



# sanitation

**KATHRYN GARCIA**  
Commissioner  
125 Worth Street, Room 714  
New York, N.Y. 10013  
Tel: (646) 885-4974

April 29, 2014

Honorable Bill de Blasio  
Mayor, City of New York  
City Hall  
New York, New York 10007

Honorable Melissa Mark-Viverito  
Speaker, New York City Council  
City Hall  
New York, New York 10007

Honorable Scott M. Stringer  
Comptroller, City of New York  
One Centre Street – Municipal Building  
Room 530  
New York, New York 10007

**Re: 2013 Report on DSNY's Alternative Fuel Program**

Dear Mayor de Blasio, Speaker Mark-Viverito and Comptroller Stringer:

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

The Department's fleet continues to be among the cleanest and "greenest" in the world. Since 2005 we have reduced our fleet's overall particulate matter (PM) emissions by 90%, and cut Nitrogen Oxide (NOx) emissions by 74%. 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 advance of the Local Law 73 of 2013 mandate and in an effort to further lower fleet emissions, including greenhouse gases, the Department currently uses B20 (20% Biodiesel made of soybeans) for its trucks citywide. DSNY plans to use B20 generally from April 15 through November 15 and B5 (5% Biodiesel) during the remainder of the year (colder weather).

In addition, we have 18 compressed natural gas (CNG)-powered street sweepers, 44 CNG-powered collection trucks, 774 light-duty vehicles that are hybrid-electric, 21 plug-in hybrid-electric Chevrolet Volt sedans, 18 all-electric Nissan Leaf sedans, 19 hybrid-hydraulic diesel collection trucks, one CNG-powered hybrid-hydraulic collection truck, three 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 remains committed to making its fleet as environmentally sustainable as possible consistent with our operational needs and will continue our active research and development efforts concerning alternative fuels and technologies for our fleet.

Sincerely,

  
Kathryn Garcia

c: Hon. Anthony Shorris, First Deputy Mayor  
City Hall

Emma Wolfe, Director  
Office of Intergovernmental Affairs, City Hall

Daniel Zarrilli, Acting Director  
Office of Long Term Planning & Sustainability, City Hall

Hon. Antonio Reynoso, Councilmember  
Chair, Committee on Sanitation & Solid Waste

Hon. Donovan Richards Jr., Councilmember  
Chair, Committee on Environmental Protection

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



---

## 2013 Annual Report on Alternative Fuel Vehicle Programs Pursuant to Local Law 38 of 2005

---



*2009: First Hybrid Hydraulic Collection Truck in North America*

---

Kathryn Garcia, Commissioner  
April 2014

---

## 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 mission of refuse and recyclables collection, street cleaning and snow removal. DSNY strives to operate the cleanest big city fleet and in 2013 won the prestigious federal EPA “Breathe Easy Leadership Award.” But the agency’s vehicles do produce air emissions. In 2005, the City Council enacted Local Law 38 (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.<sup>1</sup> 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.<sup>2</sup>

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.<sup>3</sup> New York City’s air quality has improved and in 2013 met federal standards for fine particulate matter (PM<sub>2.5</sub>), but it remains out of compliance with standards for ozone. The USEPA proposed a new, more restrictive annual standard for PM<sub>2.5</sub> in June 2012, which took effect in December 2012. The new annual standard declined from 15 micrograms per cubic meter to 12 micrograms per cubic meter. The “design value” based on 2010-2012 measurements indicates that New York City’s air meets the new standard.<sup>4</sup>

In 2013, DSNY’s fleet included 2,023 collection trucks, 437 street sweepers, 362 salt/sand spreaders, 293 front end loaders and 2,004 various other support vehicles. Based on Fiscal Year 2013 figures, the entire diesel fleet travels approximately 25 million miles and required approximately 10 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.

---

<sup>1</sup> NYC Administrative Code § 24-163.2(c)(1) & (2).

<sup>2</sup> This pilot was required by LL38/2005. *Id.*

<sup>3</sup> While not known to cause asthma, PM, especially fine PM 2.5 microns in diameter or smaller (PM<sub>2.5</sub>) 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>.

