New York City Green Loading Zones Study

Final Report

July 2014

NYSERDA Report 14-22
NYS DOT Task C-13-52

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New York City Green Loading Zones Study

Final Report

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Acronyms and Abbreviations List

A	Amperes / Amps
AC	Alternating Current
APU	Auxiliary Power Unit
BID	Business Improvement District
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Con Ed	Consolidated Edison
DC	Direct Current
DOE	U.S. Department of Energy
ECC	Empire Clean Cities
EGF	Empire Green Fleets
ELP	Environmental Loading Point
EPA	US Environmental Protection Agency
eTRU	Electric Transport Refrigeration Unit
EU	European Union
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FHWA	Federal Highway Administration
FMIA	Fulton Mall Improvement Association
GHG	Greenhouse Gas
GLZ	Green Loading Zone
GVW	gross vehicle weight
HOV	High Occupancy Vehicle
HVAC	Heating, Ventilation, and Air Conditioning (systems)
ICE	Internal Combustion Engine
kW	kilowatt
kWh	kilowatt-hour
LEZ	Low Emission Zone
LPR	License Plate Reader
MUTCD	Manual on Uniform Traffic Control Devices
NO_x	Nitrogen Oxides
NYC	New York City
NYCDOF	New York City Department of Finance
NYCDOT	New York City Department of Transportation

NYMTC	New York Metropolitan Transportation Council
NYSDOT	New York State Department of Transportation
NYSERDA	New York State Energy Research and Development Authority
NYSPSC	New York State Public Service Commission
NYT-VIP	New York Truck Voucher Incentive Program
PACB	Public Authority Control Board
PM	Particulate Matter
RFID	Radio-frequency Identification Device
RIOC	Roosevelt Island Operating Corporation
SAE	Society of Automotive Engineers
UCC	Urban Consolidated Centers
UPS	United Parcel Service
USPS	U.S. Postal Service
V, VAC	Voltage, Voltage in Alternating Current
VOC	Volatile Organic Compounds
ZEV	Zero-Emission Vehicles

Summary

S.1 Overview

The purpose of this study is to examine the impact and potential benefits of Green Loading Zones (GLZs)—a policy solution to incentivize further electric truck adoption with the creation of curbside loading zones that are exclusively available to zero-emission commercial vehicles. The study was supported by the New York State Energy Research and Development Authority (NYSERDA) and the New York State Department of Transportation (NYSDOT). It was conducted by WXY architecture + urban design, Energetics Incorporated, and Barretto Bay Strategies,

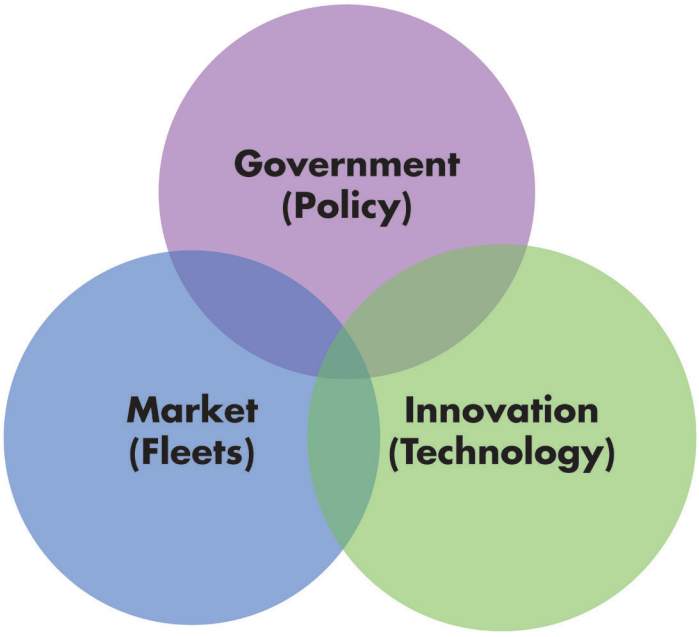
As shown in Figure S-1, an examination of the policy's viability requires understanding the GLZ's fit within:

- Policy and regulation applicable to New York City (government).
- The demands of fleets employing electric delivery trucks (market).
- Existing and future technology applications that can enable electric truck deliveries (innovation).

