

BETTER OPERATIONS

A CHANGING FOOTPRINT THAT IS
LIGHTER, CLEANER AND SAFER.

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WM
WASTE MANAGEMENT
Think Green.

SAFE LANDFILLS



Waste Management provides solid waste collection services to nearly 20 million customers in North America — from households to public venues to large companies. All told, after recycling or diverting various materials for reuse, we safely manage the disposal of nearly 100 million tons of waste annually, including common municipal trash and highly specialized materials such as medical and industrial waste. To handle this volume, Waste Management operates the largest network of landfills in our industry and works hard to minimize the impact of those facilities on neighbors and the environment.

Modern landfills are the products of sophisticated engineering, providing both secure containment systems for the disposal of waste and the opportunity to capture value through the conversion of waste to energy. Waste Management’s modern landfills in the United States were developed under the federal Resource Conservation and Recovery Act (RCRA), which requires rigorous siting evaluation, site characterization and scientific

engineering design, as well as a comprehensive permitting and regulatory approval process that includes public notification and comment. RCRA standards also require a range of measures to prevent environmental contamination, including the use of engineered liners and covers, collection and control systems for landfill gas, and collection and treatment systems for leachate (water that accumulates in and filters through waste).

Our modern sites are designed and operated to go beyond regulatory requirements. We continually monitor and work to improve the safety and environmental security of our disposal facilities and are committed to reporting the results of these efforts. We strive to avoid



Watch How a Modern Landfill Is Constructed



conditions that cause concern for neighbors and communities, including odors and noise, regardless of whether those conditions are covered in our regulatory obligations. We also work with waste sector experts to understand what happens within landfills after they are closed. Studies have shown that modern municipal solid waste landfills tend to improve predictably over time, steadily producing less gas and less (and cleaner) leachate. Many of our landfills are designed and managed to ensure they can be used after closure for commerce, industry or even conversion into wildlife habitat or public parks.

Surface and Groundwater

Waste Management’s landfills are living laboratories for testing new technologies to help us improve how we manage stormwater and leachate, and how we design and maintain landfill cover and gas collection systems. We test the effectiveness of new technologies at select sites before broadly employing them at all sites to enhance environmental performance and reduce operational costs. Waste Management utilizes extensive engineering controls and practices to protect surface water and groundwater. We maintain a comprehensive network of more than 6,000 groundwater-monitoring wells around our facilities, and every landfill uses monitoring strategies — many involving sophisticated statistical evaluations — to ensure that water quality in adjacent surface water and groundwater bodies is not impacted.

Our modern municipal solid waste landfill liners contain all liquids, which are then managed according to applicable regulations and design standards. We employ a staff of nearly 200 professional engineers, environmental scientists, regulatory experts and technicians who ensure that every facility works to protect surface water, stormwater and groundwater from any potential operational impacts.

We use managed basins, tanks, containment structures and separators to redirect liquids for proper disposal and treatment. We also monitor on-site wastewater treatment plants to optimize efficiency and utilize a toolkit of best management practices for our field operations.

**Percent of
Waste Management
Modern Landfills’
Liners Preventing
Off-site Groundwater
Contamination**

100%

2013-2017

Waste Management’s modern RCRA Subtitle C and D-regulated landfill liners continue to perform as designed, not allowing leakage through the liner requiring cleanup of groundwater under neighboring priorities.



Stormwater Filtration

Waste Management landfills collect and discharge millions of gallons of stormwater each year. The water must be managed to ensure it is clean enough to meet strict state requirements before being released to water bodies or public treatment plants. One new technology, called Terra-Tubes, has been successfully deployed at several landfills to reduce suspended solids in the stormwater. Terra-Tubes are made of engineered wood and man-made fibers encased in a heavy-duty, knitted cylindrical tube. The tubes are installed at stormwater outfalls and have been successful in slowing water flow to allow for settling and enhanced filtration of the water prior to discharging it off site.



Natural & Enhanced Leachate Evaporation

Landfills naturally produce leachate from a combination of the breakdown of waste materials and precipitation falling on the landfill. Leachate is typically stored on site in lined impoundments or tanks before it is treated and eventually discharged. Waste Management has been developing and testing technologies to reduce both the volume

of water and disposal costs. One technology harnesses nature. By constructing wetlands and planting grasslands and poplar groves to naturally filter and clean leachate, Waste Management has made use of natural ecological systems to treat water, while also increasing natural habitat for native plants.



We have also used a simple technology that recirculates and evaporates leachate using the side slopes of leachate ponds. An electric pump pulls water from the pond and circulates it through lateral pipes that are equipped with sprinkler heads. Water that is not evaporated filters through gravel placed on the side slopes to return to the pond. The system can evaporate as much as 20,000 gallons of liquid per day, reducing the volume of water that must be handled at publicly owned wastewater treatment plants by as much as 30 percent.

Another new technology deployed at several western Waste Management landfills uses a solar-powered floating recirculation device that draws leachate from deep within the pond and disperses it at the surface to help maintain warmer surface temperatures that enhance evaporation. Called the SolarBee, the device also eliminates pond scum on the surface that can interfere with evaporation.

