



sanitation

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July 31, 2012

Honorable Michael Bloomberg
Mayor, City of New York
City Hall
New York, New York 10007

Honorable Christine Quinn
Speaker, New York City Council
City Hall
New York, New York 10007

Honorable John C. Liu
One Centre Street – Municipal Building
Room 530
New York, New York 10007

Re: Local Law 38 of 2005, Sixth Annual Report

Dear Mayor Bloomberg, Speaker Quinn, and Comptroller Liu:

I am pleased to submit to you the enclosed sixth annual report on the Department of Sanitation's alternative fuel program, as required by Local Law 38 of 2005 and Section 24-163.2 of the Administrative Code.

I am particularly proud to report that the Department's fleet is now among the cleanest and "greenest" in the world. Since 2005 *we have reduced our fleet's overall particulate matter (PM) emissions by 85%, and cut Nitrogen Oxide (NOx) emissions by 50%*. In fact, the new DSNY trucks delivered since late 2006 meet PM emissions standards that are *98% cleaner* than the unregulated diesels of old, and are as clean as trucks fueled by natural gas. Similarly, the new trucks delivered this year meet the 2010 NOx standard that is *98% cleaner* than the old diesels. In addition, all diesel fuel used by the Department is ultra-low sulfur diesel (ULSD), with a maximum of just 15 parts per million (ppm) of sulfur, compared to the 2500 ppm of sulfur fuel that was the average content of highway fuel prior to 1993. The use of ULSD enables DSNY to implement our highly effective emissions retrofit program for pre-2007 model year trucks with best available retrofit technology (BART) such as diesel particulate filters.

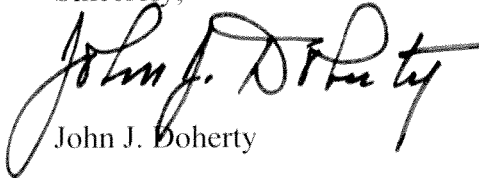
In an effort to further lower fleet emissions, including greenhouse gases, the Department currently uses B20 (20% Biodiesel made of soybeans) for its trucks in two districts, and we are currently looking into expanding the pilot study to 12 more districts in CY 2012, for a total of 14

districts. The Department uses B5 (5% Biodiesel) for all of its diesel trucks in the remaining districts.

In addition, we have 21 compressed natural gas (CNG)-powered street sweepers, 20 CNG-powered collection trucks, 254 light-duty vehicles powered by E85 ethanol, 650 light-duty vehicles that are hybrid-electric, five hybrid-hydraulic diesel collection trucks, one CNG-powered hybrid-hydraulic collection truck, and five hybrid-electric diesel collection trucks, and seven hybrid-electric street sweepers. As all of DSNY's diesel street sweepers now have BART retrofits or equivalent, CNG-fueled street sweepers offer minimal emissions advantages over our Clean Diesel sweeper fleet.

The Department is committed to making its fleet as environmentally sustainable as possible consistent with our operational needs and cost constraints and will continue our active research and development efforts concerning alternative fuels and technologies for our fleet.

Sincerely,



John J. Boherty

c: Patricia Harris, Deputy Mayor
City Hall

Caswell Holloway, Deputy Mayor of Operations
City Hall

Haeda Mihaltses, Director
Office of Intergovernmental Affairs, City Hall

David Bragdon, Director
Office of Long Term Planning & Sustainability, City Hall

Hon. Letitia James, Councilmember
Chair, Committee on Sanitation & Solid Waste

Rocco DiRico, Deputy Commissioner, Support Services
New York City Department of Sanitation

Ron Gonen, Deputy Commissioner, Sustainability and Recycling
New York City Department of Sanitation

Encl.



The City of New York Department of Sanitation



2011 Annual Report on Alternative Fuel Vehicle Programs Pursuant to Local Law 38 of 2005



2009: First Hybrid Hydraulic Collection Truck in North America

John J. Doherty, Commissioner
July 2012

DSNY Annual Report on Alternative Fuel Vehicle Programs Pursuant to LL38/2005

Introduction

The Department of Sanitation (DSNY) operates a sizeable fleet of trucks and other vehicles to carry out its assigned tasks under the City Charter of refuse and recyclables collection, street cleaning and snow removal. Such vehicle use necessarily produces air emissions, which have raised health concerns by members of the public. These concerns, in part, led to the enactment of Local Law 38 of 2005 (LL38/2005), which, among other things, directs DSNY to test alternative fuel street sweeping vehicles, and report annually on its use and testing of alternative fuel vehicles.¹ This report, which is submitted to the Mayor, the Comptroller and the City Council in accordance with LL38/2005, discusses the testing, analyses and assessments of DSNY's alternative fuel sanitation collection vehicles and street sweepers, and the feasibility of incorporating new alternative fuel sanitation vehicles and technology into DSNY's fleet. It also reviews the results of DSNY's pilot that used alternative fuel street sweeping vehicles in four sanitation districts, with one district in an area with high rates of asthma among residents.²

DSNY endeavors to operate its fleet in the most environmentally friendly manner, consistent with available resources, and therefore seeks to minimize emissions of concern from such operations, notably particulate matter (PM), nitrogen oxides (NOx), and greenhouse gases such as carbon dioxide.³ New York City's air quality has improved and in 2011 met federal standards for fine particulate matter (PM_{2.5}), but it remains out of compliance with standards for ozone. The USEPA proposed a new, more restrictive annual standard for PM_{2.5} in June 2012, which is expected to take effect in December 2012. The new annual standard will decline from 15 micrograms per cubic meter to between 12 and 13 micrograms per cubic meter. The USEPA projects that New York City's air will not meet the new standard immediately, but will meet it by 2020, based on current trends.