This report, which provides analysis of GLZ's utility, benefit, and viability, seeks to define, through analysis and case studies, the potential for implementation and guidelines to ensure success.

Figure S-1. Testing the Viability of a Green Loading Zone Approach

Source: WXY



S.2 Electric Delivery Trucks Benefit Local Health and Environment

The emergence of electric vehicle (EV) delivery trucks has enormous potential to benefit local health and environment of urban areas, especially of denser cities, and promises to significantly reduce freight-related greenhouse gases (GHGs). New York City (NYC) itself receives more than 100,000 freight deliveries daily and is a U.S. Environmental Protection Agency (EPA) non-attainment area for both ozone and particulate matter. The community impact of freight traffic can be especially acute in sensitive populations. For example, schools near the highly-trafficked Hunts Point Food Distribution Center in the South Bronx report student asthma rates of up to 25 percent, while local asthma hospitalizations have been correlated with peak trucking periods.

S.3 Green Loading Zones Complement Subsidies to Incentivize EV Trucks

Well-funded subsidy programs have had limited success in developing a market for electric delivery vehicles despite enthusiasm from officials representing environmentally sensitive areas. Commercial fleets that are aware of the subsidies have been wary to adopt electric trucks for a number of reasons: greater cost over diesel trucks (even with subsidy), cost and complexity of installing on-site charging infrastructure, and highly restrictive route planning due to the uncertainty of NYC traffic and no opportunities to recharge en route. The latter causes those fleets that do purchase EVs to oversize their battery purchases, at significant cost—$13,000 for increments of 20 kilowatt-hours (kWh).[1]

The provision of GLZ can occur at minimal cost to the municipality, and help fleets lower operating costs by reducing parking fines, providing time-based delivery assurances, and reducing trucks' need to circle. Fleet managers interviewed confirmed these multiple benefits of GLZs, specifically indicating access to GLZ would be as valuable to their operation as cash subsidies.

S.4 Enforcement and Policy

GLZs can complement existing freight policies as pilots of better optimization of curbside space, including the concept of reservation windows. The Off-Hour Delivery Program, which incentivizes fleets to shift to nighttime delivery, is a strong partnership policy for GLZs because EV trucks are ideally suited to the program. EV trucks run quieter, appealing to receivers based in residential areas.

[1] Mileage efficiency for medium-duty electric trucks is approximately 0.8 miles per kilowatt-hour.

Enforcement is the key implementation concern for fleet managers and policymakers who are unsure if designated GLZs will be respected by drivers or police officers with street markings and signage alone. Confusion and antipathy are likely to follow the removal of general-use curbside space, as has been the case for EV-designated spaces that are frequently "ICEd"—that is, occupied by internal combustion engine (ICE) or gas-powered vehicles. Automated enforcement options exist to facilitate the implementation, including radio-frequency identification device (RFID) transponders and license plate readers, and warning light indicators. These options can alert ticketing agents and tow trucks, or issue tickets themselves. The opportunity in New York City is limited though as any automated ticketing will have to be approved at the State level and New York City's Department of Transportation has been hesitant to support GLZ policy based on the previously described concerns.

S.5 Charging and Opportunities for Partnership

In New York City, exciting efforts are ongoing to provide on-street charging for specific vehicle types. Ambulances may spend up to 12 hours per day at designated waiting locations around the City and must idle to maintain the viability of onboard medicines and electronics. The emissions caused by this idling can affect sensitive populations, presenting a potential public relations debacle for health care institutions. Plugging into curbside power sources would reduce environmental and health impacts, minimize fuel consumption, and enhance driver health. A pilot to electrify 10 such waiting locations throughout NYC has recently been funded. The electrification of food trucks and carts can similarly improve the environment of pedestrian-dense areas. This electrification is being piloted near NYC's Union Square Park. Refrigerated trucks that idle curbside present a similar opportunity to reduce emissions from idling, though one not currently being pursued.