Waste Management engineers have developed a pilot evaporation system that uses waste heat from the landfill's engine plant that is used to produce renewable electricity. The waste heat warms the leachate to facilitate evaporation and enhance treatment. Data from the pilot will be used to evaluate other locations where the technology can be deployed.

Innovation in Landfill Cover

A closed landfill's final cap or cover is one of its most important environmental protection features. It must be constructed in accordance with federal and state requirements and properly maintained for years into the future. A typical final cap comprises several layers of plastic membrane, a drainage system and a covering of soil. These covers are engineered to prevent precipitation from percolating through the landfilled waste.

With approval from U.S. EPA, Waste Management has permitted over 40 sites for the design and construction of innovative final covers known as evapotranspiration covers. These covers are constructed of soil and selected vegetation and are specifically designed to store water and release it to plants through evaporation. By working with nature rather than resisting it, evapotranspiration covers provide long-term, sustainable protection, are easy to maintain and provide a natural habitat of native plants and grasses.



Credit: McMahon & Mann Consulting Engineers, P.C.

Remediating Cortese Landfill

The responsible parties at this Superfund site are finding opportunities for “green remediation” consistent with EPA Region 2’s Clean and Green Policy. The group will purchase renewable energy credits equivalent to the electrical power usage at the site in lieu of on-site renewable energy generation inconsistent with local conditions. 100 percent of electricity used at the site comes from renewable sources. Where consistent with regulations, material at the site, for example, construction material for wells and piping, is reused or recycled. Also, equipment used at the site is evaluated for incorporation of energy efficiency and recycled material.

Long-Term Stewardship

Just as we strive for safety and environmental quality at all our operating landfills, we want to be stewards of the environment when these facilities come to the end of their useful lives. Since 1991, Waste Management has had an independent, formally designated Waste Management department to manage the company’s legacy sites — closed landfills linked with companies Waste Management acquired over the years and facilities closing at end of permit life. The department is separate from ongoing operations, with specialists experienced in the science and engineering of site closure and long-term management of these properties. These experts bring a fresh eye to sites ending their useful lives, and they are attentive to opportunities for secure maintenance of the sites for the long term. The Environmental Legacy Management Group also looks for opportunities for these sites to provide new benefits to the community.

These efforts are supported by innovative, peer-reviewed science from Waste Management employees working with leading experts in their fields.

Landfills With a Lasting Legacy

Currently, Waste Management has six closed landfills that provide areas for community parks and recreation opportunities.

COUNTY LINE

Denver, CO

- > soccer fields
- > BMX track

OYSTER BAY

Oakland, CA

- > hiking trails
- > picnic areas
- > dog walking
- > frisbee golf

BLACKWELL

Ontario, Canada

- > walking trails
- > dog park
- > playground

MIDWAY AND SETTLER'S HILL

Contiguous sites in
west metro Chicago, IL

- > golf courses
- > cross-country course
that is currently in
development by the county

GREENE VALLEY

West metro Chicago, IL

viewing area open to the
public at certain times but
controlled by the Forest
Preserve

PJP LANDFILL

Jersey City, NJ

transferred to the City
and NJDEP which allowed
for use as a public park



Solar Energy Applications at Closed Landfills

Our large geographic footprint of landfills and their proximity to existing infrastructure can make them ideal locations for large-scale solar installations. We continue to increase our commitment to solar generation, a strategy that is aligned with U.S. EPA’s RE-Powering America’s Land initiative. First launched in 2008, this innovative federal program has resulted in nearly 253 installations on contaminated lands, landfills and mine sites, with a cumulative installed capacity of just over 1,397 megawatts nationwide.

Site	Size	Lease Holder
Parklands (NJ)	10.1 MW (dc)	PSE&G
L&D (NJ)	12.9 MW (dc)	PSE&G
Hunt Road (MA)	6.0 MW (dc)	Citizens Energy
Berkley (MA)	3.612 MW (dc)	Captona Energy Partners
MT Sullivan (MA)	2.54 MW (dc)	Captona Energy Partners
Hudson Stow (MA)	5.83 MW (dc)	Captona Energy Partners
Cinnaminson (NJ)	13 MW (dc)	PSE&G

Currently, we lease seven closed landfills for solar development, working collaboratively with the Waste Management Renewable Energy group. A summary of the portfolio follows:

In New Jersey, we have partnered with Public Service Electric and Gas Company (PSE&G), which, in 2018, constructed a third solar project on the

closed Cinnaminson landfill in Cinnaminson, New Jersey. The project is planned to be 13 megawatts and is anticipated to be commissioned by the end of the year. We plan to generate 54 megawatts of power from the solar fleet on closed facilities before 2019.

Expertise & Research

As the largest operator of landfill networks in the industry, we provide extensive staff training to assure continuing education and dissemination of current best practices. This training includes classes in landfill design, construction and management; landfill gas systems management; and advanced instruction in air permitting and compliance. These courses are complemented by a range of eLearning modules in the management of greenhouse and other gases. Other learning opportunities enhance expertise in almost every phase of safe landfill operation.

