



Greening Garbage Trucks: Trends in Alternative Fuel Use, 2002 - 2005

By James S. Cannon

INFORM, Inc.
120 Wall Street, 14th Floor
New York, NY 10005-4001

Tel 212 361-2400
Fax 212 361-2412
Site www.informinc.org

John Calderone, Editor
Liz McLellan, Production Editor

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By James S. Cannon

Joanna D. Underwood,
Program Advisor

INFORM

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Table of Contents

List of Tables		A
List of Figures		A
Acknowledgments		B
Preface		C
Introduction	Purpose, Scope, and History of This Project	12
Chapter 1	Trends in the Use of Alternative Fuels in the Refuse Truck Sector	18
Chapter 2	Positive and Negative Factors Affecting the Pace of Alternative Fuels Use	34
Chapter 3	INFORM's Findings, Conclusions, and Recommendations	43
Appendix	Profiles of Each US Fleet Operating in 2002 or 2005	56
	2002 Fleets Updated in 2005	56
	New Fleets Since 2002	58
Acronyms		81
About the Author		82

List of Tables

1	Fleet Operators Contacted by INFORM and Their Response to INFORM's Queries	16
2	2002 Natural Gas Refuse Truck Fleets Updated	20
3	New Natural Gas Refuse Truck Fleets since 2002	25

List of Figures

1	Growth in Natural Gas Refuse Trucks in the US	28
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Acknowledgments

I would like to thank the fleet operators and industry representatives who provided information and valuable perspectives about the progress being made in the alternative fuel refuse truck projects discussed in this report. In writing this report, I have attempted to be as accurate as possible in taking a snapshot of the refuse truck sector as it existed in 2005. However, I recognize that this sector is fluid and constantly evolving, so since the time research for this report was conducted, some of the fleets discussed here may have changed, either putting new trucks into service or removing older ones. INFORM continues to track progress in the use of new fuels and advanced technologies in this critical public service sector. I would also like to thank government representatives from the US Department of Energy for feedback and comments on this text.

I appreciated, in addition, the hard work of the research assistants who helped gather material for this report, including John Atkinson, Stephanie Mandell, and Jeff Georgeson as well as interns Matt Kilivris from Bard College and Christina Stanton from Columbia University. John Calderone's careful editing also meant a great deal to the final product.

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Finally, we are very grateful for the generous support for this work provided by the US Department of Energy, the National Energy Technology Laboratory, and the Helen Sperry Lea Foundation. While the involvement of these funders was critical to our efforts, I want to note that INFORM is fully responsible for the findings and recommendations of this report.

James S. Cannon

INFORM Senior Fellow

Preface

This INFORM report is good news for America. The report demonstrates that we can have cleaner air and quieter neighborhoods and make genuine progress toward energy independence—all by simply using a cleaner fuel and technology that has been commercialized and refined over the last 15 years. This fuel and technology are now available to the almost 200,000 refuse and recycling trucks across the country. Yes, the lowly garbage truck can lead the way to a cleaner Earth. These trucks can now run on much cleaner and domestically produced natural gas instead of diesel fuel. They can offer measurable air emission improvements, and because compressed natural gas (CNG) engines are dramatically quieter, they can considerably improve the quality of life for the operators and their neighbors along their routes.

For sanitation workers who take pride in providing one of the most essential—and sometimes one of the most daunting and thankless—public services to cities coast to coast, it offers a new way to do their job while improving the quality of life for the communities they serve. For municipal planners and leaders, it means a healthier environment for their residents. For national leaders, it means a transportation fuel option that can be reducing this country's dependence on foreign oil right now. And for those concerned about global warming, it means a step forward in the transition to a carbon-free, hydrogen economy.

Of course, it is true that natural gas, clean as it is, is a depletable fossil fuel, and it is not the final answer on pollution or global warming. However, as INFORM points out, the contribution it makes to cleaner air and greater energy security today is impressive, and that is not all CNG does. Using a gas under pressure as a transportation fuel directly equips us to move to the use of hydrogen tomorrow. Looking at the longer term, as more and more vehicles that can run on hydrogen become commercially available, we can imagine a truly sustainable transportation system through a final shift from CNG to hydrogen. It is amazing that the first, preparatory step is already available to us and already being used in some municipal waste agencies and in many private fleets.

Having served as Sanitation Commissioner for New York City, I am well aware of the daily pressures and challenges that come with this job. First and foremost, the trucks—the workhorses of our trade—have to work. The residents as well as businesses of New York City assume they will see their garbage hauled away promptly. All you need to demonstrate how much they count on this is to fail to do so once or twice (not that I ever had such an experience personally, of course). Then, New Yorkers will express very enthusiastically just how much they rely on this service and its prompt execution. And delivering this service involves an investment of millions of dollars—more than \$200,000 to buy each and every truck and a constant investment in their maintenance and repair. So judgment calls are daunting, especially when considering changing systems that have worked in the past for a new fuel or technology. So, even though INFORM and a growing number of fleet owners and operators are finding that CNG trucks can do the job perfectly well, diesel trucks are the old reliable, and people are sensibly cautious about upsetting this critical apple cart.

However, the reasons to do so—the issues at stake—are now clear and compelling, ranging from the health of millions of Americans, especially our children, to the job-related health of our workers, to US national security.

Brendan Sexton

Former Commissioner of Sanitation for the City of New York

Introduction: Purpose, Scope, and History of This Project

Why an INFORM Focus on Refuse Trucks?

Nearly every day, almost 136,000 refuse collection trucks lumber through the streets of every urban center in the United States collecting household and commercial trash. The contribution they make to the quality of life in cities, hauling away their wastes day after day, is enormous. Without them, cities would be overrun with garbage.

Unfortunately, the negative impact of their operations is also pronounced. The refuse truck fleet in the US is huge, more than three times the size of the urban bus fleet, and it is nearly 100 percent dependent on diesel fuel, often burned in old engines that operate without state-of-the-art pollution controls. Each day, each truck emits pollution and noise while making hundreds of abrupt starts and stops and when idling as onboard garbage is compressed.

For this reason, the refuse collection truck business, as it currently stands, is a major cause of air quality degradation in cities across the country, and refuse truck emissions pose a severe threat to public health. In addition, these trucks disrupt the quiet of neighborhoods as they rumble through the streets, often at early morning hours.

Until a few years ago, this sector had largely escaped public pressure for change. The questions that INFORM's research began to address in 2001 were numerous: Just how large is the refuse truck

sector in the US? What are the impacts of refuse and recycling truck operations? Can these trucks perform their vital task without the high levels of pollution and noise that many, if not most, of them generate? How much fuel do refuse trucks consume? Given the weight of these trucks, might their use of alternative fuels meaningfully contribute to reducing US dependence on foreign oil?

Greening Garbage Trucks in 2002

In early 2003, INFORM published the report *Greening Garbage Trucks: New Technologies for Cleaner Air*, which was the first analysis of this sector. It explored whether any existing alternative fuels or advanced propulsion systems could make the country's refuse trucks "good neighbors." The findings of this research were surprising and encouraging. The study found an emerging use of natural gas as a fuel to power otherwise conventional heavy-duty refuse collection vehicles in the US (particularly in California), the Netherlands, and Japan. The study noted that using natural gas as a fuel allowed trucks to perform much more cleanly and quietly.

INFORM's research also found that refuse trucks burned fuel at an astonishing rate. Because of their operation/duty cycle (i.e., stopping and starting), refuse trucks were burning approximately a gallon of fuel every 2.8 miles, making them one of the most fuel inefficient vehicles on US roads. Traveling approximately 25,000 miles annually, refuse trucks were consuming on average 8,900 gallons of diesel fuel per year. Thus, the 136,000 refuse trucks on US roadways may burn nearly 1.2 billion gallons of diesel fuel per year—an amount equivalent to almost 30 million barrels of oil.¹ Replacing 50 percent of these 136,000 diesel refuse trucks with natural gas trucks (which run on a domestically produced fuel) would annually displace approximately 600 million gallons of diesel fuel, the equivalent of 14.3 million barrels of oil—a meaningful step toward energy security.

¹ This figure does not include the diesel fuel burned by the more than 31,000 recycling trucks, 12,000 waste transfer trucks, or the thousands of private commercial hauler trucks that are also in operation.

**THE NEED FOR
BETTER NATURAL
GAS VEHICLE
INDUSTRY
COMMUNICATIONS IS
EVIDENT.**

Greening Garbage Trucks documented the following trends in the national alternative fuel market:

- ◆ Increased use of natural gas, as opposed to other alternative fuels, to achieve improved air quality and other objectives
- ◆ A shifting focus on heavy-duty as opposed to light-duty vehicles
- ◆ Success in commercial fleet applications as opposed to private individual vehicle use
- ◆ Use in fleets concentrated in urban areas where air quality concerns are high

INFORM's research found that government action, especially in the form of mandates and economic incentives at the state and local levels, was playing a key role in the advent of natural gas use in refuse trucks and that private sector engine manufacturers and fuel providers were actively promoting a switch from conventional diesel to natural gas. Based on data collected in 2002, INFORM identified 26 fleets operating 692 natural gas refuse trucks. Although still less than 1 percent of the market, the growth in natural gas use in the refuse truck sector had been surprisingly quick, and projections indicated that future deployment of natural gas could increase the US natural gas refuse truck fleet to more than 2,200 vehicles by 2010.

Since 2002, the refuse collection industry has faced, and continues to face, various issues that have the potential to dramatically alter the course it takes in terms of fuel use and pollution prevention. New heavy-duty engine emissions standards will come into effect in 2007, with even stricter standards coming into effect in 2010. Engine and vehicle manufacturers are pursuing different compliance strategies that will affect fuel efficiency, purchase cost, and maintenance costs differently. Legal and political attacks on air pollution control regulations have often been mounted in the past, some successfully, creating uncertainty about which future regulatory requirements will apply. Prices for diesel, gasoline, and natural gas have experienced wild fluctuations and are now much higher than at any time in recent history, increasing operating costs across the industry and sparking interest in strategies to switch to alternative fuels to reduce fuel costs. In addition, members of Congress and other government officials are supporting strategies to reduce America's dependence on foreign oil.

Methodology: Revisiting the Refuse Truck Sector in 2005

INFORM revisited the refuse truck industry in 2005 to see what effects these changes—and the new visibility that INFORM’s research generated for this sector—have had on the industry’s use of natural gas. In addition, this new round of research was intended to determine what progress has been made in expanding the use of natural gas and other alternative fuels or advanced technologies. INFORM also sought to gain fresh insights into fleet satisfaction with the use of new fuels or propulsion systems.

INFORM’s 2005 research began with an extensive literature search to identify issues related to the refuse truck industry and to identify fleets operating alternative fuel refuse trucks. Then, during the first four months of 2005, INFORM researchers made more than 150 attempts, through phone calls and e-mails, to contact refuse truck fleet operators to confirm the use of alternative fuels in their fleets and to ask about truck performance problems, emissions and noise problems, and any other kind of problems. Researchers also made field visits to the South Coast Air Quality Management District in Diamond Bar, California; to the headquarters of Clean Energy in Seal Beach, California; and to Cummins Westport, Inc., in Vancouver, Canada. In April, researchers gathered additional information and interviewed industry officials during the 2005 World Congress sponsored by the Society of Automotive Engineers and held in Detroit, Michigan.

**REFUSE TRUCK
EMISSIONS POSE
A SEVERE
THREAT TO
PUBLIC HEALTH.**

Table 1. Fleet Operators contacted by INFORM and their response to INFORM's queries

Fleet Location	Fleet Operator	Responded
Anaheim, CA	Anaheim Disposal (Republic Services)	Yes
Anaheim, CA	Taormina Industries	Yes
Bakersfield, CA	City of Bakersfield	No
Berkeley, CA	City of Berkeley	Yes
Boston, MA	McGeoghan	Yes
Burbank, CA	City of Burbank	Yes
Burlington County, NJ	Waste Management	Yes
Carson, CA	America Waste Systems	No
City of Industry, CA	Athens Disposal	No
Corona, CA	Waste Management of the Inland Empire	No
Culver, CA	City of Culver City	Yes
El Cajon (San Diego), CA	Waste Management of San Diego	Yes
Fairfield, CA	Solano Garbage (Republic Services)	Yes
Fontana, CA	Waste Management	No
Freemont, CA	BFI-Fremont	No
Fresno, CA	City of Fresno	Yes
Fresno, CA	USA Waste of California (Waste Management)	No
Gardenia, CA	American Waste Transfer (Republic Services)	Yes
Hawthorne, CA	H&C Disposal	No
Hemet, CA	City of Hemet	No
Huntington Beach, CA	Rainbow Disposal	No
Irvine, CA	Waste Management of Orange County	No
Lake Jackson, TX	City of Lake Jackson	Yes
Livermore, CA	Livermore Dublin Disposal (Waste Management)	No
Long Beach, CA	City of Long Beach	Yes
Long Beach, CA	Republic Services	Yes
Los Angeles, CA	City of Los Angeles	Yes
Mojave Desert, CA	Waste Management	Yes
Moreno Valley, CA	Waste Management of the Inland Empire	No
Napa, CA	Napa Garbage (Waste Management of American	No
New York, NY	Department of Sanitation of New York City	Yes
Oakland, CA	Waste Management-Alameda County	Yes
Ontario, CA	City of Ontario	No
Orange County, CA	Waste Management	No
Palm Desert, CA	Waste Management of the Desert	No
Palm Springs, CA	Palm Springs Disposal Services	Yes
Palmdale, CA	Waste Management of Antelope Valley	Yes
Redlands, CA	City of Redlands	No
Redondo Beach, CA	Consolidated Disposal (Republic Services)	No
Ripon, CA	City of Ripon	Yes
Riverside, CA	City of Riverside	Yes
Sacramento, CA	City of Sacramento	Yes

San Diego, CA	Environmental Services Department	Yes
San Francisco, CA	Norcal	No
San Gabriel, CA	Waste Management	No
Santa Clarita, CA	Santa Clarita Disposal (Bluebarrel-Waste Management)	No
Santa Rosa, CA	Empire Waste Management	Yes
Saugus, CA	Bluebarrel-Waste Management	No
Simi Valley, CA	Waste Management-GI Industries	Yes
Sunnyvale, CA	Specialty Solid Waste and Recycling	Yes
Tulare, CA	City of Tulare	Yes
Washington, DC	Department of Public Works	Yes
Washington, DC	National Parks Service	No
Washington, PA	Washington Hauling (Waste Management)	Yes
West Hollywood, CA	Athens Disposal	No
Yucca Valley, CA	Waste Management of the Desert	No

Public Information and Refuse Truck Industry Analysis

One surprising factor that influenced INFORM’s industry analysis in 2005 was the fleet operators’ limited response to INFORM’s queries. Of the 57 fleet operators contacted for this report, 31 responded to INFORM’s requests for information. (See table 1.)

Still, the information that INFORM gathered for this research produced some valuable insights into trends in alternative fuel refuse trucks between 2002 and 2005 and insights into the positive and negative factors influencing the pace of change. These findings, discussed in chapters 1 and 2, indicate a growing interest in the use of biodiesel, hybrid drivetrains, and bio-methane for refuse trucks. Most significantly, these findings show that rapid continued deployment of natural gas refuse trucks has been occurring despite some reversals in public and private programs. INFORM’s research also confirmed that natural gas refuse truck technology offers this sector an immediate and important opportunity to reduce air pollution, reduce truck noise levels, and diversify its fuel use. In addition, INFORM was able to derive some important conclusions about the existing primary obstacles to change, make recommendations about ways to overcome these obstacles, and outline steps that can be taken to accelerate the shift from petroleum-derived fuels to cleaner fuels and advanced propulsion systems.

Chapter 1.

Trends in the Use of Alternative Fuels in the Refuse Truck Sector

According to data gathered for this report, in the refuse truck market, natural gas-powered trucks have further displaced diesel trucks during the past few years. These new natural gas trucks are generally cleaner than the diesel trucks they replace, and they do not contribute to US reliance on imported oil. In general, even though INFORM sought to compile information about the use of all alternative fuels and advanced technologies as employed in the refuse truck sector, the findings of this report concentrate predominantly on what has continued to be the number one choice: natural gas refuse trucks.

In this report, the findings on alternative fuel refuse trucks are organized according to the following five research areas:

1. Beginning with the industry contacts established during the original research, INFORM sought to update the status of the 26 alternative fuel natural gas refuse truck fleets operating in the US in 2002.
2. Using a literature search and various secondary source interviews with regulatory agency officials and engine and fuel providers, INFORM sought to identify advances being made in refuse truck technology and confirm the existence of new alternative fuel fleets that had entered the US market since 2002.

3. INFORM research on the original and new fleets was combined to provide an overview of the total US natural gas refuse truck fleet.
4. Using a literature search and secondary source interviews, INFORM sought to update information about international programs that are deploying alternative fuel refuse trucks.
5. INFORM looked at progress made in employing other alternative fuels and advanced technologies in the refuse truck sector.

