

Since the late 1990s, a new trend has emerged in the refuse and recycling collection industry – one that until the last few years was almost unnoticed. Fleet operators have begun to explore new technologies and alternative fuels for their trucks driven by a variety of health, environmental, economic and national security factors.

A few fleets have been experimenting with bio-fuels and hybrid electric drive-trains, but the strongest shift by far has involved replacing diesel trucks with those fueled by natural gas. A look at this trend, the performance of natural gas trucks and the factors driving this change suggests that a shift of significant proportions may be getting underway.

### Shifting to natural gas

A 2006 study, *Greening Garbage Trucks: Trends in Alternative Fuels Use, 2002–2005*, published by INFORM (New York), a national, environmental research organization, found that the adoption of natural gas refuse truck technology has been advancing quite rapidly. In 1998, only 240 natural gas refuse trucks were operating in the U.S. By 2002, when the first analysis ever done of this industry appeared (also published by INFORM), the numbers had almost tripled to 692. And by the end of 2005, the number of natural gas refuse trucks appeared to be close to 1,500.

From 2002 to 2004, the total number of vehicles of all types powered by natural gas nationwide grew by just 20 percent, according to U.S. Energy Information Administration (Washington) data. By contrast, *Greening Garbage Trucks* reported a growth rate of 89 percent in the refuse and recycling collection truck sector (see Figure 1). And even though natural gas trucks constitute only about one percent of the overall collection truck fleet in the U.S., which totals more than 136,000 trucks, this sector emerged as the second leading market after transit buses for heavy-duty natural gas vehicles. Waste management industry leaders were projecting that 2,221 natural gas refuse trucks would be in service by 2010.

*Greening Garbage Trucks* found 27 of the 31 fleets operating natural gas trucks to be located in California, which includes a total of 1,268 trucks

# SHIFTING GEARS, PART 1:

## Collection trucks turn to alternative fuels



**MOTIVATED BY THE SKYROCKETING PRICE OF OIL, AND THE PROMISE OF ENVIRONMENTAL AND HEALTH BENEFITS, COLLECTION FLEETS HAVE BEEN EXPERIMENTING WITH ALTERNATIVE FUELS, AND A FEW OF THEM SEEM TO BE CATCHING ON.**

by **JAMES S. CANNON AND JOANNA D. UNDERWOOD**

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and the five largest natural gas fleets in the nation:

- ◆ Los Angeles (252 trucks)
- ◆ El Cajon (San Diego) (136 trucks)
- ◆ Sacramento (105 trucks)
- ◆ San Diego (77 trucks)
- ◆ Fresno (69 trucks).

The four natural gas fleets located outside of California are in New York (26 trucks); Lake Jackson, Texas (seven trucks); Washington DC (three trucks) and Boston (two trucks). More recently, Smithtown on Long Island has mandated that all of the 30 refuse collection trucks servicing its community be fueled with natural gas by January 2007.

Two factors explain the concentrated use of natural gas refuse trucks in California to date. First, the state's South Coast Air Quality Management District (Diamond Bar, California), concerned about air quality in the Los Angeles Region and reducing dependence on foreign oil, mandated that operators of municipal fleets containing more than 15 heavy-duty vehicles had to buy natural gas-powered vehicles. Second, California was providing the heavy-duty sector with public funds to support the purchase of the more expensive alternative-fuel vehicles.

### Natural gas pros and cons

The experience of the operators of natural gas truck fleets was generally found to be positive. McGeoghean Waste Systems (Cambridge, Massachusetts), for example, bought two refuse trucks in Boston. These trucks were refueled with natural gas priced at \$1.79 per gasoline gallon equivalent as of March 2005, when diesel prices were \$2.50 per gallon. While some initial problems were encountered with the front-loader truck (not related to natural gas), the two vehicles were reported to be operating well.