In 2011, DSNY's fleet included 2022 collection trucks, 450 street sweepers, and 190 dump trucks. Over the course of Fiscal Year 2011, the entire diesel fleet travelled approximately 25 million miles and required approximately 11 million gallons of diesel fuel. On average, a standard DSNY collection truck travelled approximately 6,900 miles, a DSNY dual-bin recycling collection truck: 9,000 miles, and a DSNY street sweeper: 3,400 miles. As discussed below, thanks to new technologies DSNY has achieved great success in minimizing emissions of PM and NOx from its fleet.

¹ NYC Administrative Code § 24-163.2(c)(1) & (2).

²This pilot was required by LL38/2005. Id.

³While not known to cause asthma, PM, especially fine PM 2.5 microns in diameter or smaller (PM_{2.5}) is associated with increased respiratory symptoms, while NOx can be a precursor in the formation of ground-level ozone (regional smog) which is associated with exacerbation of asthma-related symptoms. *Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*, 66 Federal Register at 5012 (Jan. 18, 2001); "Public Health" chapter in *New York City Comprehensive Solid Waste Management Plan Final Environmental Impact Statement* (April 2005), available at <http://www.nyc.gov/html/dsny/downloads/pdf/swmp/swmp/swmp-5apr-feis/feis/chapter33.pdf>.

This report includes the total number of alternative fuel “sanitation vehicles” owned or operated by DSNY by type of alternative fuel used, discusses the notable advances in DSNY’s clean diesel fleet, and provides information regarding DSNY efforts to further incorporate alternative fuel vehicles into its fleet. “Sanitation vehicles” are defined by LL38/2005 as vehicles used by DSNY “for street cleaning purposes or for the collection of solid waste or recyclable materials.”⁴

Dramatic Improvements in DSNY’s Fleet Emissions

DSNY’s fleet is already achieving an estimated *85% reduction in PM and a 50% reduction in NOx emissions* fleet-wide compared with DSNY’s fleet in 2005, while the newest trucks achieve *98% reductions* in each pollutant as compared with pre-1988 diesel engines.⁵

ULSD Fuel, New Vehicle Standards, Diesel Particulate Filters, and Retrofits

Currently all of the Department’s light, medium and heavy-duty diesel vehicles utilize the industry’s latest computer-controlled and regulated clean-diesel engines for their respective engine model years. DSNY has gone even further: its Clean Fleet Program of testing and development of state-of-the-art technology and alternative fuels helped pioneer the improvements in heavy duty diesel emissions that are now taking place nationwide. This Program includes obtaining research grants, partnering with industry to test vehicles under real world conditions, and operating a vehicle testing facility for heavy duty trucks.

- The Department pioneered the use of ultra-low sulfur diesel fuel (ULSD)—limited to 15 parts per million (ppm) of sulfur—a decade ago in certain districts and expanded its use to its entire fleet in 2004 in advance of the USEPA June 2006 nationwide ULSD mandate. The new standard represents a *reduction of 97%* from the previous low sulfur standard for on-road diesel fuel of 500 ppm that took effect in 1993. Prior to 1993, the average sulfur content for on-road diesel fuel was 2500 ppm.
- ULSD allowed DSNY to expand its use of various advanced emission-control after-treatment technologies, such as diesel particulate filters and diesel oxidation catalysts. Previously, higher sulfur content fuel would have clogged these devices. These controls reduce particulate matter by 90% or better, as verified in DSNY testing.
- Since mid-2006, all of DSNY’s new diesel truck purchases have met the stringent 2007 USEPA new-truck standards limiting particulate matter to 0.01 grams per brake horsepower-hour (g/bhp-hr), *a reduction of 90% from the 2006 model year limit of 0.1 g/bhp-hr.*⁶ As of 2010 NOx is limited to 0.2 g/bhp-hr, compared to 2.0 g/bhp-hr in the 2006 model year and 4.0 g/bhp-hr in the 2003 model year. As DSNY’s collection trucks

⁴ NYC Admin. Code § 24-163.2(a)(6).

⁵ Reduction in non-methane hydrocarbons is comparable, with 2011 standard of 0.14 g/bhp-hr, down from 0.5 g/bhp-hr in 2006 and 1.3 g/bhp-hr in 2003.

⁶ 66 Fed. Reg 5001, 5005 (Jan. 18, 2001). By comparison, the 1990 federal standard for particulate matter for heavy duty diesel highway engines was 0.60 g/bhp-hr. NOx standards have been reduced over time from 10.7 g/bhp-hr in 1988 to 0.2 g/bhp-hr starting in 2007, with a phase-in allowed until 2010, yielding an effective limit of 1.2 g/bhp-hr for 2007-2009 model years.

have a useful life of approximately seven years, fleet turnover results in the purchase of approximately 250 new trucks per year meeting these new-truck standards.

