ENVIRONMENT

GOAL

We are committed to 100 percent compliance with all discharge limits (air, water, etc.) at all facilities while also maintaining emissions at levels consistent with past performance, which are well below existing standards.

PROGRESS

Emission reductions of up to 50 percent have been maintained through the last full reporting cycle ending in 2016.

Now more than ever, we need environmentally and socially responsible means of managing solid waste. Covanta's EfW and materials-processing facilities help our communities move up the waste hierarchy, recover resources in the form of materials and energy and provide critical local and community waste management infrastructure all while helping to reduce GHG emissions from waste management. Our EfW facilities deliver clean, renewable baseload power right next to load centers and help provide resiliency to the electrical grid.

- One ton of CO_2e reduced, on average, for every ton of municipal solid waste diverted from landfill and sent to an EfW facility
- Air emissions reductions of up to 50 percent since the advent of the Clean World Initiative, our first sustainability program

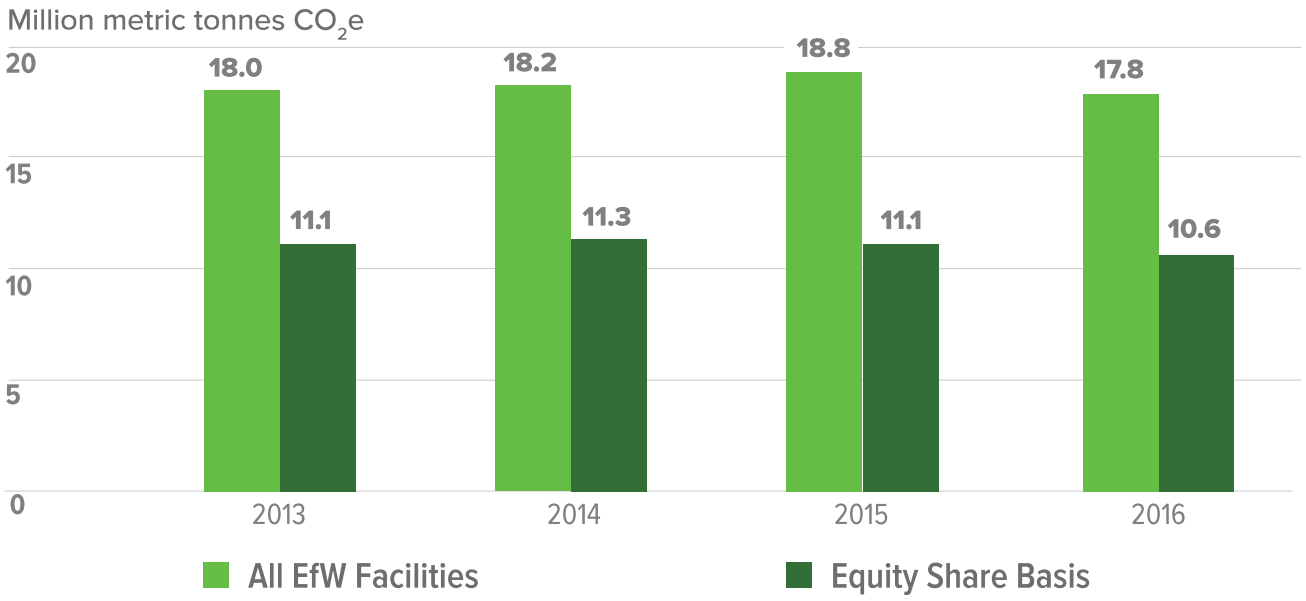
ENVIRONMENT

REDUCING GREENHOUSE GASES

When it comes to mitigating climate change, people often think of things like closing coal-fired power plants or getting more cars off the road. But how materials and waste are managed also has a significant impact on the climate. In fact, roughly one-third of GHG emissions in the U.S. every year are associated with various stages of materials management: extracting raw materials, making them into products and dealing with manufacturing waste and end-of-life disposal.

That's where Covanta comes in.

Global EfW Net GHG Avoided



The largest part of our business—operating EfW facilities—is an internationally recognized source of GHG mitigation. On average, the U.S. EPA has determined that EfW facilities reduce GHG emissions by 1 ton of CO_2 equivalents (CO_2e) for every ton of municipal solid waste (MSW) diverted from landfill and processed. By eliminating emissions that would have otherwise occurred, EfW is the only major source of electricity that reduces GHG emissions.

Furthermore, EfW can generate carbon offset credits under the Kyoto Protocol's Clean Development Mechanism and the Verified Carbon Standard. Two U.S. EfW facilities, eligible due to their recent expansion, have sold carbon offset credits into the voluntary market. EfW was also eligible to generate emission rate credits under the U.S. EPA's Clean Power Plan.

EfW contributes to the reduction of GHGs in the environment by:

generating energy that otherwise would likely be generated by fossil-fueled facilities;

diverting solid waste from landfills where it would have emitted methane for decades, even when factoring in landfill gas collection; and

recovering metals for recycling, saving the GHGs and energy associated with the production of products and materials from virgin inputs.

The GHG reductions associated with these three factors are significantly more than the fossil-based CO_2 emissions from the combustion of plastics and other fossil-fuel-based MSW components.

Treatment of EfW in Cap and Trade Programs

Although EfW is widely recognized as a source of GHG mitigation, our combustion process results in facility-level GHG emissions that are included in GHG inventories that could be subject to cap and trade or other laws or regulations designed to limit or reduce GHG emissions. Currently, none of our EfW facilities are subject to existing cap and trade programs in areas where we operate, including the Regional Greenhouse Gas Initiative (RGGI) in the Northeastern United States, the European Union Emissions Trading Scheme or the cap and trade programs in California and Ontario.