**LOS ANGELES'
FLEET WITH
252 NATURAL GAS
REFUSE TRUCKS
IS THE NATION'S
LARGEST.**

1. Original 26 US Fleets Identified and Studied in 2002

Only 14 of the 26 original fleets operating natural gas refuse trucks in 2002 responded to INFORM's request for updated information in 2005, despite numerous inquiries to all. As shown in Table 2, the 14 responding fleets now operate 704 natural gas refuse trucks, compared to 451 in 2002, an increase of 56.0 percent. Also, they operate more natural gas trucks now than all 26 fleets combined in 2002. Eight fleets have added natural gas trucks, while four have decreased in size. The size of the other natural gas fleets did not change. The following are findings for changes and progress in the 26 original fleets:

- ♦ **Los Angeles, California: City of Los Angeles.** The largest growth has occurred in the City of Los Angeles fleet, which grew from 10 natural gas trucks in 2002 to 252 in 2005. This increase occurred despite a serious setback in 2004, when the entire fleet of roughly 160 natural gas trucks was temporarily removed from service to repair the source of leaks in the liquefied natural gas (LNG) fueling system and to counter problems with overheating of the engines. (The trucks soon returned to service and have performed well since then.) Leonard Walker, former Equipment Superintendent with the City of Los Angeles told INFORM that the city "bought natural gas trucks to improve the air quality. The City Council took a proactive position and voted to improve the air quality by supporting the SCAQMD [South Coast Air Quality Management District] ruling to purchase alternative fuel trucks before it was mandated by law." He noted that the fleet is "performing okay considering it is a new technology" and that "public support for the dual-fuel trucks is positive."

- ◆ **Berkeley, California: City of Berkeley.** Rogelio Marquina, Senior Solid Waste Supervisor with the City of Berkeley, which operates seven natural gas trucks, said that the trucks “have exceeded our expectations. According to equipment maintenance, they have experienced only minor problems, such as ignition modules failures, which might not even be related to CNG [compressed natural gas].”

2002 fleets				Change
Location	Operator	2002	2005	2002-2005
Anaheim, CA	Taormina Industries	50	50	0
Bakersfield, CA	City of Bakersfield	5	NA	NA
Berkeley, CA	City of Berkeley	4	7	3
Corona, CA	Waste Management of the Inland Empire	27	NA	NA
El Cajon (San Diego), CA	Waste Management of San Diego	122	126	4
Fairfield, CA	Solano Garbage (Republic)	34	37	3
Fontana, CA	Waste Management	25	NA	NA
Fresno, CA	USA Waste of California (Waste Management)	9	NA	NA
Irvine, CA	Waste Management of Orange County	29	NA	NA
Los Angeles, CA	City of Los Angeles	10	252	242
Moreno Valley, CA	Waste Management of the Inland Empire	27	NA	NA
Napa, CA	Napa Garbage (WM of American Canyon)	6	NA	NA
New York, NY	City of New York Department of Sanitation	36	26	-10
Oakland, CA	Waste Management-Alameda County	22	32	10
Palm Desert, CA	Waste Management of the Desert	60	NA	NA
Palmdale, CA	Waste Management of Antelope Valley	9	13	4
San Diego, CA	Environmental Services Dept.	77	77	0
San Francisco, CA	Norcal	15	NA	NA
San Gabriel, CA	Waste Management	31	NA	NA
Santa Monica, CA	City of Santa Monica	20	19	-1
Santa Rosa, CA	Empire Waste Management	4	0	-4
Simi Valley, CA	GI Industries (Waste Management)	32	34	2
Sunnyvale, CA	Specialty Solid Waste and Recycling	24	31	7
Washington, DC	National Park Service	1	NA	NA
Washington, PA	Washington Hauling (Waste Management)	7	0	-7
Yucca Valley, CA	Waste Management of the Desert	6	NA	NA
Total fleets		692*	704**	253*
*Responses provided by 26 fleets.				
**Responses provided by only 14 of the original 26 fleets.				

- ♦ **San Diego, California: Waste Management of San Diego.** Alan Walsh, District Manager of Waste Management of San Diego, which operates 126 natural gas refuse trucks at El Cajon, said that the company had some problems with the LNG fuel tanks in 2004, such as loss of vacuum, and “turbo issues.” He added that the trucks have “really good uptime, low downtime,” they are a “lot quieter,” and the drivers like driving them.

SINCE 2002 NEW
NATURAL GAS
REFUSE FLEETS
HAVE BEEN LAUNCHED
IN 31 COMMUNITIES.

- ♦ **Oakland, California: Waste Management of Alameda.** Waste Management of Alameda County has increased its fleet from 22 to 32 natural gas refuse trucks since 2002. The company spokesperson told INFORM that it has experienced “a few bugs” with the new LNG trucks, but he said “that is to be expected because LNG is a newer technology.” Overall, the company has had a positive experience.

- ♦ **Santa Monica, California: City of Santa Monica.** Rick Sikes, Fleet Superintendent, said the city is “very happy with our CNG fleet.” He noted that “the drivers prefer them over the noisier and smellier diesels. Repairs to the engines have been very minor, almost exclusively limited to regular maintenance. . . . There were growing pains and some systems performed less than satisfactorily. As the industry has matured, so has [truck] reliability.”

- ♦ **Sunnyvale, California: Specialty Solid Waste and Recycling.** Jerry Nabhan, Operations Manager for Specialty Solid Waste, said his company has had a generally “good” experience and expanded its fleet from 24 to 31 CNG trucks. It has had “a few problems with our fueling station . . . but we like serving our community with clean air trucks.” The company plans to “eventually” run all of its trucks on natural gas.

- ♦ **Fairfield, California: Solano Garbage (Republic Services).** Brian Beaudrie, Western Region Maintenance Manager for Solano Garbage (Republic Services), which operates a 37 natural gas truck fleet, said his company has no plans for new trucks because buying natural

gas trucks is “up in the air” for the foreseeable future due to cost. He believes LNG trucks are “environmentally good” but “cost prohibitive.”

“THE PUBLIC
PERCEIVES THE
VEHICLES AS A
POSITIVE STEP
TOWARD
PRESERVING THE
ENVIRONMENT
AND AIR QUALITY.”

- ♦ **Palmdale, California: Waste Management of Antelope Valley.** In discussing the 13 natural gas refuse trucks operating in Palmdale, Bret Banks, Operations Manager of the Antelope Valley Air Quality Management District, said, “I think the initial experience [with the trucks] was bad. Waste Management had trouble with the hydraulic systems on the Mack trucks [problems not related to the fuel system].” However, he thought those problems had been corrected.
- ♦ **San Diego, California: Environmental Services Department.** Chuck Woolever, Deputy Director of the San Diego Environmental Services Department (ESD) noted that the city was unable to proceed with the landfill gas conversion portion of its initial program primarily because the third party provider of the liquefier technology went bankrupt but also because of low levels of methane generated at the landfill site. In 2002, the ESD project was the only identified site that proposed to use landfill gas as a fuel source for natural gas refuse trucks. Woolever added, “We have continued to operate 77 dual-fuel LNG refuse packers out of our Miramar Place Yard. That’s about 40 percent of the fleet. The replacement ratio of diesel to LNG has not lived up to expectations, and we have had continual technology issues. Our [fueling] station has experienced a main pump failure at least once per year, the fuel tanks on the trucks had to be re vac’d, and most recently, one of our trucks caught on fire after the night fueling process. The cause is still under investigation, but it appears that a valve failed.”
- ♦ **Santa Rosa, California: Empire Waste Management.** The four trucks that Empire Waste Management operated in Santa Rosa, California, were moved into fleet operations in Oakland, California. The natural gas truck program was not stopped because of mechanical problems that affected truck performance.

- ♦ **Washington, Pennsylvania: Washington Hauling (Waste Management).** The seven LNG trucks operating in Washington, Pennsylvania, as part of a special demonstration program funded by the US Department of Energy (DOE) were removed from service when the field test period ended in 2004. However, the natural gas truck program was not stopped because of mechanical problems that affected truck performance.

2. US Newcomers Using Natural Gas Trucks Since 2002

This new INFORM study found that natural gas use has continued to expand beyond the first 26 fleets. At least 17 new fleets that operate natural gas refuse trucks have been confirmed, with the use of natural gas trucks in 14 other locations being unconfirmed. As with the fleets in the 2002 study, most new fleets are located in California, but new natural gas fleets have been established in Massachusetts and Texas, while a demonstration project was initiated in New Jersey.

The 17 confirmed new fleets operate 367 natural gas refuse trucks, as shown in Table 3. These new fleets represent more than a 50-percent increase over the number of natural gas refuse trucks that were operating in 2002. All but four of these new fleets were located in California; the remaining four fleets were in Boston, Massachusetts; Burlington County, New Jersey; Washington, DC; and Lake Jackson, Texas. The following are findings for the 17 new fleets:

- ♦ **Sacramento, California: City of Sacramento.** The largest new natural gas refuse truck fleet is the 105-truck fleet operated by the City of Sacramento. According to John Abernethy, Capital Asset Manager, Sacramento “encountered some problems in production delays and the integrity of the tanks when trucks were being manufactured. We have not gotten the fuel efficiency we had hoped for with the vehicles and have experienced higher fuel costs.” However, he noted that the city has “generally had pretty good luck with the LNG trucks in terms of operating costs and scheduled maintenance.”

A TOTAL OF 1,496
NATURAL GAS
REFUSE TRUCKS
...HAVE BEEN
IDENTIFIED
TO BE OPERATING
IN THE US.

- ♦ **Fresno, California: City of Fresno.** Fresno operates the second largest new natural gas fleet with 69 vehicles, which are part of the municipal government fleet.
- ♦ **Anaheim, California: Anaheim Disposal (Republic Services).** The third largest new natural gas fleet, also in California, is the 40-natural gas truck fleet operated by Anaheim Disposal in Anaheim.
- ♦ **Long Beach, California: City of Long Beach.** The City of Long Beach added 35 natural gas trucks to its fleet.
- ♦ **Boston, Massachusetts: McGeoghean Waste Systems.** McGeoghean Waste Systems bought two CNG refuse trucks for economic and environmental reasons. In March 2005, CNG in the greater Boston area cost \$1.79 per gasoline gallon equivalent, while diesel prices were approaching \$2.50 per gallon. The two trucks seem to be operating well, although the front-loader truck experienced some initial problems, not related to CNG. Mike Manning, Lead Account Executive, NGVs, of KeySpan Energy Delivery New England said the overall experience was positive, “but very much a learning experience.” He added, “Training was very crucial,” and said, “I don’t believe that there have been excessive maintenance demands, though the CNG fuel filters, part of the CNG cylinder fuel system, need particular attention in terms of prompt replacement.”

Table 3. New Natural Gas Truck Fleets Since 2002

#	Location	Operator	2002-2005
1	Anaheim, CA	Anaheim Disposal (Republic)	40
2	Boston, MA	McGeoghan	2
3	Burbank, CA	City of Burbank	20
4	Burlington, NJ	Waste Management	2
5	Carson, CA	America Waste Systems	NA
6	City of Industry, CA	Athens Disposal	NA
7	Culver, CA	City of Culver City	7
8	Freemont, CA	BFI	NA
9	Fresno, CA	City of Fresno	69
10	Gardena, CA	American Waste Transfer (Republic)	21
11	Hawthorne, CA	H&C Disposal	NA
12	Hemet, CA	City of Hemet	NA
13	Huntington Beach, CA	Rainbow Disposal	NA
14	Lake Jackson, TX	City of Lake Jackson	7
15	Livermore, CA	Livermore Dublin Disposal (WM)	NA
16	Long Beach, CA	City of Long Beach	35
17	Long Beach, CA	Republic	12
18	Mojave Desert, CA	WM	8
19	Ontario, CA	City of Ontario	NA
20	Orange County, CA	Waste Management	NA
21	Palm Springs, CA	Palm Springs Disposal Services	15
22	Redlands, CA	City of Redlands	NA
23	Redondo Beach, CA	Consolidated Disposal (Republic)	NA
24	Ripon, CA	City of Ripon	3
25	Riverside, CA	City of Riverside	6
26	Sacramento, CA	City of Sacramento	105
27	Santa Clarita, CA	Santa Clarita Disposal (Bluebarrel / WM)	NA
28	Saugus, CA	Bluebarrel (WM)	NA
29	Tulare, CA	City of Tulare	13
30	Washington, DC	Dept of Public Works	2
31	West Hollywood, CA	Athens Disposal	NA
	Total New in 2005		367
	Grand Total		620

- ♦ **Washington, DC: Department of Public Works.** The Department of Public Works in Washington, DC, operates two CNG-powered packer garbage trucks. According to Karen Reed, Executive Assistant of the Department of Public Works, “With the natural gas packers, we initially had adjustments with the transmission engine systems. Once we worked through these adjustments the equipment performed exceptionally well. Maintenance demands have

been minimal and consistent with any new equipment. Because it was a new application with us, packer operations had to learn how to properly fuel timely (not to allow the tank to get as low with fuel as one might tend to do with gasoline). Drivers have indicated that the equipment operates very satisfactorily and quiet. The public has enjoyed seeing that we are more environmentally conscious through the use of the natural gas packers.”

- ♦ **Culver, California: City of Culver City.** Charles Herbertson told INFORM that Culver City’s experience with its CNG vehicles has been very positive. The performance and maintenance are on par with diesel-powered vehicles, so the additional cost has been marginal. He added that “the public perceives the vehicles as a positive step toward preserving the environment and air quality.”
- ♦ **Palm Springs, California: Palm Springs Disposal Services.** Palm Springs Disposal Services owns 15 CNG refuse trucks, according to General Manager Rick Wade. He said the “2004 models 8.3-L C+ Cummins are much improved over the 2001 models” and “the drivers and public are pleased with the vehicles.” However, “AFVs [alternative fuel vehicles] are expensive to maintain [in terms of parts], and based on our four years of experience, it appears that common component failures are going to continue where these parts are expensive. Diagnostics, software, and laptop experience had lagged behind the operation of the trucks, and we have had to rely on observing Cummins service repair techs diagnose the past problems in order to get hands-on experience.” Still, Wade found that “the trucks have been able to perform comparably to the diesel collection vehicles. The period of time we had to endure adapting to these trucks is now behind us, and it’s a matter of dealing with the common failure components.”
- ♦ **Lake Jackson, Texas: City of Lake Jackson.** According to Public Works Director, Craig Nisbett, the City of Lake Jackson purchased seven CNG refuse trucks because “CNG is clean burning and reduces our dependence of foreign oil. We have been pleased with them.” Nisbett adds that “The public has been very supportive of our programs, and the drivers and mechanics have been pleased.”

- ♦ **Burlington County, New Jersey: Waste Management.** In Burlington County, New Jersey, a project that converted landfill gas into LNG fuel for two Mack refuse trucks reached a major milestone when an inspection of the two truck engines after 600 hours of service showed favorable results in terms of fuel viability and reduced engine wear and maintenance. The project participants have expressed interest in seeking commercial applications for the gas extraction technology.

3. Total US Natural Gas Refuse Truck Fleet

Since reporting the use of 692 natural gas trucks in 26 natural gas truck fleets in 2002, INFORM has found that the use of these trucks has grown by 253 confirmed new natural gas trucks operating in 14 fleets, with unconfirmed reports of 241 natural gas trucks in 12 other fleets. INFORM confirmed an additional 367 natural gas trucks operating in 17 fleets that were not operating natural gas trucks at the time of the original survey. Moreover, 184 other trucks were added to 14 new fleets that depended entirely on diesel fuel in 2002, although the operators of these fleets have not confirmed these numbers.

Combining the 14 “old” fleets that responded to INFORM’s request for updated information and the 17 “new” fleets shows a total of 1,071 natural gas refuse trucks that have been confirmed to be operating in the US. This represents an increase of 618 new natural gas trucks (an 89-percent increase in the market) in just two years. By contrast, according to US Energy Information Administration data, the total number of natural gas vehicles in the US has grown by only 20 percent between 2002 and 2004.

