



[www.EnergyJustice.net](http://www.EnergyJustice.net)

*...helping communities protect themselves from polluting energy and waste technologies*

# Landfilling vs. Incineration



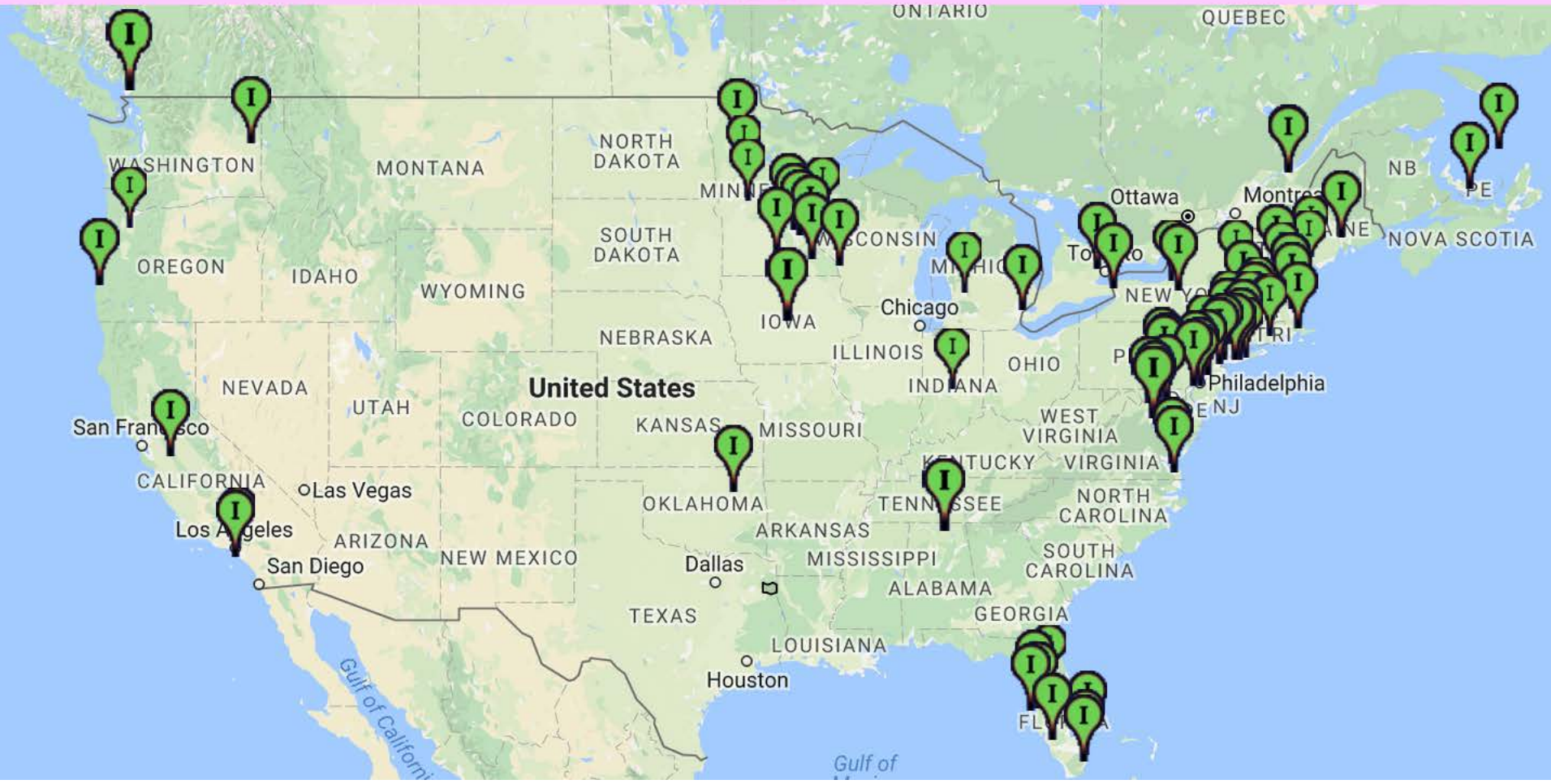
# Landfilling vs. Incineration



**...and Ash Landfilling**

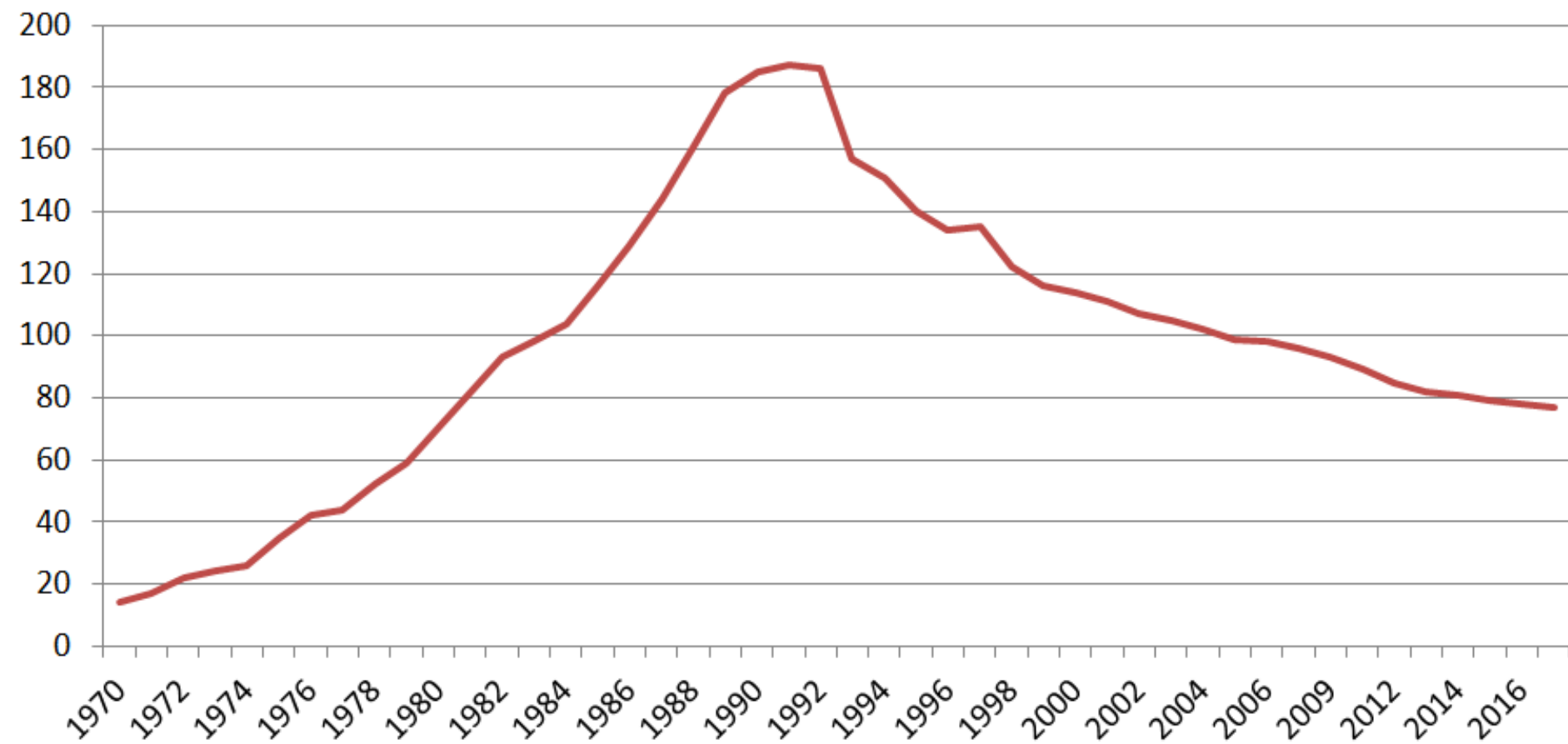
## National Map

Address:   [Save Map](#)   [Save as Image](#) [Advanced Mode](#) [Income & Race Help](#)





# Number of Commercial Trash Incinerators Operating in the U.S.



# World's largest waste corporation driving away from incineration



## THE WALL STREET JOURNAL

Jan 3, 2014: “Big Waste Hauler Rethinks Startups”

*[pulls out of gasification, pyrolysis, plasma and trash-to-ethanol investments, selling off Agilyx, Enerkem, Fulcrum, Genomatica & InEnTec]*

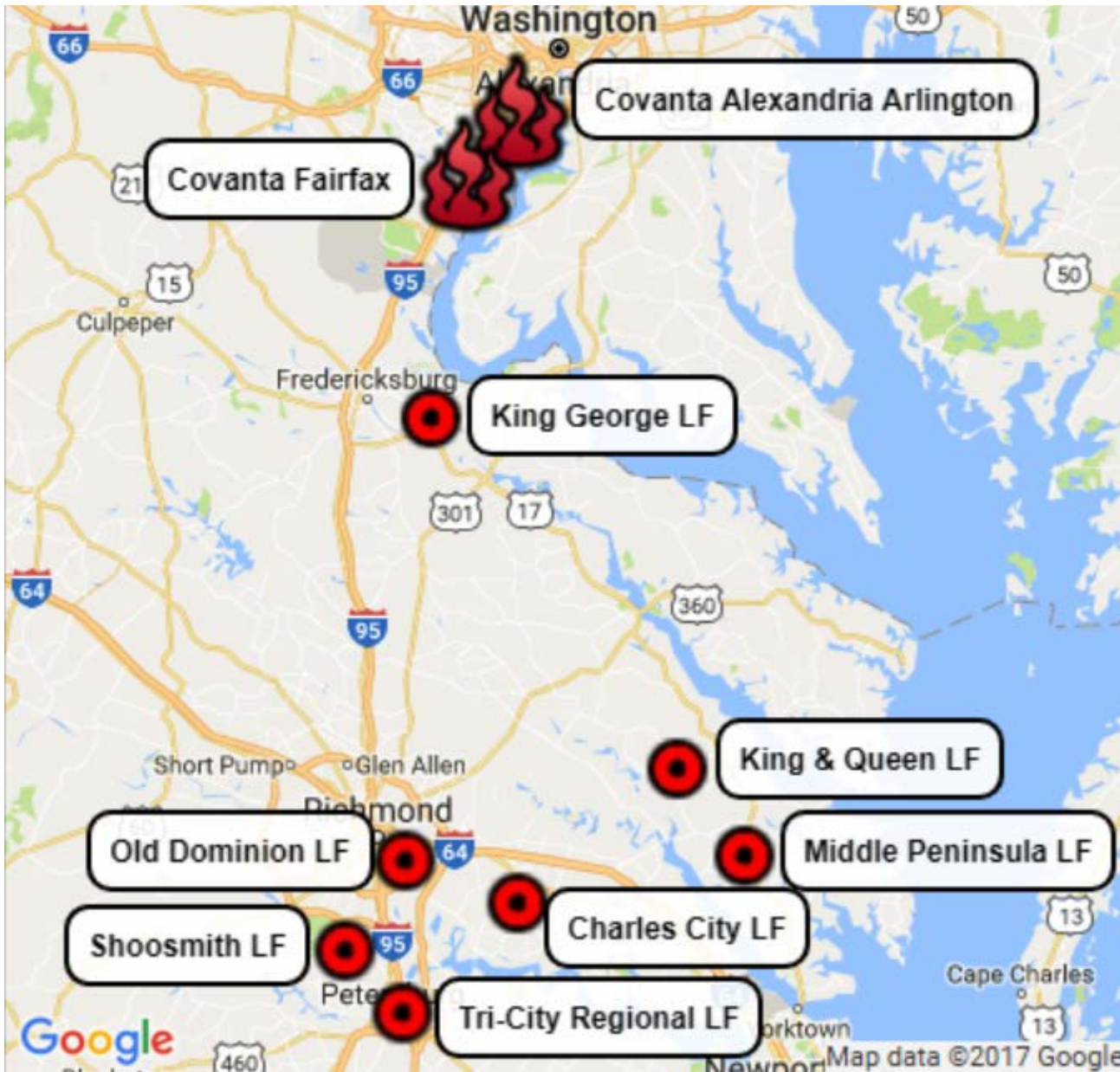
Jul 29, 2014: “Waste Management to Sell Wheelabrator for \$1.94 Billion”

*[pulls out of long-standing ownership of Wheelabrator, the second-largest operator of conventional incinerators in U.S.]*

# Where DC's waste went (to VA) in 2016:

<b>Covanta Fairfax</b>	<b>222,937</b>	<b>27%</b>
<b>Shoosmith Sanitary Landfill</b>	<b>221,415</b>	<b>27%</b>
<b>Middle Peninsula Landfill and Recycling Facility</b>	<b>190,323</b>	<b>23%</b>
<b>BFI Old Dominion Landfill</b>	<b>118,785</b>	<b>14%</b>
<b>Tri City Regional Disposal and Recycling Services</b>	<b>36,898</b>	<b>4%</b>
<b>King George Landfill &amp; Recycling Center</b>	<b>20,002</b>	<b>2%</b>
<b>Covanta Alexandria Arlington</b>	<b>16,690</b>	<b>2%</b>
<b>King and Queen Sanitary Landfill</b>	<b>267</b>	<b>0%</b>
<b>Charles City County Landfill</b>	<b>18</b>	<b>0%</b>
<b>Total:</b>	<b>827,335</b>	

# Where DC's waste went (to VA) in 2016:





# Facilities in Focus for 2017 & This Presentation

Facility Name	Type	Average Distance from DC Transfer Stations (mi)	Annual Precipitation (inches)	Years of Life Remaining
Covanta Fairfax	Incinerator	26		13 (if it lives to 40)
King George	Landfill	68	42.8	11
King & Queen	Landfill	122	45.4	26
Middle Peninsula	Landfill	130	45.4	73
Charles City	Landfill	130	46.3	74

**[“Other 3 Landfills” in future slides refers to the last three above, which are all about the same distance from DC.]**

# How to Compare?

- **Population impacted & environmental justice**
- **Human health impacts**
  - Nitrogen Oxide emissions (asthma)
  - Particulate emissions
  - Toxic and Cancer-causing emissions
- **Eutrophication**
- **Acidification (acid rain...)**
- **Ecosystem toxicity**
- **Ozone depletion**
- **Smog formation**
- **Global warming**
- **Cost**



# Data Sources

- **U.S. EPA**
  - National Emissions Inventory
  - Emissions & Generation Resource Integrated Database (eGRID)
  - FLIGHT (Greenhouse gas inventory)
  - Landfill Methane Outreach Program database
- **U.S. Energy Information Administration**
  - Form 860 database (Annual Electric Generator data)
  - Form 923 database (Annual Electric Utility Data)
- **Virginia Department of Environmental Quality**
- **DC Department of Public Works**
- **Energy Recovery Council**
- **Sound Resource Management Group**