Our exclusions in California and Ontario are temporary, potentially expiring in 2018 and 2020, respectively. Administered equitably, cap and trade programs could provide an economic incentive for EfW (relative to landfilling), as a result of the lower lifetime carbon intensity of EfW (relative to landfilling) for the management of municipal solid waste. However, the California and Ontario programs initially exempted landfilling, resulting in the potential for a perverse economic disincentive for EfW if it were to be included in the cap. The temporary exemptions have addressed this issue as policymakers work toward long-term solutions.

GHG Inventories

Covanta reports our GHG emissions to the U.S. EPA GHG Reporting Program and have been disclosing GHG emissions to CDP since 2007. For more information, please see our 2016 and 2017 CDP responses, covering emissions from 2015 and 2016 respectively.

GHG inventories are very useful in understanding where our emissions come from and identifying long-term trends, but they do not help us choose between different options, like those available for waste management.

While EfW facilities are sources of net GHG mitigation, they generate stack or “Scope 1” GHG emissions of their own as part of normal operation. The more waste we divert from landfilling, the greater the net GHG reduction achieved overall. However, this also translates to an increase in our Scope 1 emissions.

GHG Reduction Goals

The only way we can lower our stack, or Scope 1, GHG emissions would be to process less waste. Doing so would increase the amount of waste going to landfills, and as a result, increase overall net GHG emissions. So, we focus our GHG emission reduction efforts on energy efficiency, raw materials, metal recovery, and most importantly, helping our customers divert biodegradable wastes from landfills.

Our most effective tools in reducing GHG emissions:

Project / GHG Reduction Goal Type	GHG Emissions Reduction as tons CO_2e	
Recovery of metals from ash	**10.0**	Per ton of aluminum
	5.2	Per ton of copper
	2.0	Per ton of ferrous metal
Energy efficiency projects	**0.8**	Per MWh of electricity saved
Materials management	**1.0**	Per ton of MSW diverted
	0.7	Per ton of packaged foods diverted
Raw materials efficiency	**0.8**	Per ton of lime saved
	2.6	Per ton of ammonia saved

We remain committed to providing customers with more sustainable waste management practices, even though many external assessments of our corporate GHG performance do not recognize the indirect emissions benefits these solutions generate.

STORIES

WHY ADDRESS GHG EMISSIONS FROM WASTE?

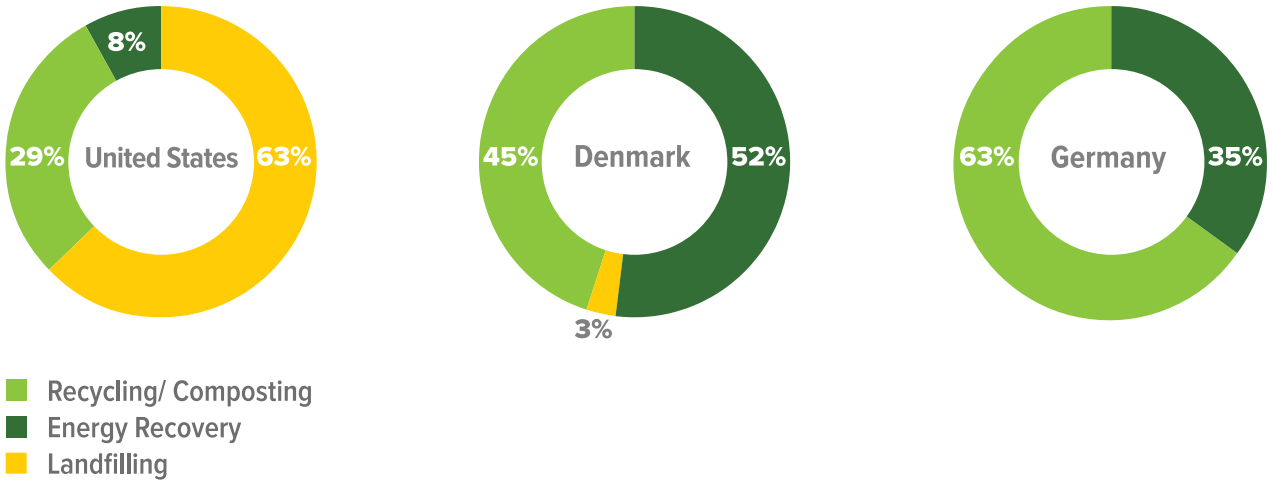
As supported by overwhelming scientific consensus, climate change is real and largely driven by human activity. The path forward for responding to climate change is far less certain. However, in the face of the tremendous risks presented by climate change to our future, we believe it prudent to reduce GHG emissions today, especially when other benefits can be realized.

A focus on more sustainable waste management can save natural resources, lower non-GHG emissions, provide high-wage jobs for local economies and diversify our electrical grid all while addressing risks of climate change by reducing life cycle GHG emissions.

We can all have a big impact on reducing GHG emissions by following the waste management hierarchy developed by the U.S. EPA and pursuing a more circular economy.

We have lots of room to grow. According to research by Columbia University, roughly two-thirds of what Americans discard ends up in landfills. In contrast, Germany has eliminated the direct landfilling of waste, with over two-thirds of their trash being recycled or composted. Energy recovery is used for the remainder.

EfW Around the World



In fact, if the United States managed its wastes as sustainably as Germany, it could:

- reduce GHG emissions equivalent to shutting down over 60 coal-fired power plants, and
- save over two quadrillion BTU of primary energy, equal to all the electricity generated by wind and solar combined.

Globally, the GHG savings could equal 1 gigaton of carbon equivalents by mid-century, equivalent to building 2 million 1 MW wind turbines.

"EfW and recycling and composting efforts are a win-win-win for the United States. EfW generates clean electricity, decreases GHGs that would have been emitted from landfills and fossil-fuel power plants, and pairs well with increased recycling rates in states."

