

# EVALUATION OF ELECTRICITY AND OTHER ALTERNATIVE FUELS FOR SOLID WASTE AND RECYCLING COLLECTION VEHICLES



A new report has been prepared by the SWANA Applied Research Foundation (ARF) to provide solid waste, recycling, and sustainability managers with up-to-date information and guidance on the use of electricity and other alternative fuels for refuse and recycling collection vehicles. This research topic was submitted by Miami-Dade County and the cities of Tucson, AZ and Durham, NC, and was elected for selection by subscribing members of the ARF's Collection Research Group.

In 2018, 292.4 million tons of municipal solid waste (MSW) were collected and transported to recycling, recovery, or disposal facilities in the United States by a fleet of about 150,000 refuse trucks, the majority of which were equipped with diesel engines that run on diesel fuel.

A vehicle is classified as heavy-duty if it has a gross vehicle weight rating (GVWR) of greater than 26,000 lbs. Refuse and recycling trucks are manufactured as "Class 7" or "Class 8" heavy-duty vehicles and are built in various configurations including rear-loader, side-loader, front-loader, and roll-off trucks. These trucks generally have a gross vehicle weight rating of approximately 66,000 pounds (i.e., are Class 8 trucks) and weigh 36,000 pounds empty, which indicates a legal payload of about 30,000 pounds or 15 tons. Refuse trucks have a fuel economy of 2.5 to 3 miles per gallon, which is the lowest for all highway vehicles.

Despite significant advances that have been made on diesel fuel engines and the growing utilization of compressed natural gas (CNG) refuse trucks over the last 20 years, refuse and recycling collection fleet managers face increasing pressure to utilize new alternative fuels such as electricity, hydrogen fuel cells, renewable natural gas, and renewable diesel. Much of this pressure is due to the concern over climate change impacts of the fossil fuel-based fuels that are currently used to power their fleets

The alternative fueled refuse and recycling trucks presented in this report and compared to diesel fueled trucks include:

- CNG Refuse Trucks
- Electric Refuse Trucks
- Hydrogen Fuel Cell Electric Refuse Trucks

The findings resulting from the evaluation of these alternative fuels are summarized in following table.

Alternative Fuels for Refuse and Recycling Collection Vehicles — Summary of Findings					
Parameter	Units	Diesel	CNG	Electric	Hydrogen Fuel Cell
Energy Usage (Well-to-Wheel)	Btus/mile	55,525	70,014	51,512	174,208
Greenhouse Gas Emissions (Well-to-Wheel)	Grams CO <sub>2</sub> e/mile	4,406	4,079	2,115	11,003
Fuel Costs	\$/mile	\$1.29	\$1.14	\$0.66	\$2.05
Total Cost	\$/mile	\$5.43	\$5.70	\$4.58	\$5.30
Stage of Commercialization		Fully Commercialized	Fully Commercialized	Demonstration Stage	Early Demonstration Stage

The analyses presented in this report indicate that the use of electricity as a fuel for refuse and recycling trucks offers many benefits including reduced noise and air pollution in the neighborhoods being served. From an economic standpoint, electricity is by far the lowest cost fuel at \$0.66 per mile, which is estimated to be about half of the costs of diesel on a fuel cost per mile basis. Electric refuse trucks also use less energy than the other

alternative-fueled trucks. Perhaps most importantly, electric refuse trucks emit less than half of the CO<sub>2</sub>e emissions of other alternative fuels even when the electricity is generated by the current mix of fossil fuel and renewable power generators in the US. Finally, electric refuse trucks were found to have the lowest total cost per mile of the alternative fuel options analyzed.

Major drawbacks to switching to electricity at the current time are the high upfront capital costs of electric refuse trucks and the relative lack of experience in North America with electric refuse trucks in real-world service environments over the lifespan of the truck (typically considered to be about ten years). Simply put, electric refuse trucks are still in the “demonstration” stage of their commercialization journey.

For this reason, it SWANA recommends that its members consider holding off on committing to transition their fleets to electric refuse trucks until performance and cost data from the 50–100 or so current demonstration projects can be compiled and analyzed.

Similar to electric refuse trucks, hydrogen fuel cell refuse trucks offer the potential for a zero-tailpipe emissions alternative that has regenerative braking capability and operates at low noise levels. Unlike electric trucks, hydrogen fuel cells offer driving ranges similar to diesel trucks before refueling is required. Demonstration projects for hydrogen fuel cell refuse vehicles are occurring in a number of European countries; however, none are being conducted in the US at this time. For this reason, the use of hydrogen fuel cells to power refuse trucks can be considered as being slightly behind electric refuse trucks with regard to its demonstration status.

While electric and hydrogen fuel cell trucks are progressing through the demonstration stage of commercialization, SWANA collection fleet managers should continue to use diesel and CNG refuse trucks to power their fleets but should pursue the replacement of these fuels with their renewable versions (renewable diesel or renewable CNG) when they become price-competitive with their fossil fuel counterparts.

Finally, as solid waste management professionals, SWANA collection fleet managers should consider their unique position of being able to generate both electricity and CNG from solid waste they collect. For this reason, recovery of electricity from waste-to-energy facilities (about 550 kWh per ton of waste combusted) and the generation of electricity and/or CNG from anaerobic digestion (AD) facilities and landfills should be investigated and pursued if found feasible from a technical, economic, political, and societal perspective.

The full report, *Evaluation of Electricity and Other Alternative Fuels for Solid Waste and Recycling Collection Vehicles* is currently only available to SWANA ARF subscribers. SWANA members receive free access to ARF industry reports one year after publication.<sup>1</sup>

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