These on-street charging pilots can complement GLZs by sharing space and charging infrastructure. Recharging of the EV's battery could extend the range and operational capacity or permit the fleet to purchase vehicles with smaller battery packs, all of which would increase the cost effectiveness of EV truck purchases. High-powered chargers would allow vehicles to recharge quickly and ensure usability by many types of electrification needs, along with multiple cord options. Wireless charging is a promising future opportunity well-suited for curbside implementation in a GLZ, though one that has yet to be proven on public roads.

S.6 Key Findings by Audience

The following subsections summarize information from this study that is specific to fleets, policy and regulation, and technology.

S.6.1 Fleets

- The costs of purchasing electric trucks are too great, even with existing subsidies, to recoup through operations. Non-cash policies such as GLZs reflect an alternate pathway to accelerate operational parity with diesel trucks.
- Fleet managers indicated GLZs would provide valuable benefits to their operations, equal to cash subsidies, both in terms of parking summons avoidance and reduced delivery time, and other values associated with guaranteed space.
- Ensuring the "guarantee" of GLZ availability is essential to provide any value, and can be achieved with a combination of enforcement, clear signage, and reservation systems, among other techniques.
- Siting GLZ locations to match fleet need is critical – specifically, close to major individual or multiple receivers. Additionally beneficial are locations in areas where fleets incur a high volume of summonses
- Similarly, any phasing of specific windows of time for GLZ would need to match fleet usage patterns
- Visibility and clear demarcation of the GLZ are critical elements to ensure safety, optimize use, and gain community support.
- Incorporating charging infrastructure into GLZs is not necessary for existing fleets, but will provide value for future purchases in the form of extending vehicle range, thereby allowing for smaller batteries
- GLZs present a branding opportunity for fleets and receivers.

S.6.2 Policy and Regulation

- Broadly, New York City Department of Transportation's (NYCDOT) current freight strategy seeks to optimize freight traffic movement and throughput in NYC, which GLZs can support in the long term. In the short term, the GLZ concept may not readily align with components of that goal, namely reduced congestion, preservation of existing parking, and avoidance of creating many different, potentially confusing and difficult to enforce curbside space distinctions.
- Based on the limited number of electric delivery trucks currently in use, there is insufficient demand to justify the conversion of some loading zones to exclusive GLZs.
- Several opportunities exist for a phased implementation of GLZ until electric truck adoption is more pervasive: moderating initial emission requirement, selecting less in-demand locations, and carving GLZ time periods out of existing loading zones.
- GLZs can complement existing policy, including NYCDOT's Off-Hour Delivery Program, and existing efforts to provide on-street charging should be expanded to accommodate GLZ or other uses.
- Observations of existing loading and commercial zones in NYC indicate that these curbside spaces are not fully utilized by freight vehicles, suggesting opportunities for incorporating GLZs.
- Models similar to GLZs have been implemented successfully elsewhere in the world, with the Environmental Loading Point in Bremen, Germany as the best example which uses automated technology for enforcement.
- Automated enforcement of GLZs with RFID or license plate readers would require approval by the State Legislature, which is a challenging proposition.

- Business Improvement Districts are well-positioned to request GLZs, educate receivers, and promote enforcement.
- Parking summons are an important source of income for NYC, currently generating more than $500 million in revenue annually, with individual fleets receiving fines in the tens of millions of dollars. A GLZ implementation would need to ensure new revenue is generated, aligning with the policy goal of monetizing curb space.

S.6.3 Technology

- Electric trucks are good candidates for urban use due to their lack of emissions and routes typically requiring frequent stops or idling. Electric truck operational costs are lower than conventional gasoline or diesel trucks due to fuel cost savings and reduced maintenance requirements.
- Different chargers and connectivity technology are currently used to power electric trucks as well as other equipment that might use a GLZ, including food trucks, ambulances, and electrified refrigeration units. In the short term there is potential to use adapters or multiple cords to accommodate multiple uses, while in the long term greater standardization is likely and should be pursued.
- High-powered standard model chargers are best for achieving the greatest compatibility with potential curbside uses, while maximizing battery recharging. This means AC Level 2 at 40 amps or more currently, and DC Levels 1 and 2 in the future.
- Wireless charging is an emerging technology that would be well-suited for use in GLZs, claiming several advantages over the corded chargers including compatibility, convenience, and safety.
- Using existing infrastructure may be critical for the provision of electricity for curbside charging, with lampposts and adjacent buildings being the likeliest sources.