Center for American Progress

For more information, please see Covanta's white paper: "Waste and Climate: Reducing Your Footprint"

STORIES

WHY LIFE CYCLE ASSESSMENT?

Life cycle analysis (LCA) is a systemic approach that can be used to assess the environmental impacts of a product or process from cradle to grave, or from the extraction of raw materials to final disposition at the end of life. Applied to waste management, LCA allows us to evaluate the environmental impacts and trade-offs of different management approaches and is a very useful tool in helping communities, governments and industry make sound decisions in advancing more sustainable waste management. Because LCA looks far beyond an inventory at a single facility, it can consider emissions and energy savings associated with waste management practices that occur at different locations or even over different time periods. For waste to energy, it allows us to quantify the positive and negative impacts of not only the energy recovery process itself, but also the benefits that accrue from avoiding landfill disposal, recovering metals for recycling, and displacing grid-connecting electrical generation.

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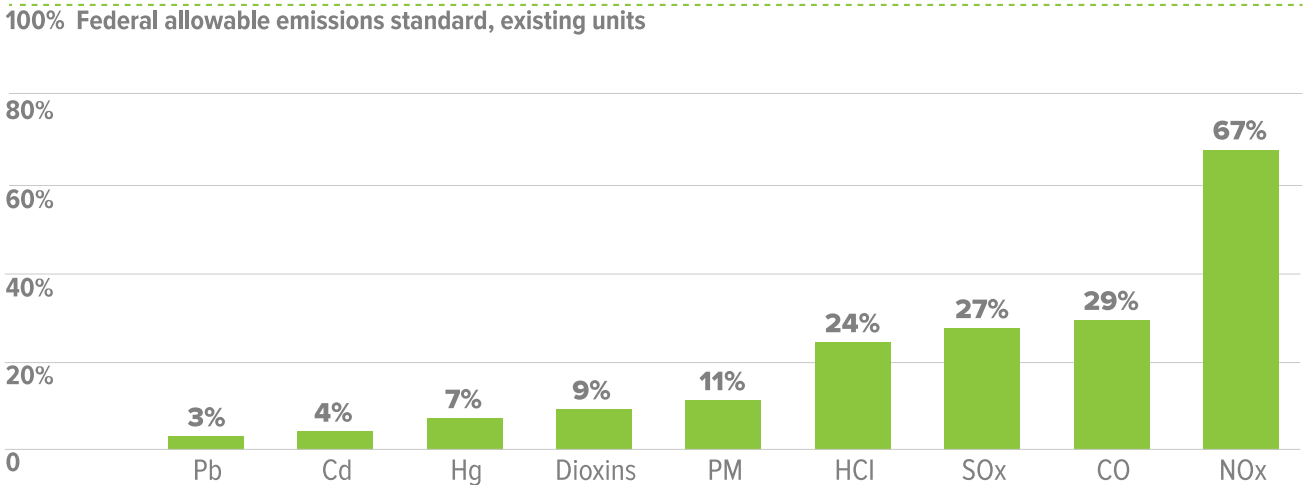
MINIMIZING AIR EMISSIONS

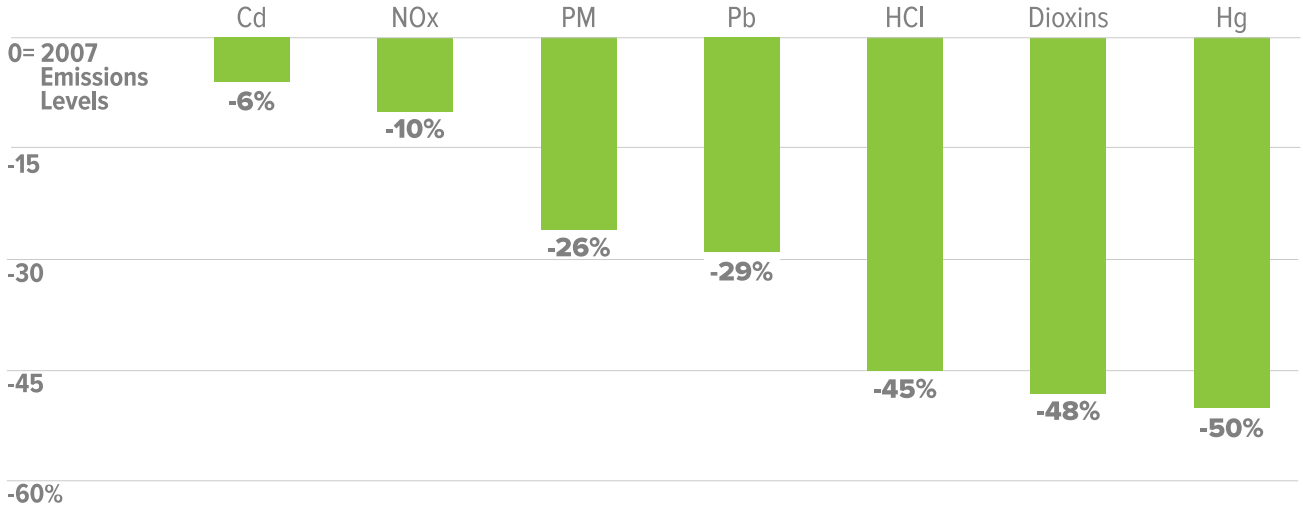
Covanta's EfW facilities strive to reduce emissions below the strict air emissions limits set by regulatory bodies that have been demonstrated to protect human health and the environment. We employ sophisticated technologies to achieve superior environmental performance and minimize our impact.

Covanta Americas 2014–2016 EfW Emissions Compared to Federal Standards



Since launching our first sustainability program in 2007, we've **reduced emissions by up to 50 percent**.

