Clean Fleet Transition Plan 2026 Update

NYC Department of Citywide Administrative Services (DCAS) Fleet

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14. ABSTRACT

As a national leader in municipal sustainability, the New York City (NYC) Department of Citywide Administrative Services (DCAS) issued the 2026 update to the Clean Fleet Transition Plan (CFTP). This report outlines progress toward electrification mandates established by Mayoral Executive Order 90 and Local Law 140 of 2023. With over 5,700 electric vehicles (EVs) currently in operation, the 2026 CFTP continues the original CFTP's three-tier market readiness framework to analyze the nearly 29,000-unit fleet. Findings show a maturing market led by legacy OEMs, with 86% of on-road vehicles now viable for electrification within five years. Notably, the report introduces Extended-Range Electric Vehicles (EREVs) as a potential bridge technology for heavy-duty applications like plows and emergency apparatus. For the first time, the plan incorporates clean construction equipment under Executive Order 23, identifying pathways for off-road decarbonization. By focusing on the safety-sustainability nexus, the CFTP demonstrates how technologies like intelligent speed assistance (ISA) can simultaneously advance Vision Zero and pollution reduction goals.

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Contents

U.S. Department of Transportation Volpe Center

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Term
APU	Auxiliary Power Unit
ANL	Argonne National Laboratory
BEB	Battery Electric Bus
BEV	Battery Electric Vehicle, i.e. All-Electric
BIC	Business Integrity Commission
CFTP	Clean Fleet Transition Plan
CNG	Compressed Natural Gas
DCAS	Department of Citywide Administrative Services
DCFC	Direct Current Fast Chargers, which require 480 volts and can replenish 120-160 miles of range per hour
DEP	Department of Environmental Protection
DOC	Department of Correction
DOE	Department of Education
DOHMH	Department of Health and Mental Hygiene
DOT	Department of Transportation
DPR	Department of Parks and Recreation
DSNY	Department of Sanitation
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment (i.e., charging station)
FDNY	Fire Department
GVWR	Gross Vehicle Weight Rating
HD	Heavy Duty
HDV	Heavy Duty Vehicle
HEV	Hybrid Electric Vehicle
ICE	Internal Combustion Engine
Lbs.	Pounds
LD	Light Duty
LDV	Light Duty Vehicle
Level 2	Refers to a Level 2 charging station, which requires 240 volts and replenishes 10-20 miles of range per hour
MD	Medium Duty
MDV	Medium Duty Vehicle
NYC	New York City
NYCHA	New York City Housing Authority
NYCSBUS	NYC School Bus Umbrella Corporation
NYPD	New York Police Department
OCME	Office of Chief Medical Examiner
OEM	Office of Emergency Management
PHEV	Plug-in Hybrid Electric Vehicle
SFTP	Safe Fleet Transition Plan
SUV	Sport Utility Vehicle
UTV	Off-road Utility Task Vehicle
Volpe	U.S. Department of Transportation John A. Volpe National Transportation Systems Center

Executive Summary

This update to the Clean Fleet Transition Plan (CFTP) outlines the progress, opportunities, and technical realities facing the New York City Department of Citywide Administrative Services (DCAS) as it works toward the electrification targets set by Mayoral Executive Order 90 and Local Law 140 of 2023. DCAS currently operates the largest municipal fleet in the United States, with over 22,000 units using electric, hybrid, biofuel, or solar power, including over 5,700 electric vehicles (EVs). Since the publication of the original CFTP in 2022, DCAS has added 2,357 EVs to its roster and expanded its charging network to include 406 DC fast chargers with 2,400 charging ports in total

This report, produced in partnership with the U.S. DOT Volpe National Transportation Systems Center, continues a three-tier framework to categorize vehicle readiness: Tier 1 (available now or in less than 3 years), Tier 2 (available in 3-5 years), and Tier 3 (available in 5+ years). This update reveals a market that has matured significantly from one dominated by niche startups and conversion offerings to more established options by legacy automotive OEMs.

Despite the progress reported here, <u>there is substantial flux and change occurring in the electric vehicle industry, including as the result of recent changes in federal policy, that can impact the availability of models discussed in this report.</u>

On-Road Fleet Trends

The availability of electric models has expanded significantly since the initial CFTP, with 195 vehicle makes and models now highlighted in the Tier 1 segment. This increase is driven largely by established automakers rather than the startup sector, which has seen instability with the bankruptcy of vocational manufacturers like Bollinger and Lightning eMotors. Legacy OEMs have moved to fill this gap, moving key vehicles like the Chrysler Pacifica and Chevrolet Silverado EV from Tier 2 to Tier 1 status. The crossover SUV segment has seen the most dramatic surge, accounting for the highest number of new additions and now comprising 40% of all Tier 1 light-duty options. Simultaneously, Class 2b passenger and cargo vans have grown to become the third-largest segment in the tier table. At the same time, in late 2025, Ford ended production of the F-150 Lightning BEV pickup, but announced its replacement with an Extended-Range Electric Vehicle version. Given the importance of legacy OEMs in the EV market progress that this report outlines, the outcome of developments such as the Ford pivot will be important to monitor for fleets seeking to electrify.

Despite availability expansion in the light-duty, medium-duty, and even general-purpose heavy-duty sectors, specialized heavy-duty applications remain a challenge. Vehicles such as plows and fire ladder trucks remain categorized as Tier 3. Current all-electric models cannot yet meet the continuous-duty energy demands of plowing shifts during cold weather and certain emergency scenarios, necessitating further technology development before they can be reliably integrated into the fleet.

Compared to the initial CFTP, Volpe analysis finds that 61 percent (up from 41 percent) of existing on-road agency vehicles are in a Tier 1 category and are feasible to transition to electric within three years. Another 25 percent of all agency vehicles now fall under Tier 2 and will have available electric replacement models in three to five years, based solely on expected EV market availability. The remaining 14 percent of vehicles that are in Tier 3 are expected to not be market-ready for electrification within five years, including collection trucks used for plowing as well as fire ladder trucks. Decarbonization for these hard-to-abate assets currently relies on renewable diesel.

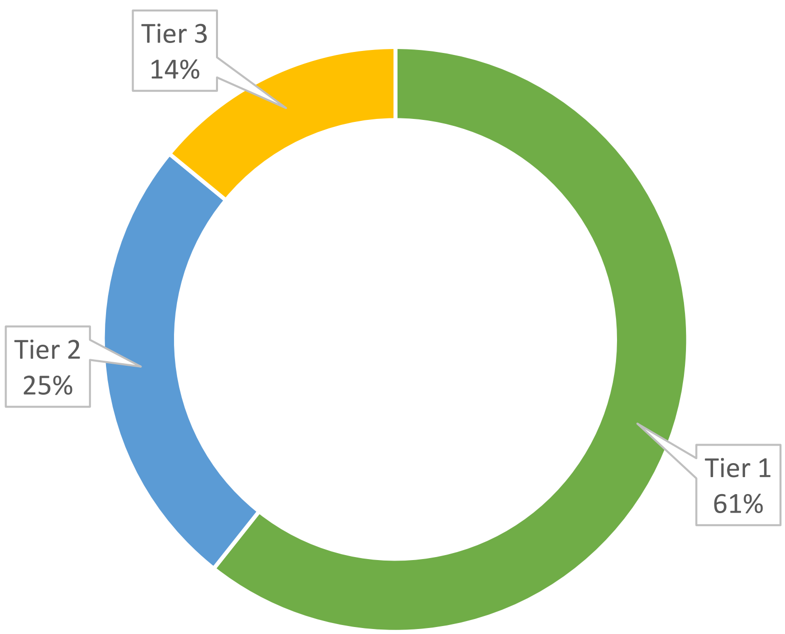

Figure 1. Percent of On-Road NYC Fleet Units by Assigned CFTP Tier

Off-Road and Clean Construction

For the first time, the CFTP includes a dedicated focus on clean construction equipment, supporting the city's Clean Construction Executive Order (EO23). This sector is critical, as private sector construction machinery releases ~12 times the emissions of the City Fleet annually in the five boroughs. Market readiness varies widely by equipment type; forklifts represent the most mature segment (Tier 1), with 42% of the City's inventory already electrified. Electric off-road utility vehicles (UTVs) are also rapidly progressing, with 44% of new purchases since 2022 being battery-electric.

Compared to the initial CFTP, Volpe analysis finds that 79 percent (up from 66 percent) of existing, fueled off-road fleet units currently have or will have models available within three years, and another eight percent are expected to have electric options within five years, as shown in Figure 2.

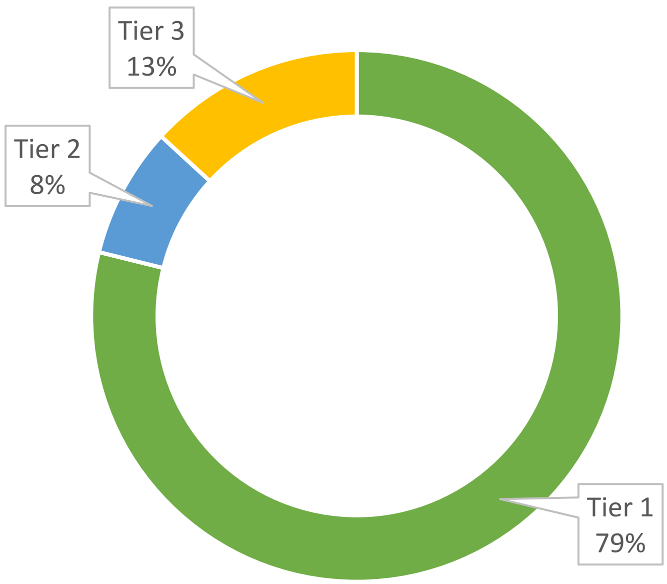

Figure 2. Percent of Fueled Off-Road NYC Fleet Units by Assigned CFTP Tier

However, heavier equipment faces steeper adoption curves. While compact excavators and mid-sized wheel loaders are entering pilot phases (Tier 2), heavy machinery such as bulldozers, asphalt pavers, and snow melters remain in Tier 3. Decarbonization for these hard-to-abate assets currently relies on renewable diesel. Furthermore, electrifying construction sites presents unique infrastructure challenges regarding temporary power. Securing utility grid connections often takes longer than the construction projects themselves, necessitating temporary solutions like mobile battery energy storage systems (BESS).

Barriers and Enablers

The transition faces persistent barriers, primarily regarding infrastructure and cost. The shortage of adequate charging infrastructure relative to fleet growth is a primary hurdle, with utility upgrades for depots often taking 18 to 24 months. Additionally, a “green premium” persists; electric construction equipment and specialized trucks command purchase prices 1.5 to 3 times higher than diesel equivalents. While lifecycle savings can offset this in some cases, the upfront capital disparity remains a significant barrier in low-bid contracting environments.

To address gaps in heavy-duty electrification, Extended-Range Electric Vehicles (EREVs) have emerged as a bridge technology. Unlike standard plug-in hybrids, EREVs use an internal combustion engine solely as a generator to recharge the battery, making a vehicle zero-emission capable for significant range. This technology offers a promising pathway to electrify heavy-duty segments—such as fire apparatus and plows—that require extended range and redundancy during emergencies but cannot yet rely on pure battery-electric powertrains.

Like plug in hybrids, EREVs will offer an additional challenge over BEVs for fleets. Fleets will need to ensure that their fleet operators maximize use of electricity to power the vehicle as opposed to the liquid fuel source. Unlike BEVs, PHEVs and EREVs introduce this long-term and challenging oversight issue.

The Safety-Sustainability Nexus

This update identifies and scopes the intersection between Vision Zero safety goals and fleet sustainability, noting that technologies reducing emissions can often enhance safety, and vice versa. DCAS evaluations have found that Intelligent Speed Assistance (ISA), for instance, effectively limits unsafe vehicle speeds to reduce crash severity while simultaneously improving energy economy by approximately 6% in electric vehicles. Similarly, rightsizing fleet units where feasible by using the smallest vehicle option that performs the agency mission can both reduce energy consumption and significantly decrease the risk of pedestrian fatalities by lowering the physical point of impact during a collision. Transitioning to high-vision cabs further supports this nexus; trucks designed with lower cabs and improved sightlines minimize blind zones that frequently lead to pedestrian crashes. Electrification of trucks offers an opportunity to also introduce these higher vision truck models. However, the additional weight of electric batteries poses an increased safety risk.

Primary Report Findings

- **Expanded Electrification Feasibility for On-Road and Off-Road Fleets:** Updated market analysis indicates a significant increase in electrification readiness, with 86% of on-road vehicles now viable for transition within five years—61% of which are Tier 1 feasible within three years (up from 41% in 2022). Similarly, fueled off-road fleet units show increased market availability, with 79% currently or soon-to-be available (up from 66%) and an additional 8% expected to have electric options within a five-year horizon.

- **More EV Models in the Market**: The availability of electric models has expanded significantly since the initial CFTP in 2022, with 195 vehicle makes and models now highlighted in the Tier 1 segment. This increase is driven largely by established automakers rather than the startup sector, which has seen instability with the bankruptcy of vocational manufacturers like Bollinger and Lightning eMotors

- **A New Category of Alternative Fuel Design**: Extended Range EVs (EREVs): The report introduces a new alternative fuel category, extended range electric vehicles (EREVs). EREVs are fully electric vehicles that utilize a small fuel engine to add electric range. These are not hybrids becausethe engine does not power the vehicle directly. EREVs could play a role in solving problems like towing, plowing, and emergency response for EVs as well as increasing range in general. The other existing alternative fuel categories applicable to NYC Fleet include battery electric vehicle (BEV), plug in hybrid electric vehicle (PHEV), and hybrid electric vehicle (HEV).

- **Reinforcing the Nexus between Clean and Safe Fleet Design**: This CFTP explores the nexuses among clean and safe fleet design. For example, intelligent speed assistance (ISA) improves fuel economy. High vision trucks offer opportunities for battery electric implementation. Right sizing, tire management, truck sideguard and/or skirts, and regenerative braking all have important fuel efficiency and safety implications. It is a critical priority of DCAS that safe and fuel-efficient vehicle design reinforce and support each other as DCAS designs the fleets of the future.

- **Exploring Clean Construction through Mayoral Executive Order 23 of 2022**: Executive Order 23 calls for DCAS to outline steps to electrify and green the commercial construction industry. This report discusses those opportunities and provides a couple of case examples from outside New York. EV equipment options for especially smaller and mid-size off-road construction equipment have increased. One of the biggest challenges is the need to bring power quickly and flexibly to construction sites to support EV equipment and the capacity to do that within current regulatory and oversight requirements.

- **Forklifts Offer a Case Study in DCAS Approach to Fleet Sustainability in a Large Off-Road Operation**. The DCAS Clean Fleet Plan calls for the agency to electrify all units as quickly as operationally feasible, implement hybrids and efficiencies including right-sizing, and to replace fossil fuels with biofuels. Forklifts provide an example of how DCAS is pursuing this approach. The City operates 736 forklifts. In the last three years, it has increased electric adoption while also transitioning remaining purchases to diesel from gasoline to enable biofuel (renewable diesel) use.

Looking Ahead

To achieve the Local Law 140 target of a fully electric light- and medium-duty fleet by 2035, DCAS will continue to advance from leading in early adoption to more systemic integration of clean fleet units. With the purchasing power of the largest municipal fleet in the United States, the City is well positioned to accelerate the commercialization of clean vehicle platforms, particularly for heavy-duty and construction applications. Future strategies can increasingly focus on overcoming infrastructure barriers by deploying mobile charging, BESS, and piloting EREVs for the vocational and heavy-duty segments. Additionally, continued coordination between the Safe and Clean Fleet Transition Plans will be key to identify and evaluate win-win opportunities for both goals, strengthening the business case for these investments. Given the current period of rapid evolution and volatility within the clean vehicle industry, DCAS recognizes that vendor and product status are shifting frequently, and market conditions will continue to change. DCAS expects to review and revise this plan at least biennially to capture market developments and maintain the City's leadership in sustainable, safe fleet operations. DCAS will also continue to partner with other municipalities and jurisdictions to promote and invest in the sustainable advancement of the fleet industry.

1. Introduction

The New York City Department of Citywide Administrative Services (DCAS) operates the largest municipal fleet in the United States, with nearly 29,000 vehicles, including approximately 24,000 on-road fleet units and an additional 5,000 off-road unit types. DCAS has implemented nearly 22,000 fleet units that use electric, hybrid, biofuel, or solar power, including over 5,700 electric vehicles (EVs), and over 2,400 charging ports at the time of writing.[1] This represented the largest alternative fuel powered municipal fleet in the United States.