S.7 Next Steps

With electric trucks numbering in the hundreds nationwide, political support rather than fleet organizing may be of greater use to the implementation of a GLZ program. GLZs should be recognized as a cost-effective tool to achieve existing goals of lowering fleet emissions and freight policies of maximizing throughput and optimization of curbside space. Meanwhile, any pursuit of curbside charging should be broadened to enable other uses, such as pairing lunchtime food trucks with morning deliveries.

1 Introduction

The study has been developed for the New York State Energy Research and Development Authority (NYSERDA) and the New York State Department of Transportation (NYSDOT) in response to Public Opportunity Notice 2618. This report has been jointly authored by the consultant team of WXY architecture + urban design, Barretto Bay Strategies, and Energetics.

Green Loading Zones (GLZs) are curbside loading zones reserved for electric trucks—either exclusively, or at particular times of day. They represent an innovative, low-cost policy incentive to encourage the purchase and use of zero-emission vehicles (ZEVs), especially electric trucks for commercial use in NYC. GLZs would act as "safe harbors" for fleet vehicles, allowing them to avoid the parking summonses often levied during deliveries while reducing the time and frustration required in searching for legal curbside space. By adding a reservation system for EV fleets and their receivers, the GLZ would be an especially attractive initiative for fleet decision-makers. This policy incentive would be designed to operate at little cost to municipalities. The objective of this study is to analyze the potential for GLZs to encourage the use of electric trucks and related vehicle electrical systems in NYC, in light of three concerns:

- Needs of companies that currently have electric delivery vehicles in their fleets.
- Current NYC curbside policy and regulations.
- Current and future technologies that relate to curbside management and charging infrastructure.

The study reviews these areas of concerns and then sets out three potential case study sites along with a proposed approach to critical design and implementation issues.

1.1 Background

Trucks, as a key component of the freight network, are essential to the prosperity of the NYC Metropolitan region, but bring with them a host of issues such as noise, emissions, and congestion. NYC receives over 100,000 freight deliveries daily, predominantly going to wholesale, retail, and food enterprises.[2] Accomplishing these deliveries, truck and van operators are required to navigate congestion, traffic gridlock, inadequate off-loading facilities and tough parking challenges that force drivers to circle, idle, and double park, resulting in economic loss and increases in the amount of pollution emitted into the air.[3] Fleet vehicles often double park to complete deliveries, blocking

[2] New York City Department of Transportation. NYCDOT Pilot Program Finds Economic Savings, Efficiencies For Truck Deliveries Made During Off-hours. Press Releases. New York City Department of Transportation, 01 July 2010. Web. 14 Jan. 2014. http://www.nyc.gov/html/dot/html/pr2010/pr10_028.shtml

[3] Kamga, Dr. Camille, and Dr. Alison Conway. Freight-Tricycle Operations in NYC. University Transportation Research Center. New York State Energy Research and Development Authority (NYSERDA), n.d. Web.

traffic flow on vehicle and bicycle lanes, while accruing parking fines for their employers. Some larger fleets accrue yearly parking summons fees totaling millions of dollars.[4]

1.2 Freight Deliveries in New York City

New York City is a difficult city for freight of all scales. Several infrastructure improvements are in the process of being implemented in and around NYC to facilitate larger-scale freight including: roadwork around ports, raising of the Bayonne Bridge roadway, expansion of rail service, and the dredging of New York Harbor to accommodate larger ships. The Port of New York and New Jersey is already the nation's third busiest seaport, but trade in the region is growing at a faster rate than at the nation's two highest volume ports. From 2010 to 2011, two-way trade through New York's seaports and airports increased by 18 percent on top of increases in rail traffic and truck traffic of 9.9 percent and 28.9 percent.

While improvements occur regionally, most parts of NYC remain highly dependent on trucks for so-called "last-mile" delivery from larger freight facilities.[5] Comparatively fewer efforts have been undertaken to optimize or increase capacity of local delivery, suggesting last-mile truck trips, and any associated impacts are likely to increase.[6] This implies a significant market opportunity for the lesser impacts of electric delivery trucks. This study seeks to leverage the market opportunity by recommending innovative policy to encourage electric delivery vehicle usage.

