



# Greener Garbage Trucks

**More trash haulers dumping diesel for cleaner fuels like natural gas, new INFORM report finds**

By Deborah Gordon, Juliet Burdelski & James S. Cannon

Every morning across the nation, garbage trucks wend their way up and down our streets, stopping at the curbs of more than 75 million urban and suburban households. These trucks haul away not just trash and recyclable paper, plastic and metal, but the materials discarded by more than seven million businesses and nearly 100,000 state and local government establishments. Hauling waste is an essential service that helps keep our streets and sidewalks free of refuse and the vermin that accompany it, yet it goes largely unnoticed.

America is an increasingly prolific garbage producer. Over the past 30 years, municipal solid waste generation per capita has doubled in the United States, from 2.3 to 4.7 pounds per day. An estimated 136,000 refuse collection trucks, 12,000 transfer vehicles and 31,000 dedicated recycling vehicles haul away America's garbage.

The negative impacts of this massive fleet are numerous and widespread. More than 90 percent of all garbage trucks — and over 99 percent of heavy-heavy-duty garbage trucks — are diesel-fueled, creating both air and noise pollution. Diesel emissions threaten our health with lung-damaging toxic substances and noise levels that can cause serious hearing damage.

For this study, INFORM investigated the effects of garbage truck operations on the environment, public health, industry workers and national energy security. We also investigated a range of experiences with today's emerging and mainstream fuel and engine technologies, profiling the pioneering waste collection agencies that have tested and deployed advanced garbage truck technologies and alternative fuels. We explored their motivations for natural gas deployment projects, the types of truck technology and fuels used, the costs of vehicles and refueling infrastructure, the obstacles faced, worker training issues, the emissions and noise reductions that trucks in service have achieved and reactions to the new vehicles. Along the way we also conducted numerous interviews with waste industry personnel, engine manufacturers, fuel suppliers, regulators and other experts. The findings that follow came from that research.

## Alternatives to diesel emerge

Diesel-fueled garbage trucks are among the oldest, least fuel-efficient and most polluting fleet vehicles in the U.S. Their operations pose significant threats to the environment, to the health of those in the communities they serve and to the workers who maintain and operate them. Moreover, the almost complete dependence of these vehicles on oil-derived fuels compounds the national security risks that our country faces because of its reliance on oil imported from politically unstable parts of the world.

The good news is that change is afoot. Profiles of 19 waste hauling operators (17 in the United States and one each in Japan and the Netherlands) at the leading edge of the transition to

## Benefits of Natural Gas Trash Trucks vs. Diesel

IMPACT	POLLUTANT	% REDUCTION FROM NG TRUCKS
Air pollution	Particulate matter	67-94%
	Nitrogen oxides	32-73%
	Non-methane hydrocarbons	69-83%
Noise	Decibels	50% behind truck
		90% inside truck
		98% beside idling truck
Water pollution	Organics	100%

Source: INFORM; see Table 15 of full report for complete data

cleaner alternative fuels show that natural gas vehicles (NGVs) are a commercially viable alternative, with other technologies emerging as well. Meanwhile, an increasing number of communities are beginning to consider introducing cleaner technologies into their local trash collection fleets.

Every new step in this direction enhances energy security, provides immediate environmental and health benefits and moves us toward the era of the hydrogen fuel cell, which may be the ultimate sustainable, pollution-free and renewable fuel and power source.

## Pioneering natural gas fleets

Diesel trash haulers are among those that will be subject to new federal heavy-duty vehicle emissions standards requiring the use of cleaner fuels and more costly technologies (including low-sulfur fuel and pollution control devices such as particulate filters and oxidation catalysts) beginning in 2004. These technologies address some but not all the pollution problems associated with diesel exhaust.