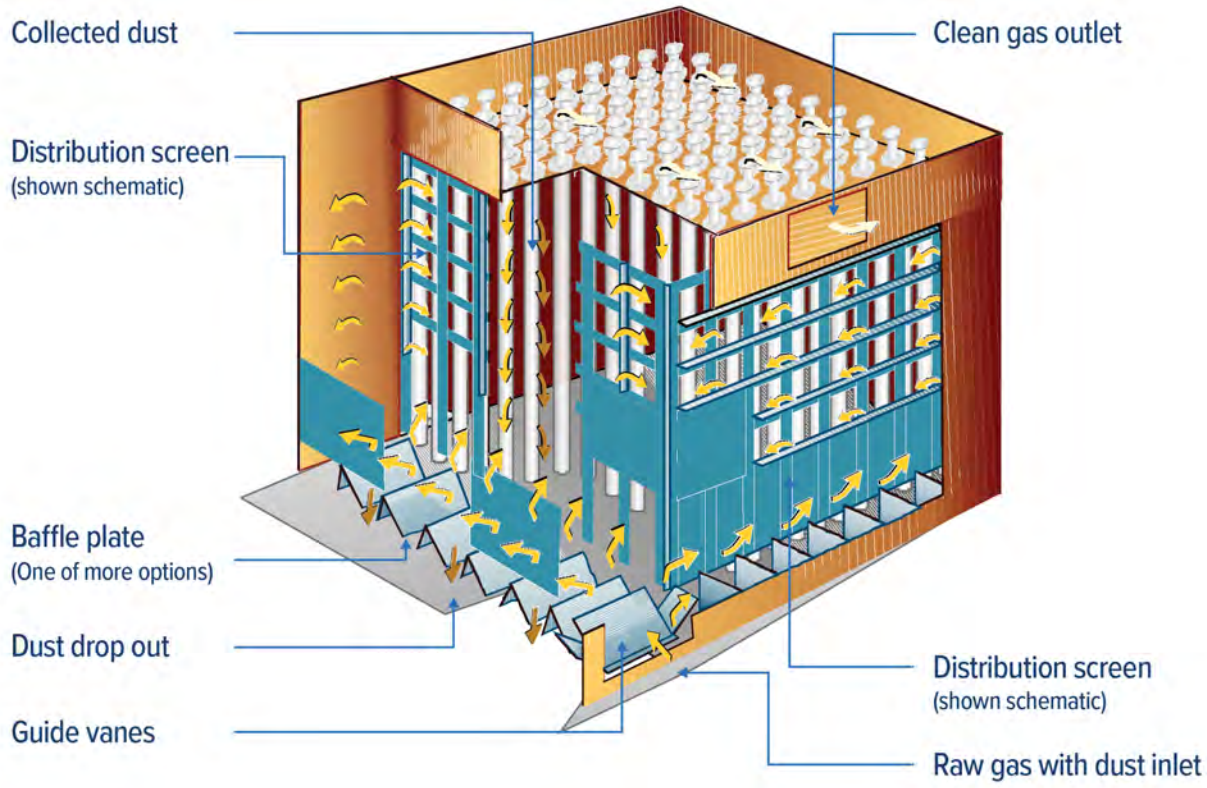
Covanta Americas 2014–2016 EfW Emissions Compared to 2007



In the United States, air emissions from our facilities consistently fall below established limits, usually operating at 60 to 90 percent or more below permitted parameters.

Covanta Essex: Pursuing Better Ways to Control Air Emissions

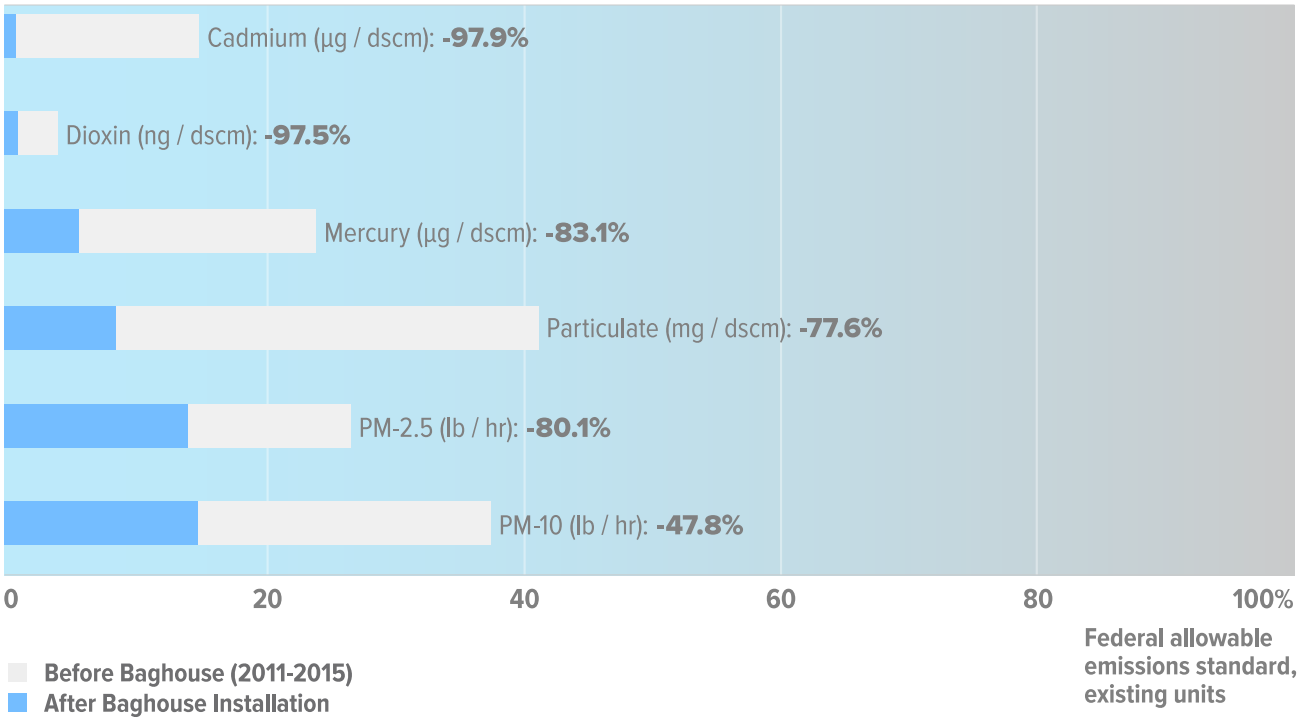
In 2016, we completed a major retrofit of the air pollution control systems at our 26-year-old Essex Resource Recovery Facility in Newark, New Jersey. Covanta operates the plant under a long-term lease with the Port Authority of New York and New Jersey, which owns the facility. Through a voluntary agreement between Covanta, the Port Authority and the New Jersey Department of Environmental Protection, we installed three new baghouses.