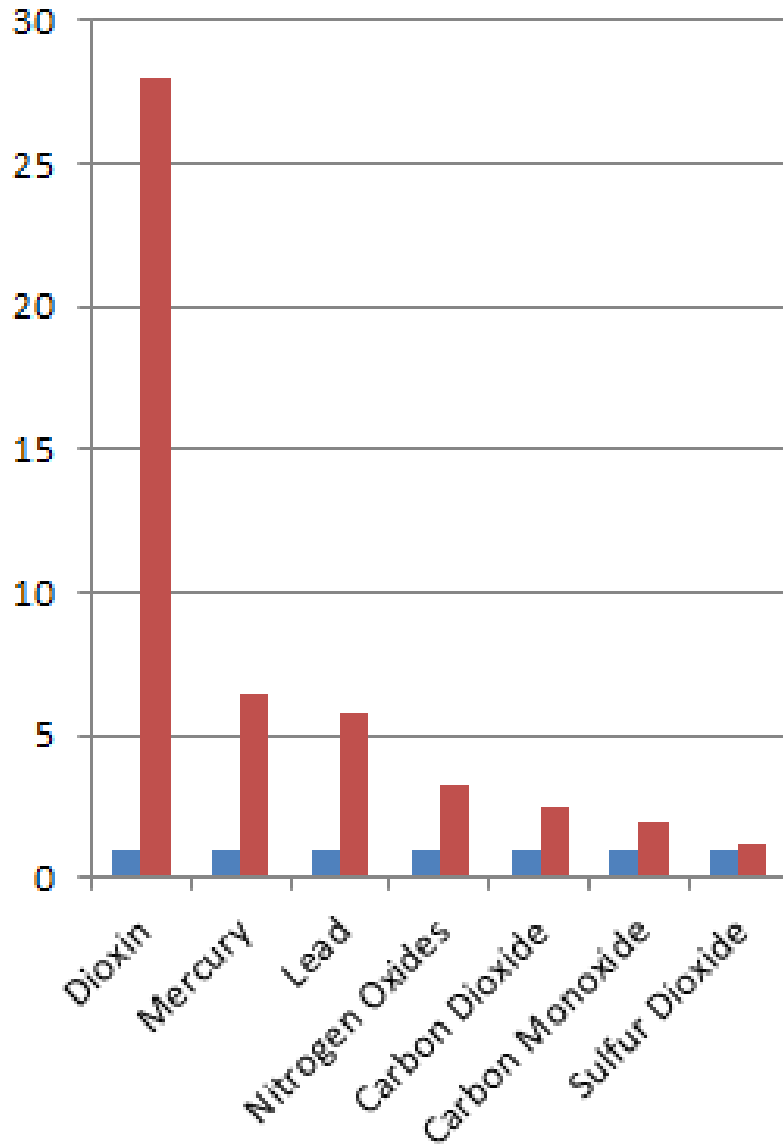
# Incineration Worse than Coal

## Toxic Air Emissions are...

- **Dioxins / furans** (28 times as much)
- **Mercury** (6-14 times as much)
- **Lead** (6 times as much)
- **Nitrogen Oxides (NO<sub>x</sub>)** (3.2 times as much)
- **Carbon Monoxide (CO)** (1.9 times as much)
- **Sulfur Dioxide (SO<sub>2</sub>)** (20% worse)
- **Carbon Dioxide (CO<sub>2</sub>)** (2.5 times as much)



# Incineration Worse than Coal



**Ratios of pollution levels emitted per unit of energy produced by U.S. coal power plants and trash incinerators**

■ Coal  
■ Trash Incineration



# Incinerator, Not a Power Plant

**“a waste-to-energy plant is designed to manage solid waste... the electricity output is a secondary function”**

Ted Michaels, President, Energy Recovery Council, March 18, 2013 testimony before Washington, DC City Council

# Covanta Fairfax Reported Emissions (2014)

<b>Global Warming Pollutants</b>	<b>Pounds released (2014)</b>
Carbon Dioxide (CO <sub>2</sub> )	2,169,540,876
Methane (CH <sub>4</sub> )	762,927
Nitrous Oxide (N <sub>2</sub> O)	100,130
<b>Health Damaging Pollutants</b>	<b>Pounds released (2014)</b>
Carbon Monoxide	11,319
Hydrochloric Acid	57,408
Hydrofluoric Acid	1,385
Lead	68
Nitrogen Oxides (NO <sub>x</sub> )	3,398,301
Particulate Matter (PM <sub>10</sub> )	14,709
Fine Particulate Matter (PM <sub>2.5</sub> )	8,862
Sulfur Dioxide	257,899
Volatile Organic Compounds	11,813

# EPA 2014 National Emissions Inventory Data

Row Labels	Grand Total	Percentage
Covanta Fairfax Inc	3,761,825.4	75%
Noman M Cole Jr Pollution Control Plant	623,138.0	12%
US Army - Fort Belvoir	264,181.0	
Kinder Morgan Southeast Terminals LLC-Newington	144,809.7	
Motiva Enterprises LLC - Springfield	105,306.2	
BARNARD	51,994.9	
Michigan Cogeneration Systems Inc	26,040.9	
I-66 Landfil	3,926.5	
RESTON HOSPITAL CENTER	603.0	
MOUNT VERNON HOSPITAL	603.0	
FORT BELVOIR COMMUNITY HOSPITAL	603.0	
INOVA FAIRFAX HOSPITAL	603.0	
ROUBIN & JANEIRO INC	603.0	
CRIPPENS	603.0	
CIA HEADQUARTERS	603.0	
FAIRFAX COUNTY POLICE	603.0	
7TH DIV STATE POLICE HQTRS	603.0	
INOVA FAIR OAKS HOSPITAL	603.0	
DAVISON AAF	12.7	
CENTREVILLE	12.7	



# Covanta Fairfax Emissions are Exceptional

**Within 20 miles of DC's borders, Covanta Fairfax is...**

- **#1 in Nitrogen Oxides**
  - So high that Covanta's home state of New Jersey singled out this incinerator as ineligible to sell renewable energy credits to NJ
  - #2 in the entire industry, worse than the Detroit incinerator (which has no NOx controls)
- **#1 in Carbon Dioxide**
- **#1 in Hydrochloric Acid**
- **#1 in Hydrofluoric Acid (was worst in their industry in 2008)**
- **#1 in Mercury**
- **#4 in Sulfur Dioxide**
- **Top 10 in Lead**
- **#3 in overall air pollution (after Dulles and DCA Airports)**

# Trash Incinerator Health Impacts

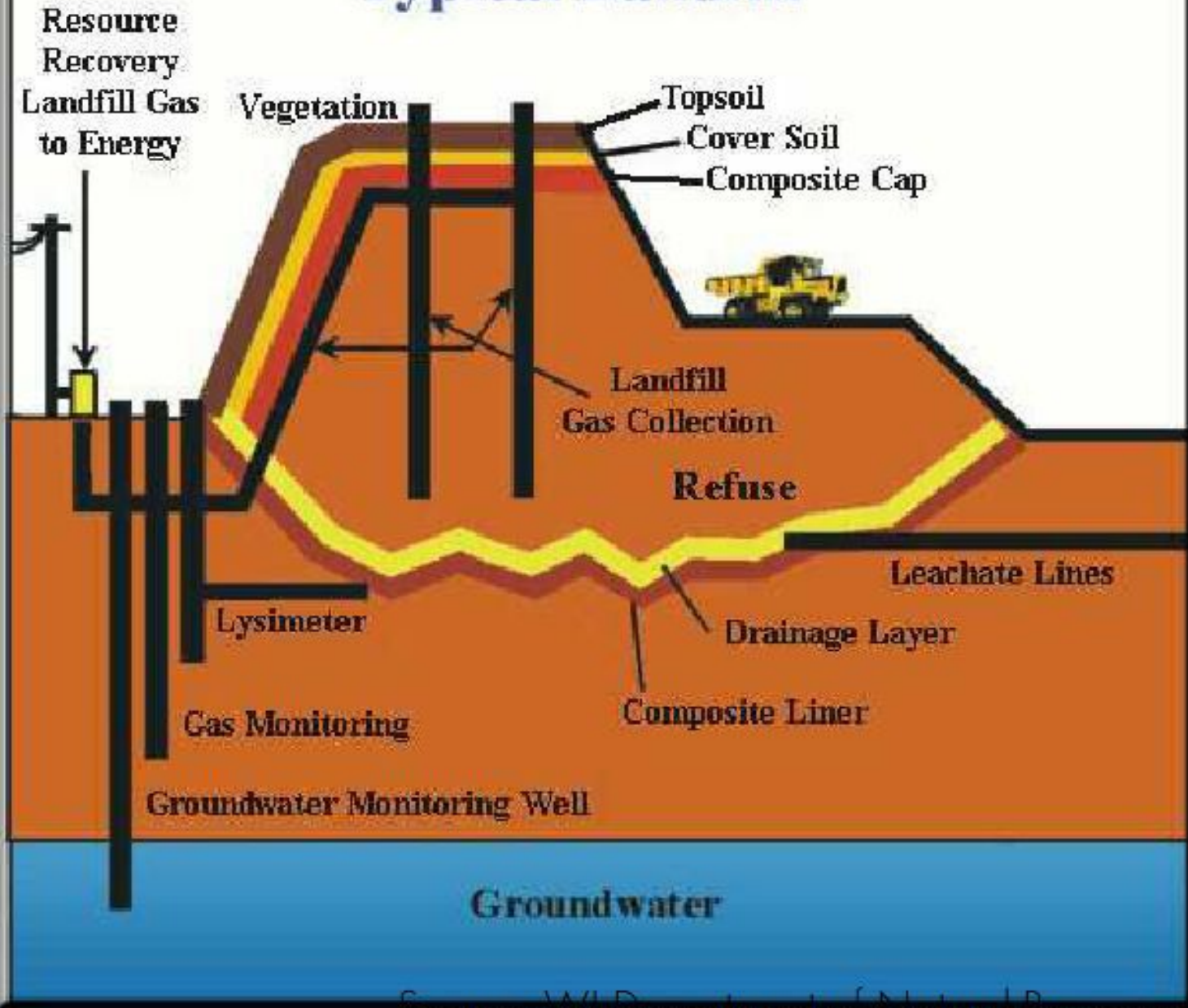
- Increased dioxins in blood of incinerator workers
- Increased cancers, especially:
  - laryngeal and lung cancers
  - childhood cancers
  - colorectal
  - liver
  - stomach
  - leukemia
  - soft-tissue sarcoma
  - non-Hodgkin's lymphoma
- Increases in babies born with spina bifida or heart defects
- Increases in pre-term births

# Landfills and Landfill Gas Burning



[www.energyjustice.net/lfg/](http://www.energyjustice.net/lfg/)

# Typical Landfill



Source: WI Department of Natural Resources

# All Landfills Leak

- U.S. EPA acknowledges that all landfill liners leak within 20 years, if not sooner
- Landfill liners are only guaranteed for about 20 years
- Landfills are permitted to leak a certain amount of gallons/acre
- It's easy not to find leakage (underground or in air); testing is often inadequate

# Landfill Gas: What it is...

- Not simply “methane”
- About half methane, half CO<sub>2</sub>
- Organics breaking down create the methane; methane helps the toxic chemicals escape
- Hundreds of toxic contaminants
  - Halogenated compounds (trichloroethane, vinyl chloride, carbon tetrachloride and many more)
  - Mercury (methylmercury – the really bad kind)
  - Sulfur compounds (the stinky stuff)
  - Tritium (radioactive)
  - Other toxic organic compounds (benzene , toluene...)

1 -butanol	2,6-dimethylheptane	4-methyl-2-pentanol + branched C-8 paraffin	butanol isomer?
1 -chloro-1 -fluoroethane	2-butanethiol	acetaldehyde	butyl hexanoate
1 -chloro-1 -propene	2-butanol	acetone	butylcyclohexane
1 -chloropropane	2-chloropropane	acetone + ethanol	butylene
1 -heptene	2-ethylfuran	alpha thujene	butylpropanoate
1 -octene	2-ethylhexyl alcohol	alpha-pinene	C-1 0 olefin
1 -pentene	2-ethyl-1-hexanol	alpha-thugene	C-1 1 diene
1 -propanol	2-methyldecalin	alpha-thujene	C-1 1 olefin
1, 1 -dichloroethane	2-methyl heptane	alpha-thujene + branched C-10 paraffin	C-1 1 paraffin
1, 1, 1 -trichloroethylene	2-methyl propanoate	benzene	C-1 1 paraffin + C-3 benzene
1, 1,2,3-tetramethyl-cyclohexane	2-methyl-2-propanethiol	benzothiazole	C-1 1 cycloparaffin
1,1,3-trimethylcyclohexane	2-methyl-3-pentanone + pentanol isomer	beta-pinene	C-10 diene
1,1-dichloroethane	2-methylbutane	branched C-1 1 olefin	C-10 olefin
1,1-dimethyl-cyclopropane	2-methyl-butane	branched C-1 1 olefin & paraffin + C-1 2 diene	C-12 diene
1,2,3-trimethylcyclohexane	2-methyl-ethyl butanoate	branched C-1 1 olefin + branched C-1 2 olefin	C-3 alkylcyclohexane isomer
1,2,3-trimethylcyclohexane isomer	2-methylfuran	branched C-1 1 paraffin	C-3 alkyl-substituted cyclopentadiene isomer
1,2-dichloroethene	2-methylheptane	branched C-1 1 paraffin	C-3 benzene
1,2-dichloroethylene	2-methylhexane	branched C-10 olefin	C-3 benzene + branched C-1 1 paraffin
1,2-dichloropropane	2-methylhexylbutyrate	branched C-10 olefin + branched C-1 1 paraffin	C-3 benzene + branched C-10 olefin + paraffin
1,3,5-trimethylcyclohexane	2-methyl-1-propanol	branched C-10 olefin + C3-benzene, ...	C-3 benzene + branched C-10 paraffin
1,3,5-trimethylcyclohexane isomer	2-methyloctahydropentalene	branched C-10 paraffin	C-3 benzene + C-1 1 paraffin
1,3-dichloro-2-butene	2-methylpentane	branched C-10 paraffin + 2-methylhexylbutanoate	C-3 benzene + C-10 paraffin
1,5-cyclooctadiene	2-methylthiobutane	branched C-10 paraffin + beta-pinene	C-3 benzene + C-9 diene
1-butanol	2-methylthiopropene	branched C-10 paraffin + branched C-10 olefin	C-3 benzene + octahydro-2-methylpentalene
1-butanol + 1,2-dichloropropane	2-pentanone + 1,2-dichloropropane	branched C-10 paraffin + phellandrene	C-3 benzene isomer
1-chloropropane	2-pentene	branched C-12 diene	C-3 cyclohexane

# Landfill Health Impacts

**A New York study of 38 landfills found that women living near solid waste landfills where gas is escaping have a four-fold increased chance of bladder cancer or leukemia.**

[“Investigation of Cancer Incidence and Residence Near 38 Landfills With Soil Gas Migration Conditions, New York State, 1980-1989,”](#) State of New York Department of Health, (Atlanta, Ga: Agency for Toxic Substances and Disease Registry, June, 1998).