Alternative fuels and advanced propulsion systems that can easily meet the new standards are being developed and some are fully commercial today — mainly with engines that run on natural gas. INFORM profiled 17 garbage truck fleets and tracked an additional nine fleets that together deploy a total of 692 natural gas trucks in the U.S. Many municipal and private operators are adding natural gas garbage trucks to their fleets every year, while a growing number of vehicle manufacturers and fuel infrastructure providers have a stake in the growth of this vehicle sector. Below are key points about current natural gas trash collection fleets, followed by INFORM's findings and recommendations regarding the integration of cleaner fuels and vehicles into garbage truck operations:

- Garbage trucks capable of burning either compressed natural gas (CNG) or liquefied natural gas (LNG) currently serve more than one million U.S. households and tens of thousands of businesses and municipal residents.

- The use of natural gas trucks was pioneered in 1989 by the New York City Dept. of Sanitation, which currently operates 36 CNG trucks.
- Waste Management, Inc., the largest hauling and disposal company in the waste industry, is the clear U.S. industry leader in the use of natural gas trucks, with 380 trucks in 14 of its fleets, including 13 in California and one in Pennsylvania.
- Of the 26 U.S. garbage truck fleets using NGVs that INFORM studied, 10 are operated by public agencies and 16 by private companies that operate under contract to a municipal government.
- Of the nearly 700 natural gas trucks, 69 percent are powered by LNG and 31 percent by CNG. LNG was preferred when the route demand for fuel was expected to exceed onboard CNG capacity. CNG was often chosen because of the availability of an existing fueling station that could be shared with other fleets.
- Despite their commercial availability, natural gas garbage trucks make up far less than one percent of the garbage trucks

operating today. If all the companies that are currently planning to implement natural gas garbage truck projects do so, the number of these trucks will increase to more than 2,200 — still only slightly more than one percent of the U.S. fleet.

- Many major truck manufacturers offer natural gas garbage trucks, yet the variety of natural gas garbage trucks still lags far behind that of diesel trucks.
- New companies are emerging to compete for business in installing refueling facilities and delivering natural gas fuel.

**FINDING:** *Garbage trucks operating on CNG or LNG have provided emissions reductions and reduced threats to workers from occupational air quality hazards and noise.*

- Workers at nine garbage truck operations cited relief from the negative health effects of diesel exhaust. Driver preferences were most clearly evident at the New York City Dept. of Sanitation, where trucks are assigned by seniority and natural gas trucks are consistently preferred.

## U.S. Natural Gas Garbage Truck Fleets

### PROFILED U.S. FLEETS

Location	Operator	Begin Date	Current Fleet	Planned Fleet	Remarks
Anaheim, CA	Taormina Industries	1997	50 LNG/diesel	50 LNG/diesel	Dual-fuel; plans unclear for remaining 250 trucks
Corona, CA	Waste Management Inland Empire	2000	27 LNG	75 LNG	35 ordered; entire 75-truck fleet planned
Fairfield, CA	Solano Garbage (Republic)	2002	1 CNG, 33 LNG	1 CNG, 53 LNG	Mobile fueling unit at landfill; new facil. being built; bal. of 54-truck fleet to be replaced; customer-owned station
Fresno, CA	Fresno Hauling/Waste Mgmt.	2001	9 LNG	9 LNG	Currently building fueling facility; plans for remaining 54-truck fleet unclear
Irvine, CA	Waste Management	1998	29 CNG	145 CNG	Fueling site shared with other area fleets; plan to shift entirely to natural gas in place before SCAQMD mandates
Moreno Valley, CA	Inland Empire/Waste Management	2001	27 CNG	27 CNG	Entire 27-truck fleet is natural gas-fueled
New York, NY	Dept. of Sanitation	1989	36 CNG	36 CNG	Building fueling facil.; no plans for rest of 2,566 truck fleet
Palm Desert, CA	Waste Management	1996	45 CNG, 15 LNG	50 CNG, 39 LNG	Entire 89-truck fleet will be natural gas by 2003
San Diego, CA	Environmental Services Dept.	2001	77 LNG/diesel	180 LNG/diesel	Dual-fuel; entire 180-truck fleet will be replaced as retired
San Diego, CA	Waste Management	1999	122 LNG	122 LNG	Part of CA program to offset air pollution from power plants with expanded use of AFVs; entire fleet is natural gas
San Francisco	Norcal	2001	15 LNG	43 LNG	37 transfer trucks ordered; one LNG/hybrid truck on-site; 6 LNG trucks planned for 2003; considering converting entire 400-450 truck fleet to LNG as funding becomes avail.
Santa Rosa, CA	Empire/Waste Management	2001	4 CNG	6 CNG	Fueling shared with Sonoma County transit; considering building their own; no plans for rest of 38-truck fleet
Simi Valley, CA	GI Industries/Waste Management	1998	30 LNG 2 LNG/diesel	110 LNG	2 dual-fuel LNG trucks converted before 1998; entire 110-truck fleet will be converted in the next 3-5 years
Sunnyvale, CA	Specialty Solid Waste & Recycling	2001	24 CNG	29 CNG	Grant application pending for 5 CNG vehicles in 2003/04
Washington, DC	National Park Service	1997	1 CNG	1 CNG	Would like to convert more trucks but lacks funds
Washington, PA	Waste Management	1997	7 LNG	7 LNG	First underground LNG fueling station in U.S.
Yucca Valley, CA	Waste Management	1999	6 CNG	6 CNG	Same operator as Palm Desert; entire fleet converted