1.3 Air Quality and Carbon Reduction Challenges

Freight trucking, primarily diesel-fueled at present, generates high volumes of noxious emissions that negatively impacts health and quality of life in local communities and contribute to global climate change, taxing the city and region. In NYC, estimated emissions of fine particulate matter causes more than 2,000 deaths, 4,800 asthma emergency room visits, and 1,500 hospitalizations for respiratory and cardiovascular disease annually.[7] The U.S. Environmental Protection Agency (EPA) designated NYC as a non-attainment area, which is defined as any area that does not meet (or impacting air quality in a nearby area that does not meet) the national primary or secondary

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4 Kamga, Dr. Camille, and Dr. Alison Conway. Freight-Tricycle Operations in NYC. University Transportation Research Center. New York State Energy Research and Development Authority (NYSERDA), n.d. Web.

5 It is important to note that, amidst New York City's truck dependency, it places limits on the length of tractor-trailers and box trucks: 55' and 35' respectively. Source: http://www.nyc.gov/html/dot/html/motorist/sizewt.shtml

6 Plan 2040 Regional Transportation Plan A Shared Vision for a Sustainable Region. Rep. New York Metropolitan Transportation Council, 04 Sept. 2013. Web. 14 Jan. 2014. http://www.nymtc.org/files/RTP_PLAN_2040_docs/Public%20Review%20Drafts/Plan%202040%20Full%20Document/Plan%202040%20Main%20Document.pdf

7 Using 2009-2011 data. Source: Kheirbek et al. New York City Trends in Air Pollution and its Health Consequences. September 16, 2013. http://www.nyc.gov/html/doh/downloads/pdf/environmental/air-quality-report-2013.pdf

ambient air quality standard for one of the six common air pollutants.[8] NYC's counties are designated as non-attainment areas for fine particulate matter, $PM_{2.5}$, and designated marginal non-attainment for ozone, while New York County (i.e., Manhattan) is further designated as moderate non-attainment for coarse particulate matter, PM_{10}.[9] These three pollutants have been strongly correlated with the exacerbation of asthma in children afflicted with the disease.[10]

Delivery trucks in NYC disproportionately impact economically challenged areas that consequently suffer from higher rates of asthma and other respiratory disease. A five-year study on the respiratory health completed by NYU's School of Medicine and Robert F. Wagner School of Public Service, found that students enrolled in schools near the Hunts Point Food Distribution Center in the South Bronx, which houses and receives approximately 3,800 trucks a day, had asthma rates as high as 25 percent, correlating asthma hospitalizations with peak periods of diesel trucking.[11] That study strongly recommended that policymakers incentivize alternatives to diesel fuel.

Using electric delivery trucks is an assured way to produce fewer emissions from freight. Electric motors are inherently more efficient to operate than diesels engine because of their superior efficiency. This efficiency, combined with lower emission rates per unit of energy from grid electricity, results in lower overall emission creation per mile for electric trucks. The EPA reports that diesel delivery trucks in the 20,000-26,000 pound category emit approximately 6.0 grams per mile of nitrogen oxide (NO_x), 0.17 grams per mile of $PM_{2.5}$, and 0.19 grams per mile of PM_{10}.[12] Electricity generation in New York State emits approximately 0.37 grams of NO_x per kWh of electricity produced and negligible levels of $PM_{2.5}$ and PM_{10}, resulting in a net NO_x savings of 5.5 grams per mile and a total elimination of $PM_{2.5}$ and PM_{10} emissions when diesel delivery trucks are replaced with similar electric powered vehicles.[13]

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8 These pollutants are ozone, particulate matter (both fine [$PM_{2.5}$] and coarse [PM_{10}]), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and lead.