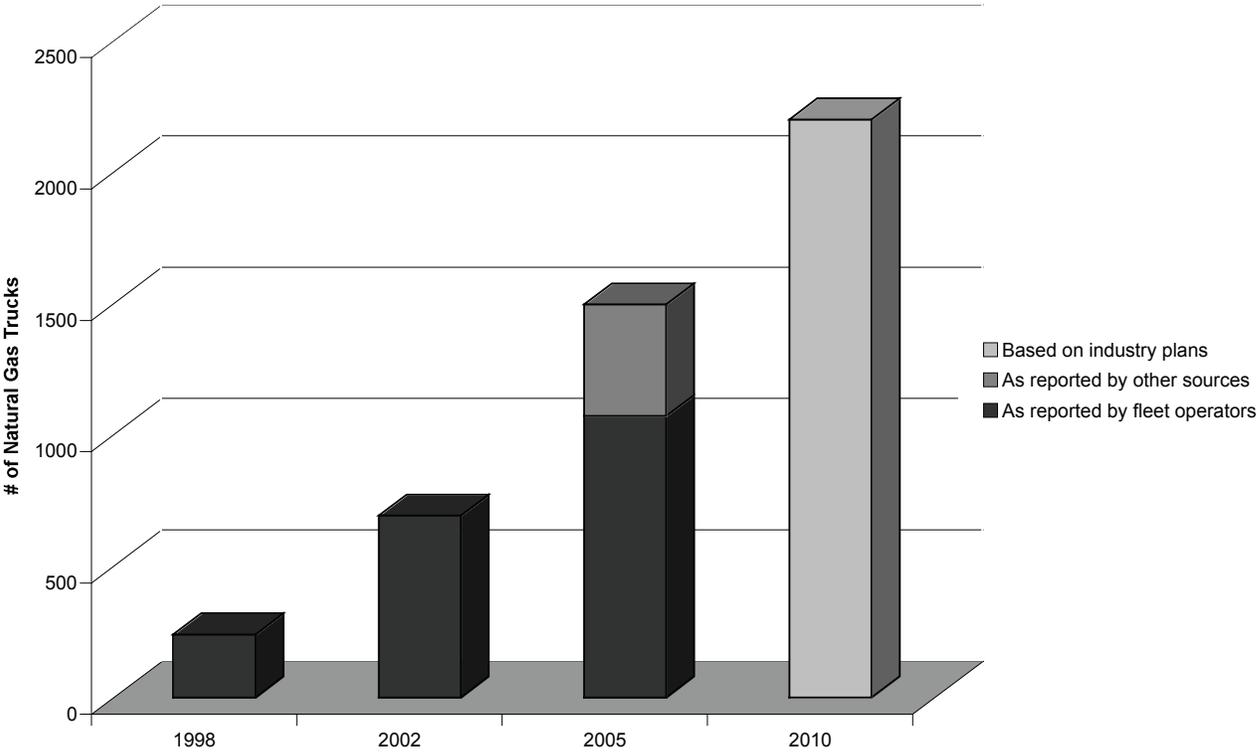
The Expanding Numbers of Newcomers

The refuse truck sector is continually evolving, and the number of natural gas refuse trucks in services is steadily increasing. Since conducting the research for this report, INFORM found another natural gas refuse collection project. In 2005, Harvard University signed a contract with Allied Waste to remove trash on its campus using a natural gas refuse truck. Allied Waste put into service a 2004 Autocar Expedito WXL64 25-yard Leach body rear-load truck with a Cummins Westport C Gas Plus Engine. According to Harvard spokesperson, Rob Gogan, the university specified the use of a CNG truck “to reduce noise for the faculty and students.” He reported that “with a spark ignited CNG engine, the noise is much less; the diesel engine sounds like a jet plane taking off. We have been very happy with the CNG sanitation trucks on our campus, and we will never go back to anything else.”

This recent rapid growth makes refuse trucks the second leading market for heavy-duty natural gas vehicles in the US; transit buses are the first. According to the American Public Transit Association, natural gas buses account for approximately 12 percent of the more than 56,000 buses on US roads today. Natural gas buses also account for roughly 20 percent of new bus orders. Although the market penetration of natural gas refuse trucks is currently less than 1 percent, their rapid rise in recent years is nevertheless impressive.

The actual number of natural gas refuse trucks operating in the US is undoubtedly larger than 1,071. Because several fleet operators did not respond to INFORM's queries for information, a number of reports of natural gas truck use identified by secondary sources but not confirmed by the fleet operators were omitted from the final tally. The 12 fleets that were included in the original survey but did not respond for this update operated 241 natural gas refuse trucks in 2002. Although most are probably still operating these trucks, this information could not be confirmed. Also, secondary sources identified

Figure 1: Growth in Natural Gas Refuse Trucks in the US



14 fleets that have deployed 184 natural gas refuse trucks during the past two years, but again, these reports could not be confirmed with the fleet operators.

Figure 1 shows the substantial growth in natural gas refuse trucks in the US since 1998. At that time, 240 natural gas refuse trucks were in operation. By 2002, the number had tripled to 692. This study identifies 1,071 confirmed natural gas refuse trucks. Combining the confirmed number with the 425 natural gas refuse trucks identified through unconfirmed reports raises the probable total to 1,496. The last bar in Figure 1 shows a total of 2,221 natural gas refuse trucks—the number that fleet operators in 2002 predicted would be operating in 2010. This study suggests that the industry is well on the path to reaching this figure.

**IN THE US,
INTEREST IN
USING LANDFILL
GAS AS A FUEL
FOR REFUSE
TRUCKS IS
GROWING.**

From this perspective, the refuse market in the US remains a strong market entry pathway for natural gas vehicle technology. The rate of growth in terms of percentage exceeds every other market sector, including the transit bus sector, which has to date been the most successful market for natural gas vehicle technology. As shown in Figure 1, the number of natural gas refuse trucks tripled between 1998 and 2002 and nearly doubled between 2002 and 2005. Even so, the total number of natural gas refuse trucks remains small, accounting for less than 1 percent of all refuse trucks in the US.

4. International Natural Gas Refuse Truck Growth

A look at international programs also shows an increase in natural gas refuse truck applications. INFORM's 2002 study identified 2 natural gas refuse trucks operating in the Netherlands and 36 in Yokohama, Japan. These fleets continue to operate, and according to the European Natural Gas Vehicle Association (ENGVA), the fleet in the Netherlands is being expanded by 85 trucks.

ENGVA says that the European sector has proven to be an important market for expanded natural gas use. Fomento de Construcciones y Contratas S.A. is operating a new natural gas refuse fleet of

approximately 379 trucks in Madrid, Spain (up from 42 trucks in 2000). Equipped with an Iveco 260 CV CNG engine, each truck in this fleet is already certified as an environmentally enhanced vehicle (EEV) under Euro 5 emission control regulations even though these regulations do not take effect until 2009. The Madrid fleet primarily comprises three-axle, 26-ton gross vehicle weight Iveco trucks, but it also includes some two-axle trucks. The trucks have reduced external dimensions of 9.5 meters (31 feet) total length, which allows them to easily circulate in city traffic and on urban streets. The special three-axle configuration, with reduced wheelbase and double steering in the first and third axle, aids driveability. An additional advantage of these CNG trucks is their very low noise levels, better than Euro 5 requirements, which is particularly appreciated in cities such as Madrid, where garbage collection occurs during the night.

Also, Paris, France is purchasing natural gas engines from Cummins Westport. By the end of 2006, Paris will have purchased nearly 300 engines, which are being installed in refuse collection trucks and street washers manufactured by PVI, a subsidiary of Ponticelli. According to ENGVA, a smaller fleet is operating in Mechlen, Belgium.

5. Progress with Other Alternative Fuels and Advanced Technologies

Although the use of natural gas in otherwise conventional refuse truck applications has been growing steadily, other alternative fuels and advanced technologies have made little progress. Refuse trucks that use biodiesel, bio-methane, and hybrid-electric (or hybrid-hydraulic) drivetrains have made tentative market entries.

Biodiesel. In 2001, the GreenTeam—a refuse collection and recycling company that serves San Jose, California and nearby communities—began running its fleet of 94 recycling and refuse trucks on biodiesel. Although biodiesel can be blended with any volume of petroleum diesel, this fleet was the first fleet to operate on pure (100 percent) biodiesel, produced from soybean oil and other domestically produced renewable fats and oils. However, after a few months, the GreenTeam switched to B20 fuel (a blend of

20 percent biodiesel and 80 percent petroleum diesel). According to a company spokesperson, even with B20, nearly all of the trucks experienced problems with their filters clogging, which required the filters to be changed much more frequently.¹ Still, the fleet continues to use B20 fuel because “the financial incentives offered by the City of San Jose for use of an alternative fuel have made it worthwhile.”

**BIODIESEL,
HYBRID ELECTRIC,
AND BIO-GAS
MARKETS ARE
STIRRING.**

Using biodiesel reduces the use of some oil and reduces emissions of particulate matter, carbon monoxide, and unburned hydrocarbons, compared to emissions of petroleum-based diesel. However, debate continues regarding whether the use of biodiesel slightly increases or decreases NOx emissions. Also, the National Renewable Energy Laboratory estimates that biodiesel fuel has a lower cancer-causing potential than regular diesel fuel. The extent depends on the blend of fuel. CNG and LNG pose the least cancer risk.

Hybrid Drivetrains. In late 2004, a developer of hydraulic-hybrid technology—Permo-Drive, Inc., based in Ballina, Australia—began a program to test its hydraulic-hybrid system in refuse collection vehicles operating in Los Angeles, California. For this test, Permo-Drive is collaborating with Waste Management, a major manufacturer of truck chassis, a tier-one driveline systems integrator, and a refuse truck body builder. This team will build and test a hybrid-hydraulic refuse collection vehicle.

In 2005, the Hybrid Truck Users Forum, a coalition of heavy-duty hybrid-electric truck developers, established a working group to promote the use of hybrid-electric technology in refuse trucks. In 2006, the working group hopes to begin testing hybrid-electric refuse trucks.

Bio-Methane. Three projects—in Gothenburg, Sweden; Burlington County, New Jersey, and Los Angeles County, California—were reported to INFORM. In Gothenburg, Sweden (the country that leads the world in using bio-methane as a transportation fuel), a primary waste and recycling company, Renova, is operating a demonstration project that uses bio-methane produced from organic wastes

¹ Because blends of biodiesel fuel can clog filters and because no standards exist to ensure that biodiesel fuel is formulated uniformly, heavy-duty engine manufacturers do not extend engine warranties for problems related to using a blend of biodiesel fuel greater than B5 (5 percent biodiesel and 95 percent petroleum diesel).

to power 15 refuse trucks equipped with hybrid drivetrains. Eleven are 18-ton, two-axle Volvo FL trucks; the other four are 26-ton, three-axle Mercedes Econic trucks. Each truck relies on separate power sources for propulsion and trash compaction: a CNG engine driven by bio-methane provides propulsion, while an electric battery pack powers a separate hydraulic trash compaction system. Separating the power sources for propulsion and compaction eliminates the need to accelerate the propulsion engine during compaction, which reduces fuel consumption, emissions, and noise.

In the US, interest in using landfill gas as a fuel for refuse trucks is growing. Using landfill gas requires building a system to collect the gas from solid waste disposal sites, clean it, and dispense it to the refuse trucks that originally delivered the garbage to the site. In the 2002 INFORM study, the Environmental Services Department of San Diego was developing a landfill gas collection unit to provide fuel for its fleet of LNG refuse trucks. According to Deputy Director, Chuck Woolever, this portion of the project was canceled because of low levels of methane generated at the landfill site and because of the bankruptcy of the third-party provider of the liquefier technology. Conventionally produced LNG continues to power the city's 77 LNG refuse trucks.

A demonstration landfill gas recovery project, conducted in Burlington County, New Jersey, in 2004 and 2005, successfully produced excellent quality gas and used it to fuel two refuse trucks. In this project, landfill gas was purified using a proprietary CO₂ Wash system, developed by Acrion Technologies, Inc., which produced a contaminant-free stream of methane (75 percent) and carbon dioxide (25 percent). This methane-carbon dioxide stream was further separated into high-purity methane (less than 100 parts per million CO₂) using membranes manufactured by Air Liquide. Additional processing liquefied the methane into high purity LNG truck fuel. The trucks were refueled with LNG at a Chart Industries fueling station located at the EcoComplex facility adjacent to the Burlington County landfill. The fuel powered two Mack trucks, with E7G engines, owned by Waste Management. Mack is now focusing on selling this process commercially and is conducting free assessments for landfills to determine the economic feasibility of building landfill gas recovery facilities.

A landfill gas recovery system is also underway at the Puente Hills Landfill in Los Angeles County. Run by the Sanitation Districts of Los Angeles County, Puente Hills started the world's first full-scale facility to produce CNG from landfill gas in 1993. Between 1994 and 2004, the facility successfully fueled four large waste transfer trucks with 350 400-horsepower engines off and on. However, this application was halted when the engines were no longer being sold. Although the facility is still capable of producing 1,000 gasoline gallon equivalents of CNG per day, it currently produces only 1,000 gasoline gallon equivalents per month. Puente Hills has met with Cummins Westport and expressed interest in running a demonstration project for a large waste transfer truck if an engine becomes available.

EPA's Landfill Methane Outreach Program (LMOP) is promoting interest in converting landfill methane, a potential greenhouse gas, into a renewable clean transportation fuel. As this trend continues, companies that own landfills and refuse truck fleets will find initiatives such as the Burlington County project especially attractive.

Chapter 2. Positive and Negative Factors Affecting the Pace of Alternative Fuel Use

INFORM research found a number of positive and negative factors that are influencing refuse truck fleet operators when they decide which fuels to burn and technologies to use. By analyzing data gathered during interviews with engine producers and fleet operators, INFORM identified seven primary drivers that favored alternative fuel use in the refuse truck sector between 2002 and 2005.

Seven Positive Factors Driving Natural Gas Use in Refuse Trucks

1. State Incentives for Alternative Fuel Vehicle Use. The primary positive factor promoting natural gas use in refuse trucks was found to be strong state government leadership, with California leading the way. Most natural gas refuse trucks were found to be concentrated in Southern California, where government mandates and economic incentives to promote their use were being most aggressively implemented. Texas has also mounted ambitious programs.

California. California has been the clear leader in enacting strict mandates and offering economic incentives for the use of alternative fuel vehicles. In Southern California, the South Coast Air Quality Management District (SCAQMD) enacted a mandate that required heavy-duty fleets larger than 15

vehicles to buy natural gas powered vehicles.¹ It is also the state with the greatest commitment to providing the heavy-duty sector with public funds to support alternative fuel vehicle purchases. The Carl Moyer Memorial Air Quality Standards Attainment Program is one of the few state programs in the US to provide funds specifically for the purchase of clean burning heavy-duty vehicles. In addition, many air quality management districts (AQMDs)—including the South Coast AQMD (which covers the Los Angeles basin), the Bay Area AQMD (which covers the San Francisco Bay area), and the Sacramento AQMD (which covers the state capital)—offer cash payments in the range of \$1,000 to \$5,000 per vehicle for the purchase of alternative fuel vehicles.

**LONG HELD
PRICE ADVANTAGE
OF DIESEL TRUCKS
IS NO LONGER
A GIVEN.**

Texas. In 2001, to reduce nitrogen oxide (NO_x) emissions, the Texas legislature established the Texas Emissions Reduction Program (TERP), a cost reimbursement program that provides grants for clean air projects in 41 heavily polluted counties. One component of TERP is the Heavy-Duty Vehicle Program—a voluntary alternative fuel purchase incentive program that funds rebates for the purchase or lease of natural gas refuse trucks and for natural gas refueling infrastructure. Under this program, when a vehicle is purchased to replace an older vehicle, the applicant must agree not to use or sell the replaced vehicle within the boundaries of Texas. In fiscal year 2005, TERP was allocated nearly \$116 million, which can be used to assist projects in any transportation sector (e.g., on-road heavy duty, off-road, commercial marine, or locomotive) for any purpose (e.g., purchase, lease, replacement, retrofit, or add-on emissions reduction technology).

2. Soaring Prices of Petroleum-Derived Fuels. Even though the price of diesel and natural gas fuels have risen significantly, CNG's pump prices continue to be lower, and this has provided some fleet operators with a major incentive to switch fuels. The national average price of gasoline and diesel has nearly doubled since 2002, and prices in Southern California have been well over \$3.00 per gallon. The national average diesel price at the end of September 2005, as reported in the quarterly *Alternative Fuel*

¹ SCAQMD clean fleet rules include seven measures requiring fleet operators of transit buses, school buses, trash trucks airport shuttles and taxis, street sweepers, and heavy-duty utility trucks to buy natural gas models when they replace vehicles or add to their fleets. This mandate was in effect from 2001 to mid-2004, when portions of it were overturned by the US Supreme Court. Subsequently, in March 2005, a US District Court in California issued a ruling that SCAQMD's fleet rules *are* applicable to state and local governments in California and are *not* preempted by the Clean Air Act. SCAQMD has issued an advisory notice to fleet owners and operators, stating that, in general, its requirements are in full force and effect.

Price Report, published by the US DOE, was \$2.81 per gallon (compared to \$0.97 per gallon in 1999).

At the end of September 2005, the *Alternative Fuel Price Report* found the average national CNG price to be \$2.36 per diesel gallon equivalent, well below the diesel price. The price of LNG also compares favorably to diesel in many locations. For example, in May 2005, Clean Energy, the largest supplier of natural gas in US transportation markets, announced a three-year deal with the Dallas Area Rapid Transit to sell 15.5 million gallons of LNG at prices not to exceed \$0.99 per LNG gallon. Correcting for the different energy content in gallons of LNG and diesel still left LNG with a significant price advantage.

THE ECONOMICS
OF SWITCHING
TO NATURAL
GAS FUEL
REMAIN A
CRITICAL ISSUE
...ON AN
EQUIVALENT
ENERGY BASIS
NATURAL GAS
PRICES REMAIN
BELOW DIESEL

3. National Energy Security Concerns. A factor connected to the soaring price of oil—and increasingly a driver for using alternative fuels—is the national energy security implications of continued reliance on imported oil. Oil imports have continued to grow from 2001 to mid-2005, and at least two fleet operators interviewed for this study cited energy security as an issue that they considered in choosing natural gas refuse trucks. During INFORM’s research, several fleet operators felt that reliance on natural gas, provided mainly from reserves in the US, offered them a measure of energy security in the face of a disruption in oil supply or a major spike in diesel prices.