- To address the legacy of emissions from older trucks, DSNY mechanics have been installing Best Available Retrofit Technology (BART) devices such as particulate filters on pre-2007 trucks, as mandated by LL39/2005. For example, DSNY has installed 575 Claire Longview units that achieve reductions of 90% in PM and up to 25% in NOx. Including both factory-installed equipment and retrofits, by January 1, 2012 DSNY had particulate filters on 290 diesel-powered street sweepers and 1,966 collection vehicles. By July 1, 2012, all of DSNY's pre-2007 diesel collection truck fleet had BART retrofits or similar after-market clean diesel technology, except for two trucks near the end of their useful life.

The benefit of Clean Diesel technology in reducing emissions from DSNY's fleet has been profound, as recognized by the City's air quality experts at the Department of Environmental Protection (DEP), who oversee the review of air quality impacts of proposed actions. For example, DEP staff have determined that if an action resulted in fewer than 90 DSNY truck trips per hour with BART or 2007-compliant equipment on principal and minor arterials, expressways and limited access roads, then no further air analysis would be warranted to conclude that an action's impact to neighborhood PM_{2.5} levels along such roadways would be deemed insignificant for purposes of environmental review.⁷ The changes and improvements made to DSNY's Clean Diesel fleet have greatly reduced air quality concerns from mobile-source PM_{2.5}.

Alternative Fuel Vehicles

Despite the clear success of DSNY's Clean Diesel Program in minimizing fleet emissions, DSNY believes further improvements are possible as technology advances. DSNY therefore continues an active program of testing other kinds of fuels and technologies to determine whether further improvements in emissions and fuel mileage may be achieved at an acceptable cost. Under LL38/2005, "alternative fuels" include natural gas, liquefied petroleum gas, hydrogen, electricity, and any other fuel which is at least eighty-five percent, singly or in combination, methanol, ethanol, any other alcohol or ether.⁸ DSNY currently has over 909 vehicles that operate on various alternative fuels.

Compressed Natural Gas (CNG)

DSNY has 42 CNG vehicles in its active heavy-duty fleet, including collection trucks and street sweepers. DSNY has no light-duty CNG vehicles.

CNG Street Sweepers

DSNY operates 21 CNG street sweepers (see Appendix 1). As explained in last year's report, DSNY has discontinued the evaluation pilot study of CNG sweepers. Since 2007 DSNY

⁷ DEP communication, based on DSNY fleet in 2012.

⁸ NYC Administrative Code § 24-163.1(a)(1). Other types of fuels, such as B5 Biodiesel, do not qualify as alternative fuels.

has performed evaluations and assessments on the operation and reliability of CNG street sweepers versus conventional clean diesel street sweepers equipped with BART pursuant to local law. Based on the results, clean diesel street sweepers with BART appeared to be more reliable than CNG sweepers. As discussed below, CNG sweepers no longer offer a significant emissions advantage over new Clean Diesel sweepers. Furthermore, in the late fourth quarter of 2009, Cummins announced that it would no longer offer the current CNG engine for street sweepers because it does not meet the USEPA 2010 air emission standard for NOx. No other manufacturer makes a CNG engine of the size needed for DSNY's street sweepers. As DSNY has no viable option for new CNG street sweepers, DSNY ended the evaluation pilot study of CNG sweepers. The 21 CNG sweepers in the fleet will continue in service until they reach the end of their operational life of approximately 5 years.

CNG Collection Trucks

DSNY currently owns 21 dedicated CNG sanitation collection trucks (see Appendix 2). DSNY phased out its older fleet (2001-2003 vintage) of CNG collection trucks that were problematic. CNG-fueled trucks are longer than conventional sanitation vehicles, making it more difficult to access certain narrower streets because of their wider turning radius. In Calendar Year 2008, DSNY put into service 10 new CNG collection trucks from Crane Carrier Corporation equipped with the new generation of the Cummins ISL-gas CNG engines to replace 10 of the oldest CNG trucks in the fleet. In Calendar Year 2009, DSNY put into service one front-loading Crane Carrier Corporation CNG collection truck equipped with a Cummins ISL-gas CNG engine. Also in Calendar Year 2009, DSNY ordered 10 additional CNG trucks from Crane Carrier Corporation, which were delivered in November/December 2009. In order to address the repeated failed cold starts of the fleet of Crane Carrier CNG trucks, at DSNY's request Cummins made improvements to the engine calibration software. With the problem corrected, DSNY formally added the last 10 Crane Carrier CNG trucks to the fleet in the third quarter of Calendar Year 2010. The cold-weather operation of the newest CNG trucks with the Cummins ISL-Gas CNG engines so far has been satisfactory.

In an agreement with National Grid, DSNY also put into service one hybrid-hydraulic CNG collection truck in October 2010. The reliability of this truck so far has been acceptable; testing is on-going. Hybrid-hydraulic technology, which can be employed with any kind of fuel, is further discussed below.

CNG Fueling Facility

Under a federal consent order, DSNY built a fully-operational, heavy-duty vehicle CNG fueling station in Woodside, Queens, at a cost of approximately \$2,950,000.⁹ This station went into service in May 2007 and provides shorter fueling times than other CNG fueling facilities.