Operating like a very efficient vacuum cleaner, a baghouse removes 99.5 percent of the particulate matter from combustion gases. As air is drawn through the baghouse, particulate matter and fly ash are caught on the surface of the bags. Periodically, the bags are cleaned by temporarily reversing the airflow or by pulsing the bags with a strong jet of air. The particulate and fly ash are then removed from the bottom of the baghouse.

The Essex retrofit lowered particulate and metals emissions by up to 90 percent below levels already well below air permit requirements.

Essex County EfW Emissions with Baghouse Compared to Previous APC System



"We are committed to improving the state's air quality, especially in our urban areas. I commend Covanta and the Port Authority of New York and New Jersey for stepping up to the plate and working cooperatively with us to modernize this facility's equipment to improve air quality in our largest city and the surrounding region. Ultimately, this project was about improving quality of life and the health of our residents."

Bob Martin,
New Jersey Department of Environmental Protection Commissioner

Covanta Fairfax: Investing in a Sustainable Future

"Powering Today, Protecting Tomorrow" also means investing in capital for both the present day and for the future. In 2016, we began a project to replace the baghouses at our Fairfax County, Virginia, facility. While the existing baghouses were performing well, they were reaching the end of their useful life. To ensure continued strong environmental performance, reduce the risk of maintenance challenges impacting facility operations and invest in the continued operation of this critical asset, we are completely replacing all four baghouses, one for each boiler. The work will be completed in 2018.

Our facilities use state-of-the-art control technologies to remove air pollutants associated with the EfW process.

Boiler Design:

Our boilers are specifically designed to recover as much energy as we practically can out of the waste resource and ensure complete combustion, including volatile organic compounds (VOCs) and other organic compounds.

Nitrogen Oxides (NOx) Control:

Most boilers are equipped with selective non-catalytic reduction (SNCR) systems, which inject ammonia or urea into the furnace to chemically convert NOx into gaseous nitrogen, a harmless gas that makes up the majority of our atmosphere. In addition, we have installed Covanta's proprietary low nitrous oxide system (Low NOx™) in more than 20 units, which helps us control NOx emissions and reduce reagent consumption.

Carbon Injection:

After leaving the boiler, combustion gases travel through an extensive air pollution control system. At many of our plants, activated carbon is added to the flue gas stream as it exits the boiler. Gaseous phase contaminants such as mercury and dioxins adsorb to the surface of the carbon so it can be removed downstream in the baghouse.

Scrubber:

A scrubber neutralizes acid gases, including sulfur dioxide and hydrochloric acid, by spraying a lime slurry into the exhaust stream. This process removes more than 95 percent of sulfur dioxide and hydrochloric acid.

Baghouse:

Operating like a very efficient vacuum cleaner, the baghouse removes 99.5 percent of the particulate matter from the combustion gases. As air is drawn through the baghouse, particulate matter and fly ash are caught on the surface of the bags. Periodically, the bags are cleaned by temporarily reversing the airflow or, in other designs, pulsing the bags with a strong jet of air. The particulate and fly ash are removed from the bottom.

Emission Monitoring:

All of our facilities operate under strict air pollutant control limits. To demonstrate compliance, we use a combination of continuous emission monitoring systems and stack tests performed at least annually.