9 US EPA, Currently Designated Nonattainment Areas for All Criteria Pollutants. December 5th, 2013. http://www.epa.gov/oaqps001/greenbk/ancl.html

10 NRDC, "Our Children At Risk." November 1997. Web. 21 Mar. 2014. http://www.nrdc.org/health/kids/ocar/ocarinx.asp

11 New York City. (2011). PlaNYC - A greener, greater New York. Pg. 97 http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/planyc_2011_transportation.pdf

12 EPA. Average In-Use Emissions from Heavy-Duty Trucks. Accessed April 18, 2014, http://www.epa.gov/otaq/consumer/420f08027.pdf

13 Leonardo Academy Inc., Leonardo Academy's Guide to Calculating Emissions Including Emission Factors and Energy Prices. Accessed April 18, 2014, http://www.cleanerandgreener.org/download/Leonardo%20Academy%20C&G%20Emission%20Factors%20and%20Energy%20Prices.pdf

Due to heavy stop-and-go traffic and relatively low speeds that are associated with delivery truck duty cycles, it is estimated that diesel trucks can produce between 125 and 175 pounds of carbon dioxide (CO_2) per truck, per day.[14] For aggressive drive cycles with many stops, as in NYC, electric trucks use 32-54 percent less energy and produce 42-61 percent less GHGs.[15] These approximations consider fuel type, electricity generation source, and battery manufacturing emissions. For NYC, which uses energy predominantly generated from hydropower, natural gas, and nuclear, the reduction percentages for other pollutants is likely to be even greater.

PlaNYC, NYC's ambitious effort to prepare for one million additional residents by 2030, tackles several sustainability goals at once: strengthening the economy, combating climate change, and enhancing the quality of life for all New Yorkers. Several GLZ-relevant goals are included such as reducing citywide GHG emissions by 30 percent (including 44 percent for transportation-related emissions), facilitating freight movements, and replacing and retrofitting diesel trucks.[16]

1.4 Existing New York City Programs

Several programs currently operate in NYC that are relevant to the GLZ concept and demonstrate the level of interest and investment major stakeholders in the region are making. Two of the projects provide charging for electric vehicles in the public realm; though concentrate on a single-purpose installation, each benefitting only one narrow user group. The other two provide funding for cleaner freight vehicles.

1.4.1 Food Truck Electrification Pilot

The NYC Mayor's Office, NYC Department of Transportation, and local utility, Consolidated Edison (Con Ed), are currently piloting a food cart electrification program immediately north of Union Square Park. The City is working with Simply Grid, a company that provides on-demand provisioning of grid electricity and metering through proprietary technology.

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14 Portland State University. Evaluating the Cost and Environmental Implications of Commercial Electric Vehicles in the LTL Delivery Industry. Accessed April 9, 2014. http://www.westernite.org/annualmeetings/santabarb12/Compendium/4B-Davis.pdf

15 Green Car Congress. Georgia Tech study finds MD (medium-duty) electric urban delivery trucks have cost advantages over diesel in some conditions; relative benefits depend on numerous factors. Accessed April 9, 2014. http://www.greencarcongress.com/2013/09/20130926-gatech.html

16 New York City. (2011). PlaNYC - A greener, greater New York. Pg. 92, 97, 124 http://www.nyc.gov/html/planyc2030/html/theplan/the-plan.shtml

Simply Grid installs pedestals on sidewalks and in lots that electric vehicles plug into to get power. Then through a wireless connection, built-in metering controllers connect to a cloud-based platform, which manages billing. Food truck vendors activate the system through their mobile phones, or radio-frequency identification device (RFID) tokens, connecting to the electric grid with cables they already have in place for use with the conventional generators they have thus far relied on. As many as three or four food trucks, which pay an hourly fee, can connect to one pedestal.[17]

This approach enables private lot managers and municipalities to provide electricity to food truck vendors at a significant cost savings while providing a more pleasant environment for their customers. Because these food trucks are often powered by noisy, inefficient and polluting gas generators, connecting to the grid to power their onboard appliances appeals to many food truck operators.[18] It is estimated that switching from generators to grid electricity can reduce carbon dioxide emissions by nine metric tons a year and save as much as 50 percent in fuel costs due to the cheaper form of energy.[19]

1.4.2 FDNY Ambulance Electrification Program

The Fire Department City of New York (FDNY) is in the process of conducting a study to electrify ambulance waiting locations power auxiliary systems, eliminating engine idling and associated emissions. Leading this effort is Jan Borodo, Executive to the Fire Department's Assistant Commissioner for Facilities Management, who explained that every ambulance, of which there are approximately 450 in NYC, has an assigned location. FDNY has been working with Con Ed and NYCDOT to assess which of these locations are best suited to install electric vehicle supply equipment (EVSE) and electricity meters. Ambulances generally idle in no standing zones, so FDNY has focused on locations that would eliminate the least amount of parking for residents and businesses.