Despite government efforts to reduce petroleum use (such as the Energy Policy Act of 2002)² imports, as a percentage of consumption, have almost doubled in the past 30 years, increasing from 35 percent to more than 60 percent. The petroleum price spike in 2005 and the threat of continued high petroleum prices are spurring many government officials to take more aggressive action to reduce petroleum demand and, therefore, imports.³

4. New More Stringent Engine Emission Standards. During INFORM’s interviews, at least six fleet

² The government has focused on reducing the oil dependency of the light duty vehicles sector. For example, EPACT, which was enacted in 1992, set a national goal of replacing 10 percent of all oil used for transportation in the US with alternative fuels by 2000 and replacing 30 percent by 2010.

³ During the week of January 16, 2005, the price of petroleum exceeded \$68 per barrel.

operators and engine manufacturers cited upcoming US Environmental Protection Agency (EPA) and California Air Resources Board (CARB) emission standards on heavy-duty engines as factors that have increasingly favored the use of alternative fuels.

The heavy-duty emissions standards that will be phased in between 2007 and 2010 are expected to have a larger impact. These standards will require particulate matter (PM) and NOx from heavy-duty engines to be reduced by more than 90 percent. Heavy-duty vehicles equipped with natural gas engines have already demonstrated compliance with these regulations. Although progress is being made with diesel engines, their compliance is likely to involve more complex and costly engine controls and aftermarket treatment systems. The reliability of the aftertreatment devices seems to be more problematic than the simpler devices needed for natural gas engines.

Natural gas engines have already shown that they can meet not only the required 2007 levels but also the lower levels that will be required in 2010. The natural gas vehicles that will be available in 2007 will be certified at 0.2 grams—1 gram less than the 1.2 grams required in NOx emissions—surpassing the 2007 standard and achieving the 2010 standard three years early. (The difference could mean up to 1 ton fewer NOx emissions per truck during seven years of operation.)

5. Strong Industry Presence in the Refuse Truck Market. Another factor encouraging fleet operators to consider natural gas truck technology has been the growing voice of alternative fuel providers and manufacturers of alternative fuel trucks and engines as they advocate for their products. They have concentrated on promoting sales in the few portions of the transportation vehicle market in which sales have been relatively robust and the experience of early adopters has been positive. For nearly a decade, urban transit buses have been one such market. Natural gas buses now account for nearly 12 percent of all urban transit buses in the US, and sales of new hybrid-electric buses have been increasing. During the past few years, INFORM has identified the refuse truck sector as a second major market success for alternative fuels, particularly natural gas.

**OIL IMPORTS, AS
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NEW HEAVY-DUTY
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COME INTO
EFFECT IN 2007,
WITH STRICTER
STANDARDS
COMING INTO
EFFECT IN 2010.

As the new EPA standards come into effect, not only are Cummins Westport and John Deere already producing heavy-duty natural gas engines that can meet the 2010 standards, but companies such as Clean Energy, Trillium, Air and Gas Technologies, ANGI, and Clean Air Products have expanded their capacities for providing natural gas refueling infrastructure. Clean Air Power, which offers dual-fuel engines, and ALT Fuels, which offers LNG equipment, also have a strong corporate presence in this industry. Cummins Westport has noted the rising costs that purchasers of diesel refuse trucks will face because of EPA's stringent 2007 and 2010 standards, while NGV America (formerly the Natural Gas Vehicle Coalition), based in Washington, DC, has promoted the overall benefits of natural gas vehicles.

6. Rising Concerns about Public Health. In providing information about their fleets, six fleet operators commented that their natural gas refuse trucks were cleaner than diesel models. Several added that these factors drew praise from drivers, government leaders, and the general public. A number of fleet operators also noted that natural gas offered the cleanest alternative fuel currently available.

These operators understand what municipal and health officials have increasingly acknowledged: Gasoline- and diesel-dependent transportation systems are responsible for most of the pollution that blankets US cities. They have also acknowledged that refuse trucks—among the oldest, least fuel-efficient, and most polluting of fleet vehicles—contribute to the problem and must help solve it. Diesel-powered refuse trucks emit particulate matter, hydrocarbons, carbon monoxide, and nitrogen oxides—all of which adversely affect human health (and the environment).

7. Recognized Benefits of Less Noise. When providing information for this report, several fleet operators mentioned noise reduction as an important benefit gained from the shift to natural gas trucks. An official with the Santa Monica fleet said, “drivers prefer them over the noisier and smellier diesels.” An operator for the Berkeley fleet said he believed that “the CNG trucks are less noisy and smog free, which should be appreciated by everyone.”

Noise pollution, a factor given little attention until recently, is emerging as an important quality of life concern in many US cities, and INFORM's 2002 research found that natural gas trucks offered significant reduction in noise. Diesel garbage trucks can generate noise levels of up to 100 decibels. However, because natural gas engines are spark-ignited rather than compression ignited, which allows them to operate at lower compression ratios, their engines are significantly quieter. Standards set by the US Occupational Safety and Health Administration (OSHA) permit employees to be exposed to 90 decibels for up to eight hours—a limit that diesel trucks come dangerously close to and may often exceed.

An in-depth study conducted in Velsen, the Netherlands, examined the noise levels experienced by refuse truck workers. It found that, with natural gas trucks, drivers experienced noise levels that were more than 90 percent lower than those of diesel trucks. Public statements by Deere Power Systems also refer to natural gas engines being 90 percent quieter than diesel engines.

Three Negative Factors Limiting Natural Gas Use in Refuse Trucks

In contrast to the seven primary drivers that favored alternative fuel use, fleet operators cited three negative factors that have discouraged the use of alternative fuel refuse trucks between 2002 and 2005.

1. Continuing Cost Concerns about Switching to Alternative Fuel Refuse Trucks. Although the lower price of natural gas fuel encouraged some fleets to consider shifting to this fuel, several other operators acknowledged the environmental benefits of using natural gas trucks but said they believed that the overall costs would be “prohibitive.” One operator remarked that its purchase of future CNG refuse trucks depended in part on receiving grants. With a price tag of approximately \$200,000, a CNG refuse truck costs almost \$40,000 more than a diesel-powered truck. Aside from incurring these additional upfront capital costs, fleet operators that switch to alternative fuels such as natural gas often have to rely on new refueling stations, make other modifications to their facilities, and support re-

training for their workers—all of which disrupt their current practices and mean a new complex cost picture that they do not want to deal with.

Another fleet operator reported lower-than-expected fuel efficiency for its LNG refuse trucks. As a result, the fuel costs for the operator's LNG trucks were higher than those for its diesel trucks.

The economics of switching to natural gas remain a critical, but confusing, issue. Although, on an equivalent energy basis, natural gas fuel prices continue to remain below diesel prices, as they have for most of the past few decades, prices for both fuels have fluctuated dramatically. Few economists, let alone fleet operators, feel confident enough to predict where prices will head in the future. Many fleet operators that INFORM interviewed were not aware of the grants that could help cover the higher up-front costs.

2. Performance of Trucks. When alternative fuel refuse trucks have experienced performance problems, fleet operators, government officials, and the public have been quick to question this new technology. In one of the most publicized cases, the City of Los Angeles had to remove nearly 160 of its LNG trucks from service to repair leaks in the fueling system and correct problems related to engines that overheated. Once the problem was solved, the trucks went back into operation.

INFORM interviewed several fleet operators whose natural gas refuse trucks experienced various mechanical glitches such as problems with transmission engine systems, fuel filters, hydraulic systems, ignition modules, and fuel tanks. More than one operator also reported problems with fueling stations, including pump failure, fuel contamination, lengthy fill times, and limited fuel availability in remote areas.

However, the data that INFORM gathered show that, for natural gas refuse trucks, the reported problems stemmed largely from mechanical issues associated with the design of the trucks, not from issues that arise from using natural gas as a fuel. Acknowledging these design issues, at least one fleet operator observed that some problems can be expected because natural gas trucks are a relatively new technology.

3. Need for Stronger National Leadership and Support for Alternative Fuel Use in Refuse Trucks.

As fleet operators consider whether to purchase alternative fuel refuse trucks, they face new challenges and questions, such as the learning curve for operators and maintenance personnel and unfamiliar financial implications. Government grants or economic incentives may make the difference between success and failure. INFORM's research has found that, even though they may have received helpful information from the federal Clean Cities programs or had access to grant funding under the federal Congestion Mitigation and Air Quality (CMAQ) program, fleet operators that actually purchased alternative fuel or advanced technology refuse trucks were mainly in California and Texas. These fleets were primarily driven by Southern California's strongly enforced mandates, attracted to the significant financial incentives provided by California and Texas, or motivated by both.

Despite federal grants being available and the local support of the Department of Energy's (DOE's) Clean Cities programs, signals given by other federal initiatives have dampened fleet operators' interest in a shift from diesel to natural gas trucks. Such signals in the past few years included the federal lawsuit, undertaken with the Engine Manufacturers Association, against SCAQMD's mandates requiring natural gas use in heavy-duty fleets and the severe reduction in DOE funds for the Clean Cities programs and the elimination of funding for the agency's heavy-duty natural gas engine development program.

However, it is important to note that, as the research for this report was being completed, federal support for alternative fuel vehicle use was expanded, and this will give refuse truck fleet operators more impetus to explore the use of alternative fuels. After years of debate, the national Energy Policy Act of 2005 (PL 109-58) was passed, as was a transportation bill (PL 109-59)—both of which contain new financial incentives.

**NATURAL GAS
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EMISSIONS LEVELS
THAT WILL BE
REQUIRED IN 2010.**

The Energy Policy Act of 2005 includes income tax credits for purchasing alternative fuel vehicles, including heavy-duty refuse trucks. Natural gas refuse trucks currently cost approximately \$40,000 more than diesel trucks. The tax credit will fund up to \$32,000 of that cost. The credit is provided to the buyer. However, dealers that sell trucks to public agencies can take the credit and pass the savings through to the agency. A second tax credit will fund up to \$30,000 of the cost of new fueling station equipment for alternative fuels.

The 2005 Highway Bill—titled the Safe, Accountable, Flexible, and Efficient Transportation Equity Act (SAFETEA)—created a new federal excise tax credit equal to \$0.50 per gallon of alternative fuel, although some of this incentive was offset by an increase in the tax rate for alternative fuels.

Chapter 3.

INFORM's Findings, Conclusions, and Recommendations

In its 2002 report, *Greening Garbage Trucks*, INFORM identified the beginnings of a trend in a new refuse truck technology: using natural gas rather than diesel fuel. This follow-up research found that the refuse truck industry is starting to explore the use of hybrid-electric technology and bio-methane from landfills. However, the predominant trend shows the continued use of natural gas. These natural gas trucks have generally worked well, in addition to producing environmental and energy security benefits at costs that many fleet operators find acceptable.

What follows is a summary of the findings of INFORM's 2005 research, identifying trends in the use of alternative fuel refuse trucks and the factors affecting fleet operators' truck purchasing decisions. INFORM's conclusions and recommendations, which follow this summary, address ways to accelerate the pace of change.

Summary of INFORM's Findings

Conventional diesel refuse trucks are no longer the only choice for refuse fleet operators. Alternative fuel trucks have started to emerge as available options, and the strongest preference has been for natural gas trucks.

- ◆ Since 2002, the use of alternative fuel refuse trucks—virtually all powered by natural gas—has more than doubled from 692 to at least 1,071 trucks (the total that INFORM could confirm with fleet operators) and possibly to 1,496 (which includes another 425 trucks identified but not confirmed). (By comparison, only 240 natural gas refuse trucks were operating in 1998.)
- ◆ Since 2002, the number of cities in which natural gas refuse trucks are operating has risen from 26 to 57.
- ◆ The nation’s five largest natural gas refuse truck fleets are operating in California.

City	Fleet Owner	Size of Fleet
Los Angeles, CA	City of Los Angeles	252 LNG
El Cajon (San Diego), CA	Waste Management-San Diego	126 LNG
Sacramento, CA	County of Sacramento	105 LNG (55 LNG/diesel, 50 LNG)
San Diego, CA	Environmental Services Dept.	77 dual-fuel LNG
Fresno, CA	City of Fresno	69 LNG

- ◆ Between 2002 and 2005, natural gas vehicle use in the US refuse truck sector expanded more rapidly, as a percentage, than in any other vehicle sector. The 89-percent increase was four times the overall 20-percent increase (between 2002 and 2004) in natural gas vehicle use nationwide as reported by the US Energy Information Administration.
- ◆ Although natural gas truck use has risen dramatically, the number now on US roadways constitutes less than 1 percent of the total refuse truck population of 136,000. Even so, this sector is the second most promising market for natural gas vehicle use after the transit bus sector, which has a market penetration of 12 percent.

The vast majority of natural gas fleet initiatives exist in California, where strong fleet mandates and economic incentives have been put in place.

Of the 57 fleet initiatives that INFORM has identified, 50 have been in California, where a combination of government mandates and financial assistance has proved to be a powerful driver.

- ◆ California had the largest number of natural gas trucks (confirmed and identified), followed by New York; Texas; Washington, DC; and Massachusetts.

State	Number of Natural Gas Refuse Trucks
California	1,268 (131 CNG; 699 LNG; 172 dual-fuel; 266 undetermined fuel type)
New York	26 (CNG)
Texas	7 (CNG)
Washington, DC	3 (CNG)
Massachusetts	2 (CNG)

Since 2002, when INFORM found natural gas trucks operating in Japan and the Netherlands, several new international cities have moved in this direction.

City	Size of Fleet
Paris, France	300 CNG trucks
Madrid, Spain	379 CNG trucks
Gothenburg, Sweden	15 CNG trucks
Mechlen, Belgium	Unknown

On the horizon, several other fuels and technologies are being tested in prototype vehicles.

These include:

- ◆ 100 percent and 20 percent biodiesel
- ◆ Hybrid-electric drivetrains
- ◆ Bio-methane

Even though INFORM could roughly estimate alternative fuel vehicle use in refuse truck fleets, the lack of systematically reported data about these fleets limited INFORM's ability to completely profile the industry in 2005.

**EVEN THOUGH
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THE PUMP
THAN DIESEL.**

- ♦ Of the 57 fleets that INFORM identified, only 31 fleet operators were willing to provide information for this report.
- ♦ Valuable systematic perspectives on the performance, costs, and environmental benefits of alternative fuel trucks were not available. Such perspectives would inform other fleets and reassure communities that these vehicles were addressing their concerns.
- ♦ In 2002, INFORM found that fleets were willing to talk loudly and publicly about their natural gas programs; however, by 2005, this seems to have changed. Conversations with fleet operators indicate the main reason may be linked more to uncertainty about future government requirements than to dissatisfaction with the technology. Although some technical problems surfaced during the past two years—most visibly, the temporary removal of the large natural gas refuse truck fleet in Los Angeles—natural gas engine and fuel management equipment has operated well in routine service in most fleets.

US fleet operators identified seven factors that encouraged their shift from diesel to natural gas fuel trucks and three major obstacles to change.

The seven positive factors were:

1. State government programs that provide incentives for purchasers of alternative fuel
2. Concern about rising gasoline and diesel prices, which have sparked fleet interest in alternatives to petroleum-based fuels

3. Looming new environmental standards for heavy-duty engines, which natural gas engine manufacturers are already prepared to meet
4. Growing concerns about national security and US dependence on foreign oil
5. Strong natural gas vehicle industry presence in the refuse truck market
6. Concern among urban leaders and health officials about the health effects of diesel exhaust, which contains carcinogens
7. Recognized benefits of less noise

The three primary obstacles to change were:

1. The higher costs of natural gas vehicles and their refueling infrastructure and the higher costs of biodiesel fuel
2. Performance issues that still affect natural gas trucks
3. Reduced federal funding for key DOE programs and a legal setback for the most ambitious California program that promoted the use of alternative fuels in the refuse truck industry

Since 2002, the economics of purchasing and operating natural gas versus diesel refuse trucks have been a key obstacle to using these trucks, but four factors are changing the economic equation.

- ♦ **The 2005 Energy Policy Act.** As research was being completed for this report, the 2005 Energy Policy Act was signed into law. It includes nearly \$1 billion in new financial incentives for alternative fuel vehicles, including heavy-duty refuse trucks. It provides a tax credit of up to \$32,000 (or 80 percent) of the incremental cost of natural gas trucks. Dealers who sell trucks to public agencies can take the credit and pass the savings through to the agency. A second tax credit will fund up to \$30,000 of the cost of new fueling station equipment for alternative fuels.
- ♦ **The 2005 Highway Bill.** Titled the Safe, Accountable, Flexible, and Efficient Transportation Equity Act (SAFETEA), the Highway Bill was also signed into law. It has created a new federal

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POSSIBLE.

excise tax credit equal to \$0.50 per gasoline equivalent gallon of alternative fuel, although some of this incentive was offset by an increase in the tax rate for alternative fuels.