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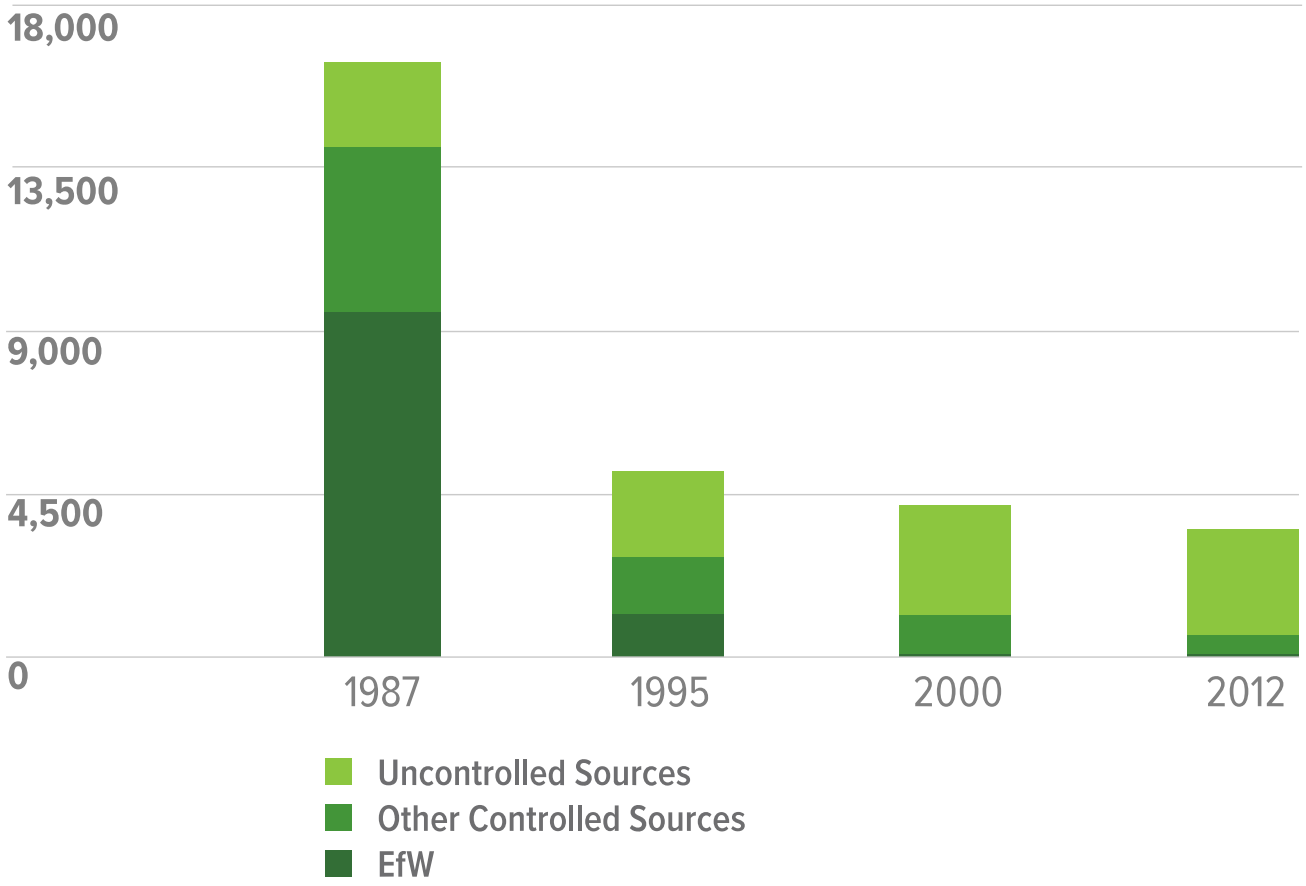
WHAT'S THE RISK?

Some of our stakeholders and community members have expressed concern about the environmental and human health impacts of air emissions associated with waste combustion. Recent studies, such as one by Public Health England, have shown that air emissions from well-managed EfW facilities do not significantly contribute to health risk and pollutant load.

U.S. Dioxin & Furan Emissions over Time



- **Mercury Emissions.** Mercury emissions from U.S. EfW facilities are a fraction of those from coal plants. From 1990 to 2005, EfW facilities reduced their mercury emissions by 96 percent, representing only 2.2 percent of the total U.S. mercury emissions in 2005. In the years since then, emissions have declined further: Currently, total U.S. EfW facility mercury emissions are estimated to be less than half a ton per year.
- **Dioxin Emissions.** Historically, municipal waste combustors were a leading source of dioxin emissions. However, advancements in boiler design, operations and air pollution control equipment have drastically reduced the industry's footprint. In fact, according to recent peer-reviewed research by Columbia University

scientists, the total dioxin emissions of all U.S. EfW plants in 2012 represented just 0.54 percent of total controlled combustion sources and just 0.09 percent of total controlled and open burning sources of dioxin.

- **Nanoparticulate Emissions.** Nanoparticles quickly agglomerate into larger particles within minutes of emission. Non-EfW sources of nanoparticulate have been found to be more significant than EfW sources. A 2010 study found nanoparticulate and larger particulate of an EfW facility negligible with respect to a nearby highway. A 2013 study found that reported particulate number counts from EfW were similar to rural background concentrations and four orders of magnitude lower than those measured at the tailpipes of road vehicles.
- **Minimal Health Risk.** Public Health England found negative health impacts associated with well-regulated EfW facilities likely to be very small, if even detectable. Long-term biomonitoring near three Dutch EfW facilities found "no potential risk with respect to human consumption quality of the investigated crops and products in the vicinity." And the Massachusetts Department of Public Health found prevalence of childhood asthma in the Merrimack Valley—where several EfW facilities are located—was not associated with emissions of particulate matter (PM10) or volatile organic compounds (VOCs) from the local stationary sources.

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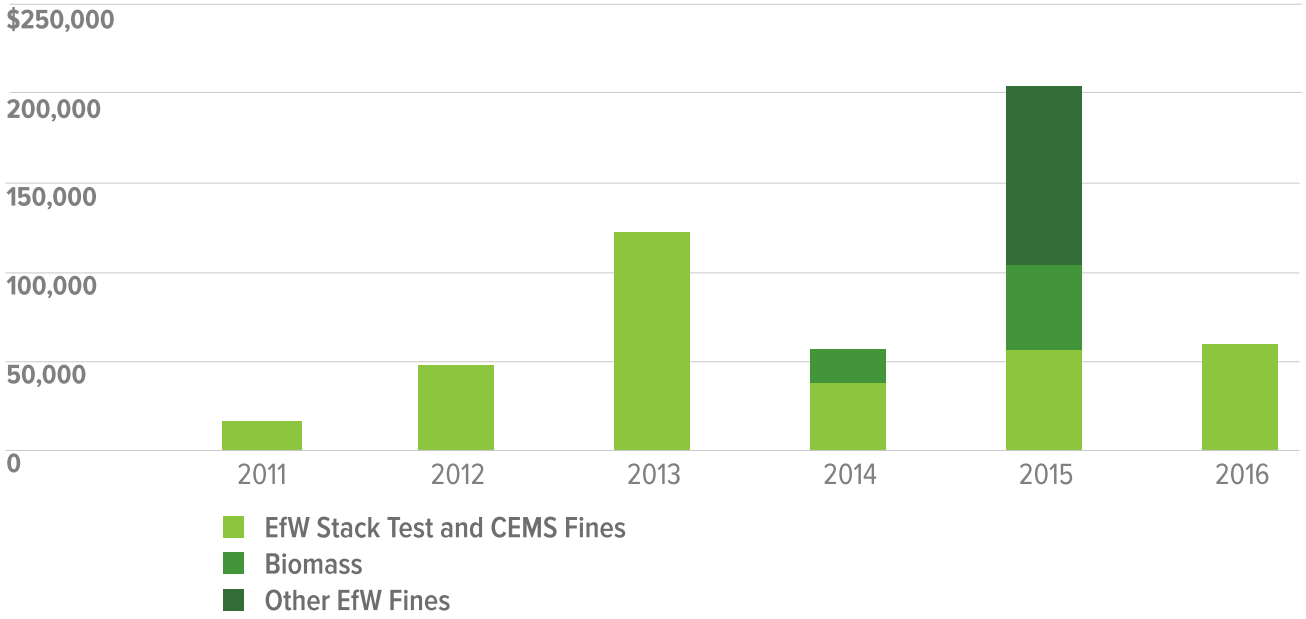
IMPROVING OUR PERFORMANCE