In 2018, Waste Management opened its first landfill gas technician training center at the former ELDA Landfill in Cincinnati, Ohio. As recognized leaders in landfill gas management, the intent and purpose of the training center is to use internal expertise to train entry-level technicians to provide continuity and consistency across the enterprise. The training center allows for both classroom instruction on the technical aspects of landfill gas and field proficiency assessment.

We also contribute to new bodies of knowledge through research collaborations with expert stakeholders. For example, Waste Management engineers working with an academic research team evaluated and estimated the capacity of an evapotranspiration cover at a subject landfill to oxidize landfill gas emissions by modeling the methane flux from the waste mass to the base of the cover system. The study provides a method for estimating when methane oxidation in a landfill's cover may represent the best available control technology for residual landfill gas emissions. Published in 2018 (Journal of the Air & Waste Management Association, DOI:10.1080/10962247.2018.1500403) the study should help landfill operators and regulators agree upon the process for determining when to cease active landfill gas system controls.

Additionally, in 2017, Waste Management and a research team completed a case study on optimal approaches to long-term landfill management by assessing threat potential from closed landfill assets to eliminate that threat. The research project evaluated the two industry standards for performance-based outcomes (functional stability and organic stability) using actual data from a closed Waste Management MSW landfill. The results were published in 2018 (Waste Management 75 (2018) 415-426), providing the industry its first implementation of performance-based analysis using real-world data to assess threat potential across media. This foundational research is key to identifying long-term stewardship options that are reliable, science-based, and designed to assure safety throughout the transition of closed landfill properties to beneficial re-use after closure. See Appendix to review a [list](#) of peer-reviewed technical articles and conference papers published by Waste Management experts in the past several years.

ENERGY CONSERVATION

Ensuring energy efficiency and conservation throughout our operations is important, as it impacts both our greenhouse gas (GHG) footprint and our cost structure. Energy use costs represent approximately 5 percent of total annual revenues. In 2017, we consumed 7.6 million MWh of total electricity across our over 1,300 Waste Management sites.

We aggressively seek solutions to improve energy efficiency in every facility we operate by implementing a range of technologies and best practices that reduce environmental impacts, improve operational efficiencies and achieve cost savings. These efforts often start with the construction of our facilities, which usually are built to the U.S. Green Building Council's LEED standards, regardless of whether we seek certification.

Waste Management is both a supplier and a user of renewable energy, increasingly utilizing sources such as wind, solar, waste heat and landfill gas to power and heat our facilities. We focus our efforts on generation of renewable energy rather than internal use of renewables, since our overall use of electricity is comparatively small.

We look for capacity to generate renewable energy throughout the organization. For example, in 2017, we hosted the generation of 100 MWh of energy from wind, and we will host up to 54 megawatts of landfill-based solar farms by the end of 2018. We continue to look for opportunities to use solar electricity in support of U.S. EPA's RE-Powering America's Land initiative, which encourages renewable energy development on current and formerly contaminated lands, landfills and mine sites when it is aligned with the community's vision for the site.



Additional innovations and investments to enhance renewable energy production at our landfills include:

- › Technologies to convert materials into ultra-low-sulfur diesel and other transportation fuels and petroleum products
- › Small-scale gasification to convert solid biomass feedstock, as well as other combustible feedstocks into a high hydrogen and carbon monoxide-rich synthetic gas
- › Thermal chemical conversion of waste materials into advanced biofuels such as ethanol, as well as renewable chemicals
- › Accelerated high solids aerobic and anaerobic digestion to produce renewable energy from organics
- › Conversion of landfill gas into renewable natural gas used to power vehicles, generate electricity at our landfill gas-to-energy (LFGTE) facilities, generate power off-site, or use as a heating fuel; and
- › Conversion of biomass into organic salts that can be converted into a high-octane gasoline that can then be blended directly into a refiner's fuel pool, avoiding many of the blending and logistics challenges presented by ethanol.



CARBON FOOTPRINT & STRATEGY



We are transforming our business model to seize opportunities to compete in tomorrow’s climate-constrained world. Each day, our customers look for our help to reduce their GHG emissions, and this is also a strategic imperative for our business.

We continue to expand the productivity of our recycling operations and explore the many options to reduce our footprint. This includes:

- › Producing low-carbon fuels from waste.
- › Transitioning our fleet to renewable natural gas vehicles.
- › Improving the energy efficiency of our facilities.
- › Increasing our use of renewable energy.
- › Expanding the productivity of our recycling operations, with an emphasis on increasing the recycling of those materials that provide the greatest GHG reduction benefit.
- › Providing climate-related sustainability consulting services to customers who want to improve tracking, reduce their carbon footprints, and/or prepare for potential carbon cap-and-trade or carbon tax scenarios.

We have a long track record of leadership in climate-related disclosure, having participated in the CDP (formerly the Climate Disclosure Program) climate reporting for more than a decade. For the past two years, we have been named to the CDP Climate A list, considered the world’s most comprehensive rating of companies leading on environmental action. See [Appendix](#) for more detail on the CDP and methodology.