♦ **New engine certification standards set by the US Environmental Protection Agency.**

Natural gas trucks are becoming economically competitive with diesel trucks because of EPA's new stringent emissions guidelines that go into effect between 2007 and 2010. The cost of diesel trucks is already increasing by as much as \$10,000 to \$12,000 per vehicle because of the changes required in their engines to meet the 2007 standards, and operating these cleaner diesel vehicles will further increase their costs and fuel use. Natural gas engines do not depend as heavily on add-on technology, which can malfunction and may deteriorate over time. For example, particulate emissions for natural gas vehicles are reduced by a simple oxidation catalyst; diesel vehicles will require advanced control technologies *and* the use of ultra low sulfur diesel fuel to achieve comparable particulate emission reductions.

- ♦ **Shifting Fuel Costs.** Even though the prices for diesel and natural gas fuels have risen dramatically in 2005, natural gas fuel has remained cheaper at the pump than diesel, and the 2005 Highway Bill will provide a new federal excise tax credit equal to \$0.50 per gasoline equivalent gallon of alternative fuel. In addition, EPA's new federal air pollution standards that are set for engines sold in 2007 and the even tighter 2010 standards are likely to increase the amount of fuel consumed by diesel trucks because of the demands of aftermarket treatment technology.

A 2005 study by TIAX, an independent California research firm, has estimated that the new requirements being placed on diesel trucks will totally erase the cost advantage that diesel trucks have long enjoyed over natural gas trucks.

When considering what new trucks to purchase, refuse truck fleet operators have a wide range of factors to weigh, all crucial for making the best local decisions. These include:

- ◆ Truck purchase cost
- ◆ Access to fuel
- ◆ Need for new refueling infrastructure, facilities modification, or land acquisition (if any)
- ◆ Costs for worker training
- ◆ Availability of outside funding from public and private sources
- ◆ The ability to leverage current capital investments against future investments
- ◆ Emissions reduction goals (government mandates)
- ◆ Goals for reducing greenhouse gas emissions (in some cases, government policy or mandates)
- ◆ Noise reduction goals
- ◆ Petroleum displacement goals

**THE 2005 ENERGY
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...INCLUDES NEARLY
\$1 BILLION IN
NEW FINANCIAL
INCENTIVES FOR
ALTERNATIVE
FUEL VEHICLES,
INCLUDING
HEAVY-DUTY
REFUSE TRUCKS.**

INFORM's Conclusions and Recommendations

A NATIONAL ENTITY—BE IT GOVERNMENT, TRADE ASSOCIATION, OR INDEPENDENT—IS NEEDED FOR TRACKING TRENDS IN THE REFUSE TRUCK FLEET SECTOR.

The growing interest in alternative fuels among the fleet operators that INFORM interviewed reflects a changing perspective of the best refuse or recycling trucks for urban use. Local municipalities are increasingly expressing concerns about worsening urban air quality and the rising price of diesel fuel and diesel trucks. At the same time, national concerns are growing about greenhouse gas emissions and the US's still expanding reliance on foreign oil, especially in transportation sectors.

As a result, refuse and recycling truck operators have recognized that not only must their fleets provide their essential services reliably, but they must also do more. The more they diversify the fuels they use (which can reduce, if not eliminate, their reliance on foreign oil), the more they may protect themselves from fuel price spikes or supply disruptions that may occur as political tensions increase in oil-rich countries and as the demand for oil increases in industrializing Asia.

The efforts to capture and re-use landfill gas, as described in this report, suggest that natural gas trucks may soon be able to use gases generated from landfills and wastewater treatment plants. Gas from these sources offers a renewable resource, which currently escapes into the atmosphere as pollutants, providing a win-win situation for the environment and the natural gas vehicle fleets.

Putting the Refuse Truck Sector on the Path to Hydrogen

INFORM's research of alternative fuels and the refuse truck sector has identified an additional, and perhaps the most significant, benefit of natural gas use—the role that using natural gas as a fuel may play in accelerating the transition of the transportation sector to the use of hydrogen. Refuse truck fleets that use natural gas (possibly combined with bio-gas) are ahead of their peers in making the long-term transition to hydrogen for two reasons. First, the current generation of market-tested natural gas vehicles and storage and fueling technologies gives them experience with a gas fuel technology and the

systems needed to handle gas under pressure. Second, investments in natural gas fueling infrastructure are investments in gaseous fuel facilities that, with added equipment, will be able to extract hydrogen from natural gas and provide it to the first generation of fuel cell trucks.

Hydrogen produced from natural gas may be the best way to power hydrogen fuel cell vehicles until a transition can be made to a truly sustainable fuel—hydrogen produced from water using renewable energy. Vehicles running on hydrogen will not rely on any fossil fuel, and they will not produce harmful emissions.

Accelerating the Pace of Progress

Given the combination of near- and long-term benefits made possible through the use of natural gas refuse trucks, the question becomes how to accelerate the use of natural gas and other alternative fuel vehicles in the refuse truck sector in the period ahead.

Government action is clearly warranted because, even though the pace of innovation in the use of natural gas trucks is rapid, it is not equivalent in scale to the environmental, health, and energy security challenges facing the US. INFORM's research documented that the shift to alternative fuel refuse trucks has affected less than 1 percent of the 136,000 truck sector. Although it is growing, the natural gas sector in the refuse truck industry is not yet self-sustaining.

Government incentives, mandates, or both are needed to address the major obstacles to change that fleet operators discussed. These obstacles include the economic uncertainty associated with switching to a new fuel and the technological challenges that this shift may entail. Fleet mandates for cleaner, petroleum-free fuels combined with economic incentives, such as those provided in California, proved to be the types of powerful drivers needed.

**THE MORE THEY
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OIL PRICE SPIKES
OR SUPPLY
DISRUPTIONS.**

Fuel switching mandates, such as those implemented in California, have resulted in energy and economic development progress. In addition to reducing fleet reliance on foreign oil, these mandates have assured manufacturers that a market for their vehicles would exist, giving them incentive to improve the technology and compete for that market.

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FLEET OPERATORS.

California's programs have had some visible effects. For example, Cummins Westport, a major manufacturer of natural gas heavy-duty engines, not only increased sales of heavy-duty natural gas engines in the California marketplace, but with increasingly sophisticated technology to offer, it expanded its heavy-duty natural gas engine business in China and India, where demand is growing. Enabling China and India to use these engines has helped these countries reduce their air pollution while lessening international competition for oil and, in turn, helping the US achieve its energy security objectives.

INFORM's Four Recommendations

INFORM's research has generated the following four recommendations:

- 1. The types of programs California has developed can provide excellent guidance for states that want to encourage the use of natural gas, bio-methane generated by landfills and wastewater treatment plants, and other alternative fuels and innovative technologies.**

Important elements of California's programs include:

- ♦ *Economic incentives to offset the capital cost of natural gas vehicle and fueling technology.*

In California, refuse truck fleet operators have relied on market-specific economic incentives such as the Carl Moyer Memorial Air Quality Standards Attainment Program to offset the front-end capital costs of natural gas engines. Such incentives allow fleet operators to recover fuel savings from using natural gas and to better manage other fuel switching costs, such as training technicians how to maintain natural gas engines.

- ◆ **Fuel use and engine mandates for fleets that have high air pollution emissions associated with burning diesel fuel.** Because of SCAQMD’s Rule 1193, many refuse truck fleet operators were required to buy natural gas vehicles. Although the US Supreme Court has prohibited the application of this rule to private sector fleets, it still applies to municipal fleets, and SCAQMD is working with CARB to ensure that a modified program remains intact.
- ◆ **Public education programs.** To garner the support and cooperation of the public and private sectors, California’s leadership has emphasized the state’s goals of pollution reduction, reduced reliance on foreign oil, and the environmental and energy security benefits of switching to cleaner non-petroleum-based alternative fuels.
- ◆ **Educational workshops for refuse fleet operators.** During the past few years, a series of workshops for fleet operators in California provided a forum for objectively defining the pros and cons of the various available fueling and technology strategies. They also provided an opportunity for fleet operators to meet the partners they need to establish successful clean fuels initiatives: fuel providers, fuel infrastructure builders, vehicle manufacturers, and government officials who can explain what economic incentives are available to make projects affordable. State and local government agencies and local chapters of DOE’s Clean Cities program have sponsored such workshops in other states, including New York and Texas.

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COMPETITION
FOR OIL.

2. A national entity—be it government, trade association, or independent—is needed for tracking and publicly reporting trends in the truck fleet sector. Such an entity could be created within an existing natural gas vehicle trade association or within another organization such as SWANA.

It would accomplish the following:

- ◆ Quantify the number and age of trucks operating in the US and their fuel use
- ◆ Quantify the extent to which the industry is reducing its dependence on oil-derived fuels and shifting to natural gas or other renewable sources
- ◆ Assess the expanded use (i.e., the success) of various fuel options and new technologies

- ◆ Encourage local municipal officials and community health and environmental organizations to monitor and evaluate the practices of local refuse fleet operators so they could distinguish innovative programs for planning purposes
- ◆ Enable players in the alternative fuel vehicle industry to track their own progress

3. The US Department of Energy can encourage multi-sector government/industry/nonprofit partnerships that can help refuse truck fleet operators overcome the obstacles to innovation and make the most of their new truck investments.

- ◆ Local Clean Cities programs can play an especially valuable role in explaining the expanded economic incentives now available to fleet operators under the Energy Policy Act of 2005 and SAFETEA and in providing linkages to vehicle, fuel, infrastructure, and grant providers.
- ◆ The National Renewable Energy Laboratory's evaluations and performance comparisons of alternative fuel and advanced technology vehicles can be increasingly important in helping refuse truck and other heavy-duty vehicle sectors focus their investments most effectively.

4. National government-industry joint efforts should include an integrated energy and technology export program to support the export of natural gas technology and other beneficial refuse truck fuel and technology options that emerge.

- ◆ Many technology export programs already exist in the government, but alternative fuel technologies receive minimal attention. Although companies such as Cummins Westport have already begun manufacturing heavy-duty natural gas engines in China and India, alternative fuel technology exports could play a much broader role in US energy and environmental protection policies. Their profile in the portfolio of technology export efforts deserves to be raised considerably.

- ◆ British Columbia, Canada, is a good example of a province that has worked hard to establish itself as an exporter of advanced transportation technology, and the large number of advanced transportation companies located in the province attests to its success.
- ◆ Business tax incentives have long been used to attract businesses to different states, but they have generally not been applied to support the operations of companies that specialize in natural gas vehicle technology for sale in global markets.

Appendix. Profiles of Each US Fleet Operating in 2002 or 2005 2002 Fleets Updated in 2005

1. Anaheim, CA, Taormina Industries

Contact: Ken Pretell, Manager, Environmental and Regulatory Affairs
Phone: 714-238-3300
E-mail: pretellk@taormina.com
Web: www.taormina.com
Current Natural Gas Fleet: 50 NG
NG Fleet in 2002: 50 NG
Refueling: N/A

Ken Pretell of Taormina Industries said that Taormina has not changed its fleet in the past two years; therefore, it still has 50 natural gas trucks. INFORM has no information about the type of natural gas trucks Taormina is using or about the company's future plans.

2. Bakersfield, CA, City of Bakersfield

Contact: Sal Moretti or Tony Briseno, Supervisor
Phone: 661-326-3114
E-mail: PW_SAN@ci.bakersfield.ca.us
Web: www.ci.bakersfield.ca.us
Current Natural Gas Fleet: No information
NG Fleet in 2002: 5 LNG
Refueling: City-owned refueling station that supplies LNG and CNG fuel

The City of Bakersfield was using five 10-year-old LNG trucks in 2002. It was to receive nine more LNG refuse trucks, but their purchase had been delayed due to a tank recall. INFORM's attempts to contact Moretti in 2005 via e-mail and phone were unsuccessful.

3. Berkeley, CA, City of Berkeley

Contact: Rogelio Marquina, Senior Solid Waste Supervisor
Phone: 510-981-6355
E-mail: RMarquina@ci.berkeley.ca.us
Web: www.ci.berkeley.ca.us
Current Natural Gas Fleet: 7 CNG
NG Fleet in 2002: 4 CNG
Refueling: N/A

The City of Berkeley runs 7 CNG garbage trucks in a total fleet of 33. The city chose CNG because it "burns cleaner than diesel or even biodiesel," said Rogelio Marquina, Senior Solid Waste Supervisor. (The city uses B20 biodiesel in 26 trucks.) Marquina also said that the trucks "have exceeded our expectations! According to equipment maintenance, they have experienced only minor problems, such as ignition modules failures, which might not even be related to CNG." Although "the drivers have

reported a loss of power [compared to diesel] when traveling up hill with a heavy load,” Marquina believed that the CNG trucks “are less noisy and smog free, which should be appreciated by everyone.”

The city plans to buy more CNG trucks in the future but will “continue to purchase rear loader trucks until the industry comes up with a design to allow space for mounting the CNG tank on the front loader trucks.”

4. Corona, CA, Waste Management-Inland Empire

Contact: Marie Leckrone (no longer at Corona)
Aurelio Perez, Maintenance Manager
Phone: 951-280-5408
Current Natural Gas Fleet: No information
NG Fleet in 2002: 27
Refueling: N/A

Waste Management of the Inland Empire is listed as the waste hauler for two cities on INFORM’s 2002 list: Corona (CA) and Moreno Valley (CA). Through May 1, 2005, Jim Gibbs was the contact for both, but after that date, Marie Leckrone became the contact for Corona, and Bill Arlington became the contact for Moreno Valley. After initially contacting Leckrone by telephone, INFORM was unable to reach her in follow-up calls.

5. El Cajon (San Diego), CA, Waste Management-San Diego

Contact: Alan Walsh, District Manager
Phone: 619-596-5117, 619-996-5100
Web: www.wastemanagementsd.com
Current Natural Gas Fleet: 126 LNG
NG Fleet in March 2004: 126 LNG
NG Fleet in 2002: 122 LNG
Refueling: N/A

Alan Walsh of Waste Management of San Diego (WM-SD) said that WM-SD has the same fleet as it did in 2004: 126 LNG garbage trucks, up from 122 in 2002. In 2004, the company had some problems with the tanks, such as loss of vacuum, and “turbo issues.” However, the trucks had “really good uptime, low downtime”; they are a “lot quieter”; and the drivers like driving them. WM-SD will buy more natural gas refuse trucks on a “replacement basis,” but these are basically the whole fleet now.

The refuse truck program at El Cajon resulted from a precedent-setting pollution control program that uses pollution reductions earned from the expanded use of alternative fuel vehicles to offset air pollution from a major new electrical generating station. The deal involves Pacific Gas & Electric Company (PG&E), a large electric utility based in San Francisco, and Waste Management, Inc. The total cost of the project is estimated to be \$33 million.

Under the program, WM-SD replaces its fleet of diesel-powered refuse collectors with new LNG-powered vehicles equipped with low-polluting, 12-liter engines from Mack Trucks. PG&E uses the air pollution reductions resulting from this switch to help offset emissions from the Otay Mesa Generating Station, a proposed 510-megawatt plant to be built near the Mexican border south of San Diego. PG&E will pay the cost difference between replacing the existing trucks with new diesel trucks and replacing them with LNG-powered trucks. It will also pay for the construction of a 45,000 gallon LNG fueling station. Under the strict pollution control regulations in effect throughout most of California, projected new

sources of emissions must be offset by pollution reductions of existing sources as a condition of obtaining the necessary construction permits. The refuse truck conversion project will reduce nitrogen oxide (NOx) emissions by more than 35 tons per year. These reductions are the equivalent of removing 9,200 new passenger cars from California roadways. The cost of reducing NOx through this program is just \$31 per pound, which is much less than NOx offsets available from most other sources. The proposed power plant is projected to emit up to 120 tons of NOx per year.

6. Fairfield, CA, Solano (Republic Services)

Contact:	Brian Beaudrie, Regional Maintenance Manager, Western Region
Phone:	702-733-6271
Web:	www.solanorecycles.com
Current Natural Gas Fleet:	37 LNG
NG Fleet in 2002:	1
Refueling:	N/A

Brian Beaudrie of Solano (part of Republic Services) said that the company has the same fleet in 2005 as it did in 2004. However, he didn't remember the exact number. Although INFORM listed the number of LNG trucks as 35 in March 2004, the following excerpt from an article in *Waste Age* suggests a different figure.

For these reasons, alternatively fueled vehicles make up just a small portion of Republic's overall fleet of 5,500 trucks located at 146 subsidiaries throughout the nation. The company has 94 total—69 of which are pure LNG-powered and 25 dual-fuel (diesel and LNG-powered) models—and all are in California, where regulatory pressure to adopt alternatively fueled equipment is highest. (“Don't It Make Your GREEN Trucks BLUE?” *Waste Age* July 1, 2004, available at http://www.wasteage.com/mag/waste_dont_green_trucks.)

Beaudrie emphasized that despite the drawbacks, alternative fuels offer a few economic advantages in the refuse market. For instance, he noted that Republic bought 37 LNG-powered collection trucks for its Solano Garbage facility in Fairfield (CA) solely to win the city of San Francisco's garbage hauling contract two years ago. The contract required bidders to provide only non-diesel-powered equipment.