The Mayoral Executive Order 53 of 2020 calls for DCAS to publish Clean and Safe Fleet Transition Plans (CFTPs and SFTPs) to outline in detail its plans to achieve these ambitious sustainability commitments. The CFTP formalizes a set of vehicle electrification and emission-reducing strategies for all fleet vehicles to eliminate the tailpipe emissions that contribute to toxic air pollution, in direct support of a series of mayoral executive orders mandating accelerated fleet electrification. Since the original CFTP in 2022, DCAS has put in place 2,357 additional EVs, and as of November 2025, DCAS operates 406 DC fast chargers. Local Law 140, which built upon Mayoral Executive Order 90 of 2021 accelerated the transition to an electric fleet from the previous target year of 2040 to:

2035 for light-duty (LD) and medium-duty (MD) units

- 2038 for trucks including specialized and emergency trucks. DCAS can issue exemptions if there are no available electric models in place and for other reasons.

DCAS has partnered with the U.S. Department of Transportation John A. Volpe National Transportation Systems Center (Volpe) to conduct research in sustainable and safe fleet options and to prepare these reports. In partnership with Volpe, DCAS has published five Safe Fleet Transition Plans. This is the second CFTP produced under Executive Order 53. Volpe partnered with DCAS to research vehicle electrification and interim emission-reducing technologies and to develop best practices to accelerate the transition. Like the Vision Zero safety-focused Safe Fleet Transition Plan (SFTP) that DCAS first adopted in 2017, the CFTP characterizes technology availability and readiness in a three-tier framework for the major categories of City fleet units.

The CFTP emphasis continues to be on the transition to an all-electric fleet in both on-road and off-road equipment, focusing on battery electric vehicles (BEVs) rather than vehicles that run solely on liquid or gaseous fuels. As intermediate steps, this CFTP incorporates the role of non-plug-in hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and for the first time,

[1] electric-vehicle-charging-stations-map.pdf

extended-range EVs (EREVs) as intermediate steps. Additionally, it incorporates the City's mass adoption of renewable diesel for medium and heavy-duty fleet units—and notably for marine vessels.[2]

Image source: [Clean Construction Innovation Pilot – NYC Smart City Testbed]

In 2022, the Clean Construction Executive Order (EO23) directed City capital construction agencies to use clean construction practices, including "making best efforts to use low-emission vehicles and equipment with a preference for all-electric equipment."[3] Approximately two million tons of carbon dioxide are released annually in the five boroughs from construction, lawn, and industrial machinery – equivalent to five natural gas-fired power plants and about 12 times the total emissions of the NYC Fleet. Construction equipment also creates localized air pollution. In 2024, to help build a market for clean construction machinery, the City launched the North American Electric Construction Coalition (NAECC).[4] This CFTP update includes a new focus area on the market of clean construction vehicles and technologies and their current feasibility.

The CFTP technologies that reduce fleet emissions can also affect fleet safety and, similarly, SFTP safety technologies can also affect vehicle fuel consumption and emissions. For example, high vision trucks without a tall engine hood are well suited to electric models. At the same time, electric vehicles are heavier due to the batteries than their fuel powered counterparts. Both issues can affect safety, and this CFTP update considers this nexus between Vision Zero and the clean fleet transition.

[2] As of May 2025, more than 27 million gallons of high carbon emitting diesel fuel have been replaced with renewable diesel. DCAS Local Law 140 Report

[3] Clean Construction - Mayor's Office of Climate & Environmental Justice

[4] NYC Clean Construction Transition Symposium September 2024; https://www.nyc.gov/assets/operations/downloads/pdf/mmr2025/2025_mmr.pdf

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Continued progress in reducing emissions to meet the EO90 targets will depend on cross-agency communication, agency willingness to pilot new technologies, close coordination with private industry including vehicle manufacturers and suppliers, and regular revision of the CFTP itself. As technologies for fleet electrification and emission reduction evolve rapidly, DCAS will review and revise the CFTP at least biennially in conjunction with the Fleet Federation agencies.

2. NYC Fleet Overview

This section provides an updated assessment of the availability and adoption of electric and hybrid vehicle technologies in New York City's municipal and non-construction fleet since the publication of the 2022 Clean Fleet Transition Plan. It summarizes changes in market readiness, vehicle availability, range and efficiency improvements, and comparative costs by segment, incorporating both on-road and off-road vehicles. Note: There is substantial flux and change occurring in the electric vehicle industry that can impact the availability of models discussed in this report

2.1 On-Road Vehicles (Non-Construction):

The following tables show the changes since the 2022 CFTP report. Table 1 compares the distribution of on-road vehicles by fuel type in 2022 and in 2025. The Tiers Table highlights the changes from the previous edition of the CFTP, including new vehicle additions, unchanged vehicles (since the 2022 report), and discontinued vehicles, while Table 1 shows the most up-to-date tier table. In addition, vehicles previously in the 2022 report that have moved from tier 2 and Tier 1 have been **bolded**. The Tiers provide a vehicle-side transition planning tool based on expected market availability within three years for Tier 1, three to five years for Tier 2, and greater than five years for Tier 3. Note: DCAS operates a small number of remaining CNG vehicles, however, CNG is no longer an area of investment for the fleet alternative fuel program.

Table 1. Comparison of on-road NYC Fleet vehicle fuel types in 2022 and 2025.

Fuel Type	2022 Vehicle Count	2022 Fleet %	2025 Vehicle Count	2025 Fleet %
Diesel/Biodiesel	10,287	39%	8,881	37%
Gasoline	8,987	34%	6,036	25%
Electric/Gas Hybrid	5,128	19%	4,438	18%
Electric Gas Plug-In	1,333	5%	1,557	6%
Electric	629	2%	2,703	11%
Diesel Plugin Hybrid	105	1%	626	3%
CNG	0	0%	6	0%
Diesel/Hybrid	0	0%	68	0%
Total	26,469	100%	24,315	100%

Tier	Vehicle Categories	Selected Example Vehicles (*Retrofit Solutions in Italics*)
Tier 1	LD Class 1 and 2a: cars, pickup trucks, passenger, and cargo vans.	***Sedans***: Audi e-Tron, BMW i4, BMW i5, BMW i7, Genesis G80, Hyundai Ioniq 6, Lucid Air, Mercedes-Benz EQE, Polestar 2, Porsche Taycan, Mercedes-Benz EQS Sedan, Tesla Model 3 (police version available) ***Hatchbacks***: Fiat 500e, MINI Cooper Countryman, Hyundai Kona, Nissan Leaf, Polestar 2, Porsche Taycan, Volkswagen ID.4, BMW i3 (Police version available), Chevrolet Bolt (Police version available), Jaguar I-Pace, MINI Cooper SE ***Crossovers***: Audi Q4, Audi Q6, Audi Q8, BMW iX, Cadillac Lyriq, Chevrolet Blazer, Chevrolet Bolt,[5] Chevrolet Equinox, Genesis GV60, Genesis GV70, Hyundai Ioniq 5, Hyundai Kona, Kia EV9, Maserati Grecale, Mercedes-Benz EQE, Mercedes-Benz EQS SUV, Nissan ARIYA, Polestar 3, Polestar 4, Porsche Macan, Volvo EC40/EX40, Volvo EX30, Chevrolet Bolt, Ford Mach-E (police version available), Kia Niro, Tesla Model Y, Volkswagen ID.4, Audi e-Tron, Hyundai Ioniq, Tesla Model X, ***SUVs***: GMC Hummer SUV, Mercedes-Benz G-Class, **Rivian R1S** ***Pickup trucks***: GMC Hummer Truck, GMC Sierra, **Chevrolet Silverado**, **Ford F150 Lightning EV**, Rivian R1T, Tesla Cybertruck ***Passenger/cargo vans***: Volkswagen ID.Buzz, Ford Transit Connect, Ford Transit passenger van ***Minivans***: **Chrysler Pacifica PHEV** ***Coupes/convertibles***: Bugatti Rimac Nevera, Maserati Grancabrio, Maserati Granturismo, Rolls-Royce Spectre
	LD Class 2b: passenger and cargo vans, including Type 2 ambulance	***Passenger / cargo vans (all w/ dedicated chassis)***: Maxwell Vehicles ePro Electric Van, Mullen One, RAM ProMaster EV, Rivian Commercial Van 500, Rivian Commercial Van 700, Rivian EDV 500, Rivian EDV 700, Ford e-Transit, **Mercedes-Benz e-Sprinter**, Brightdrop EV600, Lightning eMotors Transit Passenger Van

[5] From MY 2027, per OEM announcement. The New 2027 Bolt | Electric Car | Chevrolet

Tier	Vehicle Categories	Selected Example Vehicles (*Retrofit Solutions in Italics*)
	MD Class 3-5: chassis cab, straight trucks, and tractors	***Chassis cab, straight trucks, and tractors***: CityFreighter CF1, Endera Motors B5 SR, Endera Motors B5 XR, Envirotech Urban Electric Truck, Greenpower EV Star Cargo Plus, Hino M5e, Mullen Three, Workhorse W4 CC, ZM Trucks ZM8
	MD Class 4-6: common work truck platforms (F450/4500, etc.) that underpin different bodies including shuttle & school buses, step vans, delivery vans, box trucks, and ambulances.	***School buses***: Endera Motors B Series Type A School Bus B6, Greenpower Nano Beast ***Transit buses***: Endera Motors B4 SR, Endera Motors B4 XR, Greenpower EV Star+, Optimal EV S1 Low Floor Electric Paratransit Bus ***Collection trucks***: Robostreet LC600, XL Fleet & Curbtender Inc. All-Electric Curbtender Quantum Refuse Truck, Battle Electric, Rizon ***New EV upfit of popular MD truck chassis***: *Micro Bird G5 Electric (Ford E-450), RePower Electric Corp Ares E-Series (E-350/E-450), UES UEVCC (E-350/E-450), Collins Bus Corporation Type A School Bus (Ford E450), Motiv EPIC 4 (Ford E-450), Phoenix Motorcars Z400/Z500/Z600 (Ford E-450)* Blue Arc BA4L, Blue Bird All American Activity Bus/School Bus, Blue Bird Vision Activity Bus/School Bus, FCCC MT50e, Freightliner eM2, Harbinger HBG-04/HBG-06, Mack MD Electric, Motiv EPIC S/SL, RIDE Achiever, Peterbilt 536 EV, Rizon e16L/e16M, Workhorse W56, Xos MDXT/SV, International eMV, Kenworth K270E/K370E, Peterbilt Model 220EV, BYD 6F, BYD 5F/T7,

Tier	Vehicle Categories	Selected Example Vehicles (*Retrofit Solutions in Italics*)
	HD Class 7-8: transit and school buses, fire apparatus, collection trucks, sweepers tractors, and straight trucks.	***School buses***: Greenpower BEAST School Bus, RIDE Creator, RIDE Dreamer, Thomas Built Saf-T-Liner HDX2 Wattson, Blue Bird All American School Bus, Blue Bird Vision Activity Bus/School Bus, IC School Bus, BYD School Bus ***Transit buses***: Alexander Dennis Enviro500EV, ARBOC Specialty Vehicles Equess CHARGE - 30', ARBOC Specialty Vehicles Equess CHARGE - 35', Blue Bird All American Activity Bus, Blue Bird Vision Activity Bus, ElDorado National AXESS EVO-BE 32ft, ElDorado National AXESS EVO-BE 35ft, ElDorado National AXESS EVO-BE 40ft, Greenpower EV250 - 30 ft, Greenpower EV350 - 40 ft, Greenpower EV550 Double Decker, Letenda Electrip, Mercedes-Benz eCitaro G, New Flyer Xcelsior Trolley - 40 ft, New Flyer Xcelsior Trolley - 60 ft, Phoenix Motorcars ZX5 Max, Phoenix Motorcars ZX5+, RIDE K7M, RIDE K8M, RIDE K9MD, RIDE K11M, Temsa TS 45E, Vanhool CX45E, Vanhool TDX25E, Gillig Low Floor Battery Electric Bus, Motor Coach Industries D45, Motor Coach Industries J4500, New Flyer XE35/XE40/XE60, Proterra Transit Bus, BYD, ENC (El Dorado National), NOVA Transit Bus ***Pumper trucks***: Pierce Volterra, Rosenbauer RTX, E-ONE/REV Group Vector. (Unclear whether they match FDNY requirements) ***Collection trucks***: Battle Electric, Dennis Eagle eCollect, Heil RevAMP, Horizon Motor ELECTRIC compression garbage TRUCK, Kenworth L770E, Mack LR Electric, McNeilus Volterra ZSL, Peterbilt Model 520EV, BYD 8R, **Sweepers**: Designwerk MID CAB Sweeper, Global Environmental Products M3 EV and M4 Supercharged ***Tractors & straight trucks***: BYD 8TT, Cenntro Automotive Corporation Deepstar 864, EasyMile EZTow, Freightliner eCascadia, Freightliner eM2, Horizon Motor 4X2 HEAVY DUTY ELECTRIC TRUCK, Horizon Motor 6X4 HEAVY DUTY ELECTRIC TRUCK, International eMV, Kalmar Ottawa TX12, Kalmar Ottawa TX22, Kenworth K370E, Kenworth T680E, Kenworth T880e, Lonestar Specialty Vehicles S12/T12, Lonestar Specialty Vehicles S22/T22, Mack MD Electric, Mack Pioneer EV, OrangeEV New Extended Duty, OrangeEV New Standard Duty, OrangeEV Port, OrangeEV Rail, OrangeEV Reman Extended Duty, OrangeEV Reman Standard Duty,

Tier	Vehicle Categories	Selected Example Vehicles (***Retrofit Solutions in Italics***)
		Peterbilt 537 EV, Peterbilt 548 EV, Peterbilt 567EV, Peterbilt 579EV, Peterbilt Model 220EV, Terberg Tractors Americas YT202-EV, Terberg Tractors Americas YT203-EV, Tern RC8, Tesla Semi, Volvo VNRe, Windrose Next Generation Electric Truck, ZM Trucks ZM T75
Tier 2	LD Class 1 and 2a: minivans, SUVs (Consumer & Police).	***Minivans***: Chevrolet Blazer, Chevrolet Tahoe, Ford Mach-E, Mercedes Benz EQV, Canoo EV
	LD Class 2b/3: SUVs, cargo vans and pickup trucks	***SUVs***: Ford Excursion EV, Ford Explorer ***Cargo / passenger vans***: Mercedes Benz e-Sprinter *Note: NYPD vans and buses are currently Tier 3
	MD Class 4-6: work trucks (and subsequent body types incl. shuttle, vocational, fire, ambulance (type 1), etc.)	***Work trucks and Type I Ambulance***: Zeus Electric Chassis (*dedicated chassis, but currently no upfit)*
Tier 3	HD Class 7-8: collection trucks for plowing	Not currently available, requires enhanced energy management and/or increased density to accommodate extended, continuous use in cold temperatures. EREV options such as Edison may become more widely available.

Tier	Vehicle Categories	Selected Example Vehicles (*Retrofit Solutions in Italics*)
	HD Class 8: fire ladder trucks	Not currently available in the U.S. Rosenbauer L32A-XS Electric is an EREV turntable ladder truck commercially available in Europe.[6]

In the current CFTP report, there are a total of ***194*** vehicle makes and models highlighted in the Tier 1 segment of the table. Of those vehicles, **37** have carried over from the 2022 CFTP, and **157** are new additions for 2026. A total of **19** vehicles have also been removed, either because the model is discontinued or because the company is no longer in business. In some cases, such as for the Audi e-Tron and Hyundai Ioniq, the vehicle might have also been renamed and expanded into more trim offerings.

Some notable changes since the 2022 report include the greater number of offerings available in the crossover segment, which reflects industry-wide trends. Since the previous report, a total of **22** new crossovers have become available, and this category now makes up **40%** of the Tier 1 segment of light duty vehicles. Van and minivan models are the smallest segments in Class 1 and 2a, comprising **2%** of the light duty vehicles in the tier table. The heavier Class 2b passenger and cargo van segment saw the opposite trend, growing to become the third largest segment in the tier table, accounting for **13%** of total light duty vehicles. The change however is focused on cargo van options. Currently there are no original equipment manufacturer (OEM) passenger vans in the market. DCAS has implemented retrofits of electric cargo vans to use as EV passenger options. These were expensive however. While crossovers saw the highest number of new additions (17 new vehicles included) to the tier table since 2022, there were fewer new vans, minivans, and pickup trucks than SUVs (3 vehicles included) for 2026. While SUVs are utilized by government and commercial fleets, the work trucks including vans and pickups are critical for fleet electrification.