At Covanta, we know that maintaining our performance is critical to protecting tomorrow—for our planet, our people and the prosperity of our business. We have committed to a goal of sustaining the emissions performance gains we have achieved in the past while maintaining 100 percent compliance with all discharge limits, including stack tests and the requirements of our continuous emission monitoring system (CEMS). Our challenge is not only to meet these goals, but to meet them efficiently and consistently in the pursuit of continuous improvement.

EfW Continuous Emission Monitoring System Compliance Performance

Our North American EfW facilities averaged 99.93 percent compliant in 2015 and 2016, as measured by our CEMS; we have exceeded 99.9 percent for the past eight years. Our stack test compliance rate in 2015 and 2016 was 99.8 percent.

Environmental Fines



Occasionally, we are subject to proceedings and orders that pertain to environmental permitting and other regulatory requirements, potentially resulting in fines or penalties. Our total environmental-related fines and penalties at our North American facilities were $56,057, $203,717 and $59,219 in 2014, 2015 and 2016, respectively. $100,000 of our fines in 2015 were for the inadvertent early commencement of construction before the solid waste permit was finalized for our new Fairless Hills metals processing facility. The facility was successfully permitted and is currently operating.

Our Performance in 2015-2016

While we have successfully maintained emissions reductions at our facilities overall, our performance fell short of our expectations in 2015 and 2016. After four exemplary years of no stack test failures, we had three exceedances of air emission standards during stack tests in 2015-2016. In each case, the facilities were found to be in compliance after retesting, and our internal review confirmed that each facility is capable of meeting its limits. Consistent with our environmental management procedures—and our goal to achieve 100 percent compliance with all our discharge limits (including those evaluated through stack tests)—we performed a rigorous root cause analysis for each failure.

The root cause of the failure at our Minneapolis location was found to be the collection of a nonrepresentative sample by the independent test team, resulting from potential contamination or mishandling of sampling bottles. In response, we have implemented new quality assurance / quality control procedures to ensure the analytical results represent real conditions and proper sample management.

In the second case, at our Harrisburg, Pennsylvania, facility, particulate from one of three units was above the permit limit, caused by the process control system. New instrumentation and controls have been added and have helped improve control of the process.

In the third case, at our Durham York facility in Ontario, Canada, dioxin/furan results from one unit exceeded the technology-based permit limit (the most stringent dioxin/furan limit in North America). After consultation with the facility owner and the regulator, we proactively decided to shut down the unit to conduct a comprehensive system-wide equipment inspection and evaluation. Most importantly, the emissions did *not* result in an exceedance of the regulatory upper risk threshold at ground level downwind of the facility. Several potential contributing factors were identified and corrected during our root cause analysis process. Since the exceedance, we have successfully passed several rounds of compliance testing, and dioxin concentrations in the most recent compliance test were 13 percent of the standard.

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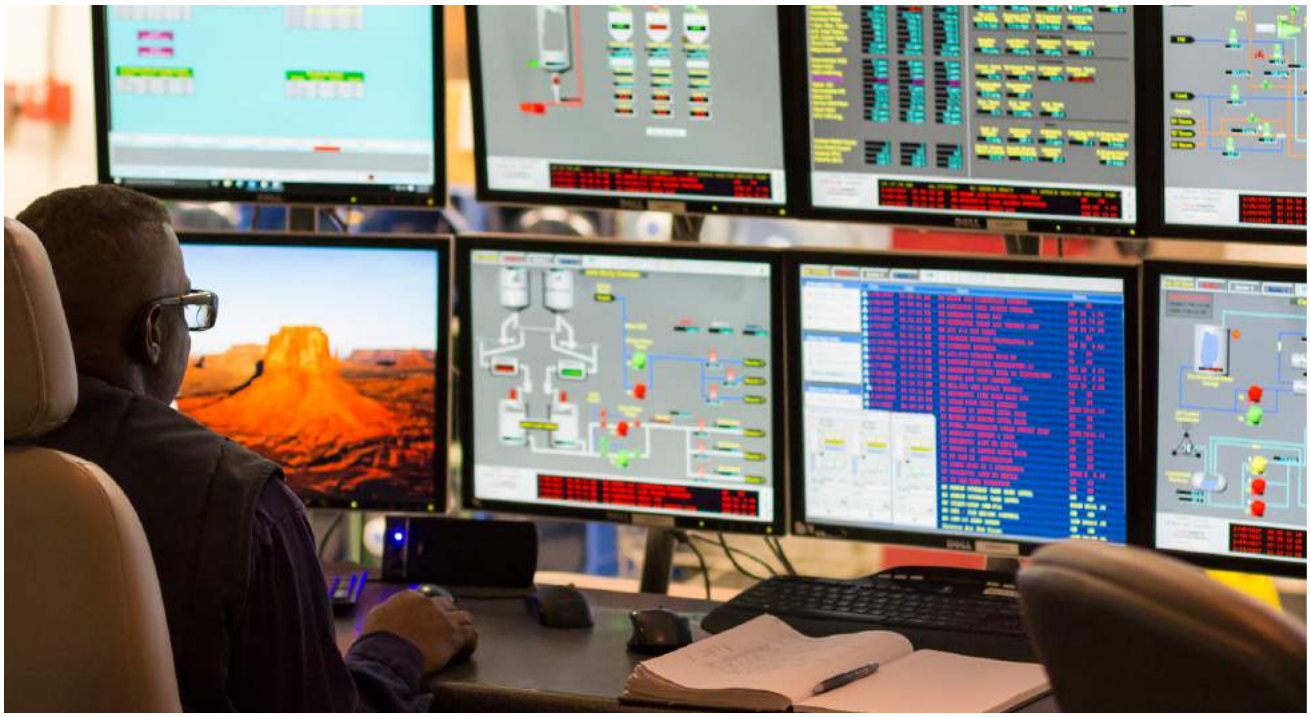
WORKING TOWARD ENVIRONMENTAL EXCELLENCE