“We won that contract solely because we had a green fleet,” Beaudrie said. “It was a requirement to bid on that contract, so we bought them.” Republic Services has no plans to buy new trucks or to get rid of these. However, the company feels that buying natural gas trucks is really “up in the air” for the foreseeable future because of costs. It considers LNG trucks to be “environmentally good” but “cost prohibitive.”

7. Fontana, CA, Waste Management

Contact:	Jimmy Totosian, Community Relations
Phone:	909-429-4200
Current Natural Gas Fleet:	No information
NG Fleet in 2002:	25
Refueling:	N/A

Efforts to contact Waste Management in Fontana (CA) in either 2004 or 2005 were unsuccessful.

8. Fresno, CA. USA Waste (Waste Management)

Contact: Lynne Brown, Vice President of Communications
Phone: 713-512-6200
Current Natural Gas Fleet: No information
NG Fleet in 2002: 9
Refueling: N/A

USA Waste is a part of Waste Management. Efforts to contact it or to get specific information from Heather Browne (who no longer works at Fresno) of Waste Management were unsuccessful.

9. Irvine, CA, Waste Management-Orange County

Contact: David Ross, Senior District Manager
Phone: 714-480-2353
E-mail: dross2@wm.com
Web: <http://www.wmorangecounty.com/CityofIrvine.htm>
Current Natural Gas Fleet: No information
NG Fleet in 2002: 29
Refueling: N/A

Repeated efforts to contact David Ross of Waste Management-Orange County were unsuccessful. Ross is the contact for three of Waste Management's natural gas truck fleets: Irvine (CA); Orange County (CA); and Santa Ana (CA).

10. Los Angeles, CA, City of Los Angeles

Contact: Leonard Walker, former Equipment Superintendent*
Mike De Leon, current Equipment Superintendent
Jim Bonnville, retired Director of Fleet Services*
Victor Martin, current Director of Fleet Services
Phone: 213-485-5486
Web: www.lacity.org/EAD/EADWeb-AQD/afvehicles.htm
Current Natural Gas Fleet: 252 LNG
NG Fleet in 2002: 10
Refueling: N/A

The City of Los Angeles has operated a growing fleet for several years. Its current fleet consists of 252 natural gas trucks in a total fleet of 741 trucks.

Leonard Walker told INFORM that the city "bought natural gas trucks to improve the air quality. The city council took a pro-active position and voted to improve the air quality by supporting the SCAQMD ruling to purchase alternative fuel trucks before it was mandated by law."

He noted that the fleet is "performing okay, considering it is a new technology" and that "public support for the dual-fuel trucks [15 percent diesel and 85 percent LNG] is positive. In fact, there are plans to send some of these trucks to the San Pedro area of the city because of their popularity."

According to INFORM's 2004 interview with Karen Higgins (khiggins@gsd.lacity.org), the City of Los Angeles plans to receive 10 to 15 LNG trucks each month and convert its entire fleet to LNG by 2010.

*1/06 update: Walker and Bonnaville have left their positions.

The two new contacts are:
Michael De Leon, Acting Equipment Supervisor
E-mail: mike.deleon@lacity.org.

Alvin Blain, General Manager of General Services
Phone: 213-928-9555
E-mail: ablain@gsd.lacity.org

11. Moreno Valley, CA, Waste Management-Inland Empire

Contact:	Bill Arlington (Marie Leckrone no longer at Moreno Valley) Jim Keels, Operations Manager
Phone:	951-280-5406
Current Natural Gas Fleet:	No information
NG Fleet in 2002:	27
Refueling:	N/A

Waste Management of the Inland Empire is listed as the waste hauler for two cities on INFORM's 2002 list: Corona (CA) and Moreno Valley (CA). Through May 1, 2005, Jim Gibbs was the contact for both, but after that date, Marie Leckrone became the contact for Corona, and Bill Arlington became the contact for Moreno Valley. (Gibbs did not return INFORM's phone calls in 2005.)

12. Napa, CA, Napa Garbage (Waste Management)

Contact:	Andrew Morris (no longer at Napa) Greg Kelly, General Manager
Phone:	707-255-5200
Current Natural Gas Fleet:	No information
NG Fleet in 2002:	6
Refueling:	N/A

Napa Garbage is a part of Waste Management of American Canyon. Although an article posted on the Napa Garbage web-site in 2004 noted that the company has natural gas trucks, it didn't mention how many. This web-site was discontinued by 2005.

13. New York City, NY, Department of Sanitation (DSNY)

Contact:	Spiro Kattan, Engineering Division
Phone:	718-334-9205
E-mail:	skattan@dsny.nyc.gov
Contact:	Rocky DiRico, Assistant Commissioner of Support Services
Phone:	718-334-8911
E-mail:	rdirico@dsny.nyc.gov
Web:	www.nyc.gov/html/dos/home.html
Current Natural Gas Fleet:	26 CNG
NG Fleet in 2002:	36 CNG
Refueling:	N/A

The New York City Department of Sanitation (DSNY) pioneered in testing the first generation of compressed natural gas refuse-collection trucks fifteen years ago. The DSNY fleet is the largest municipal fleet in the country – with more than 2,200 refuse collection and recycling vehicles.

The early CNG trucks clearly had some particular strengths and weaknesses. According to DSNY Manager Tim Harte in the mid-1990s, sanitation workers “really enjoyed running these trucks on natural gas. The vehicles were quieter and cleaner and there was no diesel knock and no fumes. The drivers appreciated the significantly lower engine noise levels of these trucks. They could “easily talk to each other in the cabs.”

However, according to Assistant Commissioner Rocky DiRico, “DSNY had problems with these first CNG trucks, and some of the same obstacles still exist today.” In January 2006, DiRico commented on DSNY’s goal, on how its trucks are selected and on its experience with natural gas trucks. “Our mission is to maintain a proactive stance of implementing the ‘Best Available Technology’ to reduce the overall exhaust emissions of the fleet. Our goal is for DSNY to continue to provide essential services, while maintaining a vigilant and environmentally responsible Clean-Air Program.”

“We pre-qualify truck chassis manufacturers to be sure they meet our specifications. We only accept bids from those who are pre qualified. Up until now, only ‘Mack Trucks’ and ‘Crane Carrier’ have been pre qualified. The last time we put out a bid for natural gas trucks, Mack came in as the low bidder. The department purchased 26 refuse-collection trucks powered by the Mack E7G engine.”

“Mack did not have a strong focus on building natural gas trucks, and we have had a lot of problems with these trucks. For example, their longer wheelbase, because the fuel tanks are between the cab and truck body, has resulted in an inadequate turning ratio. Range has been an issue, even though the CNG trucks were specified with the same capacity as their diesel counterparts. You can’t let CNG trucks run low on fuel because the pressure in the tanks drops. We also have had problems with cold weather starts. Our CNG fleet has also experienced greater downtimes at local dealerships due to a lack of technical knowledge, and replacement parts availability. CNG warranty claims have been much greater than those involving our diesel fleet.”

“Despite all this,” DiRico added, “we are looking at the new generation of natural gas trucks, and in 2006 we have increased our CNG powered street sweepers from 10 to 20. We appreciate the concern over our country’s heavy reliance on foreign oil. We will be opening a new CNG refueling facility in Queens soon, and the biggest challenge at this stage may be adequate refueling infrastructure. DSNY has almost 6000 vehicles in all, so refueling capacity is a big question.”

14. Oakland, CA, Waste Management

Contact: Dino Fontanna, Operations Manager
Bill MacIntyre, Senior District Fleet Manager
Phone: 510-613-8760
E-mail: Wmcintyre@wm.com
Current Natural Gas Fleet: 32 (12 CNG, 20 LNG)
NG Fleet in 2002: 22
Refueling: Built an LNG service station in 2003, used as a private station

Waste Management of Alameda County (WM-AC) has increased its fleet to 32 natural gas garbage trucks. WM-AC said that it has experienced “a few bugs” with its LNG trucks but added that such problems could be expected because LNG is a newer technology. Overall, WM-AC has had a positive experience. It has no plans to increase the number of natural gas trucks in the near future

15. Palm Desert, CA, Waste Management-Desert

Contact: Frank Orlett, District Manager,
Waste Management of the Desert
Phone: 760-340-5901
Current Natural Gas Fleet: No information
NG Fleet in 2002: 60
Refueling: N/A

Waste Management of the Desert is the listed fleet for Palm Desert (CA) and Yucca Valley (CA). When INFORM attempted to call Frank Orlett, the call was redirected to another individual who could not be contacted. Kermit Martin, the 2002 contact, no longer works for the company.

16. Palmdale, CA, Waste Management-Antelope Valley

Contact: Bret Banks, Operations Manager
E-mail: bbanks@avaqmd.ca.gov
Web: www.avaqmd.ca.gov
Current Natural Gas Fleet: 13 LNG
NG Fleet in 2002: 9 LNG
Refueling: N/A

Waste Management of Antelope Valley (WM-AV) ran 13 LNG refuse trucks, up one from a year ago after it acquired Looney Bins’ routes and trucks. Looney Bins had two LNG/diesel trucks, one of which was “totaled” in an accident, thus giving WM-AV a total of 13. (Of these, 12 are LNG-powered Mack trucks, while 1 is a Caterpillar LNG/diesel-powered truck.)

Bret Banks, Operations Manager of the Antelope Valley Air Quality Management District (AVAQMD) said, “I think the initial experience [with the trucks] was bad. Waste Management had trouble with the hydraulic systems on the Mack trucks. I believe those issues have been corrected. After the initial difficulties, I don’t believe there was any excessive maintenance demands. I have not heard any positive or negative comments about these trucks from drivers or customers.”

Banks said that WM-AV originally bought the trucks because of a “South Coast Air Quality Management District mandated purchase of these vehicles for refuse hauling. The rule was thrown out in court. Therefore, there is not much of a push for the companies to continue buying LNG-powered refuse

trucks. We did not have a same rule requiring purchase and operation of LNG-powered trucks, but our area is adjacent to SCAQMD and Waste Management trucks travel to and from.” Banks believed that WM-AV was not looking to purchase any more of these vehicles in the near future.

17. San Diego, CA, Environmental Services Department

Contact: Charles “Chuck” Woolever, Deputy Director, *
Environmental Services
E-mail: CWoolever@sandiego.gov
Web: www.sandiego.gov
Current Natural Gas Fleet: 77 dual-fuel LNG
NG Fleet in 2002: 77 dual-fuel LNG
Refueling: An on-site 15,000-gallon LNG refueling station at the Miramar Road location in San Diego

The Environmental Services Department of the City of San Diego operates the same number of LNG trucks as it did in 2002: 77. Chuck Woolever said that the city was unable to proceed with the landfill gas conversion portion of the initial program primarily due to the bankruptcy of the third-party provider of the liquefier technology, but also due to low levels of methane at the landfill site.

Woolever added, “We have continued to operate 77 dual-fuel LNG refuse packers out of our Miramar Place Yard. That’s about 40 percent of the fleet. [The total fleet has 180 trucks.] The replacement ratio of diesel to LNG has not lived up to expectations, and we have had many technology issues. Our [fueling] station has experienced a main pump failure at least once per year, the fuel tanks on the trucks had to be re-vac’d, and most recently, one of our trucks caught on fire after the night fueling process. The cause is still under investigation, but it appears that a valve failed.”

*1/06 Update. Woolever noted that the LNG trucks were purchased before it was required by local mandate and that the trucks were performing quite well as of January 2006. He noted the City’s pride in the fact that its fleet won the Vocational Fleet of the Year Award in 2005 from Fleet Owner magazine in part because its early adoption of LNG technology has enabled the City to get credit from the State agency – the California Air Resources Board (CARB)—for these trucks as using Best Available Control Technology, exempting them from having to add particulate traps to meet CARB’s new diesel particulate regulations (saving \$1.3 million), and giving the fleet until 2009 (instead of 2007) to add this equipment to its remaining diesel trucks.

18. San Francisco, CA, Norcal

Contact: Robert Reed, Director of Corporate Communications
Phone: 415-875-1205
E-mail: rreed@norcalwaste.com
Web: www.norcalwaste.com
Current Natural Gas Fleet: No information
NG Fleet in 2002: 15 LNG
Refueling: N/A

Norcal Waste ran 14 long-haul LNG refuse trucks as of March 2004, one truck fewer than its 2002 fleet. INFORM was unable to contact Robert Reed in 2005. INFORM also tried another contact identified on the Norcal web-site (ekempter@norcalwaste.com) but did not receive any response.

As part of the US Department of Energy's Advanced Vehicle Testing Activity (AVTA) program, Norcal evaluated the performance of its LNG trucks during a two-year period that ended in 2004. Diesel trucks were also evaluated for comparison purposes. Under contract to the National Renewable Energy Laboratory (NREL), K. Chandler at Battelle, a national technical consulting firm, wrote a report summarizing the LNG truck evaluation. The report is titled Norcal Prototype LNG Truck Fleet: Final Results.

For the evaluation, data were collected for three groups of trucks, including 12 LNG trucks, 7 new diesel trucks, and 5 older diesel trucks. Drivers reported that the performance of the LNG trucks during the test period was as good as or better than the diesel trucks. The LNG trucks operated for more than 1.8 million miles through July 2003 and were projected to operate 2.3 million miles through December 2003. The LNG trucks were driven roughly 100,000 miles per month. This high-use rate for the LNG trucks indicates an improving reliability. The LNG trucks were used almost as frequently as the diesel trucks in the same operation, with an average monthly mileage 9 percent lower during the evaluation period. This is much better than previous results from other LNG truck operations, during which LNG trucks were typically used 25 percent less than diesel trucks.

The energy equivalent fuel economy was 10.5 percent lower for the prototype LNG trucks, compared with the newest diesel trucks. This is much better than results from previous studies of spark ignition, heavy-duty natural gas trucks, which had equivalent fuel economies 27 to 37 percent below diesel trucks over the same duty cycle.

Maintenance costs for the prototype LNG trucks were typically 2.3 times higher per mile than for the newest commercial diesel trucks, primarily because the LNG engine technology is still at the prototype stage. The components and systems that caused maintenance issues were the LNG pump, the high-pressure diesel-fuel system, and the HPDI injectors.

Nearly 90 percent of the road calls for the LNG trucks resulted from the engine and fuel-related systems—for example, non-lighting electrical, air intake, cooling, exhaust, fuel, engine, and hydraulic systems. The mileage between road calls began to improve when a problem associated with the onboard LNG tanks losing vacuum began to be resolved.

Contaminants in LNG posed a threat to high-pressure LNG pumps and onboard injectors. Cummins Westport installed additional filtration on the trucks and worked with the fuel provider to install additional filtration at the fueling station. It plans future alterations of the LNG pump and onboard fuel system to alleviate some of the sensitivity to contaminants.

High LNG costs during the evaluation period resulted primarily from the delivery costs of transporting fuel from Wyoming to San Francisco. Producing LNG locally or constructing an import terminal would alleviate much of the incremental cost between diesel and LNG.

19. San Gabriel, CA, Waste Management

Contact:	George Salazar (no longer at San Gabriel) German Hernandez, Operations Manager
Phone:	626-960-7551
Current Natural Gas Fleet:	No information
NG Fleet in 2002:	27
Refueling:	N/A

George Salazar did not return INFORM's calls.

20. Santa Monica, CA, City of Santa Monica

Contact: Rick Sikes, Fleet Superintendent
Phone: 310-458-8514
E-mail: Rick-Sikes@santa-monica.org
Web: www.santa-monica.org
Current Natural Gas Fleet: 19 CNG
NG Fleet in 2002: 20
Refueling: Upgraded its CNG station

The City of Santa Monica operates 20 refuse trucks, and 19 of these are CNG (until May 2005). Rick Sikes, Fleet Superintendent, said that the city is “committed to purchasing CNGs” and is “going out to bid to replace 8 of our 1998 CNG trucks with 2006 CNGs.”

The trucks were purchased as part of the city’s Sustainable City Plan (available at <http://pen.ci.santa-monica.ca.us/epd/scp/index.htm>). Sikes added that “Natural gas is the cleanest fuel available for emissions and reduces our dependence on foreign oil.”

He noted that the city is “very happy with our CNG fleet. The drivers prefer them over the noisier and smellier diesels. Repairs to the engines have been very minor, almost exclusively limited to regular maintenance. Santa Monica started with CNG vehicles in the mid- to late 90s. There were growing pains, and some systems performed less than satisfactorily. As the industry has matured, so has the reliability.” Regarding the future, Sikes said, “The idea of a hybrid [CNG/electric] refuse truck is appealing, but we’re not there yet.”

21. Santa Rosa, CA, Empire Waste Management

Contact: Rob Zocor (no longer at Santa Rosa)
Tom Ridder, District Manager
Phone: 707-584-4200
Current Natural Gas Fleet: 0 NG trucks
NG Fleet in 2002: 4 CNG
Refueling: N/A

Empire Waste Management’s fleet of four CNG refuse trucks was moved to Oakland in 2004.