Discussion: CNG vs. Clean Diesel

From an operational perspective, preliminary results on testing the latest generation of CNG collection trucks indicate they have improved in reliability from earlier model CNG trucks,

⁹ This project was undertaken as part of a settlement of a lawsuit brought against the City and DSNY by the United States for violations of the Clean Air Act. *United States v. City of New York*, 99 Civ. 2207 (LAK) (S.D.N.Y.).

but they are still not as reliable as clean diesel trucks. From an air emissions/public health perspective, CNG no longer offers a significant advantage over clean diesel. As a result of the use of ULSD and new emissions control technologies, heavy duty diesel truck particulate matter emissions are very low, and are comparable to those from CNG-fueled heavy duty vehicles. Nitrogen oxide emissions from the two technologies are also comparable, with CNG truck NOx emissions slightly lower than the NOx emissions from diesel trucks with advanced after-treatment technologies.¹⁰ On the other hand, greenhouse gas emissions from CNG trucks are reportedly 20-23% lower than those from diesel trucks.¹¹ It has been noted that CNG trucks are somewhat quieter than diesel trucks,¹² but compaction noise from CNG collection trucks and diesel collection trucks seems generally comparable. CNG trucks emit more methane (a significant greenhouse gas) and carbon monoxide than conventional clean diesel vehicles.¹³

From an economic perspective, with increased recoverable domestic reserves due to new technology natural gas prices have fallen below current diesel prices and may offer stability advantages. As of June 1, 2012, a gallon of diesel fuel cost \$3.12 while a gallon-equivalent of CNG cost approximately \$2.55, offering a potential savings in fuel costs for CNG trucks at such prices. However, CNG-fueled vehicles have lower fuel efficiency. In addition, a CNG-fueled collection truck costs approximately \$32,000 more per unit than a diesel collection truck. DSNY has only one CNG fueling station for its 59 district garages, and the handful of private CNG filling stations in the City are generally not equipped for rapid filling of heavy duty trucks. Thus any move to significantly expand DSNY's CNG truck fleet would likely require additional investment in capital funds to build CNG fueling infrastructure and in facility modifications as required by the building code.

E85 Ethanol Blend Vehicles

Currently, 254 DSNY light-duty "flex fuel" vehicles run on E85, which is a mixture of 85% corn-based ethanol and 15% gasoline. These consist of Ford Taurus sedans and Ford Explorer sport utility vehicles. They are able to run on either E85 ethanol or gasoline, unlike "bi-fuel" vehicles which operate on either natural gas or gasoline. There are five E85 fueling facilities citywide. DSNY was the first city agency to use E85 ethanol fuel in its fleet. While the operation of these vehicles has generally been satisfactory, they do not achieve significant emissions savings over gasoline vehicles, although NOx emissions are somewhat lower. Fuel mileage is less than with gasoline. In cold weather, these vehicles have used a blend of 70% ethanol and 30% gasoline, to improve operation. Some studies suggest that production of ethanol consumes more energy than it produces, while others indicate a positive energy balance of about 35%. Therefore, greenhouse gas reductions with the use of corn-based E85 as compared to gasoline do not appear to be compelling on a life-cycle basis. Consistent with the

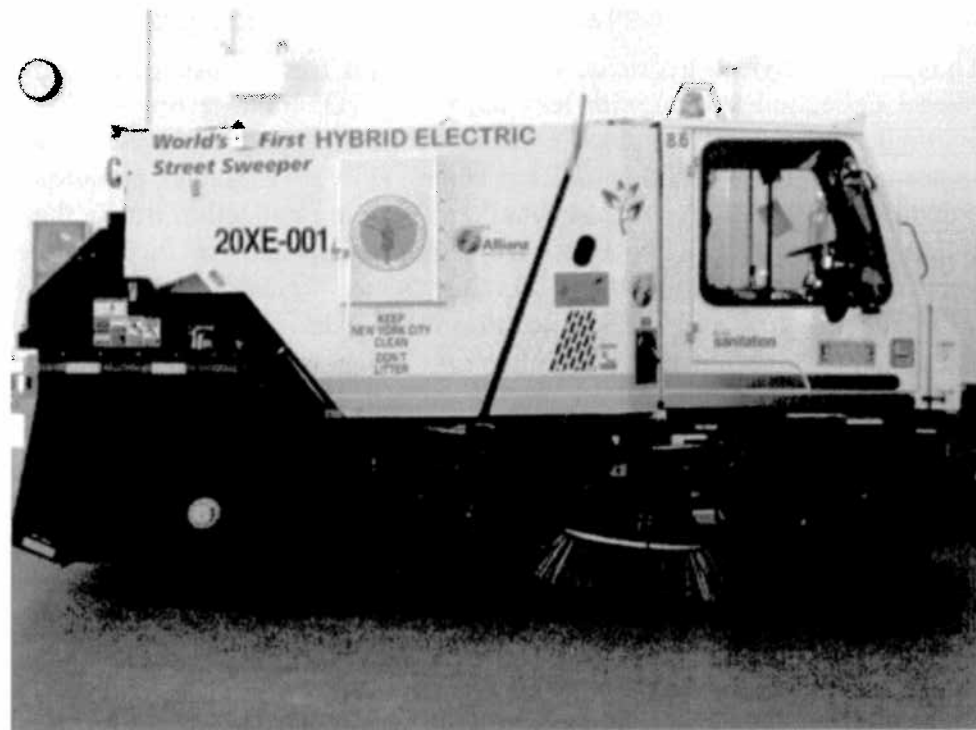
¹⁰ Ayala, *et al.*, *CNG and Diesel Transit Bus Emissions in Review* (August 2003); Ayala, *et al.*, *Diesel and CNG Heavy-Duty Transit Bus Emissions over Multiple Driving Schedules: Regulated Pollutants and Project Overview* (Society of Automotive Engineers, 2002).

¹¹ Peter Hildebrandt, "NGVs & Onboard Equipment," *MSW Management*, March/April 2011, *NGV Fleet Manager Supplement*, at 14 (citing figures from Clean Vehicle Education Foundation).

¹² INFORM, Inc., *Greening Garbage Trucks: New Technologies for Cleaner Air* (2003).

¹³ DSNY Commercial Waste Management Study, Vol. VI, at ES-5, 23 (March 2004); Ayala, *et al.*, *Diesel and CNG Heavy-Duty Transit Bus Emissions over Multiple Driving Schedules* (indicating CNG buses emit more carbon monoxide than retrofitted diesel buses).

prohibition on purchasing new bi-fuel vehicles in LL38/2005, DSNY does not plan to expand its fleet of E85 vehicles, but will operate them until they complete their useful life.



Hybrid-Electric Light-Duty Vehicles and Sweepers

DSNY has 650 hybrid-electric light-duty vehicles, with such models as the Toyota Prius sedan and Ford Hybrid Escape SUV. These vehicles operate on gasoline assisted by battery technology, and can convert and store energy captured from braking. The performance of these vehicles has been good, with significantly improved gas mileage and lower emissions than standard gasoline vehicles, despite higher initial vehicle costs than a comparably-sized gasoline model. Consistent with LL38/2005, DSNY expects to increase its fleet of these vehicles.

DSNY is currently testing seven diesel-powered hybrid-electric street sweepers in six districts (see photo above). These vehicles have the potential of even lower emissions and better fuel mileage than the latest Clean Diesel engines.

Hybrid-Electric and Hybrid-Hydraulic Diesel Collection Trucks

DSNY ordered two experimental hybrid-hydraulic diesel trucks and three experimental hybrid-electric diesel trucks from Crane Carrier Corporation in 2008, which were put into service in October 2009 and June 2010, respectively (see photo on cover and Appendix 3). This initiative was sponsored by the New York State Energy Research and Development Authority and the Hybrid Truck Users Forum. The hybrid-hydraulic diesel trucks are made with technology from Bosch Rexroth, called the Hydrostatic Regenerative Braking (HRB) System. These are the first such trucks in North America; they have also been tested in Germany. These

two different hybrid technologies have the potential to reduce fuel use and related emissions by capturing and reusing energy that is otherwise wasted during the frequent braking of collection vehicles. As noted above, DSNY also put into service one hybrid-hydraulic CNG collection truck in October 2010. Upon completion of pilot testing, in December 2010 DSNY returned a fourth hybrid-electric diesel truck to the manufacturer, Mack Trucks.

Thus far, the hybrid-hydraulic diesel collection trucks have outperformed the hybrid-electric diesel collection trucks, with less downtime. DSNY's testing of this first generation hybrid-hydraulic technology indicated a fuel savings of approximately 10% and a savings in brake replacement frequency and associated labor. DSNY mechanics are already familiar with servicing hydraulic technology from standard rear-loading collection trucks that have hydraulic compaction systems, which helps minimize retraining needed for the new technology. The trucks were also found to result in less braking "squeal" noise than from conventional diesel collection trucks. Following successful testing in 10 European cities and New York City, the manufacturer put the hybrid-hydraulic technology into mass production in October 2010. As a result, the incremental cost of hybrid-hydraulic technology has dropped to \$48,000 when applied to a diesel truck, compared to \$32,000 for CNG trucks. Accordingly, DSNY ordered 10 more next-generation Bosch Rexroth hybrid-hydraulic trucks in FY2011 which were delivered in July 2012, and plans to purchase 31 more in FY2013. DSNY applied for and obtained federal Congestion Mitigation and Air Quality grant funds for 80% of the cost of these new purchases. It is hoped that fuel and emissions savings with the newest model will be even greater than with the first generation technology, and may approach 20 to 25%.

In December 2011, Mack delivered five second-generation hybrid-electric diesel trucks for DSNY to test in CY2012. All five are currently in service.

Electric Vehicles

Plug-In Electric Vehicles

DSNY anticipates that both plug-in hybrid electric vehicles (with a gasoline engine) and pure electric (battery only) vehicles have a role to play in helping the City achieve PlaNYC2030's goals of conserving energy, making local air quality the best of any big American city, and reducing the greenhouse gas emissions from City operations 30% below FY2006 levels by 2017. Accordingly, in FY2012 DSNY purchased and received delivery of 14 state-of-the-art plug-in hybrid-electric Chevrolet Volt sedans, which are capable of running entirely on battery power for an extended range of up to 40 miles before a gasoline engine starts up to charge the battery. In total, DSNY has 21 plug-in hybrid-electric Chevrolet Volt sedans in service.

Volt vs. Prius

The Chevrolet Volt is now a commercially available model with the same California Air Resources Board (CARB) emissions rating (Alternate Technology Partial Zero Emission Vehicle, or AT-PZEV) as the 2011 Toyota Prius. As such, both the Volt and the Prius are capable of zero emissions when running only on battery power, but the Toyota Prius battery-only range is rated by the USEPA at under one mile. As a DSNY sedan on average travels

approximately 33 miles in a day, in practice a 2011 Toyota Prius will utilize its internal combustion engine and have higher direct emissions than a Volt for a DSNY shift that does not exceed 35-40 miles of driving. (The 2012 Plug-in Prius has a USEPA rating of 11 miles in electric-only mode, which is a substantial improvement; DSNY did not have this model in 2011, however.)