Another update for 2026 is that **four vehicles previously in the tier 2 category have since been made available and have been moved to the tier 1 category.** Those vehicles consist of the Ford F150 Lightning,[7] Rivian R1S, Chevrolet Silverado EV, and Mercedes-Benz e-Sprinter. In addition,

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[6] https://emobility.rosenbauer.com/en/roadmap/the-l32a-xs-electric-aerial-ladder

[7] Production of the BEV F-150 Lightning ends in 2025, but on December 15, 2025 Ford announced the F-150 Lightning EREV will replace it, with details and launch date to follow. https://www.fromtheroad.ford.com/us/en/articles/2025/next-gen-f-150-lightning-extended-range-electric-vehicle

there have been announcements suggesting near-term launches of 2 more vehicles previously in the tier 2 category of the 2022 report. Chrysler has announced the Pacifica EV to launch sometime after the regular model receives a redesign in 2026, and Zeus Electric has since signed a dealer agreement with One Stop Truck & Equipment of Sacramento, California, to distribute Class 5 electric work trucks, thus both of these vehicles have been moved over to the tier 1 category for 2025

In 2022, there were 39 total brands referenced in the tier table. Since then, that number has changed to 47. Notably, the difference between number of brands in 2025 and 2022 aren't reflective of how many new brands are highlighted in the 2025 table, since some brands no longer offer products in certain categories or have gone out of business in recent years. In the 2025 tier table, several brands now offer EVs in the light duty segment, including (but not limited to) Cadillac, Fiat, Genesis, GMC, Lucid, and Volvo.

A total of 26 highlighted vehicles have been discontinued since the 2022 report. Of those vehicles, **11** of them belonged to companies that went bankrupt in recent years. Those companies consist of Canoo, Lightning eMotors, and Lion Electric, which were known for producing class 2-8 vocational vehicles. Other than these vocational vehicles belonging to companies that are now bankrupt, several light-duty vehicles have also been discontinued due to factors such as lower-than-expected consumer demand, removal of federal tax credits for electric vehicles, or prioritization for other markets. Some of these light-duty vehicles belonging more established companies include the Audi e-Tron, BMW i3, Chevrolet Brightdrop, Ford Explorer, Ford Transit Connect, Hyundai Ioniq, and Jaguar i-Pace.

For the Audi e-Tron and Hyundai Ioniq, which were originally crossovers, those vehicles have been discontinued and spun off into new vehicle nameplates or renamed entirely. For example, the Audi e-Tron crossover from the 2022 report has been renamed to the Audi Q8 e-Tron, with the introduction of the e-Tron trim available for the Audi Q4, Q6, Q8, while the e-Tron nameplate is used for their electric sports sedan, the Audi e-Tron GT, which also shares a platform with the Porsche Taycan that was previously included in the 2022 tier table. In addition, the Hyundai Ioniq was previously offered as a standalone crossover and is now available as the Hyundai Ioniq 5 crossover and Hyundai Ioniq 6 sedan as a part of Hyundai's electric vehicle lineup.

The market for large electric vehicles (EVs) capable of **heavy-duty plowing remains in the experimental and early pilot phase**. While manufacturers like Mack and Battle Motors produce Class 8 electric trucks that can physically accept a plow, they cannot yet sustain the energy output required for a full 8-12 hour plowing shift.[8] There is currently one Extended Range Electric (EREV) heavy-duty plow truck in North America, but it comes from a specialized manufacturer: Edison Motors is expected to deliver a highway snow plow for a Canadian road maintenance contractor for the 2025-2026 winter season, which may provide a data point on EREV plowing performance.[9]

Like plow trucks, fire apparatus can be challenging to electrify, where the equipment may need to pump water at full power for 12+ hours. No pure battery-electric pumpers appear to exist without some form of backup power. **The pumper industry appears to have standardized on "zero emission capable" EREV** (Range Extended) **or PHEV** (Plug-in Hybrid) **designs to ensure redundancy**, and at least three models have become commercially available in the U.S., advancing this category up to Tier 1.

In contrast to pumper trucks, **all-electric ladder trucks are entering service internationally**. In 2023, Rosenbauer delivered the first electric aerial apparatus in Berlin, Germany (the L32A-XS). The equipment has not yet been adapted for the heavier, larger US-style of ladder trucks, so this category remains in Tier 3.

In summary, since 2022, the on-road electric vehicle market has matured significantly, pivoting from startups and conversions to more established manufacturing by OEMs. While the domestic vocational sector saw instability with the exit of several niche startups, established legacy automakers have notably expanded their U.S. portfolios. This growth is most visible in the **Crossover SUV** segment, which has surged to comprise 40% of all light-duty options in Tier 1, and in **Class 2b commercial vans**, which have grown to become the third-largest segment. With some exceptions such as pumper trucks, the market for specialized heavy-duty applications has been more stagnant; plowing and fire ladder trucks remain in Tier 3, as current U.S.-market all-electric models cannot yet meet the continuous-duty energy demands of these municipal operations.

2.2 Off-Road and Specialized Equipment:

Aside from the on-road vehicles discussed in prior sections, approximately 16 percent of New York City's fleet consists of off-road and specialized equipment. This category includes more than 4,500 units across 78 distinct standard types (56 fueled and 22 unfueled), ranging from cranes and compressors to mowers and chippers. Table 2 summarizes tiered technology availability for the most common off-road standard types, while the appendix provides a complete listing.

[8] https://nyc.streetsblog.org/2022/11/18/dsnys-electric-trucks-conk-out-too-quickly-during-snow-plowing-says-commish
[9] https://northx.ca/project/edison-motors-ltd

In this updated analysis for Off-Road and Specialized Equipment, the market-readiness tiers have been revised to better reflect current operational viability and deployment status. Unlike on-road vehicles that operate within standardized duty cycles and well-defined regulatory classes, off-road equipment performs highly specialized and variable tasks that require a higher threshold of proven performance before they can be considered deployable at-scale. Consequently, this revised framework prioritizes real-world validation over simple market presence. Tier 1 is now designated for off-road vehicles that are both commercially available and fully operational in real-world environments, indicating a readiness for fleet integration. Tier 2 off-road vehicles may be commercially available but are currently limited to pilot programs domestically or prototype stages, requiring further validation before widespread adoption. Tier 3 identifies equipment that is currently not viable for electrification, primarily due to the highly specialized nature of the machinery or constraints where current battery technology or off-road sites cannot yet support the heavy-duty operation.

Since the 2022 report, the market for clean off-road equipment has expanded significantly as advances in battery technology, increasing manufacturer investment, and international demand for sustainable, low-noise equipment have driven new product development.

Table 2. Off-Road Vehicles by Fuel Type in 2022 and 2025

Fuel Type	2022 Unit Count	2022 Fleet %	2025 Unit Count	2025 Fleet %
Diesel/Biodiesel	2,810	62%	2,913	65%
Gasoline	868	19%	700	15%
Electric	517	12%	557	12%
Solar	288	6%	221	5%
Propane	55	1%	50	1%
Solar/Hybrid	3	0%	69	2%
Diesel/Hybrid	0	0%	3	0%
Solar/Propane	0	0%	2	0%
Total	4,541	100%	4,515	100%

Volpe's 2025 update finds that technological readiness has advanced considerably: 47 percent of the 56 fueled standard types meet Tier 1 availability, with electric models on the market and with some commercial use. The share of Tier 2 equipment, defined as models that are commercially available but still challenging to implement (e.g., due to inadequate duty cycle), represents 21 percent, while 32 percent are in Tier 3, with limited or no commercially viable electric options (See Table 2 for comparison). This trend reflects both the rapid diversification of smaller and mid-sized electric equipment and the continued technological and operational challenges associated with heavy-duty, high-power off-road applications.

Table 3. Electrified Inventory of NYC Equipment

Vehicle Type	Electric Inventory	Total Inventory	% Electrified
OFF ROAD UTILITY VEHICLE	208	725	29%
FORKLIFT	268	643	42%
SCOOTER/MOPED	29	244	12%
MOWER - RIDE ON	5	164	3%
ATV	8	40	20%
UTILITY CART	24	25	96%
AERIAL LIFT - OFF ROAD BOOM	9	23	39%
TRAM/TROLLEY	2	4	50%
CRUSHER	1	3	33%
ELECTRIC UTILITY VEHICLE	2	2	100%
VACUUM - RIDE ON	1	2	50%

While technology availability continues to advance, New York City's off-road fleet remains primarily powered by conventional fuels. Diesel and biodiesel equipment together account for roughly two-thirds of the total inventory, with gasoline and hybrid-diesel models comprising much of the remainder. Electric units represent about 15 percent of the fleet which represents a 3 percent increase since 2022. Fiscal reductions have limited DCAS's recent ability to invest in replacement off-road electric units. Adoption is most visible in smaller and auxiliary equipment categories, where electric options are already widely commercialized. For example, 42 percent of forklifts, 29 percent of off-road utility vehicles, and nearly all utility carts (96 percent) in the city fleet are now electric (see Table 4 for full breakdown). This progress in light- and medium-duty equipment highlights the growing opportunity to integrate Tier 1 electric and hybrid technologies as availability and infrastructure continue to improve. For electric unity carts, plowing remains a limiter in electrification. For forklifts, heavier duty load requirements remains a limiter.

2.3 Off-Road Tier 1 Standard Types

Table 4: Selected Examples of NYC Equipment by Standard Type

Tier	Vehicle Categories	Inventory	Selected Example Vehicles
Tier 1	Off-Road Utility Vehicle	725	GEM, Polaris Ranger EV, John Deere TE 4x2 Electric, TORO 07410, Club Car Carryall, GEM ELXD, Cushman Hauler Pro X Elite
	Forklift	643	Yale Four Wheel Electric Forklift Series, Toyota Electric Forklift Series, Clark ECX20, Clark ECX360, Crown FC 5215-50, Doosan BC15S-5
	Mower - Ride On	164	Ryobi 54" Electric Riding Lawn Mower, John Deere 7370R Electric, Toro 60V Max 54in, Gravely Pro-Turn EV, Mean Green SK-48 Stalker, Mean Green Vanquish, Mean Green Rival, Mean Green EVO, Bobcat ZT6000e

Tier	Vehicle Categories	Inventory	Selected Example Vehicles
	Wheel Loaders (Compact)		Volvo L20 Electric, Volvo L25 Electric, Case CL36EV, Avant, E Series: e5, Nesher L880, Nesher L1400, Nesher L3000
	Skid Steer	213	Bobcat T7X, First Green Industries eLise 1200/700/900, Toro e-Dingo TX750/500
Tier 2	Tractors / Beach Tractors	335	Moarch MK-V, Solectrac e25 Compact Electric Tractor, New Holand T4 Electric Power
	Roller	47	Volvo CE DD25, Dynapac Z.ERA CC900e/1000e, Hamm HD CompactLine, Wacker Neuson RD28e
	Mid-Sized Wheel Loaders		Volvo L90 Electric, Volvo L120 Electric, HEVI H65L.
Tier 3	Heavy Wheel Loaders		None
	Heavy Equipment		None

2.3.1 Off-Road Utility Vehicles

The market for electric off-road utility vehicles has increased since 2022. Plowing is the main operational limitation in electrifying off-road carts. Towing and beach operations are also an impact for these units, which DCAS procures as diesel where electric is not viable to utilize renewable diesel. 208 of the city's 725 UTVs are currently electric, representing just 29% of the overall fleet. However, of the 183 new UTVs purchased since 2022, 81 (approximately 44%) were battery electric models, a greater focus on electrifying this fleet segment where-ever operationally possible.

2.3.2 Mowers – Ride On

Since 2022, the commercial market for electric ride-on mowers has expanded, driven by improved battery technology and increasing demand for sustainable fleet operations. OEMs, including Ryobi, John Deere, Toro, Mean Green, Bobcat, and Gravely, offer a variety of models for commercial and residential use, with a range of mowing deck sizes and zero-turn options. As of September 2025, the Department of Parks and Recreation (DPR) operates five electric ride on mowers, (Gravely Pro-Turn EV60 RD, Mean Green SK-48 Stalker, and Greenworks GZ 60R). Lessons learned from DPR's initial deployment of electric mowers could provide valuable insights into the operational transition to electric off-road equipment for other agencies.

2.3.3 Forklifts

Forklifts represent the most mature segment of the electric off-road fleet, with 42% of the City's inventory already electrified. This category is firmly Tier 1, as zero-emission models are the industry standard for indoor and warehousing operations. The fleet currently operates 268 electric units across all weight classes, proving that electric powertrains can meet diverse load requirements. Although just 42 percent of the overall fleet is electric, models purchased between 2022 and 2025 are signaling a rapid shift, with electric units comprising 67 percent of new acquisitions compared to just 29 percent for diesel.

Forklifts offer a case study in the DCAS CFTP approach to sustainability, electrifying every unit that operationally can be electrified and then switching the remainder to diesel units to operate on renewable diesel. **In 2022, 29% of forklifts were electric and 71% used fossil fuels. In 2025, 44% are electric, 52% use renewable diesel, and only 3% still use fossil fuels.**

Table 5. NYC forklift electrification and emissions reduction progress, 2022 to 2025

Fuel Type	2025 Count	Percent of Fleet by Fuel Type, 2022	Units Purchased Since 2022	Percent of Fleet by Fuel Type, 2025
Electric	208	29%	81	44%
Biofuels/Diesel	315	43%	96	52%
Gasoline	202	28%	6	3%
Total	725	100%	183	100%

2.4 Off-Road Tier 2 Standard Types

2.4.1 Tractors

Since the 2022 report, the market for electric tractors has evolved. While previously only a few startups offered models, established OEMs like New Holland have introduced their own electric options.[10] However, this expansion hasn't eliminated the original barriers. The City's fleet still predominantly uses robust diesel models from manufacturers like John Deere and Kubota for their proven reliability and easy fueling. The electric options, while capable on paper, face challenges with high upfront costs, the need for extensive charging infrastructure, and continued production scaling issues. These ongoing challenges mean a full fleet transition remains categorized as Tier 2,

Figure 1. First Volvo L90 Electric delivered in the US (Sept 2025)

[10] https://www.agriculture.com/new-holland-s-t4-electric-power-utility-tractor-7966136

requiring further market maturity and testing for demanding municipal applications.

2.4.2 Mid-Sized Wheel Loader

Since 2022, mid-sized electric wheel loaders have advanced from experimental prototypes to early commercialization, with manufacturers now accepting orders for models in the 15,000–50,000 lb range. However, these machines remain in a "pilot/order-only" phase and are not commercially available.[11] This segment comprises the core of the City's heavy material handling fleet, with 23 units including the Volvo L70H (~30,000 lbs) and Volvo L110H (~40,000 lbs). While emerging electric models like the Volvo L120 Electric technically match diesel capacity, their operational viability is contingent upon the availability of high-power DC fast-charging infrastructure to support energy-intensive daily workflows. Piloting mid-sized electric loaders in areas with high-powered charging would be a step toward electrification, while renewable diesel, or hybrid diesel remains the interim solution for the broader fleet.

2.4.3 Rollers

Previously categorized as Tier 3 in the 2022 CFTP, the roller category has advanced to Tier 2 due to the commercialization of Compact Electric Rollers in the 2.5-3 ton class. While manufacturers have successfully deployed battery-electric models for bike lanes and patch work, technology for heavy mainline paving remains immature. The City's fleet is currently dominated by Heavy-Duty tandem vibratory rollers (8–14 tons), like the Hamm HD+ 140, which lacks electric equivalents. The immediate opportunity is to transition the smaller utility rollers (e.g., Chicago Pneumatics AR120) to available electric models like the Volvo DD25 Electric. However, for the heavy 10+ ton units that comprise the majority of the fleet, electrification remains limited until battery energy density improves enough to sustain high-vibratory loads.

2.5 Off-Road Tier 3 Standard Types

2.5.1 Heavy Wheel Loaders

Since 2022, the heavy wheel loader market has seen minimal progress toward electrification, remaining firmly in Tier 3. While smaller segments have advanced, machines exceeding 50,000 lbs still lack commercially available zero-emission equivalents in North America. This category

[11] The first Volvo L90 Electric entered service domestically in September 2025 at a data center construction site https://www.linkedin.com/posts/volvo-construction-equipment_this-is-a-milestone-for-our-wheel-loader-activity-7377319413865336832-L2R9?utm_source=share&utm_medium=member_desktop&rcm=ACoAACJsFK0BjisxZ2VHliK90ikSo0fViyy5TrQ

represents the fleet's extreme lifting capacity, with 12 Volvo L180H (~60,000 lbs) units and 6 Caterpillar 980M (~66,000 lbs). These machines perform critical tasks requiring continuous high-power output that current battery technology cannot support. Consequently, near-term decarbonization for this segment must rely on renewable diesel, while long-term strategies await the maturity of hydrogen fuel cells or significant breakthroughs in battery energy density.

2.5.2 Heavy Construction Equipment

This category encompasses the City's most energy-intensive and specialized assets, including Asphalt Pavers, Snow Melters, Bulldozers, and Tree Chippers. These machines perform critical, high-load tasks, often during emergencies or in locations without grid access, that currently exceed battery capabilities. Consequently, electrification opportunities are limited to niche small-scale units or hybrid alternatives. The primary decarbonization strategy for this "hard-to-abate" sector remains the continued use of renewable diesel until battery density or hybrid technologies mature sufficiently to meet these rigorous duty cycles.