22. Simi Valley, CA, Waste Management-GI Industries

Contact: Mike Smith, Market Area General Manager*
Phone: 805-955-4301
Current Natural Gas Fleet: 34 LNG (plus 2 by June 2005)
NG Fleet in 2002: 32
Refueling: N/A

According to Mike Smith, Waste Management-GI Industries is running the “same number of trucks as last year,” which means 34 LNG refuse trucks, up from 32 in 2002. Waste Management-GI Industries planned to convert two more trucks to LNG in 2005.

*1/06 Update: Mike Smith indicated that in 2005, the fleet finally added four rather than two LNG trucks, by repowering diesel trucks (1985 models) at a cost of \$40,000 per truck to use Cummins dedicated LNG engines, bringing the LNG fleet total to 38.

23. Sunnyvale, CA—Specialty Solid Waste

Contact:	Jerry Nabhan, Operations Manager
E-mail:	Jerry@sswr.com
Web:	www.sswr.com
Current Natural Gas Fleet:	31 CNG
NG Fleet in 2002:	24 CNG
Refueling:	N/A

Specialty Solid Waste (SSW) has 31 CNG refuse trucks in a fleet of 56 trucks. According to Jerry Nabhan, 36 of these are used daily, and 20 are “spare” trucks used for “clean up (special events) or lease[d] out to other sister companies.”

SSW has had a generally “good” experience with the CNG trucks. Nabhan added that SSW has had “a few problems with our fueling station and some with our pcl’s, but we like serving our community with clean air trucks.” He said the company buys natural gas trucks because “they are clean air trucks.” SSW plans to run all of its trucks on natural gas “eventually.”

24. Washington, DC, National Park Service

Contact:	Charles Borders, Project Manager Division of Transportation
Phone:	202-619-7455
Current Natural Gas Fleet:	No information
NG Fleet in 2002:	1 CNG
Refueling:	N/A

According to a 2004 phone interview with Charles Borders, the National Park Service did not increase its number of natural gas refuse trucks in 2004 due to “logistical problems” such as long fill times, small full capacity, and limited fuel availability in outlying areas. Several follow-up calls to Borders in 2005 were unanswered.

25. Washington, PA, Waste Management-Washington Hauling

Current Natural Gas Fleet:	No NG trucks
NG Fleet in 2002:	7
Refueling:	N/A

The Waste Management-Washington Hauling natural gas fleet project was discontinued by March 2004.

26. Yucca Valley, CA, Waste Management-Desert

Contact: Frank Orlett, District Manager
Waste Management of the Desert
Phone: 760-340-5901
Current Natural Gas Fleet: No information
NG Fleet in 2002: 6
Refueling: N/A

Waste Management of the Desert is the listed fleet for Palm Desert (CA) and Yucca Valley (CA). When INFORM attempted to call Frank Orlett, the call was redirected to another individual who could not be contacted. Kermit Martin, the 2002 contact, no longer works for the company.

New Fleets since 2002

1. Anaheim, CA, Anaheim Disposal (Republic Services)

Contact: Brian Beaudrie, Regional Maintenance Manager
Western Region
Phone: 702-733-6271
Current Natural Gas Fleet: 40 LNG dual fuel with diesel
NG Fleet in 2002: No NG trucks
Refueling: Upgraded fueling facility in 2004 and made it a public and private station

Although Anaheim Disposal (part of Republic Services) operates 40 LNG refuse trucks, it has no plans to buy new trucks or to get rid of these. However, Republic Services feels that buying natural gas trucks is really “up in the air” for the foreseeable future because of costs. It considers LNG trucks to be “environmentally good” but “cost prohibitive.”

2. Boston, MA, McGeoghean Waste Systems

Contact: Mike Manning, KeySpan, Lead Account Executive, NGVs*
Phone: 781-466-5373
E-mail: mmanning@keyspanenergy.com
Contact: John McGeoghean, Owner
Phone: 617-547-2595
Web: www.trashpickup.com
Current Natural Gas Fleet: 2 CNG
NG Fleet in 2002: No NG trucks
Refueling: Built a network of CNG public access refueling centers on major highways and side streets

McGeoghean Waste Systems (MWS) has two CNG-powered Volvo Expedito refuse trucks with McClain bodies and Cummins engines. Mike Manning of KeySpan Energy Delivery New England helped the company apply for and receive a federal grant to offset the difference in cost between diesel trucks and CNG trucks. MWS bought the trucks for economic and environmental reasons: As of March 2005, CNG in the greater-Boston area was \$1.79 per gallon gas equivalent, while diesel was approaching \$2.50 per gallon.

Both trucks seem to be operating well, although MWS experienced some initial problems with the front-loader truck. (The problem was not related to CNG.) Mike Manning said that the overall experience has been positive, “but very much a learning experience. Training was very crucial, and problems did arise between Cummins, Volvo, McClain, Dynetek, and the dealer. I was forced to intervene to get things settled, and I think, after that, the situation improved immensely. I don’t believe that there have been excessive maintenance demands, though the CNG fuel filters, part of the CNG cylinder fuel system, need particular attention in terms of prompt replacement.” Because the MWS fleet is a relatively small private fleet, the company seems to be happy with two units for now.

*1/06 Update: Paul Delaney, Sales Manager, reported that “the 2 CNG trucks were taken out of service because of continuing fuel line problems and many breakdowns – problems mainly unrelated to the natural gas engine.”

3. Burbank, CA, City of Burbank

Contact: Stacy Holderbach, Administrative Analyst
Phone: 818-238-3800
Current Natural Gas Fleet: 20 CNG
NG Fleet in 2002: No NG trucks
Refueling: Built a CNG fueling station that was completed in April 2003

The City of Burbank's fleet of 20 CNG trucks was bought as part of the Clean Energy Campaign. Some of the trucks arrived in June 2004, some in October 2004, and some in February 2005. The city received grants from the Air Quality Management District (AQMD) to help fund the incremental cost of the trucks. Each truck cost \$200,000, which is \$20,000 to \$50,000 more than the cost of a gasoline-driven truck. In the future, the city is looking to power its regular fleet vehicles with hydrogen.

4. Burlington, NJ, Waste Management

Current Natural Gas Fleet: 2 LNG
NG Fleet in 2002: No NG trucks
Refueling: N/A

The Burlington County demonstration project in New Jersey brings together Mack Trucks, private companies, and public sector partners from the refuse industry, including Acrion Technologies, Waste Management, Air Products & Chemicals, and Chart Industries. Other partners in the project are the Rutgers University-State of New Jersey EcoComplex, Burlington County Resource Recovery Center in New Jersey, and Brookhaven National Laboratory of the US Department of Energy in New York.

Mack and Acrion are leading a feasibility analysis to assess whether refuse collection trucks that serve a particular landfill operation can run on fuel made from landfill gas (LFG) generated from the landfill itself. LFG is produced when waste material in the landfill decomposes. The waste gases, mainly methane and carbon dioxide (CO₂), are typically vented to the atmosphere, where they aggravate global climate change. This project captures, purifies, liquefies, and burns the methane as a motor fuel.

In the pilot project, two Mack MR models—owned by Waste Management and equipped with natural gas engines—collect waste from Fort Dix and McGuire Air Force Base in New Jersey and transport it to the Burlington County landfill operation. At the Rutgers University-State of New Jersey EcoComplex facility, which is adjacent to the Burlington County landfill, LFG is purified through Acrion's proprietary CO₂ Wash system and separated into methane and carbon dioxide using liquid nitrogen provided by Air Products & Chemicals. Additional processing liquefies the methane into high-purity LNG truck fuel. The trucks are then refueled with LNG at a Chart Industries fueling station at the EcoComplex facility.

All project components are in place and the first of two planned milestones has been reached. An inspection of each truck's engine after 300 hours of service has shown outstanding results in terms of reduced engine wear and maintenance. The final evaluation will involve a full engine teardown and inspection after 600 hours of service, after which the engines will be reinstalled and the trucks returned to Waste Management's natural gas-powered fleet.

If the results of the second inspection also turn out positive, the next phase will involve finding other landfill operators that are willing to host an LFG purification system and fueling station. These operators will work with Mack, Acrion, and their partners to further evaluate the potential of fully commercializing the LFG concept.

5. Carson, CA, American Waste Systems

Contact: Ralph Hughes
Phone: 562-663-3558
E-mail: hughesr@repsrvofla.com
Web: www.consolidateddisposalservice.com
Current Natural Gas Fleet: No information
NG Fleet in 2002: 0
Refueling: N/A

American Waste Systems is owned by Republic Services. In 2005, INFORM contacted Ralph Hughes three times, but he did not return any of these calls.

6. City of Industry, CA, Athens Disposal Company

Contact: Kevin Pilon (no longer at City of Industry)
Fernando Guerra, Purchasing Manager
Phone: 626-336-3636
E-mail: kpilon@athensservices.com
Web: www.athensservices.com
Current Natural Gas Fleet: No information
NG Fleet in 2002: 0 NG trucks
Refueling: N/A

Although Athens Disposal Company services the City of Industry, INFORM cannot confirm whether this company operates seven natural gas refuse trucks, as reported by a secondary source, and the city does not maintain a web-site. INFORM contacted Kevin Pilon at Athens Disposal, but he did not respond.

7. Culver City, CA, City of Culver City

Contact: Charles Herbertson, Public Works Director
Phone: 310-253-5635
E-mail: Charles.Herbertson@culvercity.org
Contact: Damian Skinner, Sanitation Manager
Phone: 310-253-6402
E-mail: damian.skinner@culvercity.org
Web: www.culvercity.org
Current Natural Gas Fleet: 7 CNG
NG Fleet in 2002: 0 NG trucks
Refueling: N/A

The City of Culver City operates seven CNG refuse trucks. Charles Herbertson told INFORM that Culver City's experience with CNG vehicles has been very positive. Performance and maintenance are on par with diesel-powered vehicles, so the additional cost is marginal. The public perceives the vehicles as a positive step toward preserving the environment and air quality. The city has a total of 19 collection vehicles, and the decision to purchase CNG vehicles resulted from stiff emissions regulations.

The city plans to buy more natural gas trucks in the near future for two reasons: (1) it wants to standardize its collection fleet, and (2) it needs to meet South Coast Air Quality Management District (SCAQMD) regulations.

8. Fremont, CA, BFI-Fremont

E-mail: www.bfifremont.com/contact.shtml
Web: www.bfifremont.com
Current Natural Gas Fleet: No information
NG Fleet in 2002: No NG trucks
Refueling: N/A

Because queries to BFI-Fremont were unanswered, INFORM cannot verify the city's use of five natural gas trucks as reported in secondary sources.

9. Fresno, CA, City of Fresno

Contact: Joseph Oldham, Fleet Acquisitions Supervisor*
Phone: 559-621-1397
E-mail: joseph.oldham@fresno.gov
Web: www.fresno.gov/public_utilities/solidwaste
Current Natural Gas Fleet: 69 LNG
NG Fleet in 2002: No NG trucks
Refueling: Two fueling stations, one shared with Waste Management; both open to the public

The City of Fresno currently operates 69 LNG garbage trucks, and it plans to add another truck in 2005 and continuing. The city will replace more the following year according to the replacement cycle of old trucks. Fresno still plans to replace all of its trucks by 2010, even though the fleet size has grown to 132.

*1/06 Update: Joseph Oldham reported that the LNG trucks in Fresno's fleet are working very well. "The drivers prefer them," he said, "because they are quieter with their spark ignition engines, and there are no diesel fumes." Oldham reported on a major new initiative – a truck being built to be ready in the fall of 2006 that will be a CNG plug-in hybrid rear loader. Many players have been involved in this project. PG&E, the major gas and electricity utility for central and northern California, first introduced the City of Fresno officials to officials from Odyne Corp, based in Happague, NY, experts in electric hybrid drive technology who PG&E met at a DOE Clean Cities Program. The plan is now unfolding. The chassis for this truck is being built by Autocar, and it then goes to Fontaine for a CNG fuel system. A Cummins 8.3 Litre C-gas Plus engine will be used, and Odyne then installs the plug-in electric hybrid system. The City of Fresno is paying for half the costs of this project, and a \$160,000 grant from the federal Congestion Mitigation and Air Quality (CMAQ) program is paying most of the costs of the hybrid drive system.

Plans call for the new truck to plug into the PG&E grid at night and to get supplemental power from a 650 KW photovoltaic array. Oldham noted that, "we chose a CNG, rather than an LNG, model because, on a longer time horizon, we plan to power this truck with an 80/20 percent blend of natural gas and hydrogen fuel. With that blend, the NOx emissions that might be expected from a CNG engine should be cut in half."

10. Gardena, CA, American Waste Transfer (Republic Services)

Contact: Brian Beaudrie, Regional Maintenance Manager
Western Region
Phone: 702-733-6271
Current Natural Gas Fleet: 21 LNG
NG Fleet in 2002: No NG trucks
Refueling: N/A

Brian Beaudrie said that the Gardena fleet operates the same natural gas fleet in 2005 as it did in 2004—21 LNG trucks. A July 1, 2004, article in *Waste Age* noted that, overall, Republic has 94 LNG (or dual-fuel LNG/diesel) trucks throughout California. (See the excerpt from the *Waste Age* article under the profile for Fairfield, California.)

Republic Services has no plans to buy new trucks or to get rid of these. However, the company feels that buying natural gas trucks is really “up in the air” for the foreseeable future because of costs. It considers LNG trucks to be “environmentally good” but “cost prohibitive.”

11. Hawthorne, CA, H&C Disposal

Contact: Roger Milsted, Operations Manager
Phone: 310-675-3331
Current Natural Gas Fleet: No information
NG Fleet in 2002: No NG trucks
Refueling: N/A

INFORM’s original information for H&C Disposal came from Chad Lindholm of Clean Energy Fuels during an interview in 2004. However, Lindholm could not be reached in 2005, nor could INFORM’s second contact, Roger Milsted. Therefore, INFORM could not verify the city’s use of eight natural gas trucks as reported by secondary sources.

12. Hemet, CA, City of Hemet

Contact: Wade Edge, Refuse Supervisor
Phone: 951-765-3777
E-mail: www.ci.hemet.ca.us/refuse_email.htm
Web: www.ci.hemet.ca.us
Current Natural Gas Fleet: No information
NG Fleet in 2002: No NG trucks
Refueling: N/A

The City of Hemet could not be contacted. Therefore, INFORM could not verify the city’s use of four natural gas trucks as reported by secondary sources.

13. Huntington Beach, CA, Rainbow Disposal

Contact: Mike Grumbo, Vice President of Operations
Phone: 714-847-3581
E-mail: mikeg@rainbowdisposal.com
Web: www.rainbowdisposal.com
Current Natural Gas Fleet: No information
NG Fleet in 2002: No NG trucks
Refueling: N/A

Rainbow Disposal is another unverifiable NG-using fleet. A report of 1 natural gas truck from secondary sources remains unverified. This project will begin in late 2006, but no NG trucks have been ordered at the time of writing.

14. Lake Jackson, TX, City of Lake Jackson

Contact: Craig Nisbett, Public Works Director
E-mail: cNisbett@ci.lake-jackson.tx.us
Phone: 979-415-2430
Current Natural Gas Fleet: 7 CNG
NG Fleet in 2002: No NG trucks
Refueling: N/A

The City of Lake Jackson has 7 CNG refuse trucks, in a total fleet of 15. According to Craig Nisbett, the city purchased these trucks because “CNG is clean burning and reduces our dependence of foreign oil.” Lake Jackson is strongly committed to CNG vehicles, and its fleet includes “around 15 Ford F150 CNG pickups, 2 CNG Honda Civics, and a CNG Forklift.”

Overall, the city has only positive things to say about its natural gas trucks. Nisbett said, “We have been pleased with them. The public has been very supportive of our programs, and the drivers and mechanics have been pleased.” The City of Lake Jackson budgeted for three CNG replacement trucks in fiscal year 2005.

15. Livermore, CA, Livermore Dublin Disposal

Contact: Sheila Fagliano, Office Supervisor
E-mail: sfagliano@wm.com
Current Natural Gas Fleet: No information
NG Fleet in 2002: No NG trucks
Refueling: N/A

Livermore Dublin Disposal, part of Waste Management, has an exclusive agreement to provide the city with solid waste collection and recycling services. INFORM was unable to contact Livermore Dublin Disposal. Therefore, INFORM could not verify the city’s use of five natural gas trucks as reported by secondary sources.

16. Long Beach, CA, City of Long Beach

Contact: David McCarty (no longer at Long Beach)
Linda Sanchez, Administrative Aide
Contact: Leslie Horikawa-Thiede, Superintendent of Fleet Operations
Phone: 562-570-5405
E-mail: Leslie_Horikawa-Thiede@longbeach.gov
Current Natural Gas Fleet: 35 (32 LNG, 3 CNG)
NG Fleet in 2002: No NG trucks
Refueling: N/A

The City of Long Beach has 32 LNG refuse trucks and 3 CNG side-loader refuse trucks. Leslie Horikawa-Thiede, superintendent of fleet operations, supplied this information, and she suggested that INFORM contacted the fleet management staff for details about the city's experiences with its natural gas trucks. However, INFORM was unable to contact the fleet management staff.