The Chevrolet Volts have performed well in the field. The primary advantage of the Volt over the 2011 Toyota Prius is the Volt's ability to run on pure electric battery mode for an extended range, therefore emitting fewer direct air emissions during a typical duty cycle than a Prius. According to the USEPA, a 2011 Volt gets the equivalent of 93 miles per gallon when operating in all-electric mode (MPGe), and 37 mpg when operating in gasoline mode, for an overall rating of 60 mpg. The USEPA rated the Volt as capable of being driven an estimated 35 miles in all-electric mode. The USEPA rated the 2011 Toyota Prius as achieving 50 mpg combined/51 mpg City/48 mpg highway; the 2012 Plug-in Prius has a USEPA mileage rating of 95 MPGe in electric mode, but still 50 mpg combined. (The 2013 Volt achieves a USEPA rating of 101 MPGe city/93 MPGe highway/98 MPGe combined, and reportedly travels 38 miles in EV mode.) If used with premium gasoline, as recommended by the manufacturer, the Volt fuel cost per gallon increases by 21 cents over regular gasoline.¹⁴ The fuel use and emissions of a Volt will vary depending on the amount driven between charges.¹⁵ In addition to fuel costs, other costs to be considered include depreciation and maintenance. As the City self-insures, any differential cost in insurance rates for these vehicles is not relevant.

In evaluating the environmental performance of plug-in electric vehicles such as the Volt, indirect pollution associated with the generation of electricity used to charge the vehicle's batteries should also be considered. Thus determining the carbon footprint of the Chevrolet Volt on a life cycle basis should take into account the source of the electricity used to charge the vehicle and whether it is from high-carbon fuels or from cleaner sources. The electric grid in New York City relies on natural gas (56%), nuclear (38%), other fossil fuels (5%). Therefore, a recent study found that the carbon footprint of a pure plug-in electric vehicle, or EV (similar to the Chevrolet Volt when operating in all-electric mode) driven and charged in New York City is lower than in parts of the country that rely mainly on higher-carbon coal for electricity.¹⁶ According to this study, charging an EV in the New York City yields global warming emissions equivalent to that of a gasoline-powered vehicle achieving 74 mpg, better than the best hybrid.¹⁷

¹⁴As DSNY fueling facilities lack premium gasoline, DSNY uses regular gasoline in the Volt, which reduces its fuel efficiency somewhat when operating in non-electric mode.

¹⁵ One recent study noted that for short trips of under 16 miles, the 2013 Plug-in Prius cost less per mile than a 2012 Volt (based only on fuel or electric use), due to the Volt's heavier battery. Ray Iannuzzelli, *Cost Per Mile Comparison: 2012 Volt vs 2013 Prius Plug-In* (April 13, 2012), using electricity costs of \$0.12/KWh and \$3.79 for regular gasoline, and \$4.00 for premium gasoline. <http://gm-volt.com/2012/04/13/cost-per-mile-comparison-2012-volt-vs-2013-prius-plug-in>. For trips between 16 and 65 miles, powering the Volt costs less per mile, and for trips over 65 miles, the Plug-In Prius has the fuel cost advantage over the Volt. *Id.* DSNY electricity and gasoline costs differ from these figures, with electricity about \$0.16/KWh and gasoline \$2.86/gallon as of June 4, 2012, but the study's basic conclusions appear valid for DSNY.

¹⁶Don Anair & Amine Mahmassani, *State of Charge, Electric Vehicles' Global Warming Emissions and Fuel-Cost Savings across the United States*, (Union of Concerned Scientists April 2012) Technical Appendix, p. 8, Table A.1, citing USEPA 2010a, and assuming an EV efficiency of a Nissan Leaf, 0.34kWh/mile.

¹⁷ *Id.* at 17.

Chevrolet Volts (at \$38,549) would cost the City significantly more than the Toyota Prius (at \$22,713), absent subsidies. As a public agency that does not pay income tax, DSNY is not eligible for the \$7500 federal tax credit available to federal income tax payers per Volt for the first 200,000 vehicles sold. Accordingly, DSNY has used Federal Congestion Mitigation and Air Quality grant funding and 2009 American Recovery and Reinvestment Act stimulus funding to cover the incremental cost of the Volts over the cost of a Prius. The price of Chevrolet Volts is expected to decline as production efficiencies are realized. As for operational costs, at current rates, a Prius that is driven 10,000 miles annually (the average for a DSNY sedan) for 10 years (the useful vehicle life for a DSNY sedan) will require 192 gallons of gasoline per year at a cost of \$2.86 per gallon, for a total of \$5487 in fuel costs (excluding oil changes, etc). A Volt that is driven the same daily distances in pure electric mode (by not exceeding 35 miles per day) would in theory require no gasoline over the 10 years, and save much of the \$5487, minus the cost of electricity consumed (0.36 kWh/mile at \$0.16/kWh), which comes to well under the equivalent cost of gasoline. Even so, however, over this period the Volt's savings in fuel would not compensate for the higher initial cost of the Volt, absent subsidies. (Even with the \$7500 tax credit, various studies have noted that the cost premium for a Volt over a Prius will not be recovered by fuel savings over the life of the vehicle.¹⁸) As for durability, the battery life of a 2012 Volt is warranted for 100,000 miles and 8 years, whichever comes first. The mileage would generally be adequate for the useful service life of a DSNY sedan, although failure after 8 years and prior to achieving 100,000 miles would be a disadvantage, given the substantial battery replacement cost for a Volt. The 2013 Volt battery is warranted for 10 years or 150,000 miles, whichever comes first, which alleviates this concern for DSNY operations.

DSNY has observed no significant difference in performance in the field between the Volt and the Prius. A Prius has more cargo space than a Volt and seats five, while the Volt seats only four, but these differences are not material for typical DSNY sedan operations. The requirement of charging the Volt creates certain operational issues not posed by the Prius, including a comparatively long charge time (about three hours at 240V), the limited number of parking spots with charging equipment at DSNY facilities, and the need for electrical upgrades at certain DSNY facilities to accommodate the required amperage for vehicle charging. The environmental benefits of operating a Volt over the Prius for DSNY's fleet can only be obtained via an adequate infrastructure and flexibility in charging time. As agency resources are limited, it must be determined whether such benefits of the Volt are worth the cost premium compared to the Prius absent subsidy support, or whether, for example, greater Agency carbon emissions reductions can be achieved at lower cost by other measures, such as converting certain DSNY facilities to natural gas heat from fuel oil.

The Department continues to assess the technological advances of hybrid electric vehicles and plug-in hybrid electric vehicles.

¹⁸ See, e.g., Ken Paulman, "Is the Chevy Volt Payback Really 26 Years?", *Midwest Energy News* (April 5, 2012) accessed at <http://www.midwestenergynews.com/2012/04/05/is-the-chevy-volts-payback-period-really-26-years/>; Michelle Krebs, "Will Higher Gas Prices Boost EV, Hybrid Sales?", *Edmunds .com* (February 28, 2012) accessed at <http://www.edmunds.com/industry-center/analysis/will-higher-gas-prices-boost-hybrid-ev-sales.html>; Nick Bunkley, "Payoff for Efficient Cars Takes Years" *New York Times* (April 4, 2012, accessed at http://www.nytimes.com/2012/04/05/business/energy-environment/for-hybrid-and-electric-cars-to-pay-off-owners-must-wait.html?_r=1).

Zero Emission Vehicles.

Under Local Law 38/2005, DSNY is obligated to purchase the lowest emission model sedan in a given vehicle class, provided such vehicle does not cost more than fifty percent more than the second-best-in-class. Until recently, DSNY could meet its obligations under Local Law 38 by purchasing either Chevrolet Volts or Toyota Priuses, which have identical emissions ratings, as noted above. However, there are now various commercially available zero emission, all-electric sedans that are considered best-in-class, and that cost less than 50% more than the second best in class.¹⁹ Consequently, DSNY anticipates having to purchase zero emission vehicles for its fleet under the mandate of LL 38/2005. Zero emission vehicles have the potential to bring further benefits to local air quality, as well as fuel cost savings and greenhouse gas reduction, compared to DSNY's current hybrid fleet. The improvement over the 2013 Plug-in Hybrid Prius will be relatively small, however, and may be insignificant over the Volt, when DSNY sedan usage stays under 35 miles per day, as it generally does, so that the Volt operates primarily in electric mode, as noted above. Moreover, such all-electric vehicles will require additional charging infrastructure, and may limit DSNY's operational flexibility for such sedans in winter emergency snow situations due to relatively slow charging times.

DSNY also purchased and is testing two Ford Transit Connects (pure plug-in electric). In addition, DSNY over a six month period tested the first diesel-powered hybrid-electric box truck in the nation. The chassis dynamometer testing of the hybrid-electric box truck indicated a significant reduction in NOx emissions.²⁰ Also in FY2010, DSNY put into service one Navistar eStar all electric Class 4 truck, which is currently being tested in fleet service.

DSNY intends to conduct further studies on the economic and operational feasibility of incorporating more alternative fuel sanitation vehicles into its fleet.

Testing of Biodiesel Blends

DSNY is further developing its clean air efforts by implementing advanced technologies to reduce emissions and utilizing clean diesel fuel with a renewable alternative biofuel component. For example, in March 2007, DSNY launched a biodiesel (B5) initiative citywide on all diesel-powered equipment (on-highway and off-highway), utilizing 5% biodiesel (made from soybeans) and 95% (petroleum-based) ULSD. To date, the B5 initiative resulted in no change in vehicle performance, no operator or mechanic complaints, no increase in down rate, and good winter operability. In August 2007, DSNY implemented its B20 (20% biodiesel) pilot study in the Queens 6 district and based on those encouraging results, in July 2010 DSNY expanded the study to the Brooklyn 5 district. Testing in both districts is on-going. DSNY plans

¹⁹ For example, the 2012 Nissan Leaf EV achieves a USEPA rating of 99 MPGe and an electricity consumption rating of 0.34 kilowatt hours (kWh) per mile. Other EVs that are now available are the 2012 Mitsubishi i-MiEV (112MPGe), and 2012 Ford Focus Electric (105 MPGe). In 2013, the Honda Fit EV is scheduled to be commercially available, with a leading USEPA rating of 118 MPGe, and a consumption rating of just 0.29 kWh per mile.

²⁰ Energetics Inc., *Hino Hybrid Fuel Economy and Emissions Testing* (2011).

to expand the pilot study to 12 more districts in CY 2012, for a total of 14 districts. B5 biodiesel costs about the same as standard ULSD, while B20 biodiesel costs somewhat more.

Conclusion

As a result of dramatic improvements in clean diesel technology, federal mandates for ultra-low sulfur diesel fuel, much stricter new vehicle emission standards, local law BART requirements for pre-2007 trucks, and DSNY’s efforts, DSNY has already cut its overall diesel fleet PM emissions by approximately 85% and NOx emissions by half since LL38/2005 was passed, with further reductions expected as the fleet turns over.

DSNY will continue participating in research and development of new technologies and evaluate the mechanical reliability and operability of CNG and other alternative fuel collection trucks to assess their respective environmental and economic performances. DSNY is currently testing seven diesel-powered hybrid-electric street sweepers in six districts and is committed to exploring fully the costs and benefits of incorporating hybrid collection trucks into its fleet. DSNY’s B5 initiative citywide has met with positive results and testing of the B20 initiative is ongoing and has expanded to a total of 14 districts. This initiative has the potential to further reduce truck emissions, including greenhouse gases.

* * *

Appendix 1: DSNY CNG Fuel Street Sweepers as of January 1, 2012

VehicleID	VIN #	Vehicle Type	Make / Model
20CNG-501	1J9VM4L903C172001	Street Sweeper	Johnston 4000
20CNG-601	1J9VM4L956C172001	Street Sweeper	Johnston 4000
20CNG-602	1J9VM4L976C172002	Street Sweeper	Johnston 4000
20CNG-603	1J9VM4L996C172003	Street Sweeper	Johnston 4000
20CNG-604	1J9VM4L906C172004	Street Sweeper	Johnston 4000
20CNG-605	1J9VM4L926C172005	Street Sweeper	Johnston 4000
20CNG-606	1J9VM4L946C172006	Street Sweeper	Johnston 4000
20CNG-607	1J9VM4L966C172007	Street Sweeper	Johnston 4000
20CNG-608	1J9VM4L986C172008	Street Sweeper	Johnston 4000
20CNG-609	1J9VM4L9X6C172009	Street Sweeper	Johnston 4000
20CNG-610	1J9VM4L966C172010	Street Sweeper	Johnston 4000
20CNG-701	1J9VM4L988C172111	Street Sweeper	Johnston 4000
20CNG-702	1J9VM4L9X8C172112	Street Sweeper	Johnston 4000
20CNG-703	1J9VM4L918C172113	Street Sweeper	Johnston 4000
20CNG-704	1J9VM4L938C172114	Street Sweeper	Johnston 4000
20CNG-705	1J9VM4L958C172115	Street Sweeper	Johnston 4000
20CNG-706	1J9VM4L978C172116	Street Sweeper	Johnston 4000
20CNG-707	1J9VM4L998C172117	Street Sweeper	Johnston 4000
20CNG-708	1J9VM4L908C172118	Street Sweeper	Johnston 4000
20CNG-709	1J9VM4L9X8C172109	Street Sweeper	Johnston 4000
20CNG-710	1J9VM4L968C172110	Street Sweeper	Johnston 4000

Appendix 2: DSNY's CNG Collection Trucks

Vehicle ID	Make / Model	Vehicle Type	VIN #
24CNG-001	Crane Carrier LET2	Front Loading	1CYCCZ4848T048392
25CNG-501	Crane Carrier LET2	Rear Loading	1CYCCZ4868T048393
25CNG-502	Crane Carrier LET2	Rear Loading	1CYCCZ4868T048569
25CNG-503	Crane Carrier LET2	Rear Loading	1CYCCZ4828T048570
25CNG-504	Crane Carrier LET2	Rear Loading	1CYCCZ4848T048571
25CNG-505	Crane Carrier LET2	Rear Loading	1CYCCZ4868T048572
25CNG-506	Crane Carrier LET2	Rear Loading	1CYCCZ4888T048573
25CNG-507	Crane Carrier LET2	Rear Loading	1CYCCZ48X8T048574
25CNG-508	Crane Carrier LET2	Rear Loading	1CYCCZ4818T048575
25CNG-509	Crane Carrier LET2	Rear Loading	1CYCCZ4838T048576
25CNG-510	Crane Carrier LET2	Rear Loading	1CYCCZ4858T048577
25CNG-601	Crane Carrier LET2	Rear Loading	1CYCCZ4819T049419
25CNG-602	Crane Carrier LET2	Rear Loading	1CYCCZ4889T049420
25CNG-603	Crane Carrier LET2	Rear Loading	1CYCCZ48X9T049421
25CNG-604	Crane Carrier LET2	Rear Loading	1CYCCZ4819T049422
25CNG-605	Crane Carrier LET2	Rear Loading	1CYCCZ4839T049423
25CNG-606	Crane Carrier LET2	Rear Loading	1CYCCZ4859T049424
25CNG-607	Crane Carrier LET2	Rear Loading	1CYCCZ4879T049425
25CNG-608	Crane Carrier LET2	Rear Loading	1CYCCZ4899T049426
25CNG-609	Crane Carrier LET2	Rear Loading	1CYCCZ4809T049427
25XG-001	Crane Carrier LET2	Rear Loading	1CYCCZ48X9T049418

Appendix 3: DSNY's Hybrid Collection Trucks

# of Units	Chassis Mfg	Fuel	Hybrid Sys	Series/Parallel	# of Units in Service
3	Crane Carrier Corp	Diesel	Electric	Series	3
5	Crane Carrier Corp	Diesel	Hydraulic	Parallel	5
1	Crane Carrier Corp	CNG	Hydraulic	Parallel	1