3. Clean Construction Vehicles: Market, Technology, & Feasibility

Approximately two million tons of carbon dioxide are released annually in the five boroughs from construction, lawn, and industrial machinery – equivalent to about 12 times the total emissions of the NYC Fleet. For this reason, and in support of the Clean Construction Executive Order (EO23), the CFTP newly includes an overview of the clean construction technology landscape. The following sections consider what is currently on the market and its potential readiness and challenges for NYC deployment, highlighting battery-electric, hybrid, and grid-electric equipment options for different use cases. To produce this overview, Volpe employed literature review and a series of semi-structured SME discussions with equipment manufacturers, general contractors, and federal and state agencies (see Table 6) with experience in clean construction deployment.

Table 6. Organizations engaged to baseline state of clean construction

Organization Name	Organization Type
Consigli	General Contractor
Turner Construction	General Contractor
Argonne National Laboratory	National Lab
National Renewable Energy Laboratory	National Lab
Caterpillar	OEM
John Deere	OEM
Volvo	OEM
Sunbelt Rentals	Rental Company

Organization Name	Organization Type
United Rentals	Rental Company
Pennsylvania DOT	State DOT

3.1 Equipment Power, Size, and Use Cases

The availability and performance of electric construction equipment continue to evolve rapidly across all power classes. Early adoption has centered on compact and mid-sized machines that can meet daily duty-cycle requirements within range and charging limitations, while maintaining the torque and hydraulic responsiveness of diesel equipment. Stakeholder interviews and pilot data indicate that these machines are increasingly capable of meeting operational demands for small to medium construction projects, though a need remains to expand performance and charging capacity for larger, continuous-duty applications.

3.1.1 Current Market Availability

Commercially available electric equipment currently meets most needs in small and select mid-sized categories. Compact electric excavators, wheel loaders, skid steers, and aerial lifts have entered the U.S. market and are in initial use for light construction, interior demolition, facility maintenance, and confined-space operations.

These machines offer zero tailpipe emissions, quieter operation, and reduced vibration, benefits that are particularly valuable for urban environments such as New York City. [12] Stakeholders noted that these performance and comfort improvements not only enhance worker well-being but also create opportunities for extended work hours in noise-sensitive zones where diesel machinery would be restricted. These compact units offer an opportunity for DCAS to expand its current fleet electrification efforts.

Figure 2: Compact equipment is often able to be charged with existing EV infrastructure

3.1.2 Mid-Sized Front Wheel Loaders (40,000 – 50,000 lbs)

These representative models illustrate the current operational range and energy profiles of

[12] FEATURE: Volvo Construction Equipment - Electric & Hybrid Vehicle Technology International

U.S. Department of Transportation Volpe Center

mid-sized electric loaders on the global market. Machines in this class, typically 40,000 to 50,000 lbs operating weight and 250–425 kWh battery capacity, are capable of matching diesel torque and lift capacities for full or partial work shifts when supported by high-capacity DC fast charging. Across manufacturers, usable runtimes of roughly 5 to 9 hours and DCFC recharge windows of 1–2 hours have become typical benchmarks. While energy storage capacity and runtime vary by duty cycle and hydraulic demand, all examples demonstrate readiness for medium-duty applications such as site loading, material handling, and quarry or yard work with access to mobile or semi-permanent charging infrastructure.

Table 7: Selected Example of Electrified Equipment - Mid-Sized Electric Wheel Loaders

Specification	Volvo L120 Electric[13]	HEVI H65L[14]	LiuGong 856HE MAX[15]
Operating Weight	43,431 - 46,297 lbs	48,942 lbs	46,297 lbs
Rated Load	~13,227 lbs	14,330 lbs	12,786 lbs
Bucket Capacity	4.3 – 7.2 yd^3	5.5 yd^3	4.58 yd^3
Battery Capacity	282 kWh	423 kWh	423 kWh
Approx. Runtime	5 – 9 hours	9 hours	8 – 10 hours
Fast Charge (DCFC)	~1 hour 40 min (10-100%)	< 4 hours	1.5 hours (at 300kW)

3.1.3 Electric Mini Excavator (4,000-4,500 lbs.)

These compact excavators represent the first generation of commercially available zero-emission machines in the 1.5 – 2-ton class. They have now been introduced for use in landscaping, trenching, utility, and interior construction tasks where noise and exhaust emissions must be minimized. Their size and power requirements allow full-day operation for light to moderate duty cycles with Level 2 AC charging or short DC fast-charge intervals.

[13] https://www.volvoce.com/united-states/en-us/products/electric-machines/l120-electric/
[14] https://gethevi.com/electric-heavy-equipment/electric-wheel-loaders/h65l/
[15] https://www.liugongna.com/wheel-loaders-856he-max

Table 8. Selected Example of Electrified Equipment - Mini-Excavator

Feature	Takeuchi TB20e[16]	Kato 17VXB (Battery)[17]	Volvo EC18 Electric[18]
Max Dig Depth	7 ft 10 in	7 ft 0 in	8 ft 2 in – 8 ft 10 in
Max Dig Force	4,226 lbf (Bucket)	3,687 lbf (Bucket)	2,900 lbf (Breakout)
Battery Capacity	24.7 kWh	Li-Ion (kWh not listed)	20 kWh
Runtime	Up to 8 hours (65% load)	8 hours	Up to 6 hours
Charging	2 hours (Off-board 400V)	8 hours (Standard)	1.25 hours (DCFC)
Max Dig Depth	7 ft 10 in	7 ft 0 in	8 ft 2 in – 8 ft 10 in

3.1.4 Electric 20-ton Excavator

Twenty-ton excavators represent a critical transition point between compact and heavy equipment categories. Across manufacturers, battery-electric models are now capable of performing full-shift excavation work comparable to diesel units in power rating and digging depth, with operating runtimes of approximately 6 to 8 hours when paired with high-capacity DC fast-charging support.

Table 9: Selected Example of Electrified Equipment - 20-Ton Excavators

Specification	Volvo EC230 Electric[19]	Caterpillar 320 Electric[20]	Komatsu PC210LCE[21]
Operating Weight	47,010 – 57,690 lbs	~56,400 lbs	~54,000 lbs
Bucket Capacity	0.6 – 1.88 yd^3	1.3 – 1.7 yd^3	0.65 – 1.57 yd^3
Battery Capacity	450 kWh	387 kWh	451 kWh
Runtime (approx)	7 – 8 hours	Up to 8 hours	5 – 9 hours
Max Dig Depth	22 ft 5 in	21 ft 9 in	21 ft 8 in
Fast Charging	90 min (250 kW DC)	1 hr (DC fast charge)	90 min (via DC)

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16 https://www.takeuchi-us.com/tb20e-specs-and-dimensions/
17 https://katoces.com/product/17vxb-battery-mini-excavator/
18 https://www.volvoce.com/united-states/en-us/products/electric-machines/ec18-electric/
19 https://www.volvoce.com/united-states/en-us/products/excavators/ec230/
20 https://www.zeppelin-cat.no/en-no/equipment/produkter/construction-machinery/excavators/medium-excavators/cat-320-z-line
21 https://www.komatsu.jp/en/-/media/home/aboutus/innovation/technology/techreport/2023/176-e02.pdf?rev=302058eacd8345078d80c22204b29f2f&hash=2C00D3F73394859142E89347CE66104B

These examples show progress in the commercial readiness of zero-emission construction equipment across several power classes. Compact and mid-size machines now provide comparable torque, control, and productivity to conventional diesel units for most single-shift operations when charging access is available on site, a critical factor that is discussed in the following section. The newest 20-ton excavators indicate that larger platforms are beginning to meet the same performance expectations for medium- and heavy-duty projects. While technical and operational challenges remain, including limited endurance for multi-shift work, site power availability, and higher capital cost, the overall trend points to continued growth in market availability and practical use. Improvements in battery capacity, charging systems, and hybridized power management are expected to further extend operating hours and expand the range of applications for which electric equipment can be used in New York City construction projects.

3.2 Charging and Infrastructure

Electrifying construction equipment introduces a distinct set of charging and infrastructure challenges that differ from those encountered in on-road fleet operations. Construction sites are temporary, space-constrained, and often lack reliable electrical service until later in the project timeline. These conditions can make it difficult to establish fixed charging infrastructure or ensure consistent power supply for heavy equipment with high energy demands. Stakeholder discussions and pilot projects highlighted that addressing these constraints will require new approaches to temporary power planning, permitting, and on-site energy management tailored specifically to construction environments.

Stakeholder interviews and pilot projects revealed that limited power availability remains the most significant barrier to implementing electric construction equipment in New York City. Because electricity is often not installed until the later phases of construction, available power typically must be generated on-site through mobile, off-grid solutions such as battery energy storage systems (BESS), transportable charging units, and similar modular systems. To bridge this gap between current site conditions and future grid service, stakeholders pointed to growing use of hybridized power systems that integrate renewable generation, battery storage, and smart controls to deliver reliable energy. Examples from both California and Europe demonstrate that pre-planned temporary power installations and containerized charging units can enable partial or full jobsite

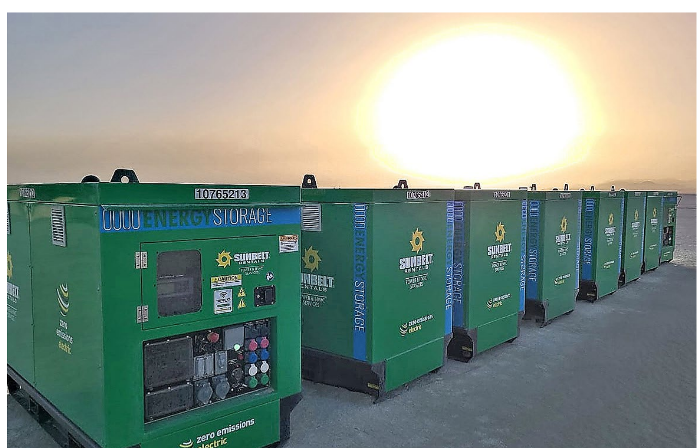

Figure 3. Sunbelt Rentals RPS150 portable energy storage units using Viridi technology help power the Burning Man event in Black Rock City, NV.

electrification without disrupting construction schedules.

Stakeholders emphasized that existing utility and permitting processes are not well suited to the temporary and fast-paced nature of construction projects. Securing electrical service or transformer installations can take more than a year, often exceeding project lifecycles, and coordination among utilities, permitting agencies, and contractors can further delay power delivery. The absence of standardized procedures for temporary high-capacity service limits early electrification even on projects prepared to deploy electric equipment. Stakeholders agreed that addressing these issues in New York City will require clearer permitting guidance, early-stage power planning, and stronger coordination with utilities to ensure consistent, low-emission power access throughout the project lifecycle.

In addition to these administrative challenges, industry players have noted several technical and spatial factors that can complicate charging deployment. Grid capacity constraints in certain neighborhoods restrict the number of high-power chargers that can be installed, even with utility support. FDNY safety reviews and the timelines for permitting large battery energy storage systems can create uncertainty for short-duration projects. Space limitations at dense urban worksites also make it challenging to locate chargers or storage units without disrupting operations. International practices such as mobile charging stations and battery swapping have helped mitigate similar constraints abroad but have not yet seen wide adoption in New York City.

3.3 Cost Analysis

Stakeholder interviews and pilot project data indicate that the current purchase or rental price of electric construction equipment remains substantially higher than that of equivalent diesel models, typically ranging from 1.5 to 3 times the upfront cost depending on equipment type, size, and market maturity. This cost differential primarily reflects the high price of battery systems and the limited scale of production for many electric models. Despite higher acquisition costs, stakeholders noted that lifecycle savings can offset, at least in part, these expenses in high-utilization scenarios where machinery operates for extended hours each day. Lower fuel and maintenance requirements contribute to long-term cost advantages, particularly for equipment that accrues significant annual operating hours. [22]

Fleet managers and rental companies that Volpe engaged for this report have emphasized that the economic viability of electrified equipment depends on total lifecycle performance rather than short-term project costs. Durable components, fewer moving parts, and reduced idling time all

[22] https://www.fultonhogan.com/electric-loader-energy-cost-savings-up-to-78-7/

help lower ongoing operating costs relative to diesel machines. Equipment used intermittently or on short-duration projects is less likely to realize these savings, because reduced fuel and maintenance costs may not balance the higher purchase price over the equipment's lifetime. As the market for electric and hybrid equipment grows and battery prices continue to decrease, the upfront price gap is expected to narrow, improving cost competitiveness for a wider range of applications.

3.3.1 Total Cost of Ownership

The total cost of ownership for electric construction equipment is primarily determined by utilization rate, operating hours, and the balance between energy savings and financing costs. Equipment that operates for long shifts or on high-demand projects tends to recover its higher initial cost more quickly, as reductions in fuel use and maintenance accrue over time. Conversely, low-utilization equipment or machinery deployed on short-duration projects is less likely to offset the initial investment within its expected service life.

In assessing lifecycle economics, fleet operators typically consider the combined effects of purchase price, maintenance requirements, energy costs, and expected resale value. Efficient energy management practices, such as reduced idling, consistent duty cycling, and planned overnight charging, can further improve financial performance by lowering total energy consumption and extending battery life. Access to affordable financing also influences the payback period, as higher borrowing costs can lengthen the timeframe required to realize net savings. As electric equipment production scales and battery costs decline, total ownership costs are expected to become increasingly competitive with conventional diesel equipment, especially for fleets with consistent, high hour operations.

3.3.2 Operational savings

Operational savings from electric construction equipment are typically realized through lower energy and maintenance expenses and modest productivity benefits related to noise and vibration reduction. Electricity can be less expensive per unit of energy than diesel fuel in some markets, depending on electricity source, resulting in immediate fuel savings when charging infrastructure is available on site. Electric powertrains also have fewer moving parts, which reduces the frequency and cost of routine maintenance such as oil changes, filter replacements, and mechanical overhauls. Over longer project durations, these factors can offset a substantial portion of the equipment's higher upfront cost. Beyond direct cost savings, quieter electric operations may allow contractors to extend permitted work hours in noise-sensitive and emissions-sensitive areas (e.g., interior, underground, near schools), improving overall project efficiency and schedule flexibility.

3.3.3 Incentives

Financial incentives and grant programs play a major role in narrowing the cost gap between electric and diesel construction equipment and encouraging early adoption. California's Clean Off-Road Equipment (CORE) and related incentive programs provide point-of-sale and project-based rebates to offset the higher capital cost of zero-emission machinery. Similar initiatives are emerging in other states but have not yet reached the same scale or coverage. At present, there is no directly comparable program in New York State or New York City targeting off-road construction equipment, and no immediate federal funding mechanisms for clean transportation and infrastructure projects may provide partial eligibility. Stakeholders consistently identified incentives, along with coordinated public procurement policies, as essential to transition the industry beyond isolated pilots toward broader market adoption.

3.4 Site Management, Operations, and Workforce

Effective site management is central to the practical use of electric construction equipment. Because construction sites operate on temporary schedules and changing power availability, managing zero-emission machinery requires deliberate planning and coordination across project activities, charging logistics, and workforce training. Experience from stakeholder interviews and pilot projects indicates that well-organized operations can minimize downtime, extend equipment runtime, and improve both safety and productivity.

3.4.1 Role that worksite planning has in managing electrified equipment

Electric construction sites perform best when charging, equipment utilization, and task sequencing are planned together. Contractors and manufacturers emphasized that scheduling work in line with available power supply and predictable charging cycles helps maintain normal productivity levels. Placement of charging units is an important early-stage design consideration; positioning chargers near equipment laydown areas or staging zones reduces unnecessary equipment movement and minimizes energy loss. Volvo and other manufacturers noted that telematics data can support this planning by identifying average runtime, idling hours, and peak power demand, allowing supervisors to match tasks to the capability and charging status of each machine. Intentional scheduling of non-productive periods, such as lunch or shift breaks, for charging has been widely adopted in existing electric equipment pilots.

3.4.2 Training the Workforce

The transition to battery-electric equipment introduces new training needs for both operators and maintenance personnel. Operators must understand equipment range limits, state-of-charge indicators, and appropriate procedures for connecting to high-voltage chargers. Cold-weather activities and charging in damp or confined areas require additional awareness of battery conditioning, ventilation, and fire-safety procedures. Fleet managers and trainers from Consigli and Turner emphasized the importance of developing technician expertise in diagnosing electric drivetrain issues and safely handling high-voltage components, noting that experienced diesel mechanics often require supplemental instruction to service electric models. At present, the availability of trained maintenance technicians remains limited, creating opportunities for partnerships with equipment manufacturers and trade schools to expand electric-equipment service capacity.

3.4.3 Telematics and Operational Efficiencies

Telematics systems are increasingly viewed as essential tools for managing electric equipment in the field. While all City agencies already use telematics for on-road vehicles, there is not yet a formal City-led program for off-road fleets. DCAS and NYC Emergency Management have begun an initial off-road tracking program. Rental companies such as United Rentals and Sunbelt have begun integrating detailed runtime and charging data collection into their off-road inventories. These systems track battery state of charge, power consumption, and idling events, enabling project managers to optimize scheduling and identify underutilized units.