The City of Long Beach operates a fairly extensive fleet of alternatively fueled vehicles, including 154 CNG, 67 CNG/gas, 52 LNG, 11 electric, 9 propane, and 7 hybrid-electric vehicles (a total of 300 vehicles). According to Horikawa-Thiede, the city currently expects to purchase "two to three additional LNG refuse trucks this year pending some contracting-in proposals." The city also expects to purchase other LNG trucks in the long term so it can retire the diesel units. Long Beach will phase out the CNG trucks and replace them with LNG trucks. According to INFORM's 2004 interview with David McCarty, the entire fleet should be replaced by 2011.

17. Long Beach, CA, Republic Services

Contact: Brian Beaudrie, Regional Maintenance Manager
Western Region
Phone: 702-733-6271
Current Natural Gas Fleet: 12 LNG
NG Fleet in 2002: No NG trucks
Refueling: N/A

According to Brian Beaudrie, the trucks that Republic Services operates in Long Beach are new and consist of "about a dozen" LNG trucks. Republic has no plans to buy new trucks or to get rid of these. However, the company feels that buying natural gas trucks is really "up in the air" for the foreseeable future because of costs. It considers LNG trucks to be "environmentally good" but "cost prohibitive."

18. Mojave Desert, CA, Waste Management

Contact: Roseana Navarro-Brasington,
Transportation Program Coordinator
Phone: 760-245-1661, ext. 5706
E-mail: rnbrasington@mdaqmd.ca.gov
Web: Mojave Desert AQMD (<http://www.mdaqmd.ca.gov>)
Current Natural Gas Fleet: 8 CNG
NG Fleet in 2002: No NG trucks
Refueling: N/A

The Mojave Desert Air Quality Management District (MDAQMD) supplied the information regarding the number of CNG trucks being used in the city. Roseana Navarro-Brasington of MDAQMD said that she expected the Waste Management-Antelope Valley fleet in Mojave Desert to acquire more trucks in the future but that their purchase depended on grant money and other factors.

19. Ontario, CA, City of Ontario

Phone: 909-395-2666
E-mail: publicworks@ci.ontario.ca.us
Web: www.ci.ontario.ca.us
Current Natural Gas Fleet: No information
NG Fleet in 2002: 0
Refueling: N/A

Secondary sources indicate that the City of Ontario operates 32 natural gas refuse trucks. However, the city's public works department did not respond to INFORM's queries. Therefore, INFORM could not verify the existence of these 32 trucks.

20. Orange County, CA, Waste Management

Contact: David Ross, Senior District Manager
Phone: 714-480-2353
E-mail: dross2@wm.com
Web: <http://www.wmorangecounty.com/CityofIrvine.htm>
Current Natural Gas Fleet: No information
NG Fleet in 2002: No NG trucks
Refueling: N/A

Repeated efforts to contact David Ross of Waste Management-Orange County were unsuccessful. Ross is the contact for three of Waste Management's natural gas truck fleets: Irvine (CA); Orange County (CA); and Santa Ana (CA).

21. Palm Springs, CA, Palm Springs Disposal Services

Contact: Rick Wade, General Manager
Phone: 760-327-1351, ext. 307
E-mail: rick@palmspringsdisposal.com
Web: www.palmspringsdisposal.com
Current Natural Gas Fleet: 15 CNG
NG Fleet in 2002: No NG trucks
Refueling: N/A

Palm Springs Disposal Services owns 15 CNG refuse trucks, 4 of them acquired in March 2005. General Manager Rick Wade said that the company bought CNG trucks because, "politically, we were forced to purchase AFVs or sell our business." He added that a "CNG fuel station is within 1.5 miles of our facility with easier accessibility over LNG."

Overall, Palm Springs Disposal Services finds that the “2004 models 8.3-L C+ Cummins are much improved over the 2001 models” and that “the drivers and public are pleased with the vehicles.” However, Wade said, “AFVs are expensive to maintain [in terms of parts], and based on our four years of experience, it appears that common component failures are going to continue where these parts are expensive. Diagnostics, software, and laptop experience had lagged behind the operation of the trucks, and we have had to rely on observing Cummins service repair techs diagnose the past problems in order to get hands-on experience.” Still, Wade noted that “the trucks have been able to perform comparably to the diesel collection vehicles. The period of time we had to endure adapting to these trucks is now behind us, and now, it’s a matter of dealing with the common failure components. Unfortunately, we are a fleet that keeps trucks 15 to 20 years, and we have concerns as to the longevity of these trucks.”

22. Redlands, CA, City of Redlands

Current Natural Gas Fleet:	No information
NG Fleet in 2002:	No NG trucks
Refueling:	N/A

INFORM could not verify whether the City of Redlands was the correct fleet operator for this unverified fleet. Therefore, INFORM could not verify the city’s use of three natural gas trucks as report by secondary sources.

23. Redondo Beach, CA, Consolidated Disposal

Contact:	Ralph Hughes
Phone:	562-663-3558
E-mail:	hughesr@repsrvofla.com
Web:	www.consolidateddisposalservice.com
Current Natural Gas Fleet:	No information
NG Fleet in 2002:	No NG trucks
Refueling:	N/A

Consolidated Disposal, a part of Republic Services, includes American Waste Systems (see the profile for Carson, California). INFORM was unable to contact Ralph Hughes. Therefore, INFORM could not verify the city’s use of 27 natural gas trucks as report by secondary sources.

24. Ripon, CA, City of Ripon

Current Natural Gas Fleet:	3 CNG
NG Fleet in 2002:	No NG trucks
Refueling:	CNG filling station scheduled for completion in summer 2006

Information about the City of Ripon was found in an article in the *Manteca Bulletin* (vol. 97, no. 4).

25. Riverside, CA, City of Riverside

Contact: Martin Bowman, Fleet Operations Manager
Phone: 951-351-6157
E-mail: Mbowman@riversideca.gov
Web: www.riversideca.gov
Current Natural Gas Fleet: 6 CNG
NG Fleet in 2002: No NG trucks
Refueling: Operates the second largest public access CNG station in the county; currently building a hydrogen station

According to Martin Bowman, fleet operations manager, the City of Riverside—a Model Clean Air City—maintains six CNG trucks. Every vehicle it purchases, “with exception of police and some fire” vehicles, is an alternative fuel vehicle. The city’s fuel of choice is CNG.

Bowman said that “Our trash utility boom, crane, storm cleaner, dump trucks, and other CNG vehicles are working great. We have also designed and had built a CNG mobile refueling truck to service our vehicles in the field if needed.” The city plans to purchase six additional CNG refuse trucks by the end of 2005.

26. Sacramento, CA, County of Sacramento

Contact: John Abernethy, Capital Asset Manager
Phone: 916-875-4527
E-mail: abernethyj@SacCounty.net
Web: www.saccounty.net
Current Natural Gas Fleet: 105 LNG (55 LNG/diesel, 50 LNG)
NG Fleet in 2002: No NG trucks
Refueling: N/A

The County of Sacramento operates a total fleet of 152 refuse trucks, of which 55 are 2001 dual-fuel LNG/diesel and 50 are dedicated LNG. According to John Abernethy, Capital Asset Manager, the remaining vehicles are diesel and “will be going out of our system over the next few years.” The county bought the LNG trucks “to comply with California Air Resources Board rules. Funding was available from the County Board of Supervisors.”

Abernethy said that the county has “generally had pretty good luck with the LNG trucks in terms of operating costs and scheduled maintenance. We encountered some problems in production delays and the integrity of the tanks when trucks were being manufactured. We have not gotten the fuel efficiency we had hoped for with the vehicles and have experienced higher fuel costs.” However, he added that the county “owns and operates a landfill with a gas collection system that is currently producing electricity. We have some surplus gas and are reviewing the feasibility of converting landfill gas to high-quality LNG to run our collection trucks.”

Abernethy reported that the county does “not expect to make any new major truck purchases in the next five years as our fleet is fairly new and the demand for vehicles is declining due to incorporations in the unincorporated area.” The county is not “experimenting with other alternative fuels at this time.”

27. Santa Clarita, CA, Bluebarrel-Waste Management

Contact: Amy Wiese, Bluebarrel Recycling Compliance Manager
Phone: 661-753-5260
E-mail: awiese@wm.com
Web: www.bluebarrel.com
Current Natural Gas Fleet: No information
NG Fleet in 2002: 0
Refueling: N/A

Bluebarrel, owned by Waste Management, is the refuse hauler for Santa Clarita (CA) and Saugus (CA). When INFORM contacted Amy Wiese of Bluebarrel, she forwarded INFORM's request to Heather Browne in Waste Management's national office. Browne did not respond with specific numbers for Santa Clarita or Saugus. Therefore, INFORM cannot verify that city's use of eight natural gas trucks as reported by secondary sources.

28. Saugus, CA, Bluebarrel-Waste Management

Contact: Amy Wiese, Bluebarrel Recycling Compliance Manager
Phone: 661-753-5260
E-mail: awiese@wm.com
Web: www.bluebarrel.com
Current Natural Gas Fleet: No information
NG Fleet in 2002: No information
Refueling: N/A

Bluebarrel, owned by Waste Management, is the refuse hauler for Santa Clarita (CA) and Saugus (CA). When INFORM contacted Amy Wiese of Bluebarrel, she forwarded INFORM's request to Heather Browne, former Director of Corporate Communications in Waste Management's national office. Browne did not respond with specific numbers for Santa Clarita or Saugus.

29. Tulare, CA, City of Tulare

Contact: Lew Nelson, Public Works Director
Phone: 559-684-4318
Web: www.ci.tulare.ca.us
Current Natural Gas Fleet: 13 LNG
NG Fleet in 2002: No NG trucks
Refueling: N/A

The City of Tulare operates 13 LNG refuse trucks, and even though it has just entered the bidding process for two additional trucks, the city doesn't expect to purchase them in 2005. Tulare's general experience with the trucks has been good. Lew Nelson said that the trucks "are still going." The city plans to buy more natural gas trucks in the future.

30. Washington, DC, Department of Public Works

Contact: Patricia Robinson, Fleet Administrator*
Phone: 202 576-6799
E-mail: Patricia.Robinson@dc.gov
Web: www.dc.gov
Current Natural Gas Fleet: 2 CNG
NG Fleet in 2002: No information
Refueling: N/A

The Department of Public Works (DPW) in Washington, DC, operates 120 packer refuse trucks, 2 of which are CNG. According to Karen Reed of DPW, “We experienced a higher degree of maintenance cost reduction with the natural gas light equipment, so we wanted to see if we would obtain the same results with the packers. We are now just getting to the point where we can do this kind of analysis.”

Reed said, “With the natural gas packers, we initially had adjustments with the transmission engine systems. Once we worked through these, the equipment performed exceptionally well. Maintenance demands have been minimal and consistent with any new equipment. Because it was a new application with us, packers operations had to learn how to properly fuel timely (not to allow the tank to get as low with fuel as one might tend to do with gasoline). Drivers have indicated that the equipment operates very satisfactorily and quiet. The public have enjoyed seeing that we are more environmentally conscious through the use of the natural gas packers.”

*1/06 Update: Patricia Robinson, the Fleet Administrator, said that “we are very pleased with DPW’s whole CNG fleet which includes, in addition to the two packers, 213 other mostly light duty CNG vehicles; 106 of these are dedicated CNG Honda Civics that are used for Parking Enforcement and the Motor car pool. There are also 15 vans. We will be buying more refuse trucks in 2007, and our biggest challenge now is getting enough refueling capacity.”

31. West Hollywood, CA, Athens Disposal Company

Contact: Kevin Pilon,(no longer at West Hollywood)
Fernando Guerra, Purchasing Manager
Phone: 888-336-6100
Web: www.athensservices.com
Current Natural Gas Fleet: No information
NG Fleet in 2002: No information
Refueling: N/A

According to a March 2004 interview with Chad Lindholm of Clean Energy Fuels, in 2004, Athens Disposal Company won a bid to service West Hollywood, and the company was going to use LNG trucks. However, INFORM was unable to contact Athens Disposal and could not confirm this report.

Acronyms

AFV	alternative fuel vehicle
AQMD	air quality management district
AVAQMD	Antelope Valley Air Quality Management District
CARB	California Air Resources Board
CNG	compressed natural gas
DOE	US Department of Energy
EEV	environmentally enhanced vehicle
EMA	Engine Manufacturers Association
ENGVA	European Natural Gas Vehicle Association
EPA	US Environmental Protection Agency
ESD	San Diego Environmental Services Department
LFG	landfill gas
LNG	liquefied natural gas
SAFETEA	Safe, Accountable, Flexible, and Efficient Transportation Equity Act
SCAQMD	South Coast Air Quality Management District
SWANA	Solid Waste Association of North America
TERP	Texas Emissions Reduction Program
ULSD	ultra-low sulfur diesel

About the Author

James S. Cannon is an internationally recognized researcher, author, analyst, and speaker on energy development, environmental protection, and related public policy issues. Long associated with INFORM as a staff member and then a senior consultant, he is the author or co-author of eight previous INFORM transportation reports. Recent studies include *The Transportation Boom in Asia: Crisis and Opportunity for the United States* (2005), *Bus Futures: New Technologies for Cleaner Cities* (2002), *Gearing Up for Hydrogen: America's Road to Sustainable Transportation* (1998), and *China at the Crossroads: Energy, Transportation and the 21st Century* (1998). Mr. Cannon is also the author of *Greening Garbage Trucks: New Technologies for Cleaner Air*. Earlier publications include *Spotlight on New York: A Decade of Innovation in Alternative Transportation Fuels* (1997), *Harnessing Hydrogen: The Key to Sustainable Transportation* (1995), *Paving the Way to Natural Gas Vehicles* (1993), and *Drive for Clean Air* (1989). Between 1975 and 1987, Mr. Cannon authored six INFORM reports on pollution and energy issues, including *A Clear View: Guide to Industrial Pollution Control* (1976), *Energy Futures: Industry and the New Technologies* (1984), *Acid Rain and Energy: A Challenge for New Jersey* (1984), and *Controlling Acid Rain: A New View of Responsibility* (1987). He also prepared two INFORM studies on coal conversion options in New York and New Jersey.

Mr. Cannon is currently president of Energy Futures, an energy and environmental research organization in Boulder, CO, that serves other nonprofit organizations, government agencies, and private industry clients. His major long-term consulting assignments have included a six-year consulting relationship with the US Congressional Office of Technology Assessment and an eight-year assignment as energy policy analyst for New Mexico, during which he served as director of the Governor's New Mexico State Energy Policy Project.

Mr. Cannon received an A.B. degree in chemistry from Princeton University and an M.S. degree in biochemistry from the University of Pennsylvania.

“This INFORM report is good news for America. Greening Garbage Trucks demonstrates that we can have cleaner air and quieter neighborhoods and make genuine progress toward energy independence—all by simply using a cleaner fuel and technology that has been commercialized and refined over the last 15 years. This fuel and technology are now available to the almost 200,000 refuse and recycling trucks across the country.”

**—Brendan Sexton, Former Commissioner
Department of Sanitation, New York City
From the preface of this report**

“There is a clear need to diversify fuel sources for the transportation sector. Garbage trucks represent a niche market for natural gas and other alternative fuels that can have a real, measurable impact on urban air quality and energy security.”

**—Guan Saw, President
Cummins Westport Inc. Vancouver, BC**

“Governor Pataki and NYSERDA see natural gas as an important component in meeting the state’s energy and transportation sector goals. The efforts described in INFORM’s report, along with other emerging renewable fuels and electric and hydraulic hybrid technologies, can be long-term solutions to the issues facing this essential service provided to our communities. We encourage all levels of government to explore the efforts these fleets have undertaken and to find solutions that can assist them in achieving our common goals of a cleaner environment and a more secure energy supply.”

**— Peter Smith
President, NYSERDA
(New York State Energy Research and Development Authority)**

“This report provides invaluable information on how communities can address the risks of respiratory disease, cancer and hearing damage posed by diesel-fueled refuse and recycling trucks to workers and others exposed to their emissions, by encouraging a shift by these fleets to natural gas powered trucks. It is another outstanding research contribution from INFORM.”

**—Dr. Bailus Walker, Jr.
Professor of Environmental and Occupational Medicine
Howard University College of Medicine**

“The world’s major urban centres are growing at unprecedented rates. More people mean more vehicles. There can be no doubt that we need to move our transportation away from oil-based fuels to those that offer a path to a more sustainable future”

**—Nola-Kate Seymoar, President
International Centre for Sustainable Cities Vancouver, BC**

“The facts and figures in INFORM’s first report on the refuse truck sector in 2002 were incredibly useful to me in understanding the environmental, economic, and energy security impacts of refuse trucks and the benefits of alternative fuels use. In this new report, I have learned much more. With INFORM’s research and assistance, I think we will see some real progress in putting natural gas projects into place in and around New York City. I applaud the role that INFORM is playing in shaping a sustainable future.”

**—Gregory Hallahan, Owner
Hallahan Truck Sales**