### OTHER U.S. FLEETS

Location	Operator	Current Fleet	Planned Fleet	Remarks
Alameda, CA	Alameda County Industries	0	9 CNG	Planning to fuel at ENRG's Oakland Airport station
Alameda County (Oakland, CA)	Waste Management	15 CNG, 7 LNG	15 CNG, 7 LNG	15 CNG trucks to fuel at ENRG Oakland Airport station
Bakersfield, CA	City of Bakersfield	5 LNG	5 LNG	Using a few LNG garbage trucks, sweepers, LD vehicles
Berkeley, CA	City of Berkeley	4 CNG	4 CNG	Interested in expanding; no definite plans
Boston, MA	McGeoghean	0	2 CNG	Purchasing 2 CNG Volvo Expeditors
Carson, CA	Waste Systems	0	20 undetermined	Plans unclear
Fontana, CA	Waste Management	25 LNG/diesel	25 LNG/diesel	Has 11 collection trucks, 14 transfer trucks; plans unclear
Fresno, CA	City of Fresno	0	30 LNG	Plans unclear
Lodi, CA	Waste Management	0	6 LNG	Entire fleet will possibly be converted due to SCAQMD rule
Los Angeles, CA	City of Los Angeles	10 LNG	680 LNG	Ordered 120 trucks in 2002; entire 680-truck fleet to be converted by 2010 (SCAQMD)
Merced, CA	Merced County	0	6 undetermined	Plans for future natural gas waste haulers in early stages
Napa, CA	Napa Garbage	6 CNG	6 CNG	Plans unclear
Palmdale, CA	Waste Mgmt. of Antelope Valley	9 LNG	14 LNG	ENRG station completed; balance of fleet plans unclear
Sacramento, CA	City of Sacramento	0	120 LNG	Planned to deploy 120 LNG garbage trucks in 2002
San Gabriel, CA	Waste Management	31 LNG	210 LNG	Plans to buy 15-18 LNG units/yr. until all 210 trucks are NG
Santa Ana, CA	Waste Management	0	35 undetermined	Entire fleet likely to be converted due to SCAQMD rule
Santa Monica, CA	City of Santa Monica	20 CNG	26 CNG	Entire heavy-duty fleet will be converted (SCAQMD)
Saugus, CA	Waste Management	0	10 undetermined	Plans unclear
Washington, DC	Dept. of Public Works	0	2 CNG	Repowering 2 diesel trucks with CNG

**Total (All U.S. Fleets) 227 CNG, 465 LNG 2,221 NGVs**

**NOTES:** Fleet plans are constantly in flux so numbers are likely to change. Totals reflect fleet statistics gathered by INFORM in the course of its research and do not necessarily reflect the entire U.S. fleet or all fleet plans. Source: INFORM, Inc., based on interviews with fleet operators and industry contacts.