# Life Cycle Analysis on DC Waste Options

Analysis done by:

Jeffrey Morris, Ph.D. (Economics)

Sound Resource Management Group

360-867-1033

jeff.morris@zerowaste.com

[www.zerowaste.com](http://www.zerowaste.com)

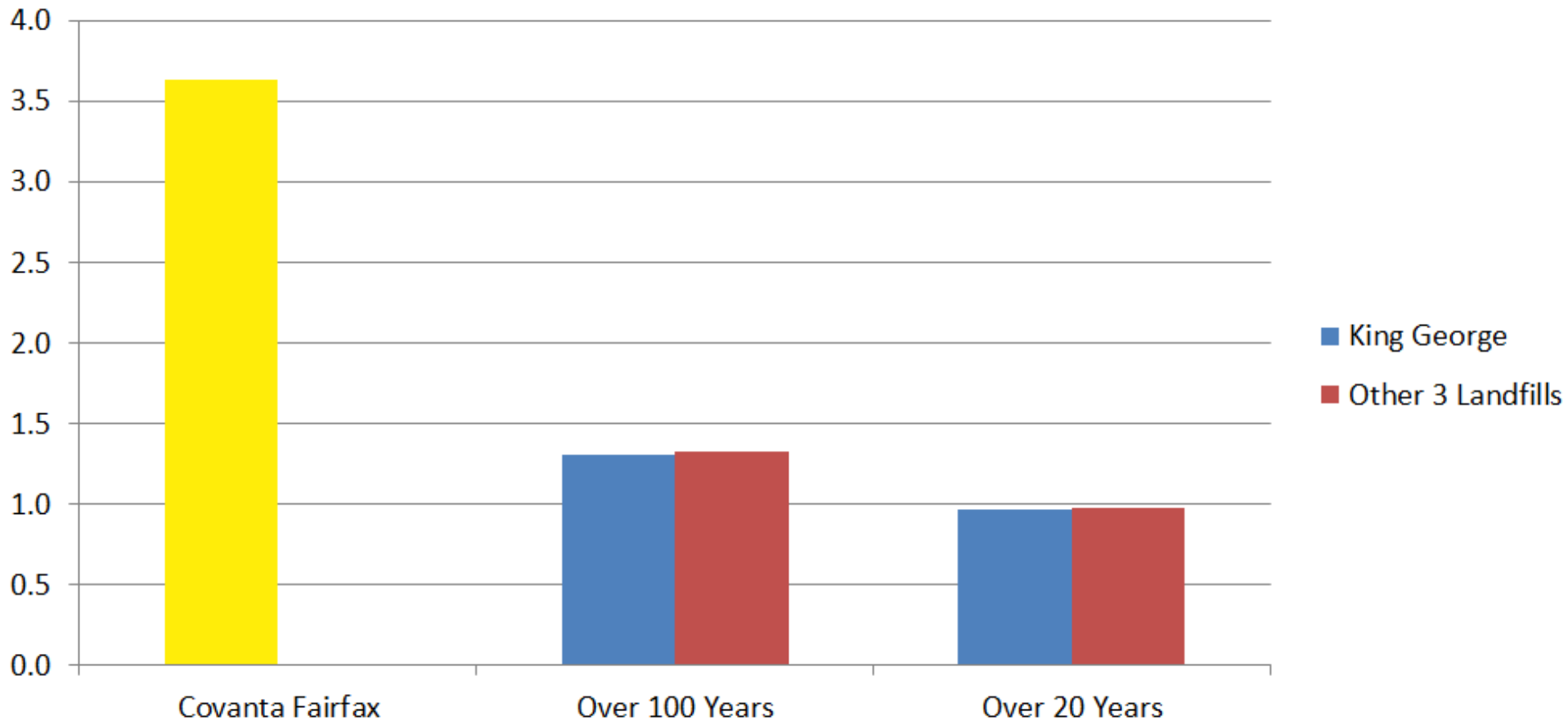
Dr. Morris authored several peer reviewed published studies on waste systems.

# Life Cycle Analysis on DC Waste Options

- All comparison data includes pollution from trucking.
  - Note the tiny difference that doubling hauling distance makes.
- A 75% landfill gas capture rate is assumed, based on what was reported to us in calls to the four landfills. All three we reached independently reported the same percentage.
- For the landfills, the best data available for DC waste composition is used. Where categories were vague, we filled in the proportions with more detailed data from Montgomery County's waste characterization study. Actual emissions data for Covanta Fairfax is used, as reported to EPA.
- We used local precipitation data from the areas where the landfills are located, which is wetter than average.
- “Other 3 Landfills” = King & Queen LF, Middle Peninsula LF, and Charles City LF

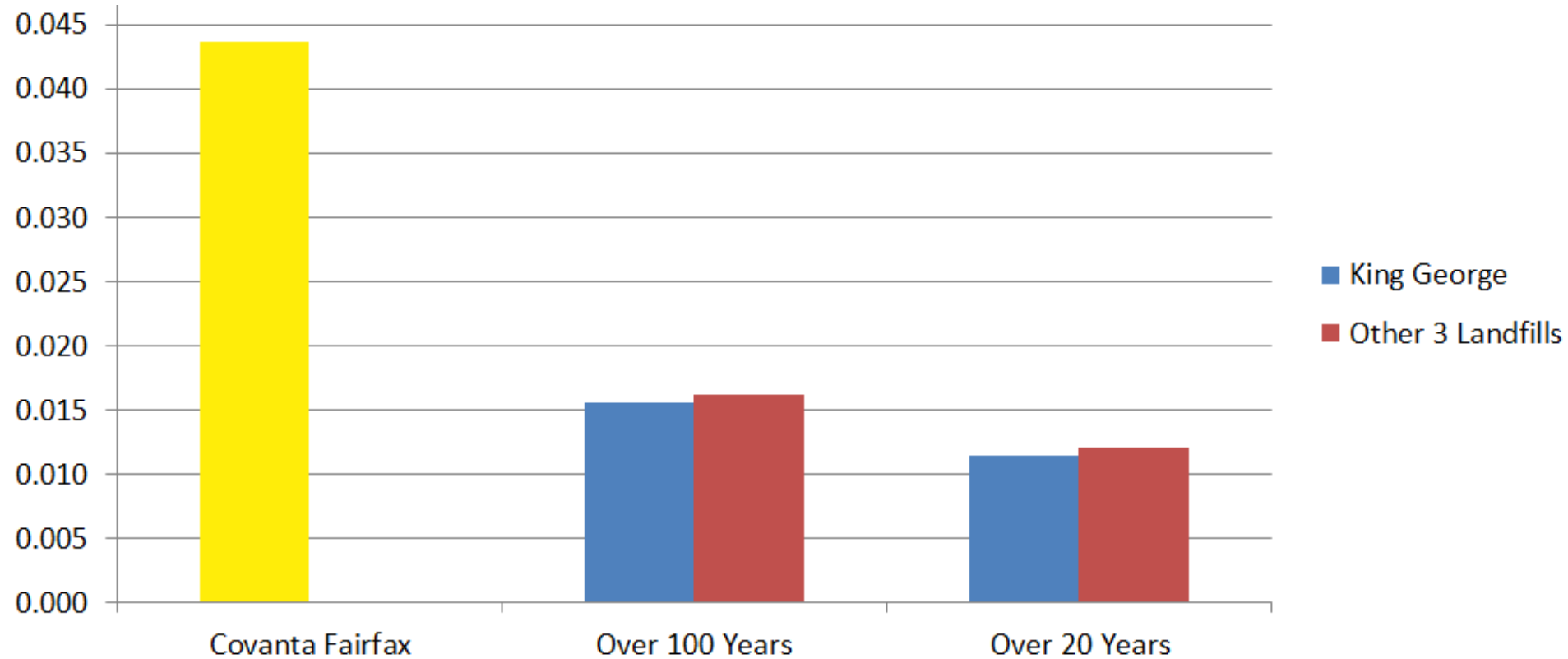
# Nitrogen Oxide (NOx) Pollution

[Pounds of NOx per ton of waste disposed.]



# Particulate Matter Pollution

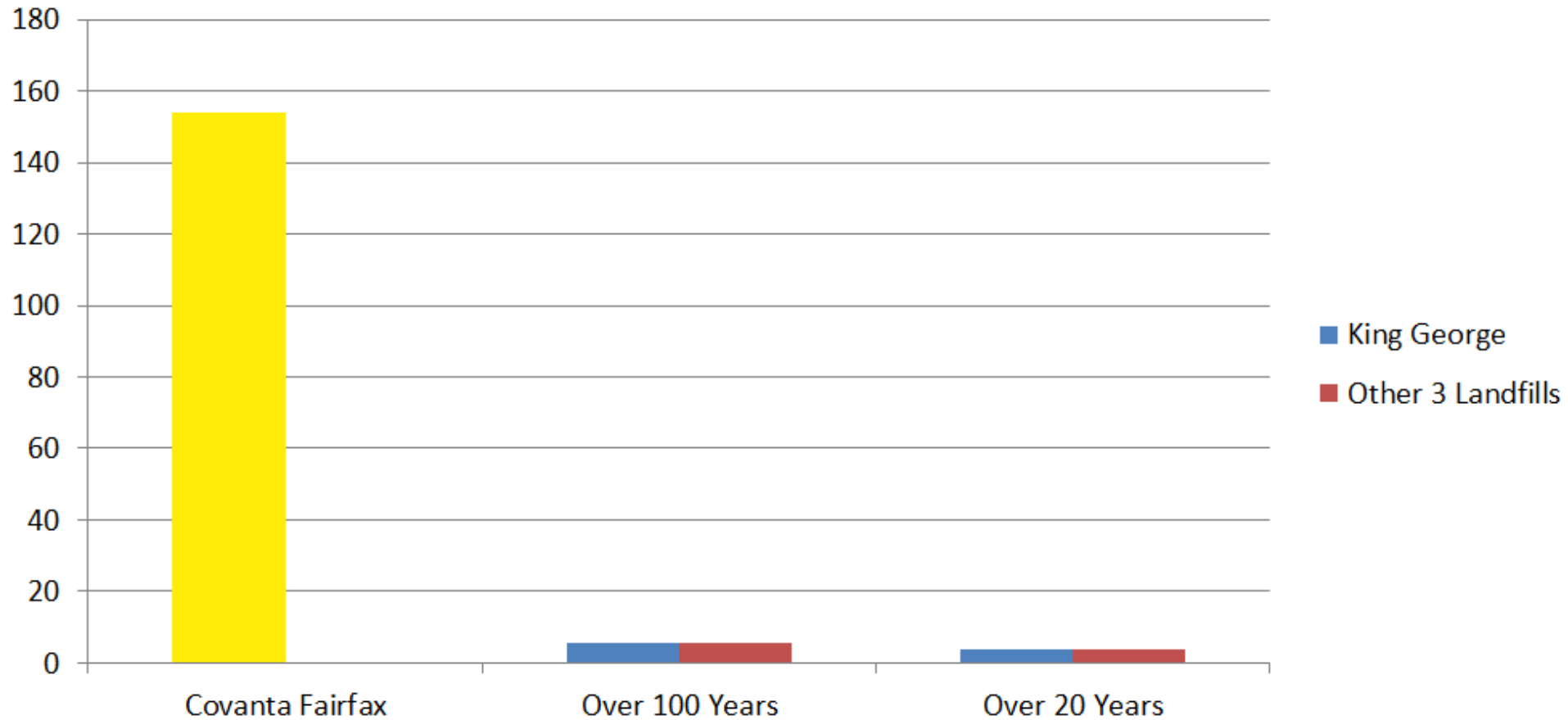
[Pounds of PM2.5 equivalent per ton of waste disposed.]



# Toxic Pollution

[Pounds of toluene equivalent per ton of waste disposed.]

Does not include dioxin/furan emissions.

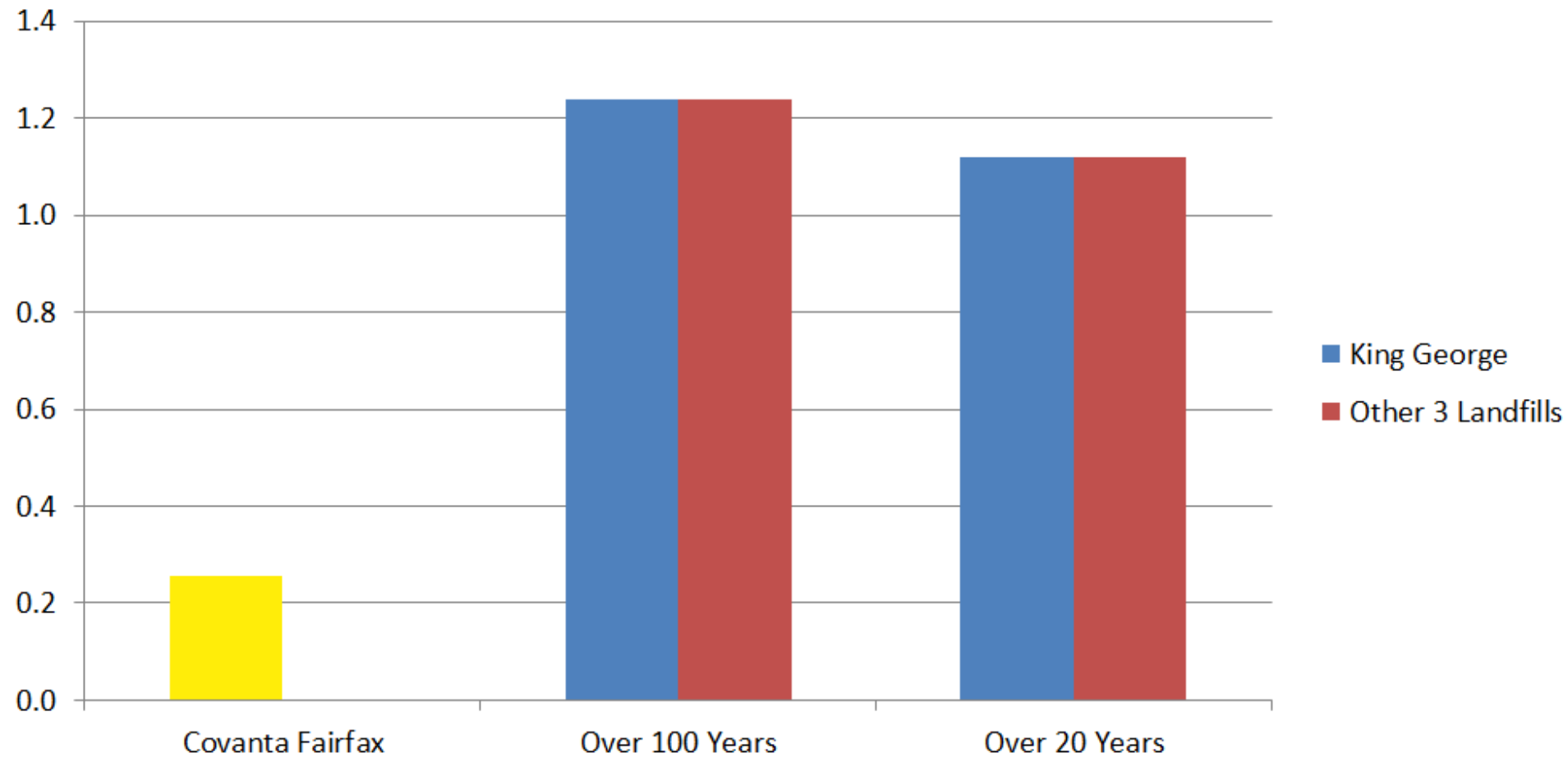




# Carcinogenic Pollution

[Pounds of benzene equivalent per ton of waste disposed.]