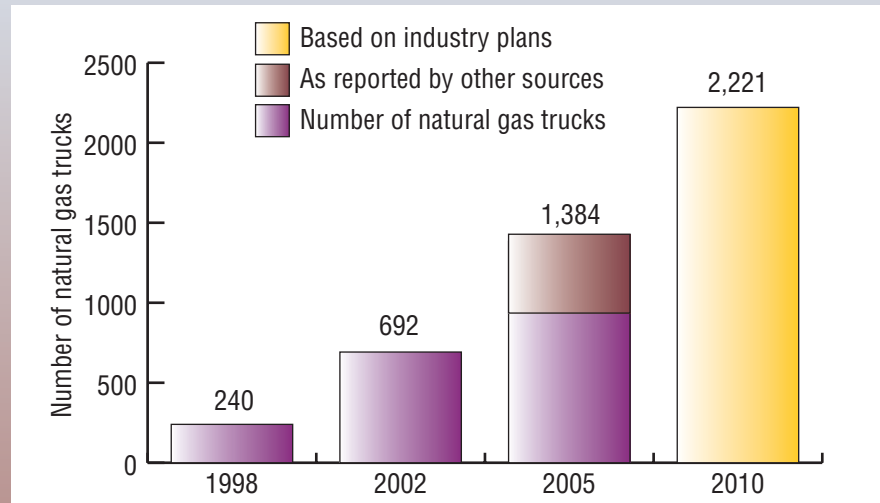
Rick Sikes, fleet superintendent for the City of Santa Monica, California, where 19 compressed natural gas (CNG) trucks are in service, said, "The city is happy with our fleet, and the drivers prefer the natural gas trucks over the noisier and smellier diesels."

Charles Herbertson, public works director of Culver City, California, said that their experience with natural gas vehicles has been very positive. "The performance and maintenance of our seven trucks is on par with diesel powered vehicles, so the additional cost has been marginal," said Herbertson. "The public perceives the vehicles as a positive step toward preserving the environment and air quality."

The City of Lake Jackson, Texas purchased seven natural gas refuse trucks, which Craig Nisbett, public works director, said was because natural gas "...is clean burning and reduces our dependence on foreign oil. We have been pleased with them."

Joseph Oldham, fleet acquisitions supervisor for Fresno, California, said that the City of

**Figure 1** Growth in natural gas refuse trucks in the U.S.



Source: INFORM, 2005.

Fresno, which currently operates 69 liquefied natural gas (LNG) trucks, will be adding an innovative model in 2006 – a CNG plug-in rear loader that, in a longer timeframe, will be powered by a combination (80/20) of CNG and hydrogen.

Interviews with fleet operators identified the positive and negative factors influencing their decisions about which fuels to burn and technologies to use. Between 2002 and 2005, seven factors favored the use of natural gas trucks:

- ◆ Rising prices of petroleum-derived fuels
- ◆ National energy security concerns
- ◆ New stringent engine emission standards
- ◆ Strong industry presence in the refuse and recycling collection truck market
- ◆ Increasing concerns about public health
- ◆ Recognized benefits of less noise
- ◆ State incentives that promote alternative-fuel vehicle use.

The growth in the use of natural gas refuse trucks has definitely been spurred by the many advantages cited by fleet operators that natural gas enjoys over diesel. From an economic standpoint, natural gas costs less per gallon equivalent than diesel, even though the price for both fuels has escalated in recent years. At the end of September 2005, the national average price for natural gas was \$2.36 per diesel gallon equivalent, compared to \$2.81 for diesel.

From a regulatory perspective, natural gas engines have shown that they can already meet the U.S. Environmental Protection Agency's (Washington) 2007 and 2010 emission standards. Under these rules, particulate matter and nitrogen oxide emissions from heavy-duty engines must be reduced by more than 90 percent. For nitrogen oxide emissions, the natural gas engines that will be available in 2007

will be certified at 0.2 grams – one gram less than the standard of 1.2 grams. The 2007 and 2010 NOx standards are proving particularly vexing for diesel engine manufacturers, because meeting them will require adding expensive new pollution control equipment.

Regarding human health, the use of natural gas reduces the potential threats posed by truck emissions while improving the quality of life in populated areas. Natural gas engines are cleaner, emitting less particulate matter, which can irritate the lungs, less carbon monoxide and fewer smog-causing nitrogen oxides. Also, natural gas engines operate up to 90-percent more quietly than diesel engines, which can generate noise levels as high as 100 decibels – sufficient enough to damage the hearing of truck operators.

In terms of national security, using natural gas as a fuel helps reduce the country's dependence on foreign oil. While the U.S. relies on imported oil to meet more than 60 percent of its needs, 97 percent of the natural gas used is produced domestically or imported from Canada. On average, a refuse truck travels 25,000 miles per year, burning approximately 8,600 gallons of diesel fuel. Replacing half of the diesel trucks operating in the U.S. with natural gas trucks would displace 15 million barrels of oil annually. *Greening Garbage Trucks* reported that investments in natural gas refuse trucks today, because they require the use of systems and refueling infrastructure suited to a gaseous, rather than a liquid, fuel, accelerate the longer term shift to hydrogen, possibly a more secure long term sustainable fuel solution.

A final benefit mentioned by fleet operators in choosing natural gas trucks is the greater availability of U.S. engine and truck manufacturers to help explore their options – manufacturers with increasingly sophisticat-

ed natural gas trucks to offer than was the case a decade ago. Cummins Westport (Vancouver, British Columbia) and John Deere (Moline, Illinois) each offer advanced, heavy-duty natural gas engines suited for use in refuse trucks. Truck manufacturers, such as Autocar (Hagerstown, Indiana), Peterbilt (Denton, Texas), Crane Carrier (Tulsa, Oklahoma) and American LaFrance Condor (Ladson, South Carolina), can accommodate natural gas engines into their truck designs. Clean Energy (Seal Beach, California), Trillium (Toronto), Air and Gas Technology (Cliffwood Beach, New Jersey) and several other fuel providers have been leaders in marketing natural gas refueling technology. The new natural gas refuse truck program in Boston benefited greatly from the support of KeySpan Energy Delivery (Brooklyn, New York), a long time leader in promoting natural gas vehicles in the northeastern U.S.

Three factors were raised by fleet operators that had discouraged their use of natural gas trucks. First were the negative reviews still circulating about truck performance difficulties – reviews largely related to earlier generations of natural gas technology.

Second was the lack of support by the federal government. This was visible in the Bush Administration's 2003 intervention in a case before the U.S. Supreme Court on the side of the diesel engine manufacturers opposing California rules requiring alternative fuel use for new fleet vehicle purchases in the Los Angeles region. The Bush

Administration's 2004 proposed elimination of funds for heavy-duty engine development work and for the network of local Clean Cities organizations, the main source of guidance for fleet operators in exploring options, also contributed this lack of gov-

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ernment support.

Third was the sense that the economics were not on their side. Natural gas engines and fuel storage systems generally added about \$50,000 to the cost of buying a refuse truck. In addition, refueling infrastructure had to be built, and those who operate and maintain the vehicles had to be trained. Even if natural gas fuel were cheaper than diesel, relying on future breakeven points seemed risky and meant having to find extra front-end capital.

### **Making a choice**

While every refuse fleet operator has individual needs and goals, exploring the natural gas refuse truck option involves mainly being

sure to ask the right questions:

- ◆ What vehicles must I replace?
- ◆ Where does natural gas fuel exist or who can build it?
- ◆ How much oil-derived fuel can I displace?
  - ◆ Will the manufacturer assure the performance of its vehicles and that its emissions will meet or exceed government standards?
  - ◆ What will the total costs be, and what public or private funding may be available to cover any higher costs related to adopting natural gas refuse truck technology?

By the beginning of 2006, however, the economics of adopting natural gas truck technology seemed to be in the process of shifting. While the U.S. EPA standards going into effect in 2007 will

increase the cost of diesel trucks, the new energy and transportation bills passed in 2005 appropriated close to a billion dollars in incentives aimed at covering most of the incremental costs of buying and refueling alternative fuel vehicles and keeping the price of natural gas low. These incentives will be the subject of a separate article that will appear next month in *Resource Recycling*.

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