Figure 4. Caterpillar telematics system monitors real-time telematics data, including fuel levels, engine performance, and hydraulic pressure.

Stakeholders also recommended integrating location tracking and remote lockout functions to prevent unauthorized use or theft of high-value electric assets, particularly in urban environments. Sunbelt is supporting a manufacturer-funded “BEWARE” pilot program using light-tower telematics to test these capabilities and evaluate their battery safety features for broader application.

3.4.4 Lessons from Early Pilot Projects

Early pilots conducted by Milwaukee Tool, Turner Construction, and others have provided useful information on day-to-day operations of electrified job sites. Reported benefits include significantly lower noise levels, easier verbal communication among workers, and reduced operator fatigue because of diminished vibration. According to the stakeholders Volpe engaged, these improvements have contributed to a safer overall work environment and greater worker acceptance of new technology. Common barriers remain, including uncertainty around actual runtime compared to rated capacity, slower charging or reduced range in cold weather, and limited access to on-site power where grid connections are delayed. Pilots also confirmed that clear communication of charging schedules and consistent recording of equipment performance data are key to maintaining reliability and building confidence in electric construction operations.

Together, these findings suggest that planning and workforce readiness are as important to successful electrification as the equipment itself. Systematic scheduling, trained personnel, and real-time operational feedback can enable construction projects to fully realize the environmental and performance benefits of zero-emission machinery.

3.5 Safety and Regulatory

Battery safety and regulatory compliance have emerged as central factors in enabling wider use of electric and hybrid equipment on construction projects. Stakeholders across New York City agencies and industry partners consistently emphasized that meeting fire-safety and permitting requirements is often the critical path to deploying on-site battery energy storage systems (BESS) or mobile charging units. While new standards and certification programs are improving the reliability of energy-storage technology, local approval processes and workforce readiness remain key determinants of when and where electric equipment can be used.

The Fire Department of New York (FDNY) regulates stationary and mobile lithium-ion battery installations through detailed testing and certification requirements intended to prevent and contain thermal events. All large battery systems, including temporary BESS supporting construction projects, must demonstrate compliance with FDNY fire-safety standards that include anti-propagation design, integrated monitoring, and ventilation controls.[23] Units certified under the national **UL 9540** testing protocol provide the highest level of current assurance and are required for FDNY consideration. Stakeholders from Sunbelt Rentals reported that the agency's review and approval timelines can exceed the duration of many short-term projects, creating uncertainty for contractors seeking to use electrified equipment for temporary worksites. These time frames are improving as the department gains experience with certified technologies, but the process remains a significant planning consideration for project sponsors and equipment providers.

As battery-electric machinery becomes more common, project sites face integrating safety procedures for the different risks associated with high-voltage systems. FDNY operational protocols now incorporate designated charging areas that meet clearance and ventilation

[23] https://www.nyserda.ny.gov/All-Programs/Clean-Energy-Siting-Resources/Battery-Energy-Storage-Guidebook

requirements, daily inspections of cables and connectors, and controlled access to stored energy systems. Emergency-response planning has expanded to include procedures for electrical isolation, fire suppression using non-conductive agents, and coordination with local fire officials before installation of any large BESS. The Port Authority and Turner Construction both indicated that specialized safety training is being developed for equipment operators, maintenance personnel, and first responders so that worksite staff can identify warning signs of battery damage and take appropriate action. These training programs build on existing occupational-safety practices but add emphasis on high-voltage awareness, personal protective equipment, and communication protocols in the event of a battery incident.

Recent generations of battery-energy-storage equipment incorporate extensive safety enhancements that have improved reliability and reduced overall fire risk. Certified UL 9540 systems are engineered with physical cell separation, heat-resistant casings, and integrated temperature and gas sensors to detect thermal runaway at an early stage. These units also include automated shutdown features and remote monitoring that allow operators to maintain situational awareness from outside the immediate battery area. The first FDNY-approved BESS units deployed in New York City construction settings have demonstrated stable operation under varying environmental conditions, enabling brief on-site charging without the need for diesel generators. However, stakeholders cautioned that potential hazards remain with untested or uncertified systems, improper charging in enclosed areas, and inadequate disposal or storage of damaged cells. Ongoing attention to equipment certification, site-specific fire-safety planning, and consistent operator training will be essential to ensure safe expansion of electric construction operations across the city.

Together, these regulatory and operational developments illustrate that safety management will necessarily evolve alongside technological advancement. Clear permitting pathways, proven safety certifications, and informed personnel will enable contractors and public agencies to adopt clean-construction technologies while maintaining the City's stringent standards for worker and community safety.

3.6 Case Studies and Pilots

Across the construction sector, a growing number of pilot projects are testing electric and hybrid equipment to evaluate their operational performance, charging requirements, and cost implications under real-world conditions. These demonstrations provide valuable insights into the feasibility of clean construction practices across a range of project types, geographic contexts, and power access scenarios. While not all pilot projects have concluded, early returns help identify practical lessons that can inform broader adoption of low and zero-emission technologies in New York City.

3.6.1 Skanska/Volvo EC230 Electric Excavator Pilot (Los Angeles, CA)

Figure 5. Volvo EC230 Excavator on site at the Los Angeles Metro Purple (D Line) Extension (2023)

Skanska USA, working with Volvo Construction Equipment, completed a 90-day demonstration of the Volvo EC230 battery electric excavator on the Los Angeles Metro Purple (D Line) Extension Transit project in 2023.[24] The trial replaced a comparable diesel unit during stockpile loading operations to assess productivity, noise, and emissions performance. The electric excavator matched diesel productivity while reducing operating noise and localized air pollution. Emission data indicated an average carbon reduction of 34 kg CO_2 per operating hour, equating to more than 4 metric tons of CO_2 avoided over the pilot. Estimated operating costs were $15.55 lower per hour compared to diesel equipment, and typical runtime per charge ranged from six to seven hours. Minor issues with charger hardware were resolved early through operator training and equipment adjustments. The project illustrated that large electric excavators can perform efficiently in complex urban construction environments while significantly lowering both operating costs and carbon footprint. Stakeholders noted that future scaling will depend on improving site power availability, optimizing charging logistics, and continuing to train operators on electrified equipment.

3.6.2 Turner Construction Pilot (Meta Data Center Projects – Altoona, IA and Los Angeles, CA)

Turner Construction Company partnered with Meta, Sunbelt Rentals, and several equipment manufacturers to pilot hybrid and all-electric construction technologies on large-scale data center projects.[25] These pilots were designed to quantify the operational, environmental, and economic impacts of electrified construction equipment and to identify strategies for scaling adoption across multiple geographic markets.

The pilot program included a full suite of equipment, such as electric mini-excavators, forklifts, utility terrain vehicles, light towers, and hybrid excavators and dozers, as well as energy storage

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[24] https://www.usa.skanska.com/who-we-are/media/constructive-thinking/electric-excavation-piloting-the-volvo-ec230-in-los-angeles/

[25] https://www.equipmentworld.com/alternative-power/article/15447774/meta-construction-site-becomes-electric-equipment-test-ground

systems and on-site hybrid generators. The Meta projects achieved emissions reductions ranging from 20 to 100 percent across equipment categories, depending on power source and application.[26] Fully electric machinery achieved zero tailpipe emissions when charged using renewable energy from Meta's clean power portfolio. Operational data showed fuel and maintenance cost savings compared to conventional diesel units, and telematics monitoring allowed Sunbelt Rentals to collect detailed performance and service information. Hybrid generator-battery systems were used to extend runtime and optimize charging schedules, contributing to measurable reductions in both emissions and noise. Qualitative operator feedback collected during the pilot indicated an initial adjustment period followed by generally positive assessments of the equipment's performance and comfort. Reduced vibration and lower operating noise levels were observed to decrease operator fatigue and improve on-site communication. Remote diagnostic capabilities also enabled faster maintenance and repair scheduling. Project teams reported that these operational characteristics contributed to sustained productivity and improved overall worksite conditions.

The most significant barriers to scaling electrified operations were tied to power availability and supply chain factors. Long utility lead times limited access to permanent power connections. Turner addressed this constraint by modeling site energy needs early in design and, where necessary, deploying temporary hybrid microgrids using solar generation, batteries, and backup generation. The company also faced extended equipment procurement times of 12 to 24 months but mitigated this through long-term partnerships and by aggregating demand across multiple projects.

4. Barriers and Enablers

Fleet electrification faces logistical and cost barriers: 18-24 month grid connection delays for high-power locations and vehicle capital costs that can be 1.5 to 3 times higher than diesel. These challenges are compounded by supply chain volatility and in some cases by "lowest-bidder" procurement policies. However, Extended-Range Electric Vehicles (EREVs) may offer a bridge for multiple vehicle types. By pairing electric propulsion with small onboard generators, EREVs bypass infrastructure gaps and can potentially meet demanding duty cycles. With heavy-duty models arriving by 2026, this technology may offer resilience for high-workload operations while the grid matures.

[26] https://driveelectricmn.org/spotlight-on-off-road-transportation-electrification-turner-construction-companys-meta-project/

4.1 Barriers

4.1.1 Electricity Infrastructure and Grid Constraints

The most common barrier to both on-road and off-road electrification is the shortage of adequate charging infrastructure relative to the fleet's rapid growth. Agencies and stakeholders consistently report that grid connections for new depots and construction projects can take 18 to 24 months to secure due to utility capacity limits and the need for extensive electrical upgrades. This delay forces construction sites to rely on temporary power solutions like mobile battery energy storage systems (BESS), which face their own hurdles; deployment in New York City has been limited by stringent FDNY permitting requirements for lithium-ion storage. For on-road fleets, this infrastructure gap creates fueling anxiety, particularly for emergency services that require DC fast charging (e.g., under 30 minutes) to maintain 24/7 readiness but lack the high-voltage power on-site to support it.

4.1.2 Financial and Contractual Constraints

The “green premium” remains a significant hurdle in a competitive contracting environment where lowest-bidder selection is the norm. Electric construction equipment and specialized heavy-duty vehicles currently command a purchase price 1.5 to 3 times higher than their diesel equivalents.

Table 10. NYC Fleet - EV Truck Versus Diesel Pricing

Truck Type	EV	Diesel	Difference	Percent
Box Truck	$474,222	$105,171	$369,051	351%
Refrigerated Box	$663,973	$171,865	$492,108	286%
25 Yard Collection Truck (R&D Model)	$538,240	$476,647	$61,593	13%
Alley Collection Truck	$569,611	$303,397	$266,214	88%
Attenuator Truck	$500,298	$187,475	$312,823	167%
Rack Truck	$369,977	$207,199	$162,778	79%
Street Sweeper	$621,021	$316,028	$304,993	97%

While lifecycle savings from reduced fuel and maintenance can offset this cost over 5 to 7 years, this long-term return on investment often does not align with short-term project budgets or rental contracts. Without targeted financial incentives or contract mandates that account for total cost of ownership (TCO), agencies and contractors face financial disincentives to choosing zero-emission equipment for individual bids.

4.1.3 Supply Chain and Market Uncertainty

The transition is further complicated by volatility in the domestic supply chain. While the global market is maturing, the U.S. supply chain faces uncertainty due to tariffs on imported components (particularly from China) and manufacturers struggling to scale production. Agencies have faced extended lead times and order cancellations for popular electric models, disrupting fleet replacement cycles. Additionally, the market for specialized electric heavy-duty chassis and high-voltage machinery is still in its infancy; the limited number of established manufacturers creates a risk of investing in unproven technology or startups that may not survive to provide long-term parts and service support. Changes in federal policy and investment are also challenging the electric vehicle industry at all levels.

4.2 Enabler

4.2.1 Implementation of EREVs

Extended-range electric vehicles (EREVs) represent a growing class of hybrids designed to bridge the transition between internal-combustion and fully battery-electric powertrains. Unlike traditional plug-in hybrids, which rely on the engine and electric motor operating in parallel, EREVs are driven exclusively by the electric motor while a small engine functions as an onboard generator to recharge the battery when state-of-charge levels fall. This configuration allows vehicles to operate primarily on battery power while maintaining the ability to travel long distances without access to charging infrastructure. For consideration within New York City's Clean Fleet Transition Plan framework, EREVs demonstrate both the evolving technological capacity of electrification worldwide and potential applications for fleets or specialized equipment where charging or power access remains limited.

Internationally, China has become a leader in the deployment and production of EREVs, with major Chinese manufacturers such as BYD, Li Auto, and Chery Auto offering a growing portfolio of EREV models. Examples such as Chery's Luxeed R7 SUV and Li Auto's L9 highlight how the technology enables travel distances nearing 1,000 miles on a single charge and refueling cycle. In 2023, China saw EREV sales jumped 79% to 1.2 million vehicles, outpacing the growth of plug-in hybrids (76% to 3.4 million), and EVs (23% to 6.3 million units).[27] The EREV market has been forecast to comprise 10 percent of all Chinese vehicles sales by 2030 as ultra-fast-charging platforms and advanced battery chemistries continue to improve.[28] These next-generation battery systems can add several hundred kilometers of range in minutes, reduce concerns about travel distance and support broader electrification in regions where public charging remains limited.

Automakers in the United States are now re-entering the extended-range electric-vehicle segment

[27] https://www.reuters.com/business/autos-transportation/automakers-rush-meet-surging-china-demand-long-range-hybrids-2025-04-25/
[28] Ibid.

with a series of models designed for larger trucks and SUVs, vehicle types where consumers prioritize performance, towing capacity, and long-distance capability. These EREVs pair medium-sized battery packs with small gasoline generators, offering an extended total range while maintaining electric propulsion for most driving conditions. According to recent industry reports, at least 16 extended-range models are expected to reach the North American market by 2028.[29] This resurgence reflects growing recognition that hybridized electric architectures can support adoption in sectors of the market where pure battery-electric range and national charging infrastructure may still limit feasibility.

In a fleet context, the benefits of EREVs depend on users plugging them in regularly to charge. However, compared to PHEVs, EREVs have a larger battery and longer electric range and can therefore be plugged in less frequently and still deliver the intended emissions reduction. It will be informative to evaluate the real-world fuel economy of fleet EREVs with actual charging behaviors in a New York City drive cycle. In NYC's experience, BEVs offers the greatest guarantee of maintenance and fuel savings. Both PHEVs currently and EREVs in the future will require constant management to minimize liquid fuel use to operational necessity. This management concern is the trade-off for the additional operational, range, and emergency capacities of the PHEV and EREV. In addition, DCAS would prefer EREVs with diesel generators, not gasoline, to enable renewable diesel and not fossil fuel as the backup fuel supply.

Table 11: Announced EREV Models (North America)

Make	Model	Expected Model Year	Notes
Jeep	Grand Wagoneer REEV	2026	Full-size SUV using 3.6 L V6 engine and 130 kW generator; ~145-mile electric range, ~500-mile total range target.
Ram	1500 REV "Ramcharger"	2026	92 kWh battery with 3.6 L Pentastar V6 generator; ~145 miles electric and ~690 miles combined range; 175 kW DC fast-charge adds ~50 miles in 10 minutes.
BMW	X5 Range Extender (iX5 REx)	2026	Uses ZF "eRE+" system; ~621-mile total range from battery and fuel tank combined.
Nissan	Rogue e-Power	2027	Compact SUV with 1.5 L engine as generator; third-generation system improving efficiency and NVH by ~15%; not externally chargeable.

[29] https://topelectricsuv.com/hybrid-trucks/range-extender-models-upcoming/

Make	Model	Expected Model Year	Notes
Hyundai	Santa Fe EREV	2027	D-class SUV using ”Two Motor System” (one drive, one generation); projected 600+ mile total range; 80,000 units targeted per year.
Genesis	GV70 EREV	2027	Luxury SUV built in Alabama; same EREV system as Santa Fe with ~600-mile range; first electric-hybrid model for Genesis.
Kia	Next-Gen Telluride / Sorento EREV	2027	Uses 2.5 L range-extender engine and xEV EREV system for D-segment SUVs; enhanced fuel efficiency targeted.
Scout Motors	Traveler Harvester EREV	2027	Off-road SUV with 60-70 kWh LFP battery and 15-gallon gas tank; ~150 miles electric and > 500 miles combined range.
Ram	Ram EREV SUV	2028	Full-size SUV built at Warren Truck Plant (MI); shares Pentastar V6 generator and 92 kWh battery with Ram 1500 REV; ~500+ mile total range.
Genesis	GV90 EREV	2028	Flagship luxury SUV on multi-powertrain platform (E-GMP update); ~621+ mile range; launch for North America and Korea.
Scout Motors	Terra Harvester EREV	2028	Pickup variant of Traveler EREV; ~150 miles electric and ~500 miles combined range using generator support.
Genesis	GV80 EREV	2028	Next-generation GV80 with ~621+ mile range on upgraded EREV/BEV platform.
Ford	F-250 Super Duty Range Extender	2027-2028	Heavy-duty pickup with dual-motor system and engine-generator; part of Ford’s ”multi-energy” platform; production at Kentucky, Ohio, and Oakville plants.
Mazda	Rotary REx Concept	~2028	Dual-rotor range extender based on Iconic SP concept; 43–45 kWh pack with rotary generator under evaluation for U.S. market.
Nissan	XTerra EREV	2028	Body-on-frame SUV sharing components with Frontier and Pathfinder; ~75 miles electric range; production planned for Canton, MS.
Volvo	XC90 EREV	2028	Next-generation XC90 with range-extender option produced in South Carolina; ~621+ mile combined range expected for U.S. market.