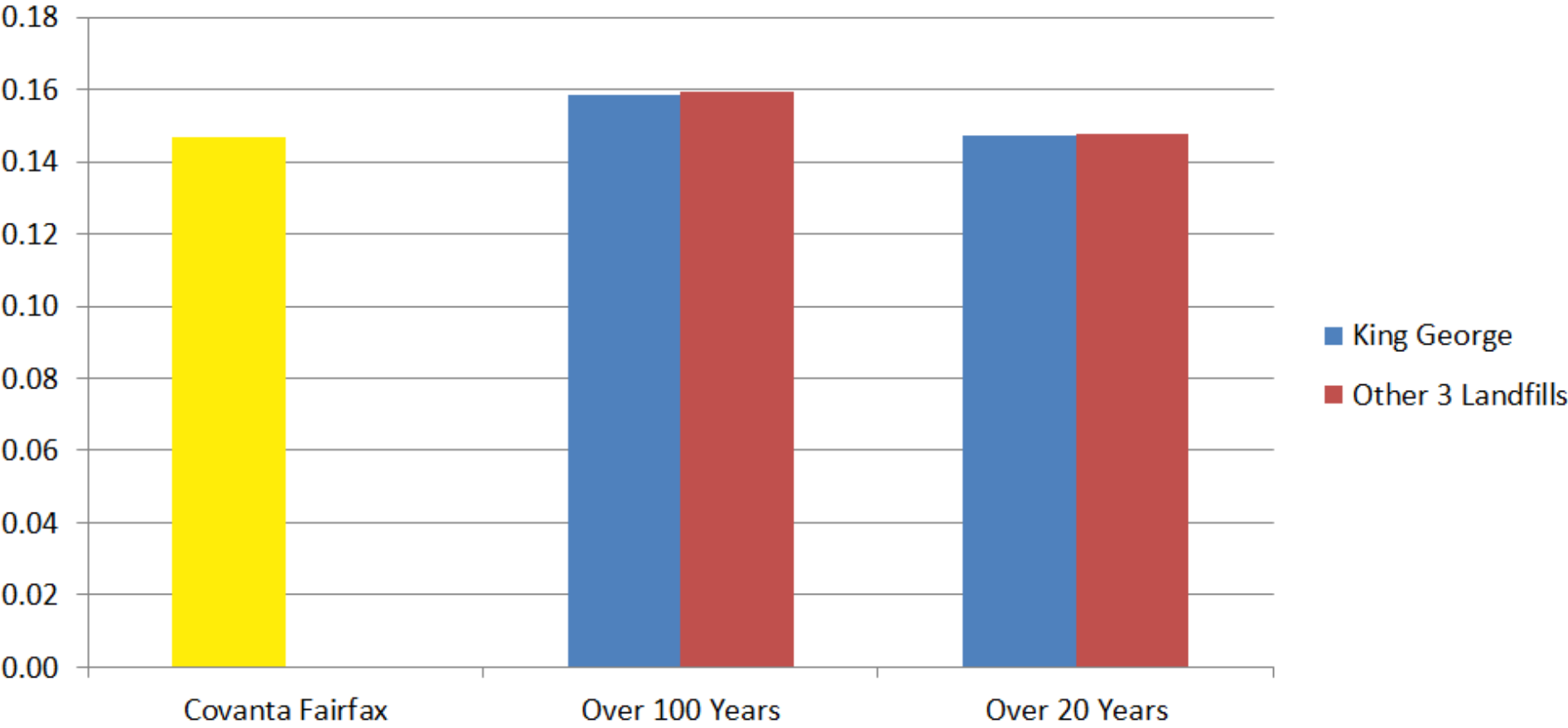
Does not include dioxin/furan emissions.



# Eutrophication

[Pounds of nitrogen equivalent per ton of waste disposed.]

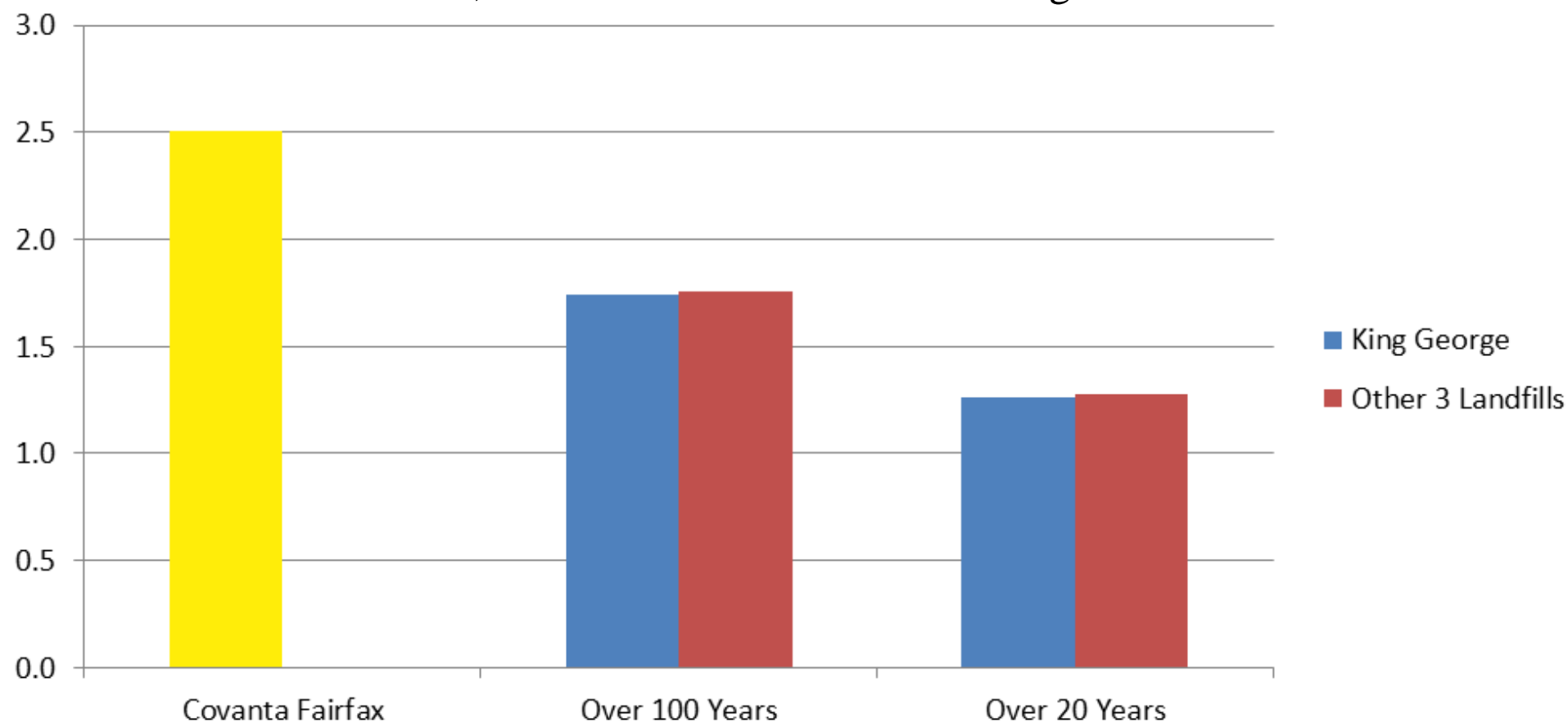
NOx and ammonia air emissions plus BOD, COD, phosphate, and ammonia water releases from landfills.



# Acidification

[Pounds of SO<sub>2</sub> equivalent per ton of waste disposed.]

Incinerator emissions are largely from nitrogen oxides, but also include other acid gases (SO<sub>2</sub>, HCl, HF). For the landfills, it's hydrogen sulfide (H<sub>2</sub>S) from the landfill, plus ammonia, NO<sub>x</sub> and SO<sub>x</sub> from the landfill gas burners.

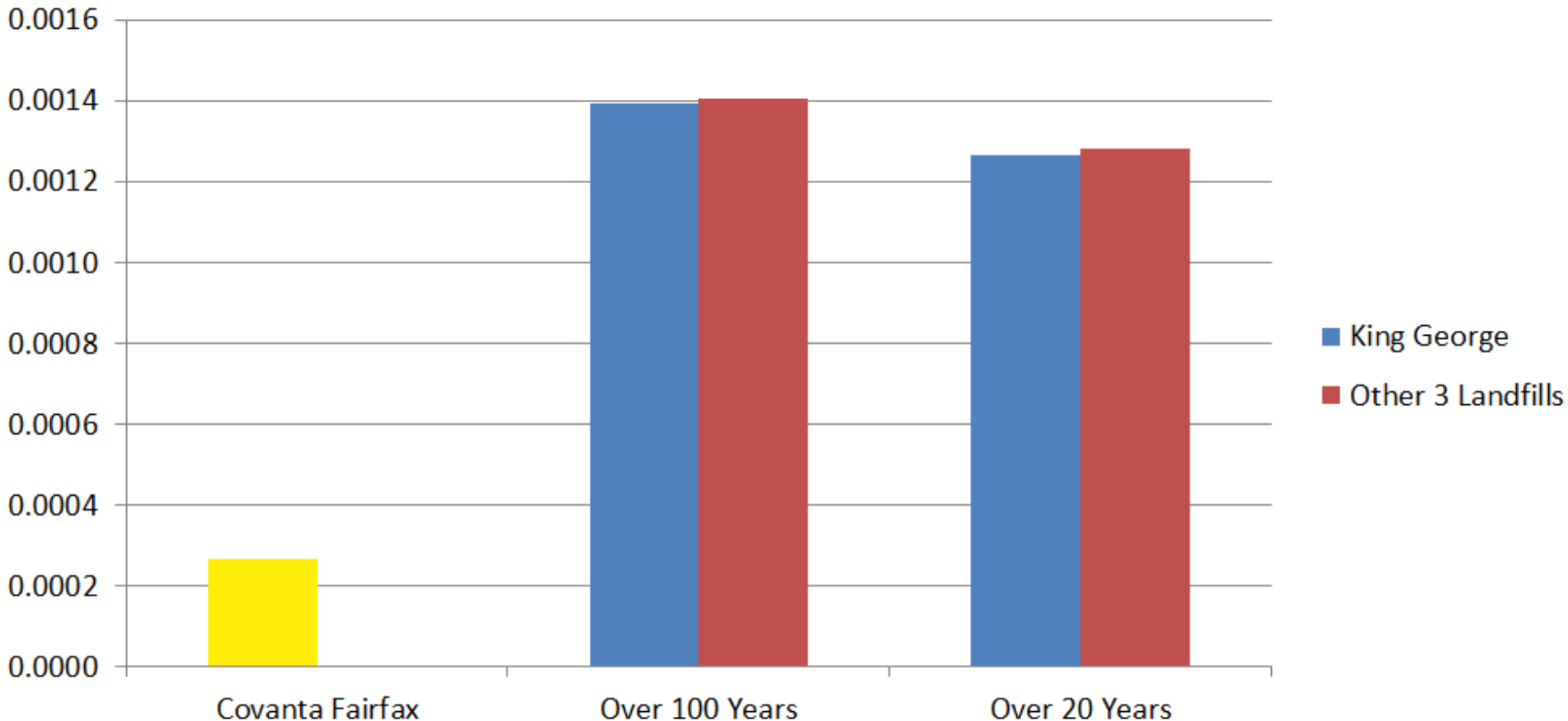




# Ecosystems Toxicity

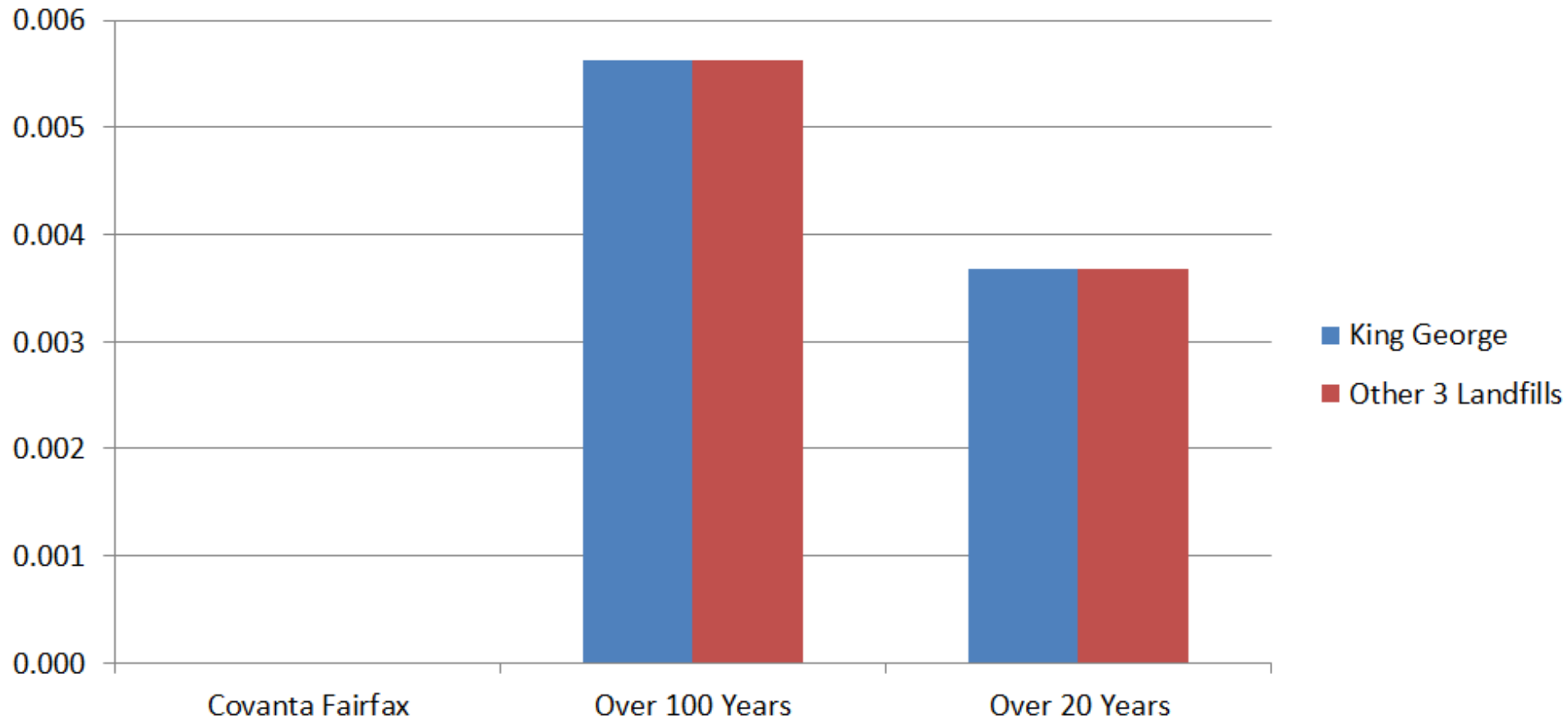
[Pounds of 2,4-D herbicide equivalent per ton of waste disposed.]

For the incinerator, this is mainly based on mercury emissions. For the landfill, mainly formaldehyde.