Our GHG Footprint

2017 Emissions (metric tons CO₂e)

	CANADA	U.S.	TOTAL
Scope 1	776,646	14,913,347	15,689,993
Scope 2	12,119	232,709	244,828
Scope 3	725,693	7,939,892	8,665,585

Scope 1 includes emissions from Waste Management-owned and -operated facilities and vehicles, Scope 2 includes indirect emissions from purchased electricity, and Scope 3 includes purchased goods and services; capital goods; fuel- and energy-related activities; business travel; employee commuting; downstream leased assets.

GHG Emissions Impact

	2016	2017
GHG Footprint (Metric Tons CO₂e)		
Process	13,603,232	13,681,187
Transportation	1,696,067	1,597,312
Energy Use	585,822	656,322
Potential Avoided GHG Emissions (Metric Tons CO₂e)		
Renewable Energy Generation	2,252,035	2,420,864
Reuse and Recycling of Materials	32,571,862	32,588,647
Carbon Permanently Sequestered	18,536,528	19,481,205
Waste-Based Energy Benefits		
Tons of Coal Equivalent	2,540,000	2,480,000
Waste-Based Energy Production (million households)	470,000	460,000
Resource Savings Achieved through Recycling*		
Households Powered Equivalent	1.7 million	1.6 million
Cars Taken Off Road Equivalent	6.9 million	6.9 million

*Based on EPA WARM model using defaults

Climate Strategy

We incorporate climate change considerations into all aspects of our business strategy. Among the climate change considerations influencing strategy are:



EMERGENCY PREPAREDNESS

Weather events can threaten business continuity. We have refined our disaster response plans for disposal facilities, using FEMA flood maps to expand the list of locations with supplemental electrical generating capacity. We also have re-evaluated where emergency equipment should be placed and where we should pre-position fuel and disaster supplies.



REGULATORY CHANGES

We monitor developments that may affect our operations or our customers' and engage with a broad array of stakeholders, including federal, state and provincial governments, to recommend approaches that produce meaningful GHG reductions at reasonable cost.



GREEN BUSINESS OPPORTUNITIES

[WMSS](#), recycling, renewable energy production and carbon sequestration in landfills are all carbon-reducing services that we provide to customers. We monitor customer advocacy and goals based upon the Paris Agreement for market trends affecting our renewable energy portfolio, recognizing that our multinational customers are shaping their procurement strategies on factors beyond U.S.-driven climate policy.

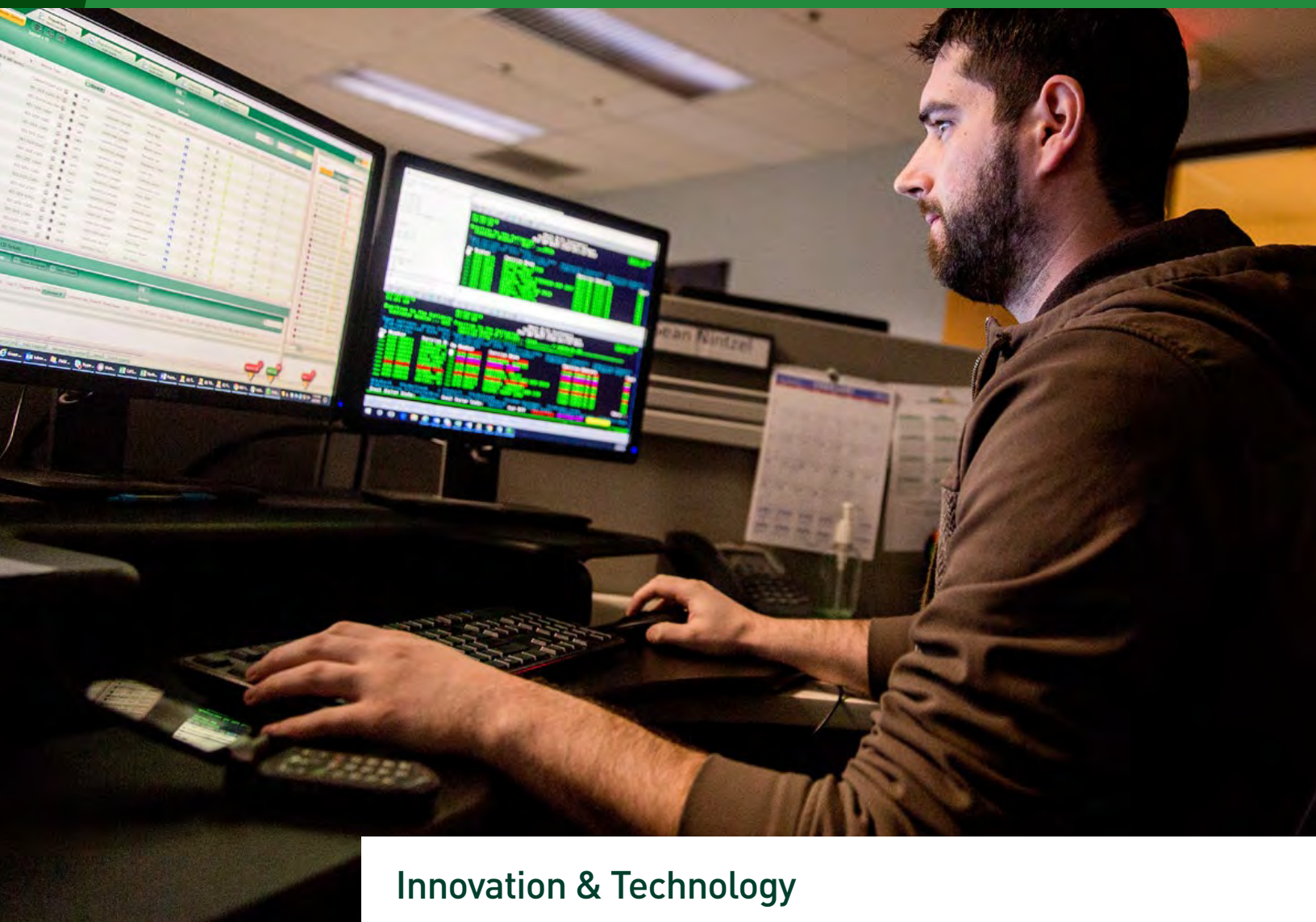
Cross-disciplinary teams continuously monitor our customers' needs to reduce carbon, as well as regulatory development and lower-carbon financial incentives. The latter are analyzed by Senior Leadership as part of our market business strategy annual assessment and used in capital allocation. Ongoing capital allocation for natural gas trucks, as an example, supports our forward-looking, science-based goal to reduce emissions associated with our fleet by 45 percent by 2038, against a 2010 baseline.



Recycling and GHG Reduction Tools

Our priority is to improve the sustainability of recycling economics by providing tools for our customers to understand the GHG reductions achieved through recycling, thus motivating them to procure services needed to improve recycling quality. Efforts to improve the quality and quantity of recycling are aligned with our science-based goal to increase avoided emissions by 38 percent by 2028, against a 2010 baseline. Recycling will play a critical role in helping to achieve that goal.

The method by which customers choose to manage waste materials has a direct impact on the amount of GHG emissions generated. According to the EPA's Waste Reduction Model (WARM), for example, three times the life cycle emissions are generated when mixed recyclable material is disposed rather than recycled. Consider that in 2017, Waste Management avoided the generation of 32,588,647 MTCO₂e life cycle emissions by recycling materials or repurposing them to generate renewable energy and create compost rather than disposing them.



Innovation & Technology

Climate change also influences our long-term strategy, including the development and incorporation of new technologies. We are focused on deployment of lower-carbon technologies that are already commercialized and identifying geographic-area targets for our commercial recycling and green fuel projects over a five-year time frame; for projects seeking to create products from renewable feed stock, our time frame extends to 15 years. Examples of development priorities include:

- › Expanding existing and identifying new beneficial use projects to manage methane at our landfills.
- › Developing high-BTU projects that convert landfill gas to renewable transportation fuels for use in our heavy-duty trucks and for sale to third parties.
- › Investing in innovations to convert waste materials into energy and other low-carbon products while perfecting the technical processes, logistics and match of products to market demand. Read more about our waste-based energy generation on [page 43](#).
- › Furthering our renewable energy production through investment in companies that are developing sustainable energy technologies. Learn more about waste-based energy production on [page 47](#).

CEO-Level Stakeholder Engagement

Our strategy to enable four times as many GHG emissions reductions as we generate is led from the top. Waste Management's CEO maintains a public dialogue on GHG emissions reduction as recycling's key benefit and advocates maximizing recovery of targeted commodities, such as cardboard or aluminum cans, that provide the most GHG benefit. Our public-sector team is closely engrained in our local communities, helping implement programs that support local community sustainability priorities. Our consulting arm, Waste Management Sustainability Services, also furthers this effort by helping customers achieve sustainability and climate change goals through "zero waste" services for large events, plus a full range of recycling, waste reduction, renewable energy, water conservation and environmental education services for large corporate customers.

Sustainable Materials Management Engagement

For the past three years, we have advocated across stakeholder groups for GHG emissions reduction to be the focus of federal, state and local government and private sector recycling goals rather than focusing merely on the weight of materials

recycled. We are especially engaged with stakeholders on ways to increase the productivity and economic sustainability of recycling. That's why we helped form the Sustainable Materials Management Coalition on recycling, headed by a former U.S. EPA assistant administrator for solid waste and emergency response. We also dedicated the entire afternoon of our 2018 Waste Management Sustainability Forum to a workshop on Sustainable Materials Management. At the Forum, we engaged over 100 stakeholders in a dialogue around using life cycle thinking to prioritize materials management programs in communities and at businesses across North America.

Educating our customers — as well as communities, schools, nonprofit organizations, other businesses and their leaders — about recycling benefits and best practices has been critical to effecting transformational change. Learn more about our education efforts on [page 122](#).



We also work with designers and the manufacturing industry to avoid or reduce raw material processing, and to include recycled materials in their products. We utilize our materials recovery facility infrastructure, as well as our consulting group, to teach designers and manufacturers about the recycling process. Waste Management's recycling activities result in a wide variety of GHG reductions that otherwise very likely would not occur.

FLEET



We charge our fleet of more than 32,000 vehicles with providing reliable everyday waste collection for our customers while minimizing its environmental impact. We've set bold goals, utilized smart solutions and leveraged innovative technology to realize progress. Sixty-six percent of our residential routes run with automated or semiautomated equipment, which reduces the number of times our employees must exit the truck while collecting trash and recyclables, which in turn reduces accidents.

That effort started in 2007 when we set our first goal to reduce CO₂ fleet emissions by 15 percent, which we achieved in 2011 primarily by transitioning our fleet of collection vehicles from diesel to cleaner-burning natural gas. With a vision to create a near-zero emissions collection fleet, we're now working toward a science-based target to reduce emissions associated with our fleet 45 percent by 2038, against a 2010 baseline, and from 2010 through 2017 we have reduced fleet emissions 28 percent.

Key to achieving this ambitious goal is a commitment to invest approximately \$400 million annually in the cleanest near-zero-emissions trucks available. At the end of 2017, our natural gas fleet counts 6,536 trucks, which comprise the largest heavy-duty natural gas truck fleet of its kind in North America. Our vehicles powered by compressed natural gas (CNG) emit nearly zero particulate emissions, cut GHG emissions by 15 percent and are quieter than diesel trucks. For every diesel truck we replace with natural gas, we reduce our use of diesel fuel by an average of 8,000 gallons per year along with a reduction of 14 metric tons of GHG emissions annually.

Natural Gas Vehicles (NGVs)

BY-THE-NUMBERS 12/13/17



6,536

NGVs IN OPERATION

38%
ROUTED
COLLECTION
TRUCKS ARE NGVs

80%
NEW PURCHASES
ARE NGVs

107
NATURAL GAS
STATIONS

195,000
METRIC TONS

GHGs Reduced
Annually Using Fossil
and Renewable Natural
Gas Fuel

>60
MILLION
Gallons of Natural Gas
Supplied at 107 Natural
Gas Stations Each Year

855
MILLION
Diesel Gallons
Displaced Over
the Useful Life of
Existing NGVs

>16
MILLION
RNG Gallons Produced
by Harnessing Methane
in Landfills



Fueling Our Fleet

Critical to our natural gas strategy is an infrastructure of Waste Management-owned and -operated fueling stations. As of the end of 2017, we operated 107 natural gas fueling stations across North America, with 29 of these also open to the public. Waste Management finances and constructs the stations, as well as purchasing the fuel.

Our landfill-gas-to-fuel plants convert landfill gas into renewable natural gas (RNG), a pipeline-quality gas that is fully interchangeable with conventional natural gas and thus can be used in our vehicles in the form of CNG or liquefied natural gas (LNG). This lowers fuel costs and reduces GHG emissions more than 80 percent compared to vehicles powered by diesel.



Offsetting Fossil Fuel With RNG

RNG is biogas, the gaseous product of the decomposition of organic matter, that has been processed to purity standards. Like conventional natural gas, RNG can be used as a transportation fuel in the form of CNG. Biogas is produced from various biomass sources through a biochemical process, such as anaerobic digestion. With minor cleanup, biogas can be used to generate electricity and heat. To fuel vehicles, biogas must be processed to a higher purity standard. This process is called conditioning or upgrading, and involves the removal of water, carbon dioxide, hydrogen sulfide and other trace elements. The resulting RNG, or biomethane, has a higher content of methane than raw biogas, which makes it comparable to conventional natural gas and thus a suitable energy source in applications that require pipeline-quality gas.

Offsetting natural gas is comparable to the process of yielding renewable electricity from our landfills. In the case of renewable electricity, energy is added to the electrical grid at one of our landfills, and that same amount of energy is “credited” as renewable electricity by a user at another site within the same electric grid. Key to this process is that the amount of electricity delivered into the grid equals the amount of electricity taken off the same grid. Waste Management has been offsetting electricity with renewable energy for decades using this process.

Renewable fuel works in exactly the same way. Biogas is processed and cleaned before the clean biomethane is put into the pipeline at our (or another company’s) landfill — and an equal amount is used as fuel within the same pipeline system. As with electricity, the gas input and outflow must be on the same gas pipeline system and must be carefully recorded to ensure that they are the same. The process is carefully

tracked and verified as renewable fuel by the U.S. EPA when the cycle is complete and only qualifies as RNG after the gas has been used in natural gas vehicles. This certification system is in place at each of our qualified landfills and fueling facilities. Each gas project is reviewed and qualified by the U.S. EPA using engineers who verify that the RNG entering the gas pipeline equals the volume of gas extracted from that same pipeline, and is actually used for vehicle fuel.

Closing the Loop: Converting Landfill Gas to RNG

Waste Management has the largest fleet of natural gas vehicles in our industry, with 6,536 natural gas collection trucks operating in North America. We support this fleet with our 107 natural gas fueling facilities. Waste Management is unique in that we are both a source of, and an end user of, renewable fuel. We currently fuel over a third of our natural gas fleet with RNG produced from landfill biogas at three of our own facilities plus third-party producers. Our long-term and ongoing investments in RNG production facilities, coupled with a natural gas fleet that can operate on RNG, are moving us closer to a near-zero emissions collection fleet.

Using Every Tool to Reduce Emissions in Seattle

Waste Management began using compressed natural gas (CNG) collection vehicles for all of its collection services in the City of Seattle in 2009. Further, all 144 trucks are fueled by renewable natural gas (RNG). By using RNG, Waste Management has reduced our Seattle fleet's GHG emissions by 70 percent compared to diesel. By comparison, trucks fueled with traditional fossil CNG only reduce GHG emissions by about 15 percent compared to diesel. In Seattle, Waste Management also relies on other fleet investments to reduce emissions in the City, including the use of electric and hybrid vehicles for specific tasks and eRoute Logistics™ mapping software to streamline routes for our fleet, thereby cutting the amount of fuel we need and lowering our carbon footprint.

In 2017, Waste Management's fleet consumed 6,670,000 MMBtu of natural gas in 6,536 natural gas vehicles (NGVs). Of that total usage, we are managing approximately 2,010,000 MMBtu/year, or 30 percent, of biogas that offsets our total fleet needs. This includes internal and external biogas sources. 100 percent of our natural gas fleet in California, Oregon and Washington runs on RNG, which reduces GHG emissions by 70 percent compared to diesel.

Currently, Waste Management has four facilities that produce RNG:

1. **Altamont Landfill** (Livermore, CA) — In 2009, this facility began producing enough RNG to fuel 300 trucks.
2. **Milam Landfill** (St. Louis, Illinois) — This site, which debuted in 2014, processes and purifies gas from the landfill and injects it into the Ameren Illinois pipeline. The facility produces about 12,000 diesel gallon equivalents (DGE) per day of RNG, enough to fuel approximately 500 of our natural gas collection trucks.
3. **American Landfill** (Waynesburg, Ohio) — This facility processes and purifies gas from the landfill and injects it into the Dominion East Ohio pipeline. It produces 6,000 DGEs per day of RNG, enough to fuel about 250 of our natural gas trucks.
4. **Outer Loop Landfill** (Louisville, Kentucky) — Brought on-line in June of 2018, this facility produces 2,500 MMBtu per day of RNG — enough to fuel about 800 natural gas collection trucks.

Our Midwest facilities pump RNG directly into the pipeline, displacing reliance on fossil natural gas.

Equipment Efficiencies

While our “last generation” natural gas engine cuts smog-producing nitrogen oxide (NOx) emissions by up to 50 percent compared to the cleanest diesels, our 2017 near-zero-emission natural gas engine (ISL-G “NZ”) is the cleanest heavy-duty machine ever certified by the California Air Resources Board (CARB). Waste Management helped pioneer this engine with Cummins, and it now provides a 95 percent reduction in NOx emissions compared to the current NOx standard and a 93 percent reduction in NOx compared to the latest diesel engine technology. Additionally, the new engine is already certified at 16 percent below the current GHG emission standard and is 12 percent below the 2027 standard.

We also have the largest fleet of hybrid bulldozers in the industry, operating 42 Caterpillar D7E’s at 39 different landfill locations across the country. The D7E’s rate of hourly fuel consumption is on average six gallons less than the D8 tractors it replaces, translating into annual savings of nearly one half million gallons of diesel fuel.



Our collection of Caterpillar D7Es is the largest fleet of hybrid bulldozers in the industry.



Volvo LX1 Electric Hybrid Wheel Loader

Wheel loaders are another electric hybrid machine we are exploring. In conjunction with Volvo Construction Equipment, we hosted two field tests for Volvo’s prototype LX1 electric hybrid wheel loader at our Redwood Landfill and Moreno Valley Transfer Station, both in California. Data was collected on the wheel loader’s fuel efficiency and GHG reduction against a conventional machine. The LX1 achieved approximately a 50 percent and 45 percent fuel efficiency improvement on average, at the Redwood and Moreno Valley sites respectively.

Driving Fewer Miles

Efficient logistics are an effective way to reduce fleet emissions. The logic is simple: a more efficient route means fewer miles traveled, and that translates into reduced fuel consumption and associated emissions. Since 2017, Waste Management’s fleet has reduced miles driven by 2 percent, which equates to an approximate 8.9 million fewer miles a year. Optimizing routes not only reduces our environmental impact, but also increases the quality of service. As we’ve driven fewer miles, we’ve improved the number of stops missed for both commercial and residential customers.

Credit for much of this progress goes to our Service Delivery Optimization (SDO) initiative, which helps us streamline routes. Under a “Safety, Service, Savings” motto, 95 percent of collection vehicles are SDO certified. SDO technology includes DriveCam®, a video



Optimizing Logistics

Waste Management's Routing & Logistics organization was established to create route optimization and logistics capabilities within the Collection Operations. We recognize that to be a world class leader in the industry, it is very important to have a centralized organization where route optimization techniques and processes are standardized, refined and deployed. It's proven to be a valuable and consistent method for managing the safety, efficiency and overall quality of our routes across the enterprise.

The Routing & Logistics team is made up of 12 Corporate engineers and 40 local area logistics resources. Together, the team partners to create comprehensive logistics plans that identify routing opportunities and key operational metrics. Logistics plans are reviewed regularly with the local area leadership to ensure routing efforts are addressing priority opportunities.

In 2017, we did 150 reroutes in 80 locations. Our plan is to continue to route the top 20 percent of our commercial and residential routes each year.

Overall mile reduction reduces the exposure to risk for drivers. A well-planned route reduces potentially dangerous driving behavior by elimination of U-turns and backing and reduced left turns. A well-planned route executed consistently each day provides the driver with a steady routine that keeps safety in the forefront.

Reroutes provide the opportunity to make changes to service days, allowing Waste Management to service customers on the requested service days and times. Servicing customers on the correct day at the correct time provides an improved customer experience.

recorder mounted on the windshield of collection vehicles that is automatically activated by sudden movements. This helps us to coach drivers on fuel-saving driving techniques, such as proper acceleration, deceleration and efficient speeds. Similarly, an on-board computing system enables drivers to use a tablet for logistics support and route optimization. This is one of several types of software that we utilize to enhance driver safety, communication and route optimization.

Our fleet organization has also taken the next step in mobile technology by launching its first mobile app in 2017. The app provides a number of benefits that include allowing fleet managers who are responsible for multiple districts to get a real-time view of shop operations when they are not physically present; a "current labor" tab that provides a communications link to shop technicians and updates on standard repair times; a "unit availability" tab that lets users know at a glance if the district has enough assets to serve customers; and a "customer service interruption events" tab that reveals downtime opportunities.

We've also instituted an anti-idling program to reduce fuel consumption. Through this program we are ensuring that all collection vehicles made since 1998 can verify that idle shutdown timers are programmed to five minutes, in accordance with the American Transportation Research Institute's Compendium of Idling Regulations .

Our Bagster® service continues to eliminate the need to send a truck to deliver an empty container to customers by offering compact containers for sale at more than 4,000 retail locations across the United States and Canada. Bagster is strong enough to hold up to 3,300 pounds of debris or waste, making it suitable for anything from home renovations to disaster cleanup. When customers are finished with their projects, Waste Management can collect up to 15 full Bagsters on a single, efficient collection route.



WATER CONSERVATION

Though our operations are not relatively water intensive, as global water consumption increases at a historic pace we work to use water sparingly and responsibly in our operations. Primary water uses include vehicle washing, dust suppression, sanitation and employee consumption.

Waste Management operates facilities ranging from landfills and hauling facilities to transfer stations and recycling facilities, dispersed across 17 market areas in the U.S. and Canada. We also own or lease office space throughout North America. Due to the geographic and operational variations in the facilities we operate — as well as the numerous utility providers — obtaining complete operational water consumption data can be a challenge.

Enhanced Water Tracking

We estimate that our current annual operations use approximately 627.5 million gallons of water. After accounting for the water consumed by our employees and operations, we estimate that approximately 490.8 million gallons of water is returned to either the municipal sewer system or groundwater aquifers, depending on the site’s location.

In 2016, we began employing a third-party utility bill management (UBM) service to assist in gathering water and energy usage data across our sites. Through the UBM system, Waste Management can now retrieve water withdrawal data by market area, which offers a baseline understanding of consumption patterns on a regional level. Our goal is to complete the enablement of all sites into the UBM system. Utilizing the information gathered from this process, we will be developing more meaningful quantitative goals around water usage.



Water Risk Assessment

The ability to pull consumption data by site also enables us to complete water risk mapping. By overlaying our regional water use with geographic information regarding water stress, we can both focus conservation efforts to minimize Waste Management’s impacts where they are potentially most detrimental and develop effective risk mitigation and action plans to minimize disruptions to our business that may occur due to inadequate water quantity or quality.



Currently, 20 percent of our water consumption occurs at sites located in water-stressed regions. We continually strive to reduce the amount of water consumed in these regions through innovative programs such as using recycled graywater for truck washing to reduce dependence on the municipal water supply.

While we are still in the process of applying a standardized process to capture quantitative data on water recycling and reuse initiatives, we are moving forward with implementation of the initiatives themselves. We continually look for ways to reduce water consumption across our operations, whether through implementation of graywater initiatives, fixture replacement or other conservation methods. In addition, we engage with other

stakeholders by working with policymakers and trade associations on water policy through our work with the RCRA Corrective Action Project (RCAP) and the Sediment Management Work Group on sediment sites. Waste Management reports on our operations and supply chain impacts on water and responds to our customers’ and investors’ requests for this information through CDP (formerly Carbon Disclosure Project).

Finally, we utilize the Waste Management Phoenix Open to highlight water concerns and coordinate restoration efforts. We have reported our water consumption since baselining the tournament’s operations, and we implement a graywater capture program that reduces freshwater consumption by 5,000 to 6,000 gallons each year. In 2018, we worked with The Thunderbirds as well as Kohler and M Culinary to restore 75 million gallons, or 283.91 megaliters, to Northern Arizona rivers and streams. Since initiating this effort with Change the Course in 2015, the Waste Management Phoenix Open has been responsible for the restoration of 236 million gallons of water to the Verde River and other freshwater ecosystems in Arizona.