4.2.2 Medium Duty/Heavy Duty EREV Outlook

This market is now being targeted by new players like Harbinger Motors, which is offering a Class 4-6 series-hybrid chassis with up to 500 miles of total range.[30] The EREV's onboard generator functions as a mobile power source or Auxiliary Power Unit (APU). The Ramcharger, for example, features a "Battery Hold Mode" and an available 7.2 kW power panel, allowing the V6 generator to continuously power tools, equipment, or refrigeration units ("reefers") at a worksite without idling a large propulsion engine or draining the traction battery.[31]

4.2.3 Market Outlook and Implications

The forecast expansion of extended-range systems in the U.S. market demonstrates how manufacturers are adapting electric-drive technology to meet consumer expectations for larger vehicle classes. Heavy-duty pickup trucks and full-size SUVs dominate recently announced EREV offerings, reflecting continued demand for long-distance capability while still reducing dependence on petroleum fuels. Most manufacturers appear to plan ranges between 500 and 700 miles combined and pure-electric ranges of 100 to 150 miles, supported by fast-charging times of approximately 15-45 minutes.

For fleet operators and city agencies, this evolution illustrates how extended-range technologies can complement all-electric strategies in the near term. EREVs could support use cases that require sustained operations beyond grid connections, or in emergency conditions when temporary power or refueling flexibility is essential.

5. Safety-Sustainability Nexus

CFTP technologies that reduce fleet emissions can also affect fleet safety and, conversely, SFTP safety technologies can also affect fleet energy consumption and emissions. This section considers the potential safety effects of alternative fuel/fuel-efficiency (AF/FE) technologies as well as the energy efficiency effects of selected safety countermeasures. In actual vehicle design, more than one of these technologies is commonly incorporated. Suites of some interacting technologies can yield increased benefits, whereas other technologies may not be practical to combine. This section reviews potential benefits and risks associated with AF/FE technologies and their interactions from an engineering perspective.

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[30] https://electrek.co/2025/05/17/game-changer-harbinger-launches-a-medium-duty-erev-with-500-mile-range/

[31] https://www.elkgrovecdjr.com/ram-1500-ramcharger/

Certain clusters of technologies, implemented together by drive-cycle or application, hold the potential for synergistic outcomes for vehicle emissions reduction, safety, and improved driver or public health. For example, highway-dominated vehicles may realize safety and efficiency co-benefits, especially given their high-speed duty cycle, when equipped with aerodynamic fairings that double as lateral protection devices (LPDs), tire pressure management systems (TPMS), intelligent speed assistance (ISA), and adaptive cruise control (ACC) or predictive cruise control (PCC). Vocational trucks can combat typical issues associated with operating within a geographic service area and spending a significant portion of their time stopped and idling when using idle reduction, electric drivetrains or alternative fuels, and accessory improvements. School buses, transit buses, and shuttles may realize similar benefits using different packages of technologies focused on reduced emissions near schools and in cities, or those tailored to safer operating speeds on highways.

This remainder of this section illustrates the benefits of combinations of technologies using the examples summarized in Table 12.

Table 12. Safe-sustainability nexus example with potential energy and safety benefits.

Technology or strategy	Energy potential benefit	Safety potential benefit
Intelligent speed assistance	Reduce energy consumption	Reduce severity and frequency of crashes
Improved direct vision	Offers opportunities to redesign trucks to BEVs	Reduce the risk of collisions with people outside the vehicle
Rightsizing	Reduce energy consumption and operating costs	Reduce the risk and severity of collisions with people outside the vehicle
Regenerative braking	Recapture energy	Reduce or mitigate brake failures; support safer driving style
Tire pressure management system (TPMS) and automatic tire inflations system (ATIS)	Reduce energy consumption	Reduce tire blowouts
Reduced or eliminated idling	Reduce energy consumption	Reduce truck driver fatigue and potential to cause a crash
Reinforced aerodynamic side skirts and/or truck side guards	Reduce energy consumption at higher speeds	Provide crash protection for pedestrians, bicyclists, and micromobility users and potentially reduce road spray and cross-wind instability
Telematics systems	Increase energy-efficient driver behavior	Reduce incidents through monitoring and feedback

5.1 Active Intelligent Speed Assistance (ISA)

Active ISA demonstrates a clear link between safety and efficiency, because it directly addresses speeding, the primary crash risk factor, by limiting a vehicle's maximum speed to the local speed limit. New York City's 500-vehicle pilot program, for example, showed a 64% relative decrease in driving time at more than 11 mph over the speed limit. Further, ISA was effective against habitual speeders and is therefore expected to meaningfully reduce severe crash outcomes.[32] Simultaneously, ISA can improve energy economy. An analysis of DCAS battery-electric vehicles (BEVs) found that units equipped with ISA achieved approximately 6% better energy economy (116 MPGe vs. 109 MPGe) over a five-month sample period, saving over 3,100 kilowatt-hours across 82 vehicles.[33]

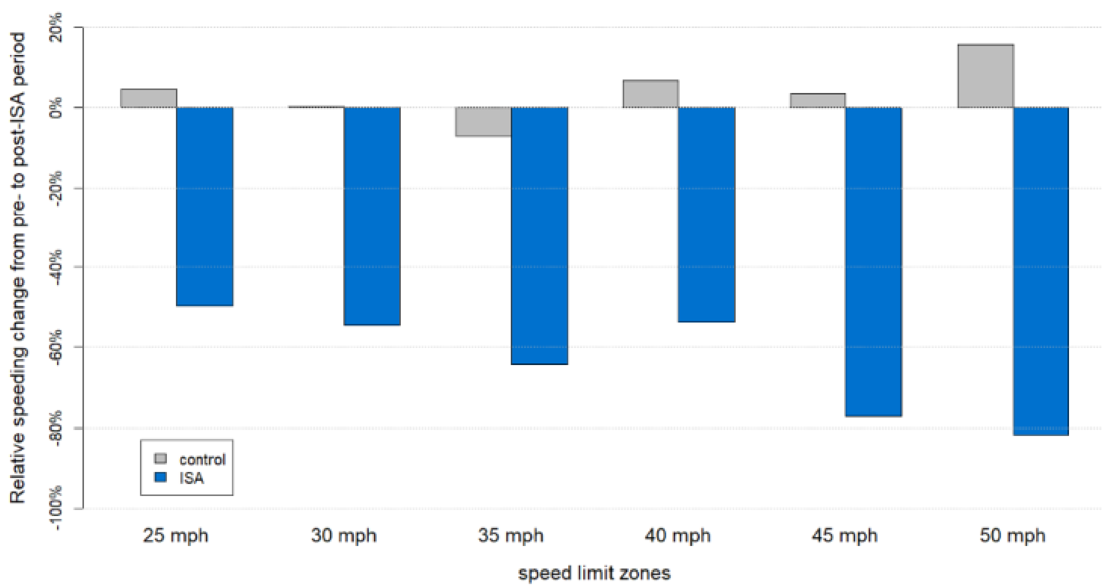

Figure 6. Relative speeding change from pre- to post-ISA period.

5.2 Direct Vision

Vehicle design choices related can also yield co-benefits. High vision trucks offer an opportunity to introduce electric models since they entail a truck re-design, in many cases mounting battery

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[32] https://www.nyc.gov/assets/dcas/downloads/pdf/fleet/nyc-intelligent-speed-assistance-pilot-evaluation-2024-oct.pdf

[33] Analysis of Electric Vehicle Battery Operations: https://www.nyc.gov/assets/dcas/downloads/pdf/fleet/2025/dcas-fleet-electric-vehicle-study-final.pdf

packs in the vehicle's frame. Unlike traditional internal combustion engine (ICE) trucks, which often have a high hood creating large front blind zones, electric medium- and heavy-duty vehicles built on a dedicated platform can be more flexible to design for safer sightlines.

High hoods and wide pillars common in legacy platforms can create significant blind zones, which increase the risk of a crash with people outside the vehicle.[34] A recent study of 60 vehicle makes and models by Volpe and the Massachusetts DOT found that drivers in 50% of the heavy-duty vehicles in the study cannot see a child directly in front of the vehicle in a typical crosswalk.[35] Side visibility was found to be worse. For the heavy-duty vehicles studied, drivers in 90% of the trucks cannot see a child in the bike lane and 80% cannot see an adult in a bike lane. Prioritizing high-vision cab designs improves an operator's reaction time—by approximately 50% compared to indirect vision (mirrors/cameras)—and reduces crash risk. Previous Volpe research, [36] as cited in the SFTP and illustrated in Figure 7, simulated driving of high- and low-vision trucks when stopped at a traffic light in front of a crosswalk, finding that drivers in low-vision trucks failed to notice and then struck a pedestrian in the crosswalk a full 87% percent of the time after the traffic light changed from red to green. In contrast, 100% of the drivers in high-vision trucks noticed the pedestrian and avoided this crash.

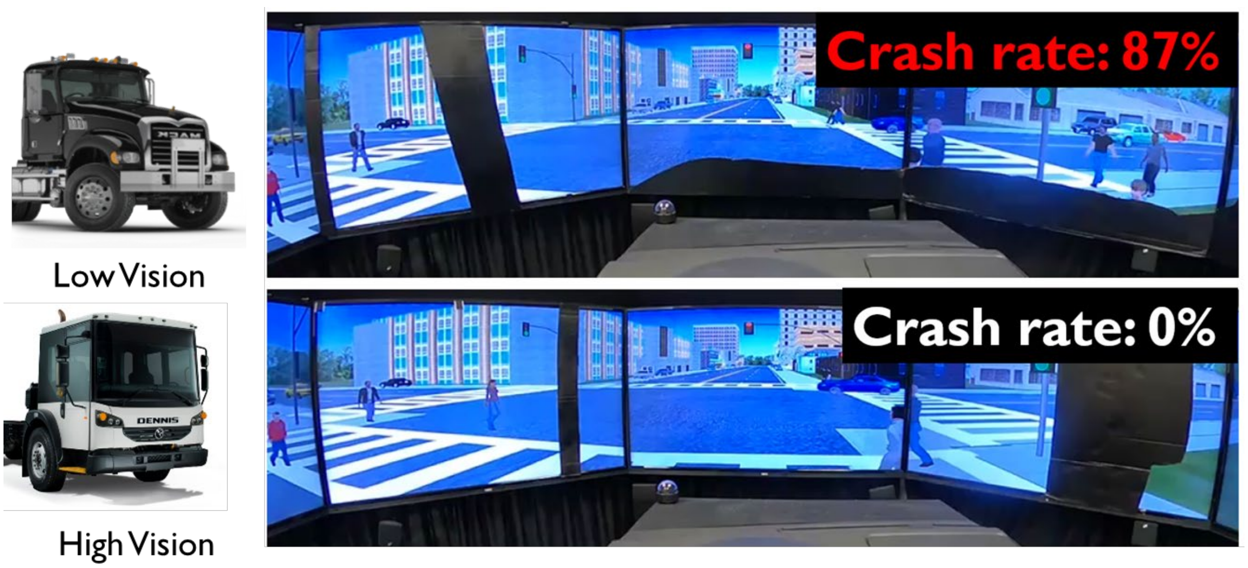

Figure 7. Vehicles simulated in Volpe research for blind zone crash outcomes with a person in the crosswalk at a signalized intersection

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[34] [Vehicles with big blind zones spell danger to pedestrians during left turns]
[35] [Direct vision study | Mass.gov]
[36] https://journals.sagepub.com/doi/10.1177/03611981221121267

5.3 Rightsizing

Rightsizing vehicles involves selecting the most compact vehicle size that accomplishes the intended purpose, whether that is to bring a professional to a jobsite or to transport specialized equipment around the city. This can be a critical initiative for both environmental and safety improvements. Smaller vehicles can reduce capital cost, reduce operating expense, fuel and energy consumption, and improve maneuverability in urban driving. On average, light-duty vehicles were found in the MassDOT direct vision study to have the highest direct vision, medium-duty vehicles had lower visibility, and heavy-duty vehicles had the lowest visibility. While right-sizing is not strictly linked to high vision vehicle rollout, on average, rightsizing vehicles helps increase visibility, which can reduce the risk of a crash. When a crash occurs, smaller vehicles can significantly reduce the risk of death for people outside of the vehicle. For example, crashes that strike a pedestrian's legs are more survivable than crashes that strike a pedestrian's torso or head directly.

Examining which fleet vehicles are suitable to rightsize is made more timely by the fact that the average U.S. passenger vehicle has become about 4 inches wider, 10 inches longer, 8 inches taller and 1,000 pounds heavier over the past 30 years.[37] Many passenger vehicles are now more than 40 inches tall at the leading edge of the hood. According to recent Insurance Institute for Highway Safety (IIHS) studies, these vehicles are about 45 percent more likely to cause fatalities in pedestrian crashes than vehicles with a hood height of 30 inches or less. Further, the hoods on some large pickups are nearly at eye level for median-height adult women. Taller, blunter front ends are more likely to strike a person's torso or head, potentially inflicting severe injuries.

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[37] Vehicles with higher, more vertical front ends pose greater risk to pedestrians
[38] Ibid.

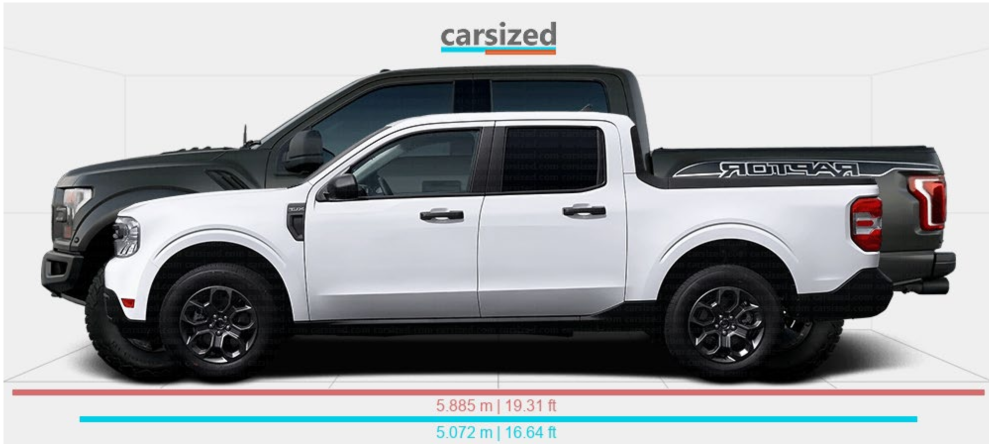

Figure 8. Illustrative size comparison of a compact versus large pickup. (source: Carsized)

An example of a vehicle substitution would be replacing a full-size pickup truck—often used for light-duty tasks but featuring a tall, blunt hood with a leading edge that can reach 50 inches—with a compact truck like a Ford Maverick where the smaller vehicle could still perform the intended job. The Maverick has a leading-edge height of 40 inches,[39] which moves the vehicle out of the highest-risk category. Similarly, replacing a large, high-riding SUV with a modern crossover or a compact utility van like a Ford Transit Connect can achieve the same goal, lowering the point of impact on a pedestrian and reducing the likelihood of a fatal head or torso strike. As shown in Figure 9, changing from a median-height pickup truck to a median-height passenger car (that still meets the needs of the intended purpose) would reduce the risk of serious injury by about half and the risk of fatality by over 75% to a person struck at the NYC default speed limit of 25 mph.[40] A detailed analysis of the NYC Fleet assets and their daily operations could identify how many and which vehicles and their functions are likely to lend themselves to rightsizing as a safety and sustainability strategy. Right-sizing is a critical complement to the fleet electrification initiatives to help mitigate the additional safety risk that heavier electric batteries introduce.

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[39] MaverickTruckClub
[40] Vehicle height compounds dangers of speed for pedestrians

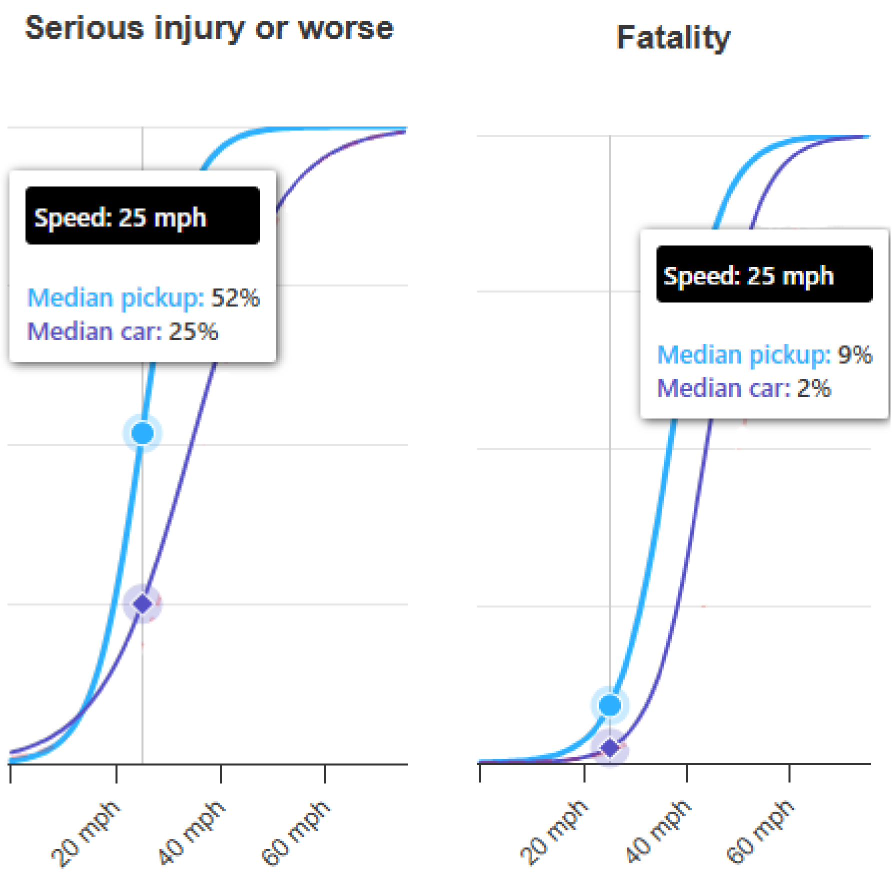

Figure 9. Risk of serious injury (left) or fatality (right) to a pedestrian struck by a median height pickup or a median height passenger car at the NYC speed limit of 25 mph (adapted from IIHS)

Through Executive Order 90, DCAS has worked to reduce the size of its SUV fleet and right-size SUVs to sedans where possible. DCAS has made progress for civilian vehicles. However, major manufacturers have ceased most sedan police models, leaving few alternatives to SUVs in policing, even where electrics or hybrids are introduced.

5.4 Regenerative Braking and One Pedal Driving

Electric and hybrid-electric medium- and heavy-duty (MDHD) vehicles utilize regenerative braking systems that can provide significant safety, particulate emissions, and efficiency benefits. These systems recapture the vehicle's kinetic energy during braking, converting it to stored electrical energy and reducing overall energy use by up to 20% in urban driving. Additionally, regenerative braking reduces wear on friction brakes, which lowers maintenance costs and brake failures that put safety at risk. For example, a 2019 NREL analysis recorded a 65% reduction in brake maintenance costs for a transit bus fleet. [41] Reduced reliance on friction brakes can also decrease brake-particulate emissions by up to 83% and provides a redundant safety layer that mitigates the risk of crashes from friction brake failure. [42]Electric vehicles also enable the opportunity to drive in "one pedal" status, greatly minimizing use of the brake to stop the car. One pedal driving improves driving experience. It also can reduce cost and safety risk tied to brake failures as the brakes receive dramatically less wear and tear.

5.5 Tire Pressure Management

Proper tire inflation pressure is important for the safe and efficient operation of fleet vehicles. Underinflated tires decrease fuel efficiency and increase tire wear, which can lead to tire failure. Tire Pressure Monitoring Systems (TPMS) and Automatic Tire Inflation Systems (ATIS) address this by detecting low pressure and maintaining correct inflation. This can yield a fuel efficiency improvement of approximately 1.5% while simultaneously reducing the potential for breakdowns and crashes associated with tire ruptures or failures. [43]

5.6 Idle Reduction

Reducing time spent idling has both health/safety benefits and energy benefits. A 2015 FMCSA study measured air pollution inside truck cabs and sleeping berths while vehicles were idling at a truck stop. [44] The study found that pollution inside truck cabs exceeded the EPA National Ambient Air Quality Standards, and the pollution was worse when trucks were idling. Potential adverse health effects for truck operators include asthma, lung cancer, cardiovascular issues, and premature death. Reduced driver sleep quality increases the operator's fatigue,and the federal Large Truck Crash Causation Study coded driver fatigue as a factor in 13 percent of all truck crashes nationally.[45] Reducing or eliminating the idling of diesel engines can support improved

[41] https://www.nrel.gov/docs/fy19osti/72209.pdf
[42] https://nads.uiowa.edu/news/2022/02/does-regenerative-braking-have-safety-benefits
[43] https://nacfe.org/technology/tire-pressure-inflation-systems-trailers/
[44] https://www.researchgate.net/publication/317871402_Driver_Exposure_-_Impact_of_Idle_Reduction_Technologies
[45] FMCSA and NHTSA jointly undertook the LTCCS based on a nationally representative sample of nearly 1,000 injury and fatal crashes involving large trucks that occurred between April 2001 and December 2003. The data collected provide a detailed description of the physical events of each crash, along with information about all the vehicles and drivers, weather and roadway conditions, and trucking companies involved in the crashes.

driver health,[46] which may be expected to translate to operational safety benefits associated with long-shift vocational truck drivers who idle for extended periods.[47] The safety benefits here may be more critical to long haul operations than some of the in-City operations that NYC undertakes.

5.7 Aerodynamic Skirts and Lateral Protection

Aerodynamic fairings and side skirts are primarily known for fuel savings, but they can also serve a safety function. When designed to meet Lateral Protective Device (LPD) structural criteria, side skirts can prevent vulnerable road users (VRUs) like pedestrians and bicyclists from falling under the vehicle's wheels in side-impact collisions. [48] Several manufacturers report their panels can meet LPD criteria, and studies suggest such designs could mitigate 48 to 111 fatalities per year in the U.S. [49] [50] Additional reported co-benefits include improved trailer wind stability in crosswind conditions and reduced road spray, which improves following driver visibility and can reduce associated crash risk for other road users. [51]

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[46] The FMCSA study considered a range of technologies to reduce the amount of diesel emissions that enter a truck cab and to improve air quality in the cab while a driver is resting in a sleeper berth. Among these were automatic shut-down/start-up systems; auxiliary power units; battery air conditioning systems; electrified parking spaces; filtering devices; fuel-operated heaters; shore connection systems; and thermal storage systems.

[47] https://www.fmcsa.dot.gov/safety/research-and-analysis/large-truck-crash-causation-study-analysis-brief

[48] National Academies of Science: https://nap.nationalacademies.org/read/12845/chapter/7#102; National Research Council Canada: https://www.volpe.dot.gov/sites/volpe.dot.gov/files/2021-04/National-Research-Council-Canada-Report_Patten.pdf; additional examples: Jahromi, Ali F., Transtex Crash Guard Test with Aluminum reinforcement RD-17-033 Crash Guard resilient test, May 2017; Windyne: https://www.windyne.com/; Fortier PHSS: https://protectionlaterale.ca/en/our-product-lateral-protection/

[49] https://one.nhtsa.gov/DOT/NHTSA/NVS/Crash%20Avoidance/Technical%20Publications/2015/812159-RevSafetyImpactsRegulatoryFuelEfficiencyTechMDHD.pdf; https://www.volpe.dot.gov/LPDs

[50] https://rosap.ntl.bts.gov/view/dot/49250; https://www.fmcsa.dot.gov/research-and-analysis/technology/study-truck-side-guards-reduce-pedestrian-fatalities; https://www.worldcat.org/title/project-report/oclc/1071276813; http://content.tfl.gov.uk/analysis-of-police-collision-files-for-pedal-cyclist-fatalities-in-london.pdf; https://www.volpe.dot.gov/sites/volpe.dot.gov/files/2021-04/SWOV-96.pdf; https://www.ntsb.gov/safety/safety-studies/Documents/SS1301.pdf; https://www.ntsb.gov/safety/safety-recs/RecLetters/H-14-001-007.pdf; email correspondence with Dr. Ivan Cheung, Senior Advisor, Office of Member Tom Chapman, NTSB, February 9, 2022.

[51] https://nacfe.org/technology/trailer-fairings/

Conversely, truck LPDs, or side guards, play a key role in pedestrian safety while also providing potential fuel efficiency benefits when designed with an aerodynamic form factor. In launching its nation-leading truck safety side guard program in 2015, DCAS began with a product from a company called “Air Flow Deflector” that had designed the product for fuel efficiency. The additional weight of a truck side-guard offsets fuel efficiency savings, but both skirts and aerodynamic LPDs can play a role in both pedestrian safety and fuel efficiency.

Figure 10. Aerodynamic trailer skirt (left) and LPD (right)

5.8 Telematics

Beyond vehicle-based hardware, operational strategies and driver behavior are important for lowering fuel and energy use, and telematics allows these behaviors to be measured. Fleet telematics systems and associated driver coaching programs can support both safety and sustainability objectives by measuring and reporting on speeding, harsh braking events, and energy efficiency. With telematics data, fleets can target interventions, such as ISA rollouts, enhanced seat belt warnings, or white noise backup alarms to the highest-risk vehicles and least efficient vehicles.

Driving style can account for ~30% variability in fuel efficiency. [52] [53] While traditional eco-driving for internal combustion engine (ICE) vehicles involves coasting and limiting acceleration, electric-drive vehicles use “one-pedal driving” that relies on regenerative braking and on planning sufficient space to slow the vehicle without applying the friction brake.

The safety and sustainability effects of telematics intersect because measuring and coaching for

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[52] U.S. DOE Fireside Chat: Clean Trucks and Moving Freight on the Road to Decarbonization (webinar), April 15, 2021
[53] https://nacfe.org/run-on-less-regional-report/

efficient driving can result in safer operation by promoting a more anticipatory driving style. [54] Some vehicles provide real-time dashboard feedback to incentivize high-efficiency driving "scores," and navigation systems can further contribute by providing real-time traffic updates and routing options to avoid stop-and-go driving.

5.9 Fire Risk Reduction

Recent research indicates that EVs may experience vehicle fires between 20 and over 100 times less frequently than internal combustion engine (ICE) vehicles, with one study reporting 25 EV fire incidents versus 1,530 ICE vehicle fire incidents per 100,000 sales.[55] [56] Between 2012 and 2023, NYC fleet agencies recorded 212 vehicle fires in the fleet management system. Of these, 95% involved gas and diesel vehicles, 5% involved hybrid vehicles, including two destroyed by an externally caused fire, and none involved an all-electric vehicle.[57]

The cause of EV fires is often difficult to determine due to the complicated nature of electrical circuitry. However, some of the primary causes are collision/road debris, external fire spreading to the vehicle, battery fault, overheating and submersion, many of which, including battery faults, are the most common causes of fires in gas vehicles as well. A study in Poland found that 13% of reported EV fires were caused by arson and fire transfer, but that statistic is difficult to determine in the U.S. due to wildfire prevalence and inconsistencies in reporting structures.[58] Submersion has also been a concern in coastal areas due to the ionic nature of saltwater presenting issues for lithium-ion batteries. Recent research from Idaho National Laboratory showed that out of the 3000-5000 EVs impacted by Hurricane Ian in 2022, 36 caught fire, or approximately 1%.[59] Flooding caused by Hurricane Ida created fires for a number of solar carports with battery storage operated by DCAS.

A comprehensive analysis from Australia found that approximately 15% of fires occurred during or within an hour of charging and a similar U.S. based analysis found that figure to be 18-30% but noted that EVs spend upwards of 30% of the time plugged-in, so there is no statistical increase in

[54] https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation-alternative-fuels/personal-vehicles/fuel-efficient-driving-techniques/21038
[55] https://alliedworldinsurance.com/risk-management/electric-vehicle-fires-a-cause-for-concern/
[56] Gas vs. Electric Car Fires in 2025 (Shocking Stats)| AutoinsuranceEZ.com
[57] nyc-fleet-newsletter-428-2023-06-06-electric-vehicles-and-safety.pdf
[58] The facts about EV fire safety - Plug In America
[59] A Teardown Study of Flood Damaged Electric Vehicles, EV Battery Safety Part 2

fire likelihood during charging.[60] [61] The Australian study also found that of those fires, most were caused by vehicles damaged prior to plug-in. "Put simply, in normally operating, road-registered EVs, it is electrically impossible for the battery to be overcharged [such that] it catches fire while using an electrically compliant unit that has been installed to standard by a qualified person."[62]

Although EV fires are significantly less frequent than ICE vehicle fires, EV fires can be more difficult to extinguish, burn hotter, and require different safety training and response protocols than ICE vehicle fires. For example, unlike gasoline and diesel fuel fires, electric battery fires are chemical fires that can reignite after an initial fire is doused. For these reasons, DCAS prioritizes storing EVs outside with a safety perimeter. The agency has been working with FDNY, which is taking lead on these issues in the NYC context, and has trained operators on the different nature of and appropriate response to EV fires. The DOE Alternative Fuels Data Center offers an extensive list of trainings and best practices relating to EV fire suppression and safety measures. It is also important to consider the potential for reignition when transporting damaged vehicles.

Fire suppression techniques and EV related safety standards have continued to advance as further research has been conducted. New tools such as specialized fire hose nozzles are being developed to help target battery fires at the bottom of vehicles.[63] Meanwhile, advances in vehicle and battery technology will help prevent faults from wiring and even develop batteries capable of being pierced without initiating a fire. These advances are helping to inform the next iteration of National Electric Code, which will include clarified guidance on emergency disconnects for EV charging stations and other related topics.

While EVs are less likely to catch fire, the risk they pose is still significant. To help prevent this, it is important to have an EV inspected for any potential circuitry or battery damage after any collision or submersion and monitor recalls. It is also important to only charge at trusted stations and with certified power adaptors, and never with an extension cord. Finally, EVs are designed with very high safety standards in mind. Because of the modular nature of batteries, it often takes 5 or more minutes for the battery to ignite, allowing drivers and passengers time to exit. Current

[60] 04.5 Research - EV fire + charging | EV Fire Safe
[61] EV-EVSE Fault Study
[67] 04.5 Research - EV fire + charging | EV Fire Safe
[63] Naperville firefighter Danny Puknaitis helps invent new tool to battle electric vehicle fires - ABC7 Chicago

regulations require vehicles to produce an alarm to alert users of the first cell failure that can lead to a battery fire.[64]

5.10 Future Research: Sound Perceptibility

Some interactions of AF/FE technologies may have unintended consequences that are not yet clear and that may warrant additional focus. For example, quieter zero-emission MDHDs reduce critical auditory cues for vision-impaired pedestrians, an issue that has been regulated in the U.S. light-duty vehicle segment but not extensively investigated in the medium- and heavy-duty sectors. Globally, as part of Transport for London's (TfL) Bus Safety Standard, electric and hybrid electric buses must be fitted from July 2021 with an Acoustic Vehicle Alerting System (AVAS) to increase their audible detection, particularly for vulnerable road users. This requirement goes above and beyond mandatory measures already stipulated in United Nations Economic Commission for Europe (UN ECE) Regulation 138.[65] There is currently no equivalent North American standard or requirement.

6. Looking Ahead & Opportunities

As New York City advances toward the Local Law 140 targets of a fully electric light- and medium-duty fleet by 2035, the Clean Fleet Transition Plan offers an update on the status of the fleet electrification marketplace and additional options to pursue. These include deploying mobile charging solutions and temporary battery energy storage systems (BESS) to bridge immediate infrastructure gaps and implementing extended range electric vehicles (EREVs) as a strategic bridge for specialized heavy-duty segments like plowing and fire apparatus. Long-term opportunities involve coordinating high-capacity grid connections for heavy-duty vehicle depots and transitioning specialized equipment to zero-emission or zero-emission capable versions as the market matures. The need for emergency backup power further complicates electrification of emergency assets. Both the mobile charging and EREV solutions can assist with this challenge.

To de-risk future adoption, the City can leverage initiatives like the Clean Construction Innovation Pilot and NYC Smart City Testbed to test electric earthmoving machinery and mobile power-as-a-service logistics. These pilots offer a pathway to evolve procurement toward Total Cost of Ownership (TCO) models that account for lifecycle savings, potentially justifying the "green premium" of electric assets. Additionally, prioritizing synergies between Vision Zero and

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64 The facts about EV fire safety - Plug In America

65 TfL Bus Acoustic Vehicle Alerting System 2020-03-05; The Sound Of The TFL London/Urban Bus - Zelig Sound - YouTube

sustainability, such as Intelligent Speed Assistance (ISA) and vehicle rightsizing, presents opportunities to improve energy economy while significantly lowering the risk of severe crashes. Recognizing the rapid pace of technological evolution, DCAS intends to review and revise this plan every 2-3 years to capture new market developments and ensure the fleet remains on the cutting edge of safety and sustainability.

DCAS also identifies a new opportunity for pollution reduction and equipment electrification by targeting its inventory of over 10,000 two- and four-cycle horticulture units, such as mowers, leaf blowers, weed-trimmers, and chainsaws, which currently contribute meaningfully to DCAS Fleet fuel totals through disbursement via gas cans. While vehicles like pickup trucks transport equipment to job sites, the primary pollution sources are often the auxiliary units, such as chippers or the lawn mowers and leaf blowers used by the pickup crews. By threading these equipment categories into broader sustainability reporting, the City aims to build on its 2024 emission reduction of 46.5% from 2006 levels across the fleet, aviation, and maritime programs. This focused approach to small-engine replacement and electrification can be a key driver in the plan to achieve an 80% greenhouse gas reduction by 2035 as targeted in the current NYC Clean Fleet Plan. NYC Parks has already successfully introduced hundreds of electric versions of horticultural equipment.

To provide a framework that evolves with the rapid pace of innovation and market shifts in clean fleet vehicles and technology, the CFTP will continue to be updated. The City anticipates revising this plan approximately every two years in accordance with Executive Order 53 of 2020.

Appendix A: DCAS Standard Types Tiers

While this report uses several broad vehicle categories for the main tier designation in Sections 2.1 and 2.3 and the associated discussion, DCAS categorizes its fleet roster into 194 standard types. The subsections in this Appendix A map these standard types to their respective tier designations. An additional "not applicable" category shows equipment that does not use fuel.

A.1 Off-Road Tier 1 Standard Types

Type	2025 Count	2022 Tier	2025 Tier	BEV Models	DCAS Notes
AERIAL LIFT – MOBILE LIFT	1	N/A	Tier 1		
AERIAL LIFT – OFF ROAD BOOM	23	Tier 1	Tier 1	JLG Aerial/Boom lift, JLG X430AJ, Genie Z-60 DC, Genie Z-45 DC, Genie Z-40/23 N RJ, Genie Z-40/23 N, Genie Z-34/22 DC,	DCAS, DOTR, DSNY each have electric boom lifts in their inventory, as well as biodiesel/hybrid lifts which have higher weight capacity than their electric counterparts.
AERIAL LIFT - PLATFORM LIFT	4	Tier 1	Tier 1	JLG Aerial/Boom lift, Yale AERO AWP, Hyster Ascender AWP, Altec Ariel Boom Vehicle with JEMS	
ATV	38	Tier 2	Tier 1	Polaris Ranger XP Kinetic, DDR Stealth, Can-Am Stealth, John Deere Gator TE,	Improvements in battery technology have improved performance, now commercially available and capable machines. DSNY has 8 electric John Deere Gator TEs
COMPACT TRACK LOADER	14	Tier 1	Tier 1	Bobcat T7X Compact Track Loader, Toro TX 750 eDingo, Solectrac e25	

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Type	2025 Count	2022 Tier	2025 Tier	BEV Models	DCAS Notes
				Compact Electric Tractor,	
COMPRESSOR - TRAILER	101	Tier 1	Tier 1	Atlas Copco E-Air Series H185, ELGi Electric Series,	
CRANE	20	Tier 2	Tier 1	Liebherr-Werk Nenzing “unplugged” series, Tadano eGR-1000XLL-1 Evolt, Zee Crane 4500, Zee Crane 9000, Jekko SPX series (SPX312C+, SPX424C+, SPX429C+)	Lighter duty cranes have benefitted from improved battery life, faster charging, Heavy Duty electric cranes have less flexibility on constructions sites due to charging times.
ELECTRIC UTILITY VEHICLE	2	N/A	Tier 1	ERIDE EXV4, ERIDE EXV2, Polaris Ranger EV, Hisun Motors Sector E1	
FORKLIFT	634	Tier 2	Tier 1	Yale Four Wheel Electric Forklift Series, Toyota Electric Forklift Series, Clark ECX20, Clark ECX360, Crown FC 5215-50, Doosan BC15S-5	Electric forklifts are in operation now. Load capacity has improved since 2022. Transition to lithium-ion systems over lead-acid have improved charging/operation time.
FRONT END LOADER	366	Tier 3	Tier 1	Volvo L25 Electric, Volvo L20 Electric, Bobcat T7X, HEVI Electric Wheel Loaders, LiuGong 820TE,	Capacity of compact loaders has improved and are commercially available from multiple brands. Larger front loaders are planned by Volvo CE (L120).
ICE RESURFACER	1	Tier 1	Tier 1	Zamboni	
LIGHT TOWER	529	Tier 2	Tier 1	Generac MLT6, Doosan L20, Magnum MLT6SK, Wacker Neuson LTW6, Terex	DCAS implements solar-electric light towers now. Assignments in shaded areas is a limiter.

Type	2025 Count	2022 Tier	2025 Tier	BEV Models	DCAS Notes
				Corporation RL4, Ingersoll Rand Light Source, Coleman MH4000RL	
LIGHT TOWER – SOLAR	122	Tier 1	Tier 1	Progress Solar Solutions SLT1200, Progress Solar Solutions SLT1400W, Progress Solar Solutions SHYB-LT1200, Progress Solar Solutions SHYB800, Progress Solar Solutions SHYB-1000, Progress Solar Solutions SHYB-1400	These are solar units now.
MESSAGE BOARD - TRAILER	204	Tier 1	Tier 1	American Signal CMS-131T, American Signal CMS-T4260, Ver-Mac PCMS-548, Ver-Mac SP-3248V, MPH Industries 1027, Wink Unidentified, Wanco WTLMB, Wanco WSDT-S, Precision SMC 100ST, Mobile Technologies SOLR2125	These are solar units now.
MOWER - RIDE ON	165	Tier 1	Tier 1	Ryobi 54" Electric Riding Lawn Mower, John Deere 7370R Electric, Toro 60V Max 54in, Gravely Pro-Turn EV, Mean Green SK-48 Stalker, Mean Green	Gravely Pro-Turn EV, Mean Green SK-48 Stalker, and Greenworks GZ 60R are inventoried by DPAR

Type	2025 Count	2022 Tier	2025 Tier	BEV Models	DCAS Notes
				Vanquish, Mean Green Rival, Mean Green EVO, Bobcat ZT6000e	
NYPD SINGLE PERSON CAR	152	Tier 1	Tier 1	Chevy	Formerly Cushman, then Smart Cars, Bolt
OFF ROAD UTILITY VEHICLE	711	Tier 2	Tier 1	GEM, Polaris Ranger EV, John Deere TE 4x2 Electric, TORO 07410, Club Car Carryall, GEM ELXD, Cushman Hauler Pro X Elite	EV in operation today. Plowing and 4x4 are limiters to electric models.
OFF-ROAD ENFORCEMENT UNIT	50	Tier 2	Tier 1	Smart EQ, GM Bolt, Chevy Spark	NYPD operates 5 Chevy Sparks, and 49 Smart Car FORTWOs. These are currently listed as off-road tied to historic use. NYPD was previously assessing GM Bolt. NOTE: Smart Car FORTWO have been discontinued.
SCOOTER/MOPED	243	Tier 2	Tier 1	Piaggio 1, Westward Max EV 3, Westward GO-4 EV, T3 Motion, Segway eScooter E125S, Vespa Elettrica	Must be proven for policing operations. NYPD currently operates 29 electric T3 Motion electric personal transporters.
SKID STEER	214	Tier 2	Tier 1	Bobcat T7X, First Green Industries eLise 1200/700/900, Toro e-Dingo TX750/500	More commercially available equipment with indoor applications, but sustained heavy-duty use is a limiter. John Deere, Caterpillar, and Volvo have prototypes that are not commercially available

Type	2025 Count	2022 Tier	2025 Tier	BEV Models	DCAS Notes
SNOWMOBILE	3	Tier 1	Tier 1	Taiga	Range can be a limiter
SWEEPER	3	Tier 1	Tier 1	Tennant S16 Battery-Powered Compact Ride-On Sweeper, Tennant S680, Tennant 6100,	Sweepers for use inside buildings.
TRAILER – JET SKI	8	N/A	Tier 1	Taiga	
TRAM/TROLLEY	4	Tier 1	Tier 1	Moto Electric Electro Transit Buddy, Specialty Vehicles ECO 14 Electric Shuttle	
UTILITY CART	25	Tier 1	Tier 1	GEM 825, GEM E4, Club Car Villager 6	DCAS operates electric units now. Plow capacity is a limiter.
VACUUM – RIDE ON	1	N/A	Tier 1		DCAS operates an initial EV model
VACUUM LEAF TRUCK	3	Tier 1	Tier 1	Madvac	Parks implementing first electric version now.
WHEEL LOADER	33	Tier 2	Tier 1	Volvo CE L25 Electric, HEVI H65L, HEVI H55L	Compact Wheel Loaders are more advanced than heavy. Volvo is set to release the electric L120 this year.
ZAMBONI	1	Tier 1	Tier 1	Zamboni	

A.2 Off-Road Tier 2 Standard Types

Type	2025 Count	2022 Tier	2025 Tier	BEV Models	DCAS Notes
AMBULANCE - OFF ROAD	14	**Tier 3**	**Tier 2**	John Deere Gator GX Electric, Polaris Ranger XP Kinetic, GEM Electric Ambulance, Alke ATX 330E	Gator type units. New John Deere models have graduated from 48 volt lead-acid based batteries to 51 volt lithium-ion batteries, offering greater range and power than predecessors.
BALLFIELD RAKE	19	**Tier 2**	**Tier 2**	SmithCo Sand Star E	Equipment is similar to ride on mowers.
BEACH TRACTOR	27	**Tier 2**	**Tier 2**	Moarch MK-V, Solectrac e25 Compact Electric Tractor, Solectrac e70n, Case IH Farmall Utility 75C Electric	Operating hours and sustained power output are two barriers for medium-sized tractors.
REFRIGERATED - TRAILER	41	**Tier 2**	**Tier 2**	Thermo King e1000 All-Electric Reefer Unit for Class 5-7 Trucks,	Only refrigeration unit requires power source, typically biodiesel
TOW TRUCK – TUG PUSHER	5	**Tier 3**	**Tier 2**	Eagle ETT-8X, Eagle ETT-16, Eagle ETT-12X	Very low mileage but heavy power requirements. For towing within compounds.
TRACTOR	307	**Tier 2**	**Tier 2**	Moarch MK-V, Solectrac e25 Compact Electric Tractor, New Holland T4 Electric Power	Commercial units (e.g., Monarch) are shipping, but high upfront costs and charging constraints for remote or continuous-duty work limit 'in-kind' replacement capability. Tier 2 reflects this operational readiness gap

A.3 Off-Road Tier 3 Standard Types

Type	2025 Count	2022 Tier	2025 Tier	BEV Models	DCAS Notes
ASPHALT HEATER – TRAILER	106	Tier 3	Tier 3	Patch King PK30T,	DOT specialized equipment. Portable options are available, but not full tar kettles or heaters.
ASPHALT PAVER	25	Tier 3	Tier 3	LeeBoy 8520C, 8510E, 8500E Electric	DOT specialized equipment. No widespread use domestically, but being piloted by contractors. Limited due to charging, work cycles.
BACKHOE	43	Tier 3	Tier 3	Case 580 EV Electric Backhoe (compact construction vehicle), John Deere 310 X-Tier Backhoe	While models like the Case 580EV are commercially purchasable, pilot feedback indicates TRL gaps in cold-weather performance, runtime, and site-charging logistics. Supporting infrastructure is not yet viable for widespread implementation
BARRIER TRANSFER MACHINE	3	Tier 3	Tier 3		Highly specialized unit. This will be very challenging to implement as electric.
BASKET LOADER	4	Tier 3	Tier 3		Highly specialized unit. This will be very challenging to implement as electric.
BEACH CLEANER	2	Tier 3	Tier 3		Highly specialized unit. This will be very challenging to implement as electric.
BULLDOZER	5	Tier 3	Tier 3		Highly specialized unit. This will be very challenging to implement as electric.Hybrid versions are available from Caterpillar
CHIPPER - TRAILER	61	Tier 3	Tier 3		Parks. Highly specialized unit. Energy intensive. This will be very challenging to implement as electric. Small electric units for light-scale duty are available to market.

Type	2025 Count	2022 Tier	2025 Tier	BEV Models	DCAS Notes
CONCRETE/CEMENT MIXER - TRAILER	27	Tier 3	Tier 3		
CRUSHER	3	Tier 3	Tier 3	Astec CS4250, Sandvik UJ443E, Eagle 1400-OC Electric, Eagle Stealth 500	DOTR employs an all-electric Astec CS4250 stone crusher.
EXCAVATOR	21	Tier 3	Tier 3	Volvo EC230, Caterpillar 320 Z-Line Electric, Komatsu PC210E	Pilots of these machines are occurring domestically. Implementation abroad has been more widespread.
FIRE BRUSH UNIT	1	Tier 3	Tier 3	John Deere Gator GX, Polaris Ranger XP, GEM Electric Ambulance, Alke ATX 330E	Fire emergency unit.
FORESTRY - STUMP CUTTER	12	Tier 3	Tier 3		Highly specialized unit. This will be very challenging to implement as electric. Smaller models available
GENERATOR - TRAILER	110	Tier 3	Tier 3		Diesel Back Up Generators may remain in place. DCAS will look for batter storage alternatives.
HYDRAULIC EXCAVATOR	7	Tier 3	Tier 3	Volvo ECR25/ECR18, Wacker Neuson EZ17, Volvo EC230, Caterpillar 320 Electric	Mini-excavators have wide availability for all-electric versions from multiple OEMs. Medium/Large models are being developed by Volvo CE, Caterpillar, and Hitachi.
LANDFILL CRAWLER	6	Tier 3	Tier 3		Highly specialized unit. This will be very challenging to implement as electric.
LANDFILL OFF ROAD DUMP	2	Tier 3	Tier 3		Highly specialized unit. This will be very challenging to implement as electric.
MILLER PLANER	15	Tier 3	Tier 3		DOT specialized equipment.

Type	2025 Count	2022 Tier	2025 Tier	BEV Models	DCAS Notes
ROLLER	48	**Tier 3**	**Tier 3**	Volvo CE DD25, Dynapac Z.ERA CC900e/1000e, Hamm HD CompactLine, Wacker Neuson RD28e	The electric options listed are generally in the lighter, more compact categories (e.g., walk-behind or small ride-on models). Fully electric versions of heavy-duty, large single-drum rollers are not in the near future.
SNOW MELTER	27	**Tier 3**	**Tier 3**		DSNY. Highly specialized unit. Energy intensive. This will be very challenging to implement as electric.
TAR KETTLE TRAILER	51	**Tier 3**	**Tier 3**		DOT specialized equipment.
TRAILER - CARGO/UTILITY	10	**Tier 3**	**Tier 3**		
TRAILER – HIGH PRESS JET RODDER	5	**Tier 3**	**Tier 3**		Highly specialized trailer unit. This will be very challenging to implement as electric.
TRAILER – PRESSURE WASHER	2	**Tier 3**	**Tier 3**		Parks specialized equipment.
TUB GRINDER	2	**Tier 3**	**Tier 3**	Vermeer TG5000E,	Highly specialized unit. Energy intensive. This will be very challenging to implement as electric, few models to choose from.
UTILITY WORK MACHINE	32	N/A	**Tier 3**	GEM eL XD, Cushman Hauler PRO LSV, Landmaster AMP Series, Polaris Pro XD Kinetic, Greenworks CU400W	
VACUUM LEAF - TRAILER	2	**Tier 3**	**Tier 3**		Specialized tow behind unit

A.4 Off-Road Standard Types for which Tiers Designation Is Not Applicable

2025 Fueled Off-Road	2025 Count	DCAS Notes
AGGREGRATE SCREEN	4	No fuel
ATTENUATOR - TRAILER	4	No fuel
COMMAND POST TRAILER	7	No fuel
CONTAINER BOX - OFF ROAD	5	No fuel
FLATBED TRAILER	12	No fuel
FUEL TRAILER	2	Fuel trailer carries but does not use fuel itself. Part of emergency fuel operations.
GRADER	1	
MOBILE COMMAND SHELTER	3	No fuel
MOBILE OFFICE	1	No fuel
PRESSURE WASHER - TRAILER	2	No fuel
SCRUBBER	1	No fuel
SHOWMOBILE	5	No fuel
SURF/TURF RAKE	25	No fuel
TRAILER	201	No fuel
TRAILER - DUMP	21	No fuel
TRAILER – HORSE	22	No fuel
TRAILER - LIVE BOTTOM	10	No fuel
TRAILER - LOAD BANK	1	No fuel
TRAILER - REEL	9	No fuel
TRAILER - ROCK WALL	1	No fuel
TRAILER - STAGE	6	No fuel
TRAILER - VACUUM	1	No fuel

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