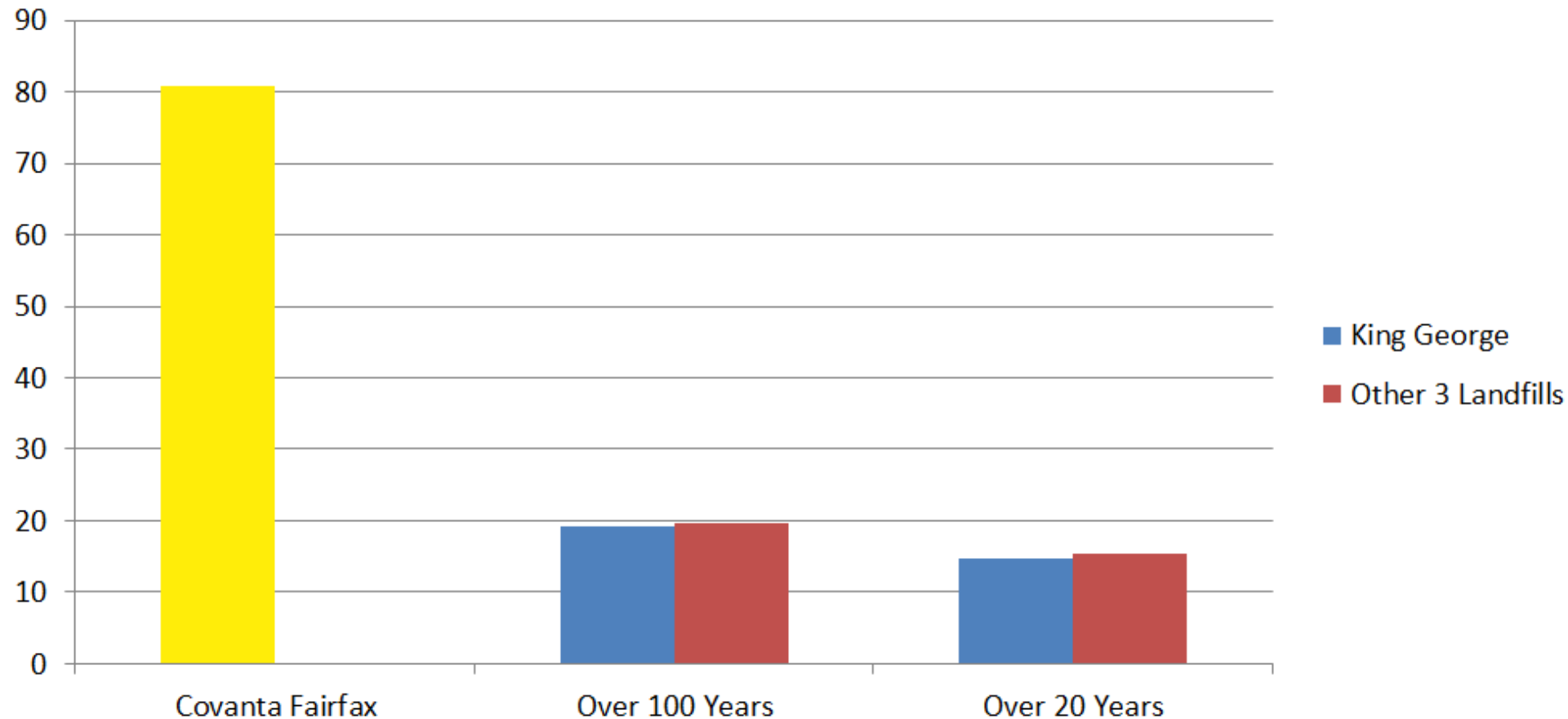
# Ozone Depletion

[Pounds of CFC-11 equivalent per ton of waste disposed.]



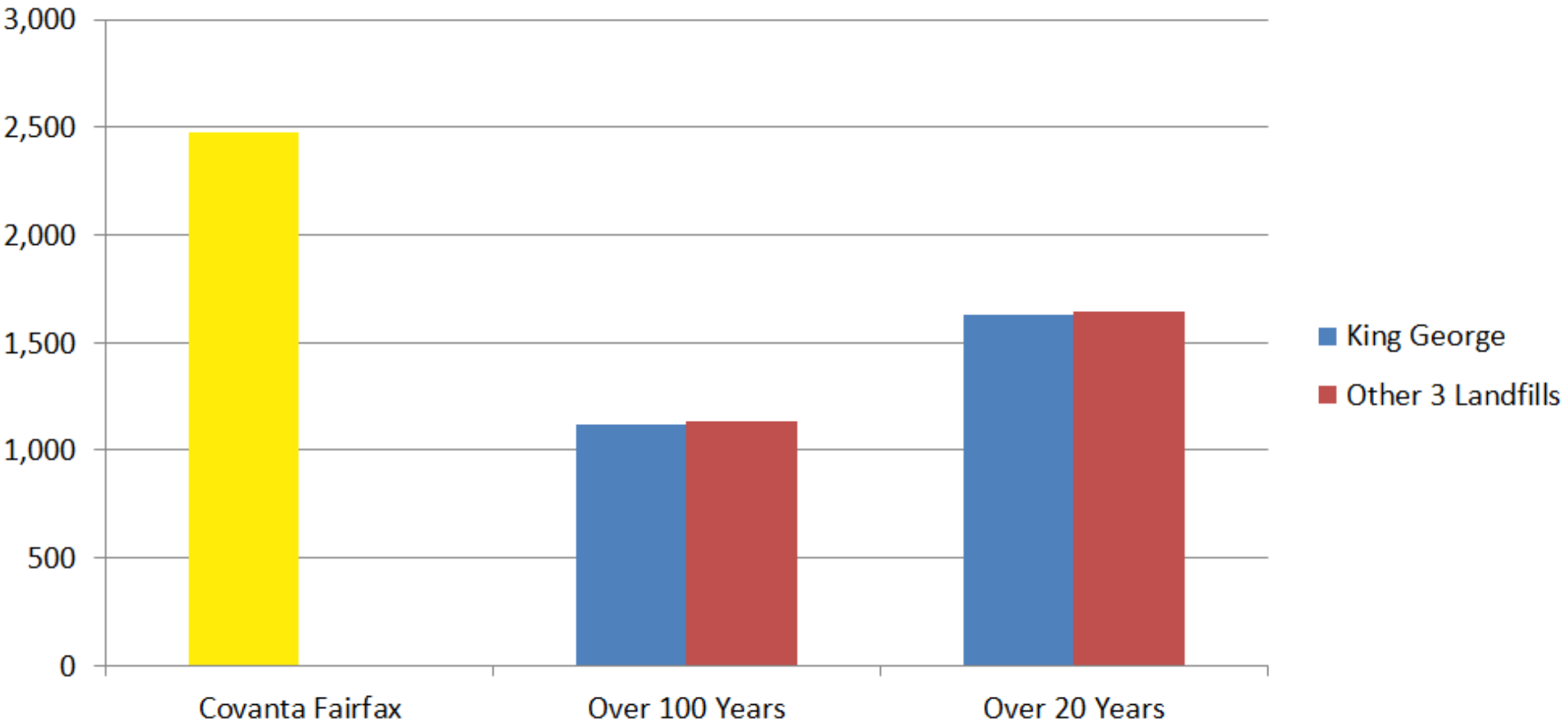
# Smog Formation

[Pounds of ozone (O<sub>3</sub>) equivalent per ton of waste disposed.]



# Global Warming Pollution

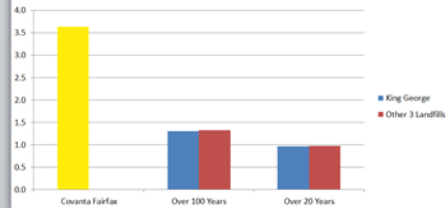
[Pounds of CO<sub>2</sub> equivalent per ton of waste disposed.]



# Recap!

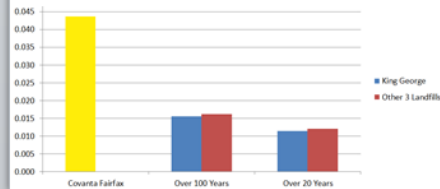
## Nitrogen Oxide (NOx) Pollution

[Pounds of NOx per ton of waste disposed.]



## Particulate Matter Pollution

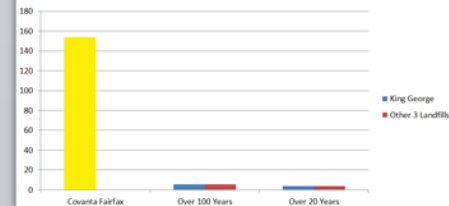
[Pounds of PM2.5 equivalent per ton of waste disposed.]



## Toxic Pollution

[Pounds of toluene equivalents per ton of waste disposed.]

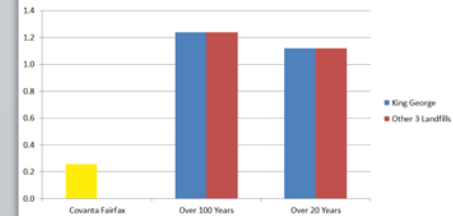
Does not include dioxin/furan emissions.



## Carcinogenic Pollution

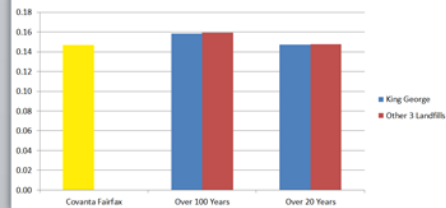
[Pounds of benzene equivalent per ton of waste disposed.]

Does not include dioxin/furan emissions.



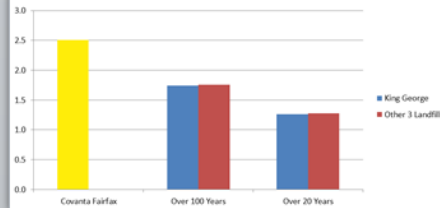
## Eutrophication

[Pounds of nitrogen equivalent per ton of waste disposed.]



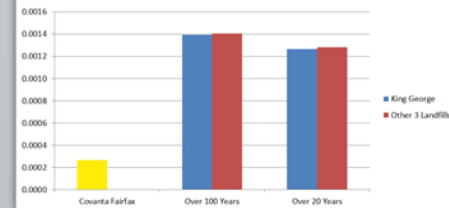
## Acidification

[Pounds of SO<sub>2</sub> equivalent per ton of waste disposed.]



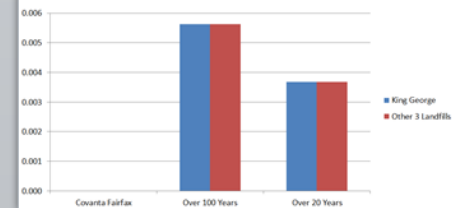
## Ecosystems Toxicity

[Pounds of 2,4-D herbicide equivalents per ton of waste disposed.]



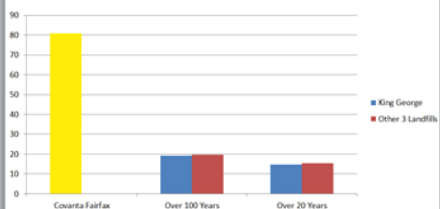
## Ozone Depletion

[Pounds of CFC-11 equivalent per ton of waste disposed.]



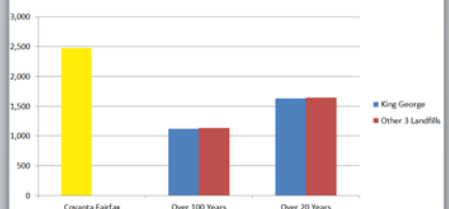
## Smog Formation

[Pounds of ozone (O<sub>3</sub>) equivalent per ton of waste disposed.]



## Global Warming Pollution

[Pounds of CO<sub>2</sub> equivalent per ton of waste disposed.]

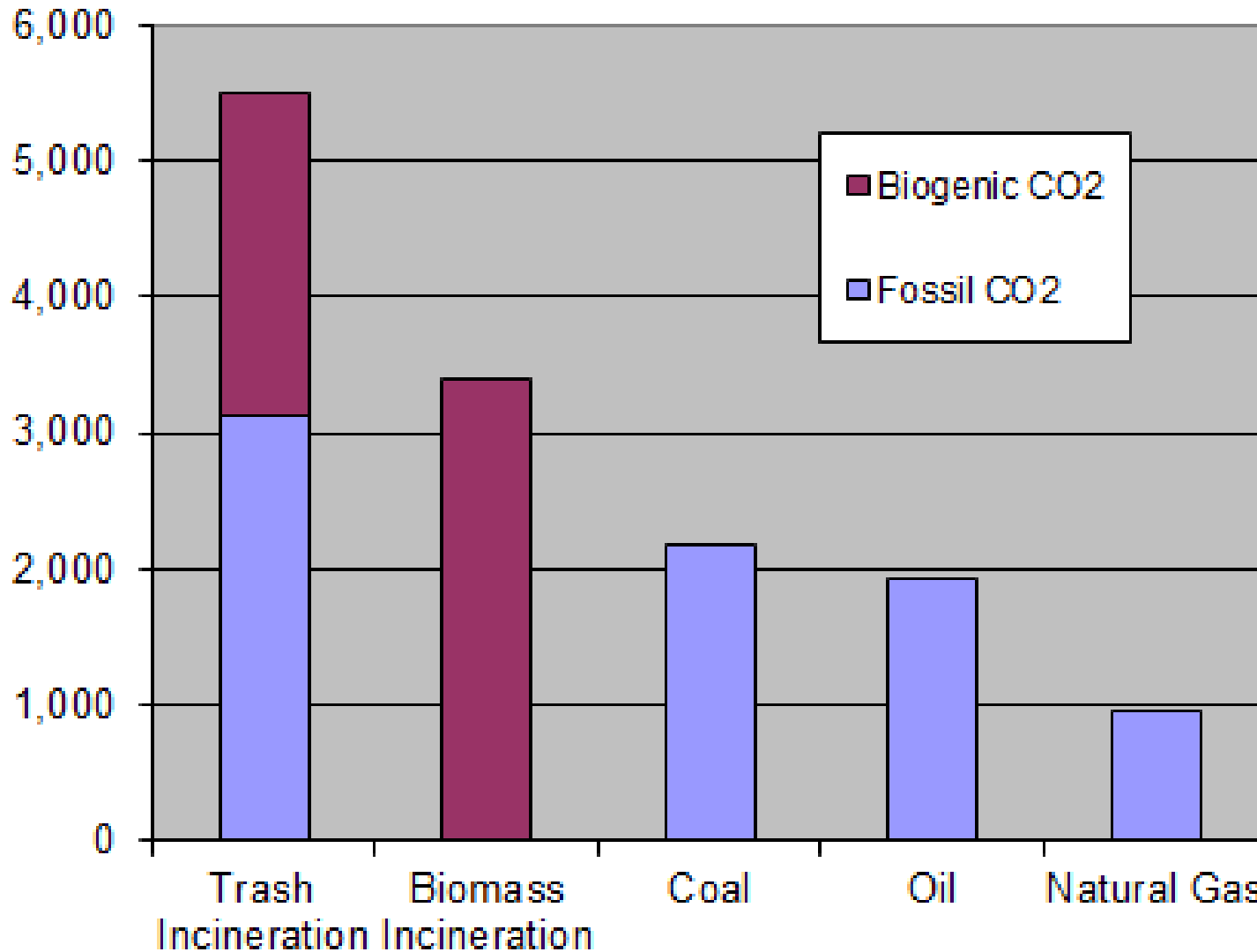




# Global Warming Pollution

## Smokestack CO2 Emissions from U.S. Power Plants

### CO2 (lbs/MWh)



Data is in pounds of CO2 per unit of energy produced (lbs/MWh)

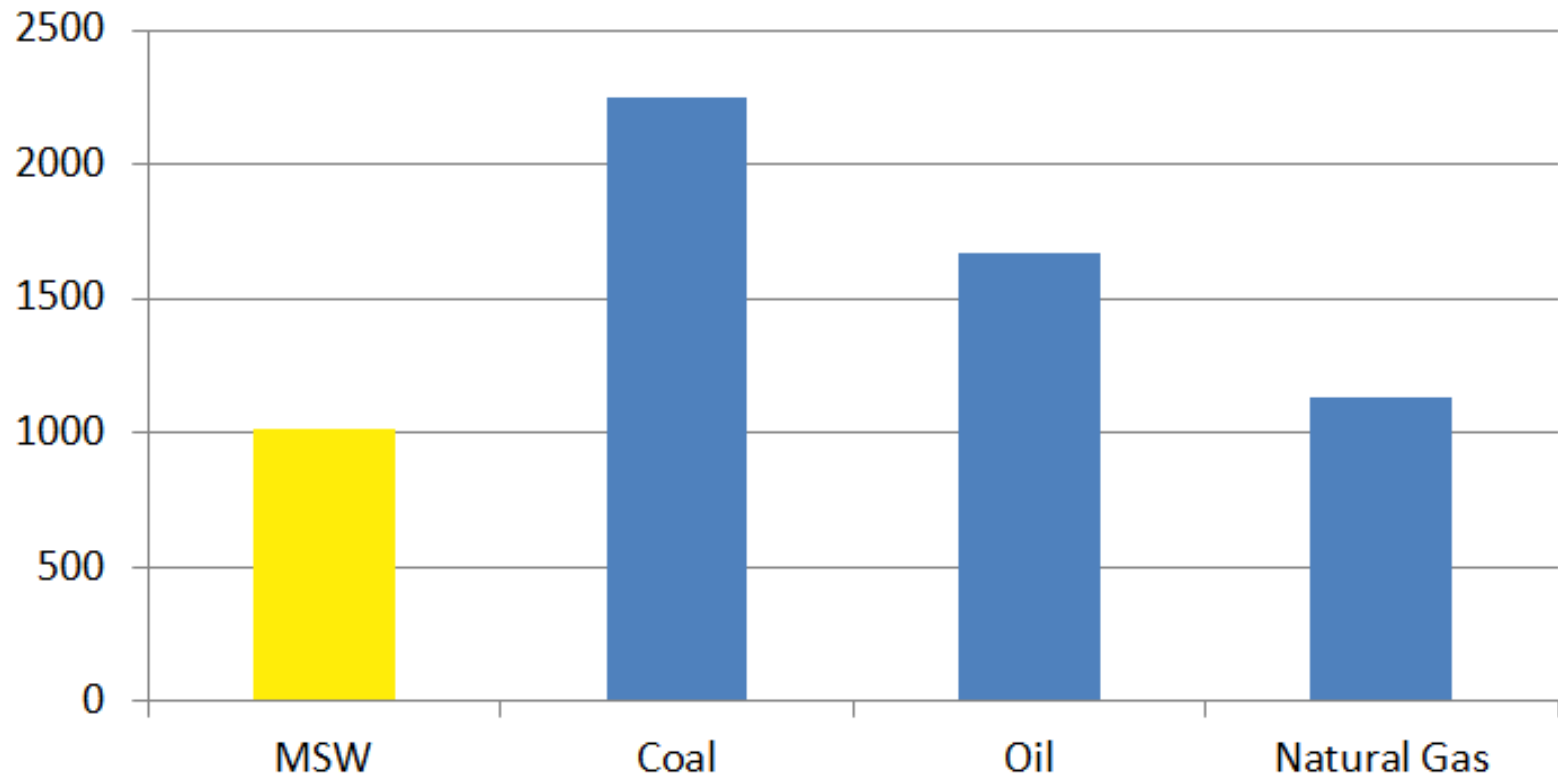
Source: U.S. EPA  
Emissions &  
Generation  
Resource Integrated  
Database (eGRID)  
v.9, released  
2/24/2014  
(2010 data)



# Global Warming Pollution

[EPA Public Relations on MSW Incineration]

## CO2 (pounds per megawatt hour)

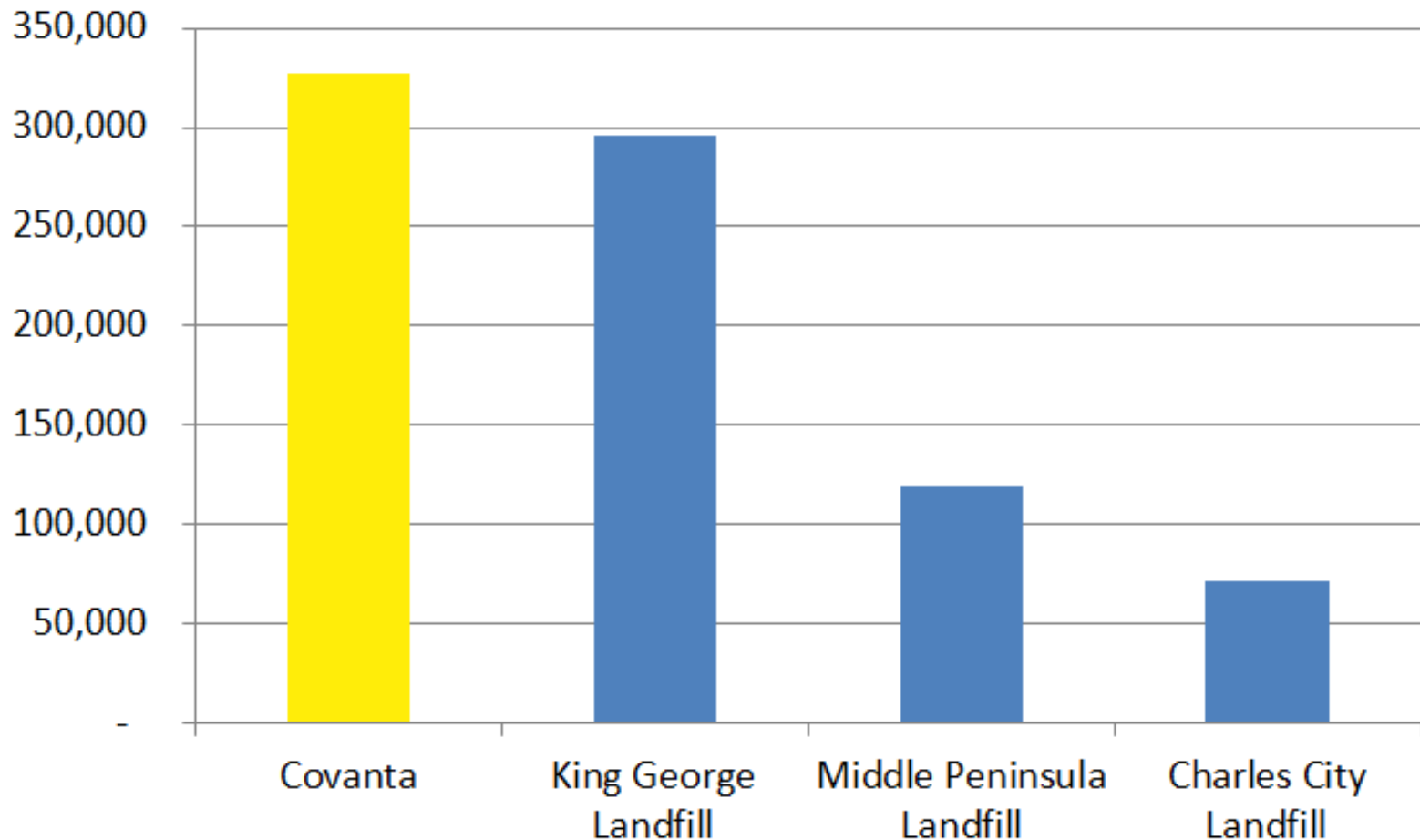




# Global Warming Pollution

[EPA FLIGHT Data in 2015 metric tons CO2 equivalent.]

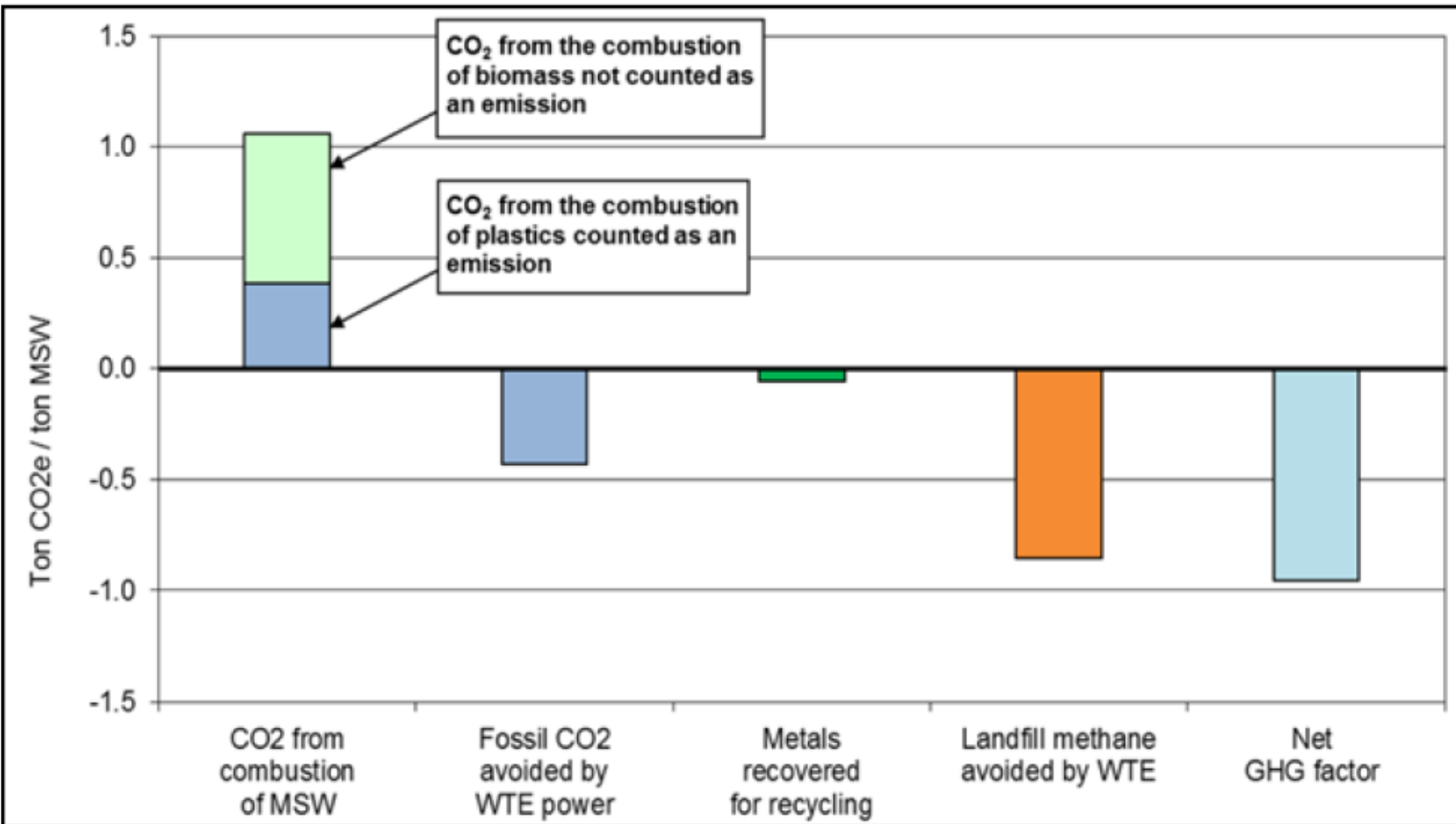
NOTE: This ignores biogenic emissions from incineration, but not from landfills, making Covanta seem half as bad as they are.





# Global Warming Pollution

[Energy Recovery Council Public Relations on MSW Incineration]





# How they Mislead on Global Warming

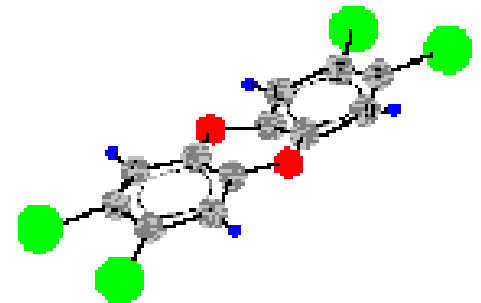
- Ignoring the “biogenic” half of carbon emissions.
  - Biomass carbon neutrality has been scientifically debunked. See a compilation of the science here: [www.energyjustice.net/biomass/carbon](http://www.energyjustice.net/biomass/carbon)
- Pretending “biogenic” carbon’s share in MSW is larger than the 52.7% that EPA factors into their eGRID data.
- Subtracting avoided methane emissions from landfills, as if conventional landfills are the only alternative.
- Subtracting emissions from offsetting fossil fuel electricity
  - ...as if they’re not just as readily competing with wind power, especially with Covanta Fairfax cashing in on in Maryland Tier I Renewable Energy Credits (\$3.9 million in 2015).
- Subtracting emissions due to recycling of metals that remain in the ash after combustion.
- Subtracting emissions from avoided transportation to landfills.

Details at: [www.energyjustice.net/incineration/climate](http://www.energyjustice.net/incineration/climate)

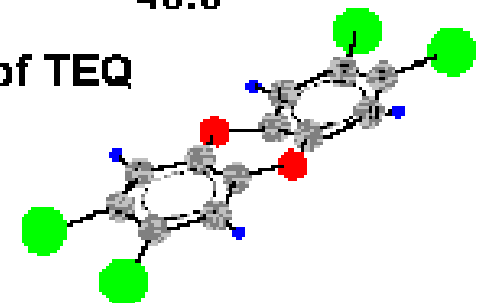
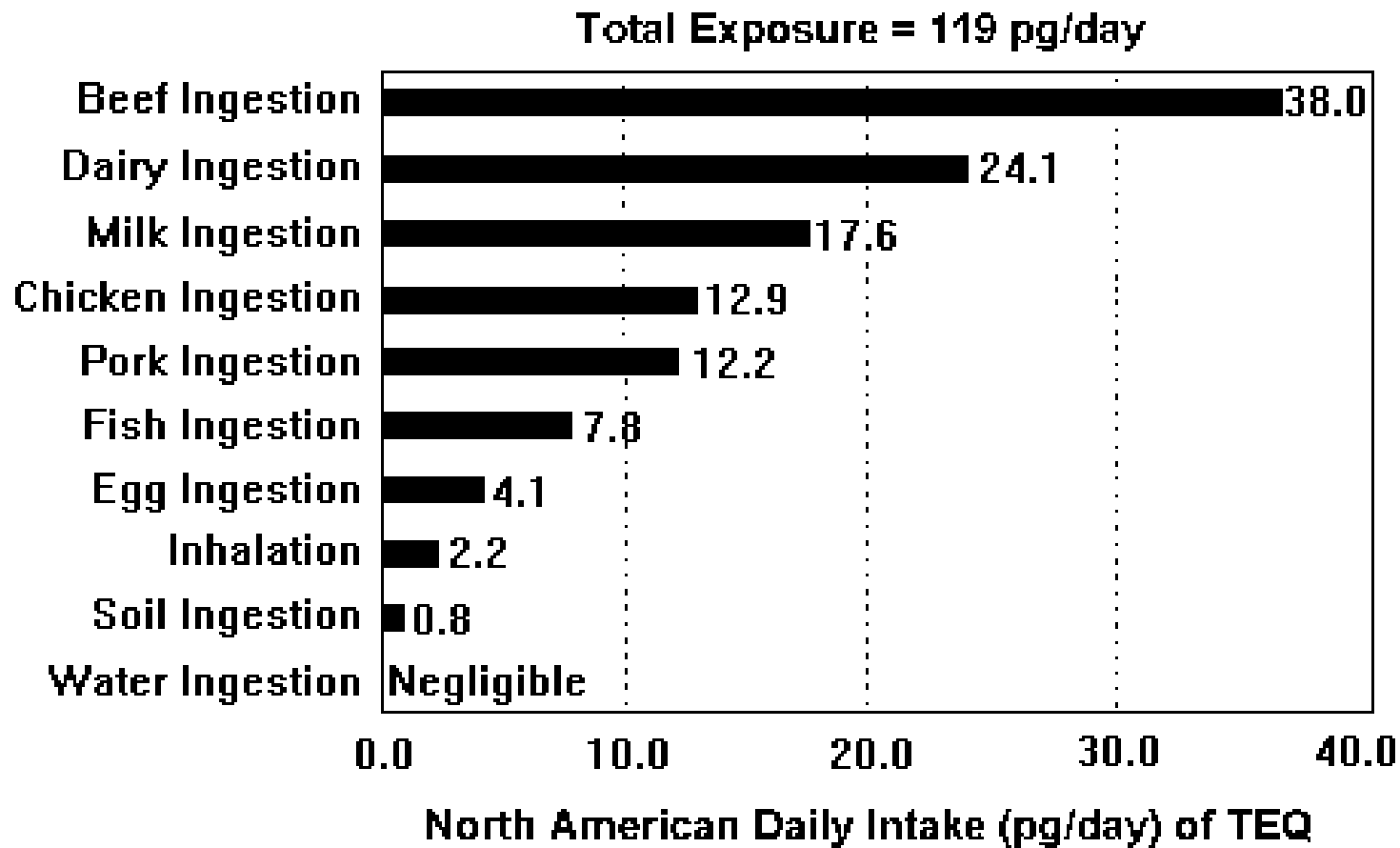
# Dioxin Facts

- Dioxins and furans are the most toxic chemicals known to science. They are highly toxic even in miniscule amounts.
- Dioxins cause infertility, learning disabilities, endometriosis, birth defects, sexual reproductive disorders, damage to the immune system, cancer and more.
- 93% of dioxin exposure is from eating meat and dairy products.

[www.ejnet.org/dioxin/](http://www.ejnet.org/dioxin/)

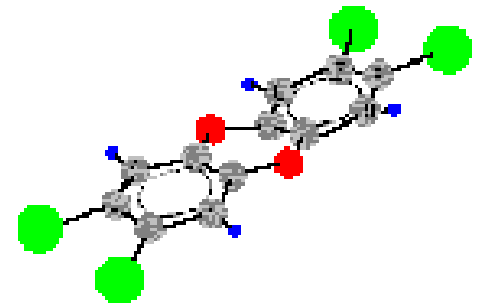


# Exposure to Dioxins



# How to make dioxin

- Dioxins are created by burning hydrocarbons with chlorine in the presence of oxygen.
- Dioxin emissions increase when:
  - More chlorine is in the fuel/waste stream
  - Certain metal catalysts are present (Copper, Iron, Zinc...)
  - The gases stay in a low temperature range (200-450° C)



“ In our industry, and in the waste industry as a whole, fires are becoming more prevalent.”

-Mark Harlacker –  
Covanta's  
Commercial Business  
Director for Mid-  
Atlantic Region,  
4/26/2017 testimony  
before DC City  
Council



INCINERATOR FIRE

Michael See TAG @NBCWASHINGTON ON YOUR INSTAGRAM PHOTOS SNAP WI

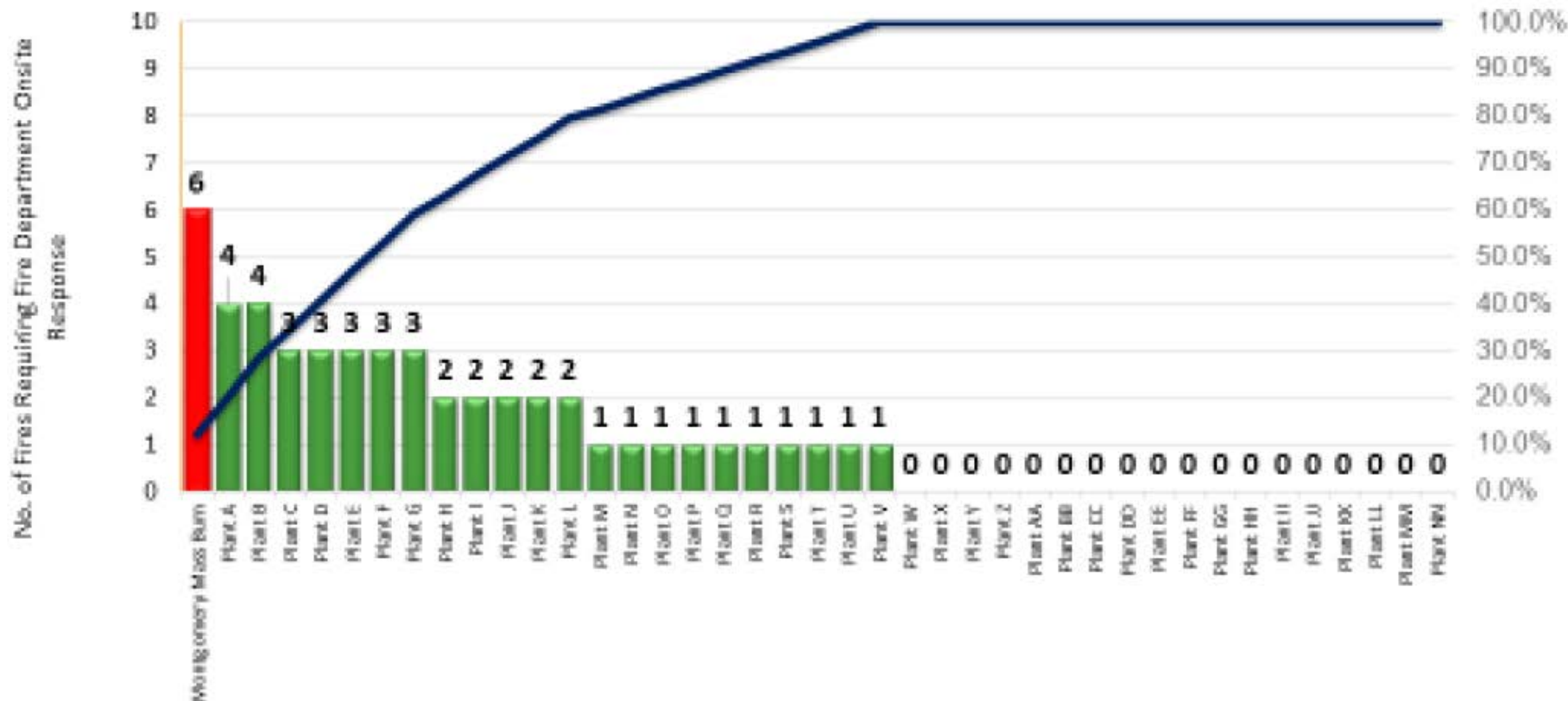
6:32 34°

GAITHERSBURG  
TODAY



# Covanta Mass Burn 5 Year Fire History

## No. of Fires Requiring Fire Department Onsite Response





# Most Expensive Way to Manage Waste

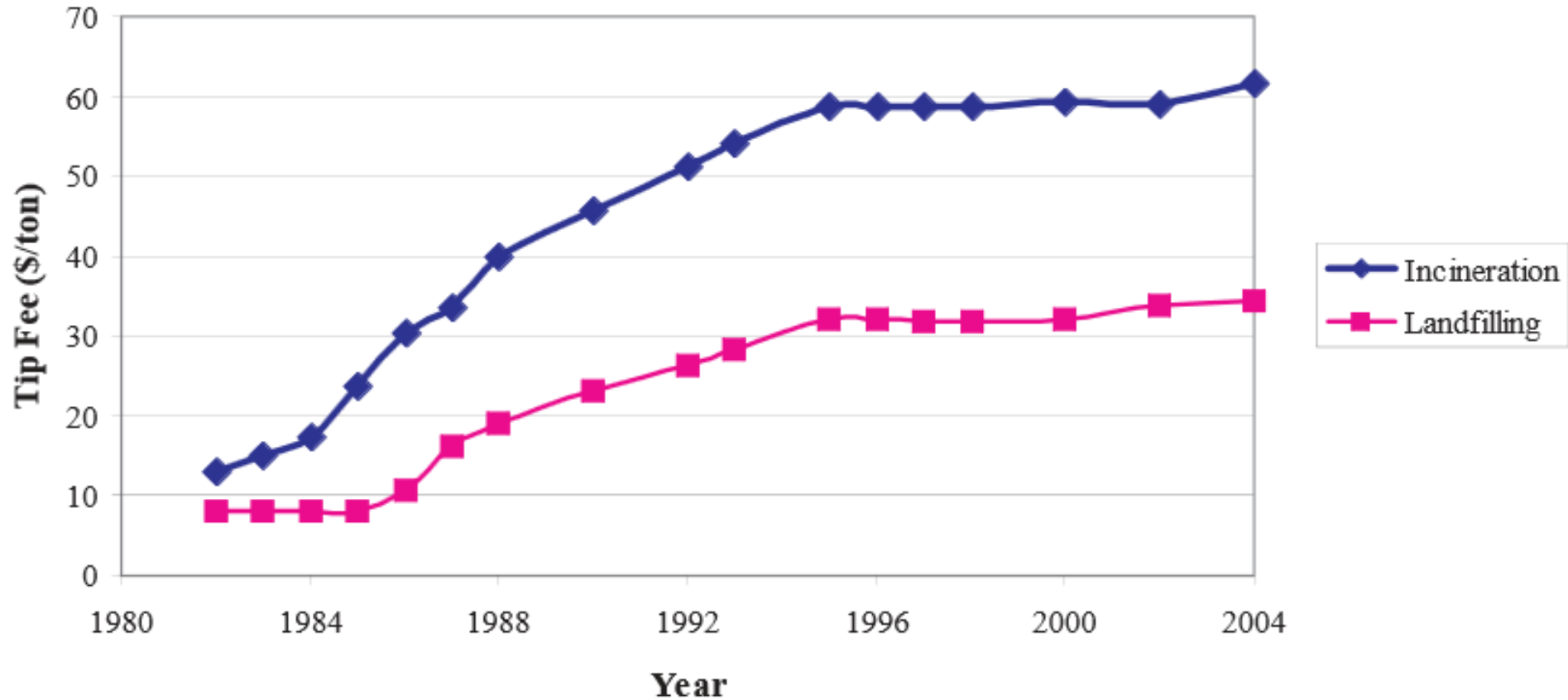
**“Waste-to-energy is an additional capital cost. That is not in dispute, compared to a landfill... compared to a landfill, which is a less capital-intensive structure – it is more expensive. If you had a landfill next to a waste-to-energy facility, then almost in every case, you would think the landfill is going to be cheaper.”**

Ted Michaels, President, Energy Recovery Council, March 18, 2013 testimony before Washington, DC City Council



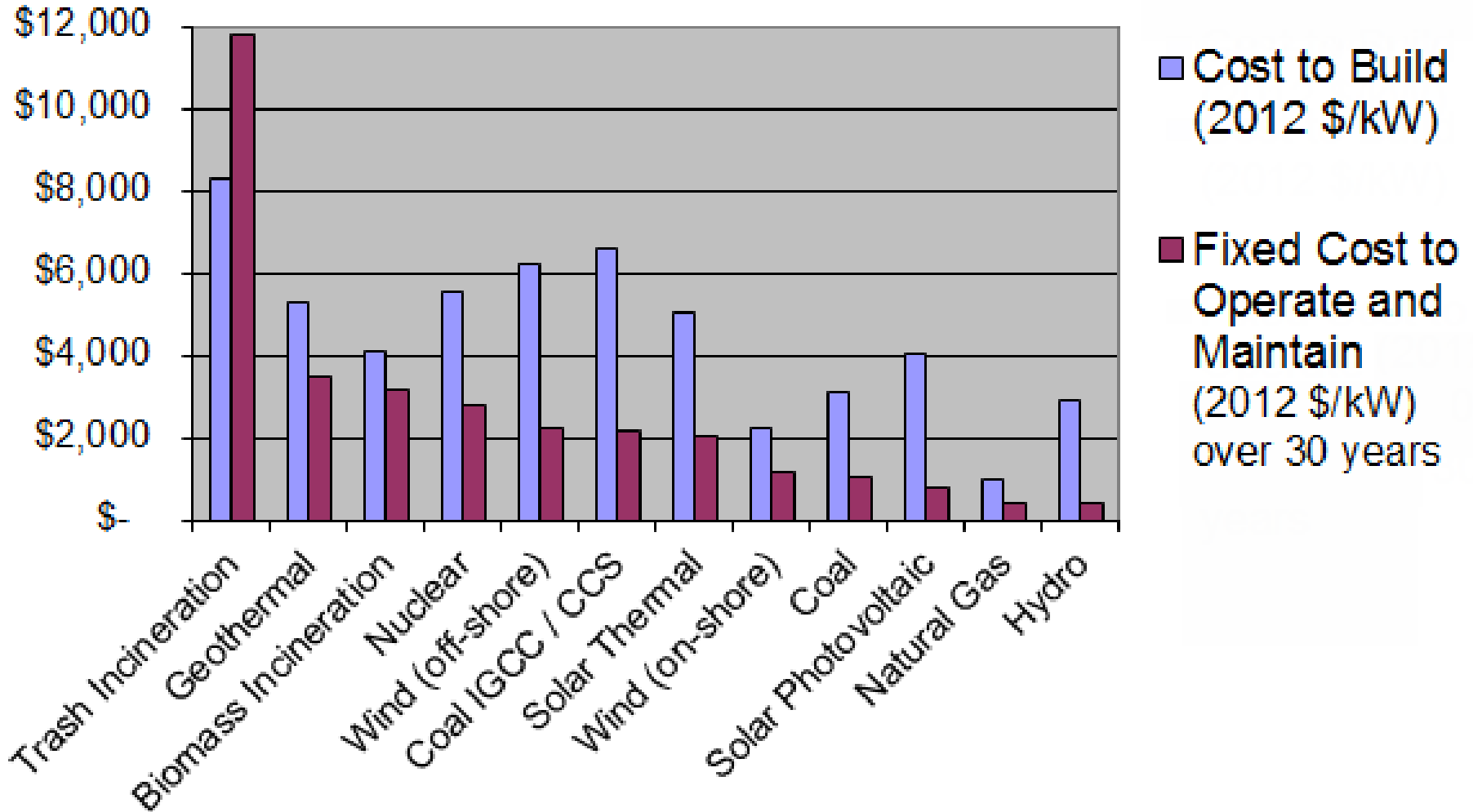
# Most Expensive Way to Manage Waste

Figure 3. Landfill and Incinerator Tip Fees



Source: National Solid Waste Management Association 2005 Tip Fee Survey, p4.  
[www.environmentalistseveryday.org/docs/Tipping-Fee-Bulletin-2005.pdf](http://www.environmentalistseveryday.org/docs/Tipping-Fee-Bulletin-2005.pdf)

# Most Expensive Way to Make Energy



Source: "Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants," Energy Information Administration, April 2013, p.6, Table 1. Full report here: [www.eia.gov/forecasts/capitalcost/pdf/updated\\_capcost.pdf](http://www.eia.gov/forecasts/capitalcost/pdf/updated_capcost.pdf)



# Landfills Cheaper for DC

**Former DPW Director William Howland, answering questions from Transportation and Environment Committee Chair, Mary Cheh, in hearing on 9/28/2012:**

Howland: “We made the decision I think 2 years ago, 3 years ago, that – we were taking our trash to the landfill, then – that’s a policy decision, the department, we signed a long-term contract with Fairfax County to convert it from waste to energy. One of the interesting things about that is that the last two trash hauling contracts that we entered into, we asked each vendor to give us a proposal on whether to send the – what would the cost be to send it to landfill? What would be the cost to send it to Fairfax? **We negotiated the price with Fairfax and you just needed to give us the hauling costs from DC to Fairfax. There were 9 vendors in 2004 that bid, and 5 vendors that bid in 2009. All 14 bids, it was cheaper to take it to a landfill, which typically was as far away as Richmond, than it was to take it to Fairfax County. But we thought, environmentally, it was better to take it to Fairfax County and convert it to energy, than it was to landfill it.”**



# Landfills Cheaper for DC

-----Original Message-----

From: Howland, William (DPW)

Sent: Tuesday, February 03, 2009 8:00 PM

To: Thomas, Chimeka (EOM)

Subject: RE: Waste To Energy proposal

Chimeka

Not exactly. I am sure the distance is a factor in determining the cost.

Five years ago, DPW issued a solicitation for waste disposal. In the solicitation DPW asked for the vendors for pricing on two different scenarios. We asked them to give us a price for disposal if the vendors disposed of the trash at any facility of their choosing.

We also asked for a price to transport it to Fairfax County to their waste to energy facility. The price for disposal was fixed at the same cost for all of the vendors so the only thing we needed to know is what the transport cost would be to Fairfax.

We had three bidders and **all three companies bid a lower cost to haul the trash to a landfill** much further away than it would be to haul it to Fairfax with a set disposal fee.

I doubt seriously that any waste to energy facility can get the cost significantly below \$40 per ton. I realize the Fairfax County facility is nearly 20 years old and the technology has probably radically evolved.

I am still very much interested in discussing this option. I think it is environmentally a better option for the District. I am just not sure that it is a cheaper option. I think we will have achieved something if we can find an option that is price competitive.

Thanks

Bill

William O. Howland, Jr.

# Landfills Cheaper for DC

- RFP for current contract was rigged by prior DPW administration
- Only bidders allowed were “waste to energy” facilities with at least a 3-year operating history, located within 50 miles of DC’s transfer stations
  - Only four such incinerators exist.
  - The only one in a white community (Montgomery County, MD) does not take out-of-county waste [Civil Rights Act Title VI violation]
  - Baltimore and Alexandria’s incinerators lacked capacity to bid, leaving the one and only bidder (Covanta Fairfax) to get the 5-11 year contract (five years plus two 3-year renewal options)

# Landfills Cheaper for DC

- Tip fee at Covanta is \$34.64/ton plus Lucky Dog hauling contract (\$10.95/ton), totaling \$45.59/ton.
- As in the past, if landfills were permitted to bid on such a multi-year contract, they could provide cost-competitive bids to the current Covanta and Lucky Dog arrangement, even with the greater hauling distance.
- Since there is no “put or pay” clause requiring use of the Covanta contract, DPW ought to issue an RFP for landfill bids over a comparable contract term, and continue the current use of landfills, even once Covanta Fairfax is operational again.

# Incinerator Ash

- Incinerators still require landfills for their toxic ash
- Choice is NOT landfill vs. incinerator, but:

**landfill**

vs.

**incinerator AND a smaller, more toxic landfill**

# Incinerator Ash

- Incinerators still require landfills for their toxic ash
- Choice is NOT landfill vs. incinerator, but:

**landfill**

vs.

**incinerator AND a smaller, more toxic landfill**

**OR...**

**Zero Waste and minimal landfilling**





# Incinerator Ash

- Incinerators still require landfills for their toxic ash
- 30 tons of ash produced for every 100 tons burned





# Incinerator Ash = Hazardous Waste

Incinerator ash is toxic, but the U.S. EPA allows a special test that enables it to test as non-hazardous, saving the industry a lot of money

Despite Canada relying on the same test, Vancouver's incinerator ash is leaching toxic cadmium at levels about twice the province's acceptable limits. They've had to ship the hazardous ash to a hazardous waste landfill in Alberta.



# The back end is still a landfill...

1. Direct landfilling  
(bad, but better than incineration)
2. Incineration → toxic ash to landfill  
(most polluting and expensive option)
3. Anaerobic digestion → landfill  
(best option, economically and environmentally; avoids having gassy, stinky landfills)



# Impacts of Each Major Option

## 1. Direct landfilling

leachate (toxins)

air emissions (toxins, methane, odors)

## 2. Incineration → toxic ash to landfill

leachate (even more toxins)

air emissions from ash blowing off site  
(toxins)

## 3. Anaerobic digestion → landfill

odor, leachate and air emissions highly  
minimized



# Zero Waste Hierarchy

**Product Redesign**

**Source Reduction**

**Reuse**

**Recycling**

**Composting**

**Waste Composition Research**

**Material Recovery**

**Biological Treatment**

**Stabilized  
Landfill**

# Zero Waste Hierarchy

- Rethink / Redesign
- Reduce
- Reuse
- Source Separate:
  - **Recycle** (multi-stream)
  - **Compost**
  - **Waste**
    - **Research** to see what is left, and encourage redesign
    - **Recovery**: mechanically remove additional recyclables
    - Anaerobically digest, then aerobically compost residuals
    - Stabilized (digested) residuals to landfill

# What is the best disposal option for the “Leftovers” on the way to Zero Waste?

By

Dr. Jeffrey Morris

Dr. Enzo Favoino

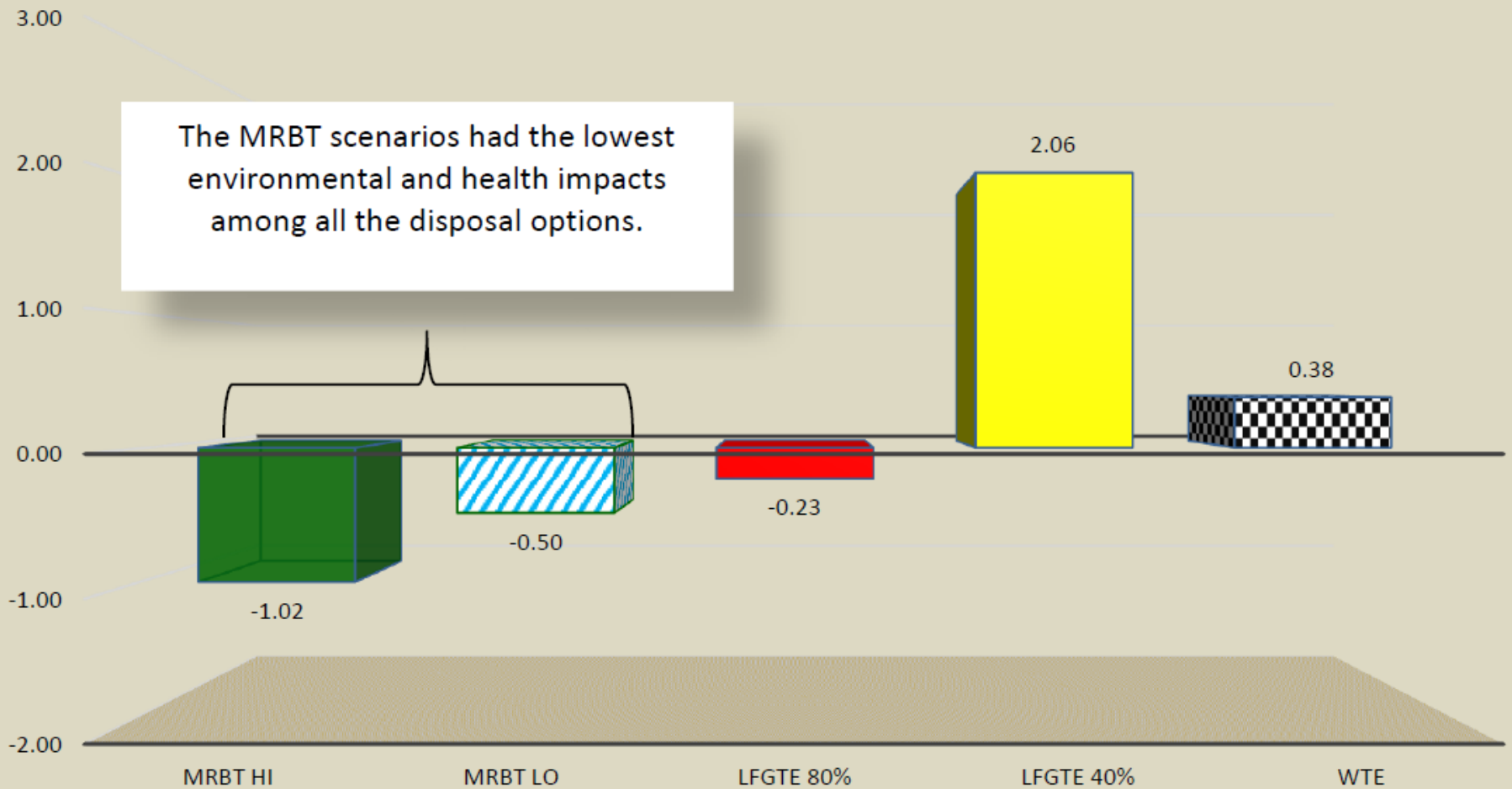
Eric Lombardi

Kate Bailey



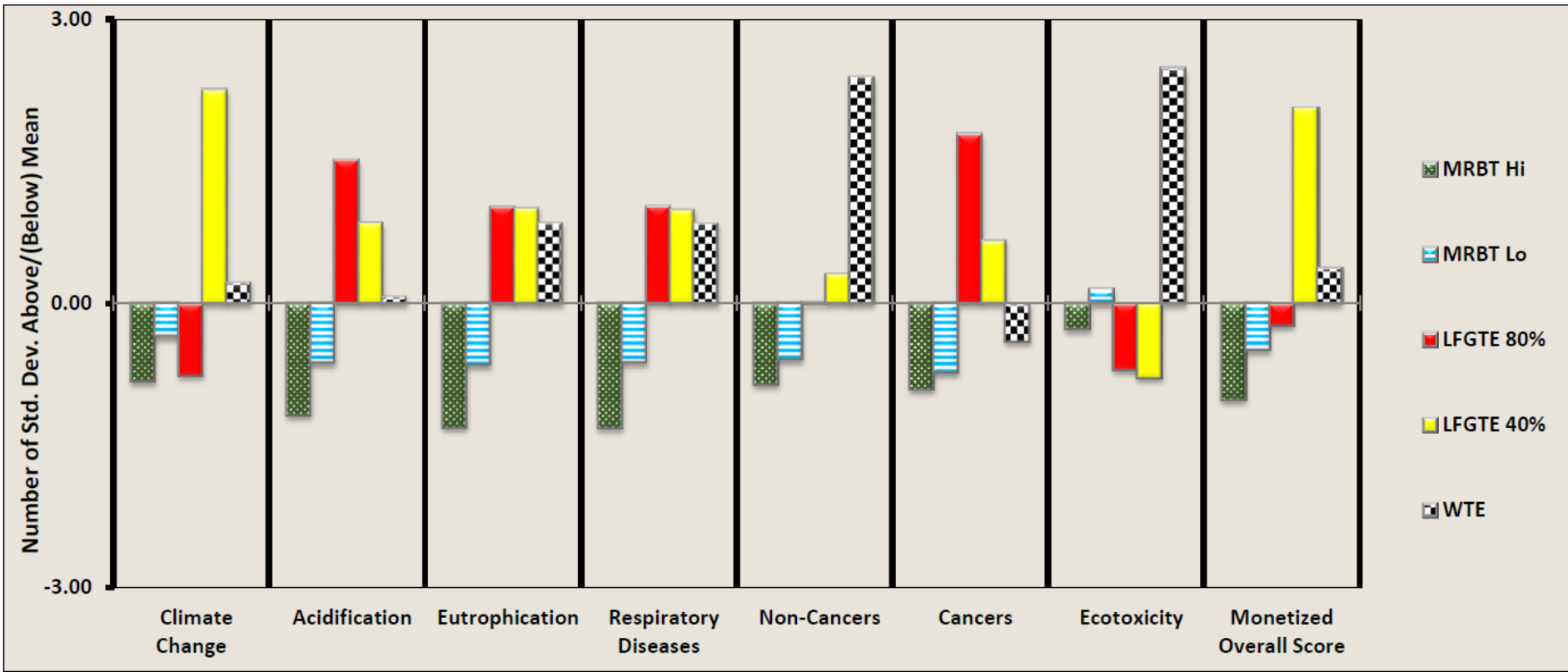
[www.ecocycle.org/specialreports/leftovers](http://www.ecocycle.org/specialreports/leftovers)

# Monetized Overall Environmental Impact





**Figure 3: Standardized Environmental Impact Scores for the Five Management Options for Leftover Waste Remaining after 70% Recycling**



# For more Info...

- Incineration:
  - [www.EnergyJustice.net/incineration](http://www.EnergyJustice.net/incineration)
  - [www.EnergyJustice.net/biomass](http://www.EnergyJustice.net/biomass)
  - [www.EnergyJustice.net/tires](http://www.EnergyJustice.net/tires)
  - [www.no-burn.org](http://www.no-burn.org)
  - [www.GreenAction.org](http://www.GreenAction.org)
- Landfills and Landfill Gas Burning:
  - [www.EnergyJustice.net/lfg](http://www.EnergyJustice.net/lfg)
  - [www.ejnet.org/landfills](http://www.ejnet.org/landfills)
  - [www.beyondlandfilling.org](http://www.beyondlandfilling.org)
- Zero Waste:
  - [www.EnergyJustice.net/zerowaste](http://www.EnergyJustice.net/zerowaste)
  - [www.ilsr.org/initiatives/waste-to-wealth](http://www.ilsr.org/initiatives/waste-to-wealth)
  - [www.grrn.org/zerowaste](http://www.grrn.org/zerowaste)
  - [www.zwia.org](http://www.zwia.org)



[www.EnergyJustice.net](http://www.EnergyJustice.net)

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