<sup>4</sup> The design value for the annual PM<sub>2.5</sub> NAAQS is the 3-year average annual mean concentration.

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.”<sup>5</sup>

## **Dramatic Improvements in DSNY’s Fleet Emissions**

DSNY’s fleet is already achieving an estimated *90% reduction in PM and 74% reduction in NOx emissions* fleet-wide compared with DSNY’s heavy duty diesel fleet in 2005, while the newest trucks achieve *98% reductions* in each pollutant as compared with pre-1988 diesel engines.<sup>6</sup> In addition, DSNY has cut its light duty fleet fuel use and emissions in half since 2005.

### *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.*<sup>7</sup> As of 2010 NOx is limited to 0.2 g/bhp-hr, compared to 2.0 g/bhp-hr in the

---

<sup>5</sup> NYC Admin. Code § 24-163.2(a)(6).

<sup>6</sup> Reduction in non-methane hydrocarbons is comparable, with 2012 standard of 0.14 g/bhp-hr, down from 0.5 g/bhp-hr in 2006 and 1.3 g/bhp-hr in 2003. For NOx, DSNY collection trucks have now achieved a 75% reduction and mechanical brooms have achieved a 67% reduction from their respective 2005 levels.

<sup>7</sup> 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

2006 model year and 4.0 g/bhp-hr in the 2003 model year. As DSNY's collection trucks 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. These devices achieve reductions of up to 90% in PM and up to 25% in NOx. Including both factory-installed equipment and retrofits, by January 1, 2014 DSNY had particulate filters on 324 diesel-powered street sweepers and 2,159 collection vehicles. By July 1, 2012, all of DSNY's pre-2007 diesel collection truck fleet had the required BART retrofits or similar after-market clean diesel technology. As of January 1, 2014, DSNY has approximately 25 pre-2007 non-collection truck diesel vehicles without retrofits. They, however, are slated to be replaced within the next year with clean diesel models with factory-installed controls; therefore, retrofits are not required.

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<sub>2.5</sub> levels along such roadways would be deemed insignificant for purposes of environmental review.<sup>8</sup> The changes and improvements made to DSNY's Clean Diesel fleet have greatly reduced air quality concerns from mobile-source PM<sub>2.5</sub>.

### **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. 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.<sup>9</sup> Including collection trucks, sweepers, and light duty vehicles that are not used to collect refuse or recyclables, DSNY currently has 816 vehicles that operate on various alternative fuels.

#### ***Compressed Natural Gas (CNG)***

DSNY has 62 CNG vehicles in its active heavy-duty fleet, including collection trucks and street sweepers. DSNY has no light-duty CNG vehicles.

---

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.

<sup>8</sup> DEP communication.

<sup>9</sup> NYC Administrative Code § 24-163.1(a)(1). Other types of fuels, such as B5 Biodiesel, do not qualify as alternative fuels.

### *CNG Street Sweepers*

DSNY operates 18 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 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 are 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 18 CNG sweepers in the fleet will continue in service until they reach the end of their operational life of approximately 5 years.

Currently, Cummins is developing a 6.7 Liter CNG engine (ISB Gas). This engine is applicable to the CNG street sweeper and will be available in 2015, at which time DSNY will assess whether to purchase additional CNG sweepers.

### *CNG Collection Trucks*

DSNY currently owns 44 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 Calendar Year 2013, DSNY ordered and received delivery of 23 additional CNG trucks from Mack Trucks, equipped with a Cummins ISL-gas CNG engine. DSNY put these 23 additional trucks into service in January 2014.

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.<sup>10</sup> 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, 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.<sup>11</sup> On the other hand, greenhouse gas emissions from CNG trucks are reportedly 20-23% lower than those from diesel trucks.<sup>12</sup> It has been noted that CNG trucks are somewhat quieter than diesel trucks,<sup>13</sup> but compaction noise from CNG collection trucks and diesel collection trucks are generally comparable. CNG trucks emit more methane (a greenhouse gas) and more carbon monoxide than conventional clean diesel vehicles.<sup>14</sup>