We will reach our goal of environmental excellence when every Covanta facility meets or exceeds our strict standards for environmental performance. We address underperforming facilities by enrolling them in our Environmental Improvement Plan (EIP), which takes a similar approach to our Safety Improvement Plan.

Through the EIP, we review operating and environmental metrics and new procedures or ideas on how to improve performance. Periodic calls foster discussion about how facilities can improve on both a quantitative basis—such as environmental results and statistics—as well as qualitatively—such as improving communication. In 2016, two of our facilities that had been under an EIP the previous year made significant performance improvements, enabling them to be cleared from the EIP process.

We also have a rigorous environmental auditing program, designed to identify potential issues before they become noncompliance events and to help share best practices around our fleet of facilities.

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OPTIMIZING WATER USE

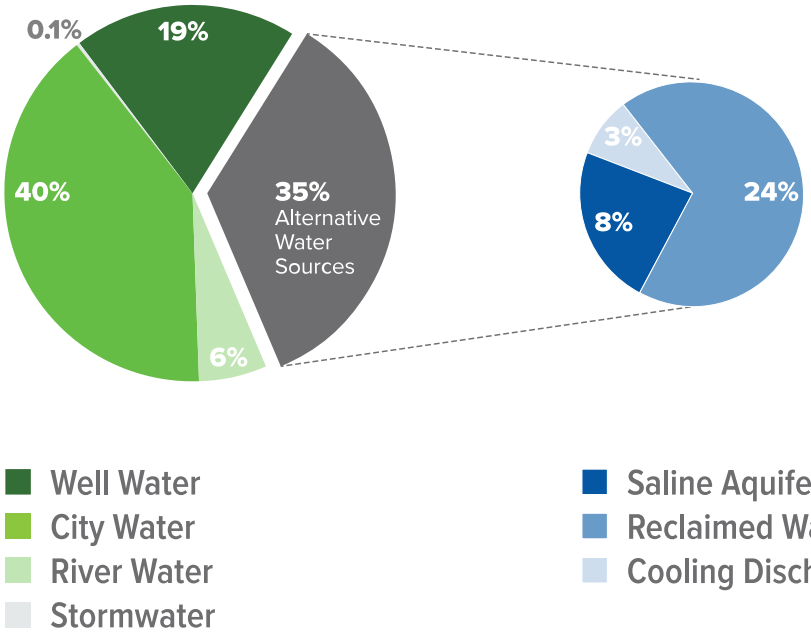
As part of our commitment to responsible environmental stewardship, we engineer our facilities to run as efficiently as possible. That means that wherever we can, we minimize potable water use and wastewater discharge. In addition to benefiting the environment, these efforts frequently help us save money.

The Lee County Resource Recovery Facility uses treated effluent from a nearby wastewater treatment plant.

Water Consumption

All thermal power plants—including our EfW facilities—use water to generate electricity. In the boiler, water is heated to generate steam, which runs the turbine to generate electricity. Most of this water is condensed and reused in the process of producing power. At some of our plants, we also generate steam that we export to communities and local businesses. While steam generation is a very efficient use of the waste resource, it can increase water consumption because the condensed water produced by the steam we export may not be returned to the facility to produce additional steam.

Water Consumption by Source



Our total water use has been fairly steady over the last three years; however, we are increasingly using stormwater and other nonpotable water sources in our operations. For example, alternative water sources, including reclaimed wastewater (which now makes up 24 percent of our water consumption, up from 11 percent in 2007), saline aquifer water and once-through cooling discharge water made up 35 percent of our 2016 water consumption.

In addition to optimizing our water consumption, we also minimize our wastewater discharge, using water internally to the extent possible. A total of 17 of our facilities are zero-process water discharge, meaning that only sanitary wastewater is discharged to the local wastewater treatment plant.

	2014	2015	2016
Total Water Use (millions of gal.)	9,038	9,193	9,129
Percent alternative (nonpotable) water	29.8%	35.6%	35.3%

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REDUCING WATER CONSUMPTION AT COVANTA

Covanta engineers at our Lancaster facility noticed that manually controlled water drain valves were being left on longer than necessary during plant start-ups, as operators tended to other tasks. Installing new automatic shut-off valves reduced the amount of water that drains to the sewer during start-up by 90 percent. Since the initial installation in 2015, this technology has now been installed at roughly three-quarters of our facilities.

Additionally, as part of a $240 million capital plan that we initiated in late 2014 at our Pinellas County EfW facility in Florida, we rebuilt the cooling tower, reducing water consumption by 40 percent from 2015 to 2016.