The FDNY compiled a list of their 10 ambulances which are idling most, and is working with Con Ed and NYCDOT to find power sources to connect them to EVSE. The current program is noteworthy from a policy standpoint because in this scenario, in contrast to the food truck electrification pilot, charging occurs on-street. One key component of the proposed ambulance chargers is a quick release so as not to delay ambulance departures. Unfortunately, these do not fit existing standard EV plugs, discouraging use by other electric vehicles.

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17 Field, Anne. "Greener Food Trucks, Thanks To A New Plug-In Charging System." Forbes. Forbes Magazine, 30 Jan. 2014. Web. 14 Jan. 2014. http://www.forbes.com/sites/annefield/2014/01/30/greener-food-trucks-thanks-to-a-new-plug-in-charging-system/

18 "Reducing Emissions, One NYC Street-Vendor Cart At A Time." Green Car Reports. N.p., n.d. Web. 14 Jan. 2014. http://www.greencarreports.com/news/1086931_reducing-emissions-one-nyc-street-vendor-cart-at-a-time

19 "Reducing Emissions, One NYC Street-Vendor Cart At A Time." Green Car Reports. N.p., n.d. Web. 14 Jan. 2014. http://www.greencarreports.com/news/1086931_reducing-emissions-one-nyc-street-vendor-cart-at-a-time

1.4.3 New York Truck Voucher Incentive Program

One recent effort to specifically accelerate the deployment of alternative fuel vehicles for medium- to heavy- duty commercial fleets in New York was the release of the New York Truck Voucher Incentive Program (NY-VIP), a $19 million program from NYSERDA. The largest portion of NYT-VIP is geared for all-electric trucks, covering 80 percent of the incremental costs of purchasing an electric truck over a standard diesel truck, up to $60,000.[20] NY-VIP's goal is to reduce diesel emissions and promote a more fuel-independent New York.

1.4.4 Hunts Point Clean Truck Program

Developed by NYCDOT prior to the implementation of NYT-VIP, the Hunts Point Clean Trucks Program is designed to promote more sustainable transportation and a cleaner environment in the South Bronx, perhaps the most environmentally affected areas in the city, as indicated in Section 1.3. Aiming to replace up to 500 of the area's older, more polluting trucks, the Hunts Point Clean Trucks Program offers rebate incentives for the purchase of advanced transportation technologies and a wider array of alternative fuel vehicles than the NY-VIP such as new diesel, hybrid electric, compressed natural gas (CNG), and electric vehicles. Over $3.5 million has been distributed through the program, which is funded by the Federal Highway Administration's (FHWA) Congestion Mitigation and Air Quality Improvement Program, a program specifically targeting areas of air quality nonattainment.

[20] "About NYT-VIP." NY Truck VIP -. NYSERDA, n.d. Web. 21 Mar. 2014. https://truck-vip.ny.gov/about.php

2 Fleet Market Needs: Electric Fleets Review

Fleets operations in NYC are complex and present significant challenges to implementing curbside space specifically for EV trucks in high-demand areas. The challenge of designating GLZs is to find solutions and locations that benefit multiple fleets with varying degrees of overlapping use cases, from idling ambulances and utility companies to three-minute deliveries at restaurants. Representatives from several fleets that currently include electric vehicles were interviewed were interviewed for this report to better understand how GLZs might be used, their perceived benefits, and to document the charging infrastructure requirements of their existing systems.

2.1 Questionnaire Responses

Several fleet representatives completed response questionnaires addressing characteristics of their fleet and vehicles, potential electrical infrastructure requirements, and other factors related to the use of GLZs. Responses pertaining to the fleet characteristics and operations are provided in Table 1.

Table 1. Select Questionnaire Responses

	Product or Service	Number of NYC Vehicles	Electric Equipment	Make and Model	Average Time at Destination
Con Ed	Electricity Services	200	12 EVