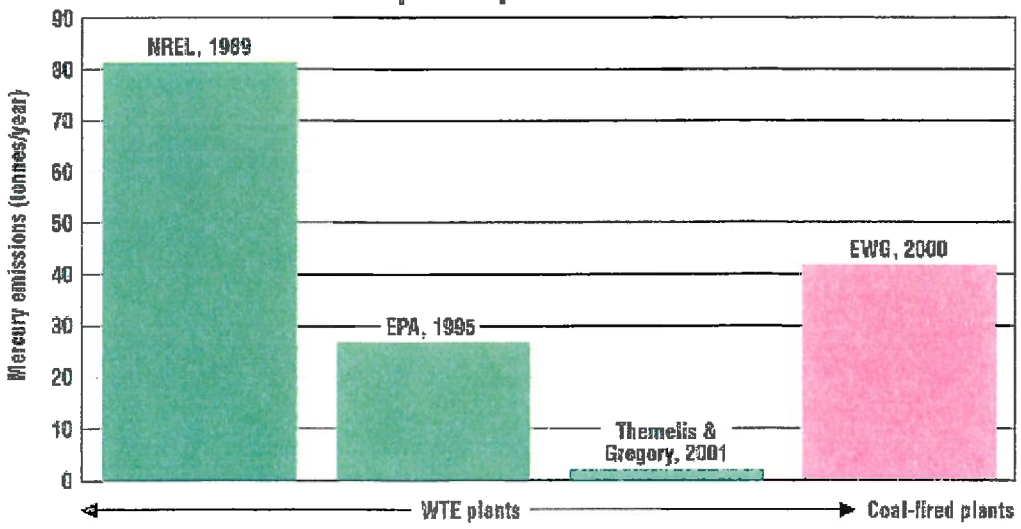
FIGURE 4. The distribution of dioxin sources in the US in recent years, showing how waste-to-energy ceased to be a major contributor of dioxin emissions [8,9]



Mercury

The use of mercury in the US decreased from 3000 tonnes per year in the 1970s to less than 400 tonnes by the end of the century.[10] Due to the lower input and also the use of activated carbon injection and fabric bag filters, the US WTE emissions decreased by a factor of 60 between 1987 and 2000. Figure 5 shows that, by 2000, WTE mercury emissions were a small fraction of those from coal-fired power plants.

FIGURE 5. Mercury emissions from WTE (1989-1999) and coal-fired power plants [10]



Environmental benefits of WTE

Despite the great reduction in emissions attained by WTE facilities in the last 15 years, some

environmental groups in the US continue to oppose new WTE facilities on principle, unaware that the only alternative for MSW disposal - landfills - have much larger environmental impacts. For every tonne of waste landfilled, greenhouse gas emissions in the form of carbon dioxide increase by at least 1.3 tonnes. During the life of a modern landfill and for a mandated period after closure, aqueous effluents are collected and treated chemically; however, chemical reactions and volume decrease of the landfilled MSW can continue for decades and centuries. Thus, there is potential for future contamination of adjacent waters. It is for this reason that communities built on sandy soil, such as those in Long Island in New York State and the state of Florida have opted for WTE disposal of their MSW.

Landfill gaseous emissions

Modern landfills try to collect the biogas produced by anaerobic digestion. However, the number of gas wells provided is limited (about one well per 4,000 m^2 of landfill),[11] so that only part of the biogas is actually collected. Landfill biogas generally contains about 54% methane and 46% carbon dioxide. On the assumption that 25% of the landfilled MSW is biodegradable (food, plant, wastes, paper, leather, wood), the maximum amount of natural gas generated by biodegradation has been estimated at 130 Nm^3/metric tonne.[12] The maximum capacity of landfilled MSW to produce methane is reported by Franklin[13] to be 62 standard m^3 of CH_4 per tonne. Also, the compilation of US landfill gas data by Berenyi[11] showed the annual capture of landfill gas to be 8 billion Nm^3 (778 million scfd).

Putting these numbers together and assuming that the landfill gas is generated only from the current deposition of MSW in US landfills (109 million tonnes in 1999) leads to the following calculation:

Amount of non-captured methane	= Amount generated - Amount captured
	= (109 million tonnes MSW x 62 Nm^3/tonne)- (8 billion Nm^3 x 0.54)
	= 2.4 billion Nm^3 of methane
	= 1.7 million tonnes of methane
	= 39.1 million tonnes of carbon equivalent
	= 0.369 tonnes of carbon equivalent/tonne MSW
	= 1.32 tonnes of CO_2 /tonne MSW

The carbon equivalent number was obtained by multiplying methane emissions by its global warming potential of 23 times that of carbon dioxide.[14] This calculation for US methane emissions can be compared with the estimate of global carbon emissions from waste treatment of 60-100 million tonnes per year.[15] Also, the above estimate of 1.32 tonnes of CO_2 per tonne MSW is close to the estimate by Thorneloe *et al.*[16] and lower than the estimates of about 1.5 tonnes of CO_2, by Batchelor *et al.*,[17] for Australia, and by Ayalon *et al.*18 for Israel.

Mercury emissions from landfills

Mercury concentration in US MSW has been estimated at about one part per million.[10] On this basis, the amount of mercury disposed annually in US landfills is about 120 tonnes per year (i.e. about 25% of the present mercury consumption in the US). Most of the mercury in MSW is in metallic form (fluorescent lamps, thermometers, etc.), and the vapour pressure of mercury at landfill temperatures

(40°C) is 0.007 mm Hg, as compared with the vapour pressure of water of 5.67 mm Hg at 40° C.Therefore, if an exposed water droplet evaporates in one hour, then a mercury droplet of the same size will evaporate in four weeks.[10] Also, the conditions in an MSW landfill (such as temperature, moisture, and reducing capacity) are favourable for aqueous mobilization of mercury (e.g. in the form of methyl mercury). However, since both gaseous emissions and aqueous mobilization are dispersed sources, they are not easy to measure.

TABLE 4. Gaseous emissions of US landfills

Volatile compound	Molecular weight	Mean concentration in landfill gas,[19] ppbv	Landfill emissions, kg/million tonnes of MSW
Acetone	58.08	6,838	826
Benzene	78.01	2,057	339
Chlorobenzene	112.56	82	17
Chloroform	119.39	245	61
1,1-Dichloroethane	98.97	2,801	574
Dichloromethane	84.80	25,694	4,539
Diethylene chloride	58.00	2,835	339
Ethyl benzene	106.16	7,334	1,626
Methyl ethyl ketone	72.10	3,092	461
1,1,1-Trichloroethane	133.42	615	174
Trichloroethylene	131.40	2,079	565
Toluene	92.13	34,907	6,704
Tetrachloroethylene	165.85	5,244	1,809
Vinyl chloride	62.50	3,508	461
Styrenes	104.15	1,517	330
Vinyl acetate	62.50	5,663	1,017
Xylenes	106.16	2,651	583
Total VOC emissions			20,435
Ammonia	17.03	550,000	-
Sulphides/mercaptans	60.00	500,000	-

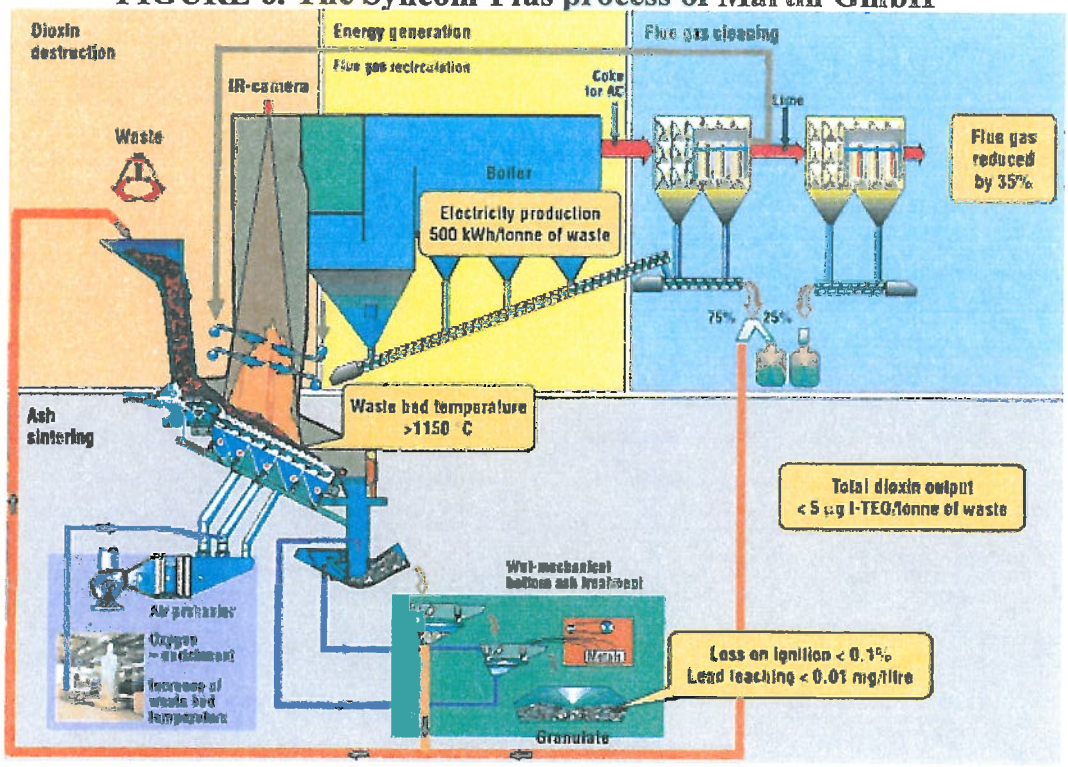
Volatile organic compounds

The annual gaseous emissions of landfills in the US can be estimated by multiplying the above estimate of non-captured landfill gas flow (about 46 Nm^3 of methane plus CO_2 escaping per tonne of MSW) by the reported concentrations of volatile organic compounds (VOC) in landfill gas.[19] Table 4 shows the estimated emissions from US landfills, expressed on the basis of kilograms per million tonnes of MSW landfilled.

The next generation of WTE processes

The existing WTE combustion chambers have been developed largely empirically. Their size, percentage of excess air used, and the volume of process gas are much larger than for coal-fired power plants of the same combustion capacity. Therefore, the capital and maintenance costs of a WTE facility are nearly three times as high as that for a coal-fired power plant generating the same amount of electricity. One of the objectives of the Waste-to-Energy Research and Technology Council is to apply engineering science in understanding the phenomena occurring in the best of the existing WTE processes and then to implement this knowledge during the design of the next generation of WTE facilities. Two obvious means for increasing the turbulence and transport rates in the WTE chamber are oxygen enrichment, as practised in the metallurgical industry, and flue gas recirculation. The latter has already been implemented very successfully in the Brescia WTE facility. Also, Martin GmbH has already piloted oxygen enrichment on a large scale and is in the process of building two 'next generation' plants, in Arnoldstein, Austria, and in Sendai, Japan, in collaboration with Mitsubishi Heavy Industries. Figure 6 is a schematic diagram of the Martin Syncom-Plus® process that will be used in these plants. In addition to oxygen enrichment of the air injected through the grate, Syncom-Plus makes use of an infrared camera for monitoring the temperature of the bed on the grate and a sophisticated control system to ensure complete combustion and produce a bottom ash that is nearly fused and ready to be used beneficially.

FIGURE 6. The Syncom-Plus process of Martin GmbH [5]



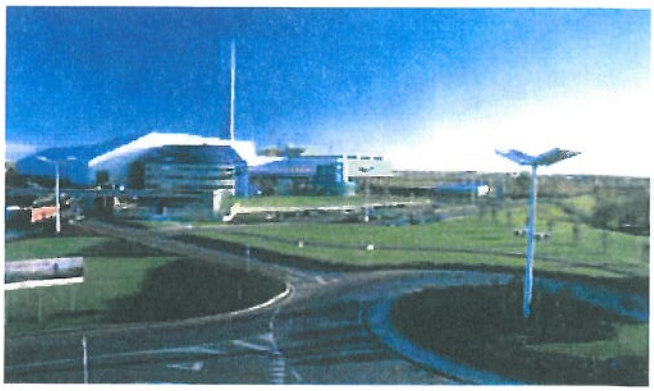
The WTE Research and Technology Council

During the course of several graduate studies of various facets of integrated waste management, the Earth Engineering Center (EEC) of Columbia University came to the realization that, despite the

importance of WTE technology to the US, there were no industrial or government research centres dedicated to advancing the WTE technology. The only organization addressing the concerns of the US WTE facilities and of the major WTE companies (American Ref- Fuel, Covanta Energy, Montenay-Onyx, and Wheelabrator) is the Integrated Wastes Services Association (IWSA) formed in 1991. Its role does not include R&D, however.

Therefore, in the spring of 2002, EEC and IWSA, with the help of Columbia's Earth Institute, founded the Waste-to- Energy Research and Technology Council (WTERT).One of the objectives is to link academic research groups working on various aspects of WTE technology, as well as engineers in the WTE industry and government agencies concerned with waste-to-energy and integrated waste management. The mission of the Council is to advance both the economic and environmental performance of waste-to-energy technologies, and this includes both conservation of resources and environmental quality.

Two views of Brescia WTE facility in Italy. Photo: ASM Brescia



At the present time, WTERT is sponsored by its founders, the US EPA, the Solid Wastes Processing Division of ASME International, the Municipal Waste Management Association of the US Conference of Mayors, and other organizations. One of the services provided by WTERT is the interactive database 'SOFOS' that provides information on technical papers and reports related to the integrated management of solid wastes.

The following academic groups are currently participating in the WTERT University Consortium:

- Earth Engineering Center, Department of Earth and Environmental Engineering, and Department of Civil Engineering, Columbia University, USA
- Marine Sciences Research Center, State University of New York at Stony Brook, USA
- Department of Civil and Environmental Engineering, Temple University, USA
- Department of Applied Earth Sciences, Delft University of Technology, the Netherlands

- Sheffield University Waste Incineration Center (SUWIC), UK.

WTERT welcomes other universities interested in the goals of the Council to join this consortium.

Conclusion

Worldwide, about 130 million tonnes of municipal solid wastes are combusted annually in WTE facilities that produce electricity and steam for district heating and also recover metals for recycling. Since 2001, there have been 47 new WTE facilities that either have started or are under construction, adding 6 million tonnes to the total capacity. WTE expansion in the US has been stymied by environmental opposition that does not consider the enormous reduction in gas emissions made by the US WTE industry following implementation of the US EPA regulations for Maximum Available Control Technology and by the fact that existing legislation does not recognize the significant environmental benefits of WTE, in terms of energy generation, environmental quality, and reduction of greenhouse gases.

In the last few years, there have been significant advances in WTE technology that include the use of implementation of flue gas recirculation and the design of new plants that will use oxygen enrichment of the primary air. The importance of WTE in the universal effort for sustainable development and its need for R&D resources has led to the formation of the Waste-to-Energy Research and Technology Council. This organization brings together several universities concerned with waste management. The Council started operations by making an inventory of the global WTE industry and the research resources available. The overall goal of the Council is to improve the economic and environmental performance of technologies that can be used to recover materials and energy from solid wastes.

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webpage of the WTERT Council: www.columbia.edu/cu/wtert

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- Petroleum Storage Systems
- Solid and Hazardous Waste
- Waste Cleanup

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- News
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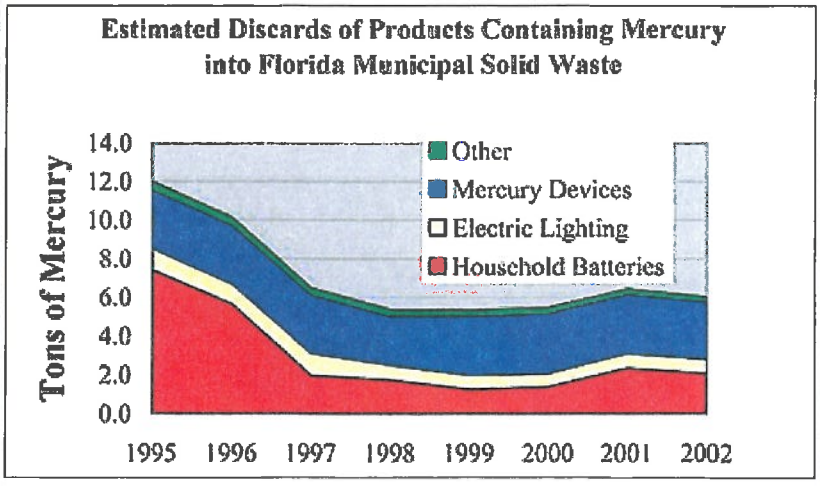
Quantifying Mercury in Florida's Solid Waste

Most discarded MCLs (about 80%) and MCDs come from commercial and governmental facilities, while the rest are generated from households and other residential buildings. Many commercial and governmental facilities do periodic relamping to improve the energy efficiency of their buildings and to save on energy costs. These efforts are to be encouraged as reductions in energy use may also have benefits in respect to lower emissions (including mercury) from certain fossil fuel power plants.

Mercury Containing Lamps (MCLs): Using US EPA and manufacturer data, the annual discards of fluorescent lamps, which make up the vast majority of MCLs, and MCDs for Florida have been estimated since 1995. About 39 million fluorescent lamps were estimated to be discarded in Florida in 2002. Four-foot fluorescent lamps, the most common type of fluoresent lamp sold, were estimated to have an average mercury composition of about 10 milligrams (mg) per lamp based on the lamp manufacturing industry's data. Prior to 1994, new fluorescent lamps sold in the US were reported by this industry to contain an average of about 41.6 mg. Beginning in 1994, this average dropped to about 22.8 mg of mercury per this lamp type. Fluorescent lamp manufacturers have continued to reduce the amount of mercury their lamps contain through source reduction, and the average mercury content in four-foot fluorescent lamps dropped to about 8 mg in lamps made in 2001. This would be about an 80% reduction in the mercury content of these lamps over the last ten years. Based on an average lamp life of four years, fluorescent lamps that are discarded beginning in 2005 will be assumed to have an average mercury concentration of about 8 mg.



Mercury Containing Devices (MCDs): Florida's current estimates of discarded MCDs and the mercury they contain comes from a variety of sources including US EPA reports and manufacturer-reported information. The types of MCDs included in Florida's estimates are mercury-containing thermostats, thermometers, and electric switches (e.g., light switches, displacement relays, and boat bilge pump float switches). Since 1997, MCDs have been the largest source of mercury in Florida's MSW stream. The chart above and table below show the mercury in MCLs and MCDs that are estimated to have been discarded

Highlights
- Mercury Main Page
- Background
- Contacts
- Developing Trends
- Drum Top Crushers for Fluorescent Lamps
- Environmental Issues
- Florida's Definitions for Mercury Containing Lamps and Devices
- Health & Safety Information
- High Pressure Sodium HID Lamps
- Household Lighting FAQs
- Low Mercury Fluorescent Lamps
- Medical Facilities
- Mercury Switch Recovery from Scrap Vehicles
- Online Forms
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- Publications and Related Links
- Quantifying Mercury in Florida's Solid Waste
- Reduce the Risk of Exposure to Mercury
- Registering to Handle/Transport Mercury Lamps and Devices for Recycling
- Retail Collection & Recycling of

in Florida's MSW since 1995 in comparison with other sources. For more information on the sources of mercury in Florida's MSW, see Chapter 5 "Special Wastes" of the "Solid Waste Management in Florida 2001-2002 Annual Report."

Table I
Estimated Mercury in Florida Municipal Solid Waste, 1995 - 2002
Estimate, in Tons

Product Category	1995	1996	1997	1998	1999	2000	2001	2002	2002%
Household Batteries	7.4	5.6	2.0	1.7	1.3	1.4	2.3	2.1	34%
Electric Lighting	1.1	1.1	1.1	.07	.07	0.7	0.7	0.3	12%
Mercury Devices	3.0	3.0	3.0	2.5	3.0	3.1	3.1	3.0	49%
Other	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	4%
TOTALS	12.0	10.1	6.5	5.4	5.3	5.5	6.4	6.0	100%

- Fluorescent Lamps
- Rules & Related Laws
- See Mercury Vapors on Video
- Sources and Quantities of Mercury in Florida's Solid Waste
- Spill Cleanup
- State Recycling Contract for Government Agencies

Last updated: January 25, 2012

Bureau of Solid & Hazardous Waste #850-245-8707 MS #4550

Division of Waste Management #850-245-8705 MS #4500
2600 Blair Stone Road, Tallahassee, Florida 32399-2400

Questions & Comments Form

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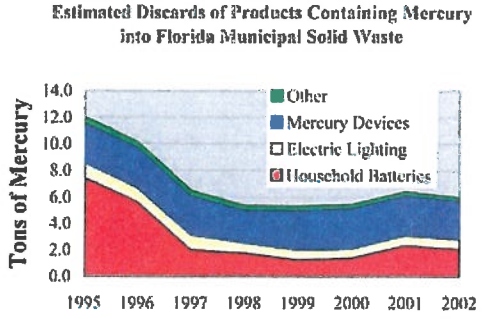
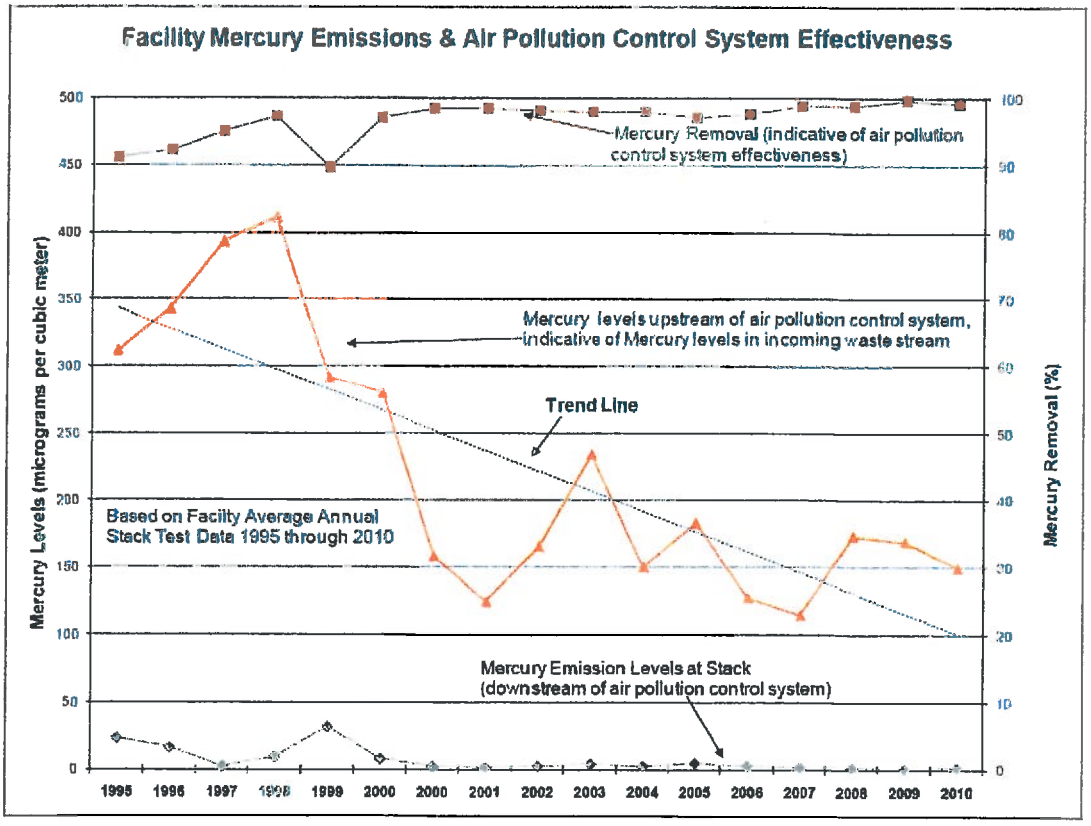
Mercury Reduction Information

"The use of mercury in the US decreased from 3000 tonnes per year in the 1970s to less than 400 tonnes by the end of the century"

Source
Themelis,N J. and Gregory, A., Mercury Emissions from High Temperature Sources in Hudson Basin, Proceedings NAWTEC 10, Solid Wastes Processing Division, ASME International, pp 205-215 (May 2002).

Quantifying Mercury in Florida's Solid Waste Page
|http://www dep state.fl.us/waste/categories/mercury/pages/sources_and_quantities.htm





Source:
Onondaga County, Resource Recovery Facility,
NYSDEC Part 360 Permit D No. 7-3142-00028/00011
Title V Air Permit D No. 7-3142-00028/00009
Annual Report of Facility Performance, Operating Year 2010
Onondaga County Resource Recovery Agency
WWW.OCRRA.ORG
Prepared May 2011

ATTACHMENT 3

Ash Handling System Baghouse Control Guarantee

Dynamis Energy, LLC
776 E Riverside Dr. Ste.150
Eagle, ID 83616

Donaldson
Filtration Solutions

Donaldson Company, Inc.
Industrial Air Filtration
1400 West 94th Street
Bloomington, MN
55431-2370

Mailing Address:
P.O. Box 1299
Minneapolis, MN
55440-1299 U.S.A.

Tel 952-887-3847
Fax 952-698-2479
www.Donaldson.com
www.donaldsontorit.com

Dynamis Energy, LLC
Attn: K. Patrick Silveira
Address: 776 E Riverside Drive, Suite 150

April 25, 2012

Reference: Dynamis Energy, LLC Emission Guarantee for a Donaldson® Torit® Model DFO 3-24 Dust Collector with Ultra-Web® Filters.

Equipment	One Donaldson Torit Model DFO 3-24 dust collector equipped with (24) Ultra-Web filters.
Application	Waste-to-Energy Facility
Dust	Flyash
Inlet Loading	< 2 gr/dscf
Air Volume	14,000 ACFM
Gas Stream	Operating temperature of 100°F with a maximum temperature of 150°F
Collector Location	Outdoors
Collector Exhaust	Outdoors

The Donaldson® Torit® Model DFO 3-24 Collector equipped with 24 Donaldson Torit Ultra-Web® filters offers a net filtration area of 4560 square feet. Dividing the actual air volume by the filtration area provides a net air-to-media ratio of 3.07:1. Based on the Donaldson Torit Model DFO 3-24 Collector being installed and operated in accordance with the DFO Installation, Operation, and Maintenance Manual; accepted industrial ventilation practices; and under the conditions stated above, we are offering the following emission guarantee utilizing Donaldson Torit Ultra-Web filters. This guarantee does not cover filter failure due to negligence or improper operation and specifically excludes failure due to exceeding the recommended air-to-media ratio; damage due to fire, corrosion, abrasion or physical abuse; wet or oily compressed air usage, or the lack of adequate compressed air for proper filter cleaning.

Emission: The maximum average particulate emissions in the discharge gas stream from the Donaldson Torit DFO 3-24 Collector using the Donaldson Torit Ultra-Web filters will not exceed 0.005 grains per dry standard cubic foot of particulate matter 2.5 microns or smaller over the life of the media.

The guarantee period ends after 4000 hours of operation or 12 months from the date of shipment, whichever is shorter. This provides ample time to confirm performance meets the stipulated thresholds in this document.

[The emissions portion of this warranty requires that all emission testing be performed by a qualified testing agency agreed upon by Donaldson Company and Dynamis Energy, LLC. Such testing will be performed in accordance with recognized testing procedures, agreed upon by both Donaldson Company and Dynamis Energy, LLC. Fees for the testing will be the responsibility of Dynamis Energy, LLC.]

Pressure Drop: Average pressure drop not to exceed 6.0 inches of water gauge on a continual basis as measured across Donaldson Torit Ultra-Web filter media and tube sheet of the Torit DFO 3-24 collector.

During the warranty period, Donaldson Company reserves the right to make any modifications, adjustments or take other necessary corrective actions, at Donaldson's expense, should the guarantee not be met by equipment malfunction due to defects in materials and/or workmanship as supplied by Donaldson Company. In no event shall Donaldson Company be liable for incidental, special or consequential damages resulting from nonconformity. Failure to use genuine Donaldson replacement parts or changes to the original system, either process or engineering, will cancel this guarantee.

Regards,

Hube Visee

IAF National Sales Director

Guarantee Number: 12CK0406 Dynamis Energy, LLC

ATTACHMENT 4

Revised Air Dispersion Modeling Files (on CD)

Dynamis Energy, LLC
776 E Riverside Dr. Ste.150
Eagle, ID 83616

ATTACHMENT 5

Source Test Data (on CD)

Dynamis Energy, LLC
776 E Riverside Dr. Ste.150
Eagle, ID 83616

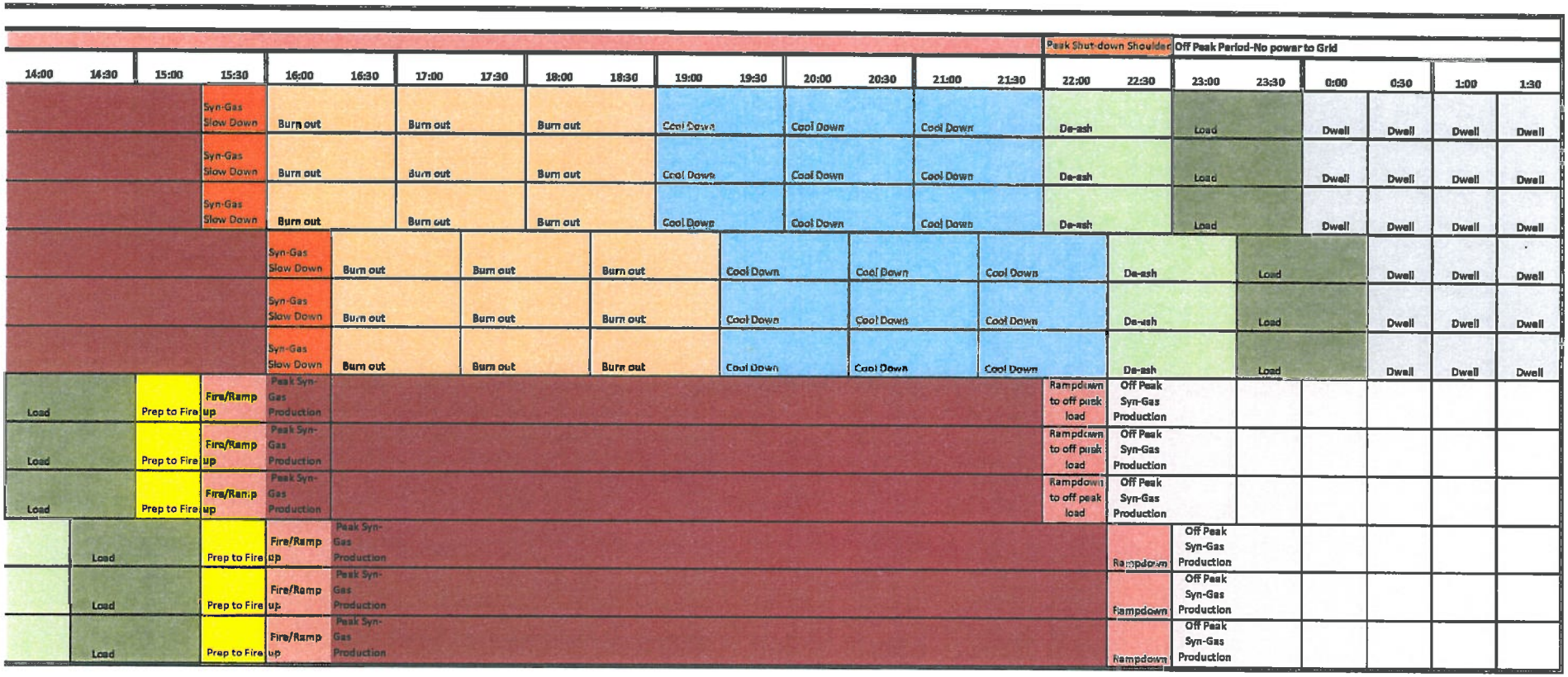
ATTACHMENT 6

Operations Time Chart

Dynamis Energy, LLC
776 E Riverside Dr. Ste.150
Eagle, ID 83616

Burn Schedule-6 Primaries/Super Peak Hour (12.5 lb/ft^3 MSW Density ~5800 BTU/lb MSW Heat Content)

Chamber Number	Off Peak No power to Grid hours										Peak Start-up Shoulder		Peak Power Production									
	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30
1	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Prep to Fire	Fire/Ramp up	Peak Syn-Gas Production												
2	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Prep to Fire	Fire/Ramp up	Peak Syn-Gas Production												
3	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Prep to Fire	Fire/Ramp up	Peak Syn-Gas Production												
4	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Prep to Fire	Fire/Ramp up	Peak Syn-Gas Production											
5	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Prep to Fire	Fire/Ramp up	Peak Syn-Gas Production											
6	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Dwell	Prep to Fire	Fire/Ramp up	Peak Syn-Gas Production											
7	Off Peak Syn-Gas Production										Syn-Gas Slow Down	Burn out					Cool Down		Cool Down		Cool Down		De-ash	
8	Off Peak Syn-Gas Production										Syn-Gas Slow Down	Burn out					Cool Down		Cool Down		Cool Down		De-ash	
9	Off Peak Syn-Gas Production										Syn-Gas Slow Down	Burn out					Cool Down		Cool Down		Cool Down		De-ash	
10	Off Peak Syn-Gas Production											Syn-Gas Slow Down	Burn out					Cool Down		Cool Down		Cool Down		De-ash
11	Off Peak Syn-Gas Production											Syn-Gas Slow Down	Burn out					Cool Down		Cool Down		Cool Down		De-ash
12	Off Peak Syn-Gas Production											Syn-Gas Slow Down	Burn out					Cool Down		Cool Down		Cool Down		De-ash


Peak Shut-down Shoulder
Off Peak Period-No power to Grid
14:00 14:30 15:00 15:30 16:00 16:30 17:00 17:30 18:00 18:30 19:00 19:30 20:00 20:30 21:00 21:30 22:00 22:30 23:00 23:30 0:00 0:30 1:00 1:30
Syn-Gas Slow Down
Burn out
Cool Down
De-ash
Load
Dwell
Load
Prep to Fire
Fire/Ramp up
Peak Syn-Gas Production
Rampdown to off peak load
Off Peak Syn-Gas Production
Rampdown