From an economic perspective, with an increase in recoverable domestic reserves due to new technology, natural gas prices have fallen below current diesel prices and may offer price stability advantages. As of January 1, 2014, a gallon of diesel fuel cost \$3.29 while a gallon-equivalent of CNG cost approximately \$2.31, 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 \$35,000 more per unit than a diesel collection truck. For a collection truck that drives 6900 miles in a year at an average 2.5 miles per gallon, the annual diesel fuel cost at \$3.29/gal is \$9,080; the equivalent in CNG fuel at \$2.31/gal eq. is \$6,375; over seven years, the saving from CNG (assuming constant fuel prices) would be \$18,935, not counting capital costs. 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 require additional investment in capital funds to build CNG fueling infrastructure and in facility modifications as required by the New York City Building Code.

---

<sup>10</sup> 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.).

<sup>11</sup> 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).

<sup>12</sup> Peter Hildebrandt, "NGVs & Onboard Equipment," *MSW Management*, March/April 2011, *NGV Fleet Manager Supplement*, at 14 (citing figures from Clean Vehicle Education Foundation).

<sup>13</sup> INFORM, Inc., *Greening Garbage Trucks: New Technologies for Cleaner Air* (2003).

<sup>14</sup> 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).



### ***E85 Ethanol Blend Vehicles***

Local Law 38 of 2005 prohibits the purchase of new bi-fuel vehicles, such as vehicles capable of running on E85. DSNY has discontinued the use of E85 in its light-duty fleet. E85 is a fuel blend of 85% corn-based ethanol (which is renewable) and 15% gasoline. It requires separate fuel storage tanks. DSNY vehicles capable of running on E85 consisted of bi-fuel Ford Taurus sedans and Ford Explorer sport utility vehicles. Such vehicles did not always run on E85 in practice when it was more convenient to utilize gasoline. While the operation of these vehicles using E85 was generally satisfactory, they did not achieve significant emissions savings over gasoline vehicles, although NOx emissions were somewhat lower. Fuel mileage was less than with gasoline. Greenhouse gas reductions from using E85 have not proven to be compelling, according to various studies.



### ***Hybrid-Electric Light-Duty Vehicles and Sweepers***

DSNY has 774 hybrid-electric light-duty vehicles, with such models as the Toyota Prius sedan and Ford Hybrid Escape sport utility vehicle (SUV). These vehicles operate on gasoline assisted by battery technology, and can recover and reuse energy captured during 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. As a result, DSNY has cut its light duty vehicle fuel use (gasoline and ethanol) in half since 2005 mainly through the use of such hybrid vehicles. In FY2012 and FY2013, DSNY purchased 16 and 136 Ford Fusion Hybrids, respectively.<sup>15</sup> In FY2014 so far, DSNY purchased 24 additional Ford Fusion Hybrids, for a total of 176 Ford Fusion Hybrids.

---

<sup>15</sup> EPA mileage estimates for the Fusion Hybrid are 47 mpg highway and 47 mpg city.

Consistent with LL38/2005, DSNY expects to increase its fleet of hybrid-electric light-duty vehicles.

DSNY is currently testing seven diesel-powered hybrid-electric street sweepers in six districts (see photo above). In Calendar Year 2013, DSNY purchased seven additional diesel powered hybrid-electric street sweepers to be tested in Calendar Year 2014. 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 (prototype) hybrid-hydraulic diesel trucks and three experimental (prototype) 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.

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 reduction in greenhouse gases 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 \$47,000 when applied to a diesel truck, compared to \$35,000 for CNG trucks. Thus, for a collection truck that drives 6900 miles in a year at an average 2.5 miles per gallon, the annual diesel fuel cost at \$3.29/gal is \$9,080; a 10% savings in fuel amounts to approximately \$908/year, or \$6356 over the seven year useful life of the hybrid hydraulic collection truck, compared to a conventional clean diesel collection truck, assuming stable fuel costs. Vehicle emissions would likewise be reduced by approximately 10%. Additional savings are expected on maintenance costs (brakes and labor), not including capital costs. In CY2013, DSNY put into service 17 additional next-generation Bosch Rexroth hybrid-hydraulic trucks. DSNY applied for and obtained federal Congestion Mitigation and Air Quality grant funds for 80% of the cost of these new purchases.

In Calendar Year 2013, DSNY successfully applied for additional Federal Congestion Mitigation and Air Quality grant funding to purchase 32 additional diesel-powered hybrid-hydraulic trucks from Mack Trucks for Calendar Year 2014 delivery.

## *Electric Vehicles*

### *Plug-In Electric Vehicles*

Beyond the hybrid-electric light duty vehicles discussed above, 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 FY2005 levels by 2017. 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. DSNY purchased seven more Chevy Volts in CY2013, for a total of 21 plug-in hybrid-electric Chevrolet Volt sedans in service by the end of Calendar Year 2013.

### *Volt vs. Conventional Hybrid*

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 Chevrolet Volts have performed well in the field. The primary advantage of the Volt over a conventional hybrid such as the Toyota Prius or Ford Fusion Hybrid 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 conventional hybrid. 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 2012 Volt has a USEPA rating of 94 miles per gallon in electric-only mode). 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. If used with premium gasoline, as recommended by the manufacturer, the Volt fuel cost per gallon increases by 21 cents over regular gasoline. The fuel use and emissions of a Volt will vary depending on the amount driven between charges.<sup>16</sup> In addition to fuel costs, other costs to be

---

<sup>16</sup> 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 \$0.15/KWh and gasoline \$2.82/gallon as of February 21, 2014, but the study's basic conclusions appear valid for DSNY.

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. 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.<sup>17</sup> 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.<sup>18</sup>

Chevrolet Volts (at \$34,185) would cost the City significantly more than a Toyota Prius (at \$24,200) or Ford Fusion Hybrid (at \$26,270), 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 or Fusion. The price of Chevrolet Volts is expected to decline as production efficiencies are realized. As for operational costs, at current rates, a conventional hybrid 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 \$2.82 per gallon, for a total of \$5414 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 \$5414, minus the cost of electricity consumed (0.36 kWh/mile at \$0.15/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 conventional hybrid will not be recovered by fuel savings over the life of the vehicle.<sup>19</sup>) As for durability, the battery life of a Volt is warranted for 100,000 miles and 8 years, whichever comes first. The mileage would generally be adequate

---

<sup>17</sup>Don 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.

<sup>18</sup> *Id.* at 17.

<sup>19</sup> 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?", *Edmonds.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](http://www.nytimes.com/2012/04/05/business/energy-environment/for-hybrid-and-electric-cars-to-pay-off-owners-must-wait.html?_r=1)).

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.

In determining which vehicles to purchase, DSNY evaluated the Volt's and conventional hybrid's operational performance together with environmental considerations. DSNY has observed no significant difference in performance in the field between the Volt and the Prius or Fusion Hybrid. A Prius has more cargo space than a Volt and like the Fusion 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 or Fusion Hybrid, 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 or Fusion Hybrid for DSNY's fleet (equivalent to 24 to 27 more mpg equivalent, with lower local emissions and lower carbon emissions) can only be obtained via an adequate infrastructure and flexibility in charging time.

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

#### *Zero Emission Vehicles.*

DSNY has also started purchasing zero emission all-electric 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 Volt may be insignificant however, 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 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. In 2013, DSNY installed 18 Level 2 electric vehicle charging stations at DSNY garages throughout the five boroughs. DSNY currently has 49 Level 2 electric vehicle charging stations citywide. In CY 2013, DSNY acquired 18 all-electric Nissan Leafs (\$29,929) for light duty use. Their performance has been satisfactory.

DSNY also purchased and is testing two Ford Transit Connects (pure plug-in electric vans). 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. In advance of the Local Law 73 of 2013 mandate to power all diesel fuel-powered motor vehicles owned or operated by the city of New York with at least B20 for the fiscal year beginning July 1, 2016 and thereafter between the months of April and November, DSNY expanded the pilot study citywide in CY 2013, for a total of 59 districts. Testing in all districts is on-going. B5 biodiesel costs about the same as standard ULSD, while B20 biodiesel costs somewhat more. DSNY plans to use B20 generally from April 15 through November 15 and B5 during the remainder of the year (colder weather). This yields a net reduction in carbon emissions of more than 10% compared to conventional fossil fuel diesel use.

## **Conclusion**

As a result of DSNY's efforts, dramatic improvements in clean diesel technology, federal mandates for ultra-low sulfur diesel fuel, much stricter new vehicle emission standards, and local law BART requirements for pre-2007 trucks, DSNY has already cut its overall diesel fleet PM emissions by approximately 90% and NOx emissions by 74% since LL38/2005 was passed, with further reductions expected as the fleet turns over. Furthermore, in accordance with PlaNYC2030's goal of a 30% reduction below FY2005 levels by 2017, DSNY has already achieved a 10 to 20% reduction in greenhouse gas emissions from fleet operations, including a 50% reduction in light duty vehicle emissions.

DSNY will continue to participate in research and development of new technologies and to 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 will add seven more in CY 2014. DSNY is committed to exploring fully the costs and benefits of incorporating hybrid collection trucks into its fleet. DSNY's B20 initiative citywide has met with positive results and testing is ongoing. This initiative has the potential to further reduce truck emissions, including greenhouse gases.

\* \* \*

**Appendix 1: DSNY CNG Fuel Street Sweepers as of January 1, 2014**

<b>VehicleID</b>	<b>VIN #</b>	<b>Vehicle Type</b>	<b>Make / Model</b>
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-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-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**

<b>Vehicle ID</b>	<b>Make / Model</b>	<b>Vehicle Type</b>	<b>VIN #</b>
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
25CNG-701	Crane Carrier LET2	Rear Loading	1M2AU14C4DM001603
25CNG-702	Crane Carrier LET2	Rear Loading	1M2AU14C6DM001604
25CNG-703	Crane Carrier LET2	Rear Loading	1M2AU14C8DM001605
25CNG-721	Crane Carrier LET2	Rear Loading	1M2AU14C9DM001709
25CNG-722	Crane Carrier LET2	Rear Loading	1M2AU14C5DM001710



25CNG-723	Crane Carrier LET2	Rear Loading	1M2AU14C7DM001711
25CNG-724	Crane Carrier LET2	Rear Loading	1M2AU14C9DM001712
25CNG-725	Crane Carrier LET2	Rear Loading	1M2AU14C0DM001713
25CNG-726	Crane Carrier LET2	Rear Loading	1M2AU14C2DM001714
25CNG-727	Crane Carrier LET2	Rear Loading	1M2AU14C4DM001715
25CNG-728	Crane Carrier LET2	Rear Loading	1M2AU14C6DM001716
25CNG-729	Crane Carrier LET2	Rear Loading	1M2AU14C8DM001717
25CNG-730	Crane Carrier LET2	Rear Loading	1M2AU14CXDM001718
25CNG-731	Crane Carrier LET2	Rear Loading	1M2AU14C9DM001726
25CNG-732	Crane Carrier LET2	Rear Loading	1M2AU14C0DM001727
25CNG-733	Crane Carrier LET2	Rear Loading	1M2AU14C2DM001728
25CNG-734	Crane Carrier LET2	Rear Loading	1M2AU14C4DM001729
25CNG-735	Crane Carrier LET2	Rear Loading	1M2AU14C0DM001730
25CNG-736	Crane Carrier LET2	Rear Loading	1M2AU14C2DM001731
25CNG-737	Crane Carrier LET2	Rear Loading	1M2AU14C4DM001732
25CNG-738	Crane Carrier LET2	Rear Loading	1M2AU14C6DM001733
25CNG-739	Crane Carrier LET2	Rear Loading	1M2AU14C8DM001734
25CNG-740	Crane Carrier LET2	Rear Loading	1M2AU14CXDM001735
25XG-001	Crane Carrier LET2	Rear Loading	1CYCCZ48X9T049418

Appendix 3: DSNY's Hybrid Collection Trucks

Chassis Mfg	Fuel	Hybrid Sys	Series/Parallel	# of Units in Service
Crane Carrier Corp	Diesel	Electric	Parallel	3
Crane Carrier Corp	Diesel	Hydraulic	Parallel	2
Crane Carrier Corp	CNG	Hydraulic	Parallel	1
Mack	Diesel	Hydraulic	Parallel	17