- The Netherlands program, where the most comprehensive study of noise reductions with natural gas trucks was conducted, verified reductions of 98 percent alongside, 90 percent inside and 50 percent behind the truck.
- Fleet managers overwhelmingly reported that truck operators appreciated the reduction in noise, which was hazardous to their hearing and made communication difficult.

**FINDING:** CNG and LNG have a stellar record of fuel safety.

- CNG tanks have survived remarkable durability tests in extensive worldwide applications without leaking or rupture. Thousands of truckloads of LNG have been transported over U.S. highways without significant incident. In the course of 6 to 8 million miles traveled by over 300 LNG vehicles from 1990 to 1993, four collisions occurred, with little damage to the fuel system. Yet the perception still exists that natural gas is not as safe as conventional fuels.

**FINDING:** The costs of switching to CNG/LNG vary greatly.

- The capital cost of implementing an alternative fuel program can be a significant disincentive to voluntary action by refuse collection agencies.
- Among U.S. fleets studied, the cost of a natural gas garbage truck ranged from \$210,000 to \$250,000, 15 to 25 percent more than the cost of a comparable diesel truck. The cost to repower an existing truck ranges from \$30,000 to \$100,000.
- The overall cost of shifting a garbage truck fleet to natural gas depends on numerous factors, including refueling infrastructure options, truck maintenance costs, facility requirements, local safety codes, labor and training costs, fuel

cost and available economic incentives.

**FINDING:** External and internal motivations are driving the solid waste industry to use cleaner fuels — and natural gas in particular.

- Fleet officials most commonly cited the need to meet existing and pending environmental regulations as the reason for converting their diesel garbage trucks to natural gas. NGVs allow fleets to meet current and planned government regulations designed to clean up heavy-duty vehicles and improve air quality.
- Decisionmakers were often influenced by economics. The lower cost of natural gas, tax incentives, grant programs and bid specifications that give preference to companies that operate NGVs can make natural gas trucks more economically feasible for waste haulers.
- States that allow mobile-source emissions reduction credit (MSERC) trading have created a market for the air pollution benefits of natural gas garbage trucks.
- Court-issued mandates and citizen lawsuits have resulted in the deployment of natural gas garbage trucks and the development of heavy-duty natural gas engines.
- The desire of a high-level decisionmaker to be an environmental leader or to position his/her organization as an environmental leader has motivated several operators.
- In areas where there is competition in the refuse industry, some haulers were motivated to use NGVs to give their organization a marketing edge over competitors.
- The decision to deploy alternative fuel garbage trucks also was motivated by the desire to improve worker conditions and reduce the health risks associated with diesel exhaust and the excessive noise of diesel engines.

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**FINDING:** *Natural gas garbage trucks offer multiple air quality, public health and energy security benefits while supporting an eventual shift to more fuel-efficient propulsion systems and even cleaner hydrogen fuel.*

- Today's nearly 700 natural gas garbage trucks displace almost six million gallons of diesel fuel (143,000 barrels of oil) per year. Currently planned natural gas garbage truck purchases will displace nearly 20 million gallons of diesel fuel, or 476,000 barrels of oil, annually.
- Once natural gas is fueling the nation's trucks, it can be used in the demonstration and refinement of hybrid-electric natural gas trucks, which are potentially even cleaner and more energy-efficient.
- The development of a natural gas infrastructure will encourage the future transition to hydrogen fuel cell vehicles, since hydrogen can be produced from natural gas and the storage and fueling technologies for natural gas are similar to those needed for hydrogen.

## Recommendations

To accelerate the transition away from diesel and toward a clean, sustainable transportation future, INFORM recommends the following policies and programs:

- **Deploy alternative-fuel garbage trucks now** to avoid the future expense of low-sulfur diesel fuels and emissions control technologies that will be needed to meet much more stringent EPA and state government standards, along with other potentially costly future diesel truck and fuel ordinances. Given the increasingly stringent regulations and heightened public concern about the toxicity of diesel exhaust, refuse haulers that take the initiative by shifting to alternative-fuel technologies such as natural gas may avoid interruptions of their business caused by current and future regulations and local ordinances.
  - **Ease the shift to cleaner fuels by utilizing grants, other economic incentives and, where available, emissions offset credits** to cover the incremental costs of these new trucks and refueling facilities. The U.S. Dept. of Energy, various states and local air districts have substantial grant funds available to assist local refuse agencies and contractors to acquire natural gas or other clean-fuel trucks and install related fueling infrastructure.
  - **Develop partnerships** with fuel suppliers, station builders and vehicle providers to help reduce the costs of implementation. Effective partnering has been a key element in successful programs to date.
  - **Provide strong economic incentives** for vehicle procurement, infrastructure development and alternative fuel use that reward private sector innovation and investment in clean-fuel garbage trucks. The incremental cost of vehicles and infrastructure development remains one of the greatest obstacles to a widespread industry shift. Targeted government funding programs can reduce or eliminate these costs. For maximum environmental and public health impact, regulations and incentives should target high-usage, high-mileage and older trucks.
  - **Implement stronger regulatory measures** to ensure a shift away from diesel garbage trucks to cleaner fuels in areas of
- exceptional concern. Government regulations have provided a strong motivation for pioneering clean-fuel garbage truck projects, giving fleet purchasers a wider range of road-tested, commercially available and cleaner NGVs. In areas with the poorest air quality, government officials may look to the route taken by the South Coast Air Quality Management District in Southern California, where a ban on diesel garbage trucks was put in place.
  - **Encourage or require clean fuel use in franchise contract negotiations and awards.** An overwhelming majority of garbage trucks are operated by private companies under contract to local governments. These contracts give governments a powerful tool to set terms during the bidding process. Alternative fuel vehicle specifications can be included in franchise contract negotiations and awards, creating an economic motivation and a contractual obligation to change fuels.
  - **Develop and participate in public/private partnerships** specifically created to implement alternative fuel garbage truck programs. Many parties have an interest in the success of a campaign to shift to natural gas garbage trucks. Private companies can make or save money, government officials stand to gain from successfully implementing programs that provide significant public benefits and community residents get healthier air to breathe. By collaborating, these parties can achieve their goals in a cost-effective manner.
  - **Inform decisionmakers** about the benefits of switching garbage truck fleets to cleaner fuels. Local clean-fuels programs and advocacy groups such as Clean Cities coalitions can play an important role in disseminating information about opportunities to expand the use of clean-fuel garbage trucks.
  - **Conduct a comprehensive inventory of U.S. garbage truck fleets** and continually monitor changes in the industry. If "greening" garbage trucks is to be a national priority, a comprehensive and ongoing inventory of fleets is needed, including number of trucks, type, age and mileage.
  - **Research, refine and demonstrate hybrid-electric and fuel cell technologies** along with emerging alternatives such as landfill gas, biodiesel, propane and hydrogen, all of which show promise for the heavy-duty truck sector.
  - **Perform in-use emissions testing** of diesel and alternative fuel garbage trucks to refine estimates of emissions reductions and more accurately identify the costs and benefits of a transition to clean fuels.
  - **Investigate several issues relating to NGVs**, including: volume production of natural gas garbage trucks to lower per vehicle costs; lowering the tank and fuel minimum weight requirement to give natural gas trucks a more competitive load capacity; developing natural gas engines with more torque and power (above 400 hp) to compete with diesel engines; identifying factors leading to reduced refueling infrastructure costs; and, standardizing refueling facilities and truck designs within the natural gas garbage truck industry.

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*The above article was excerpted from a draft of **Green Garbage Trucks: New Technologies for Cleaner Air**, a report scheduled for publication in early 2003 by INFORM, Inc., an environmental research organization based in New York City that promotes sustainable modes of transportation. For a copy of the full report visit [www.inform.org](http://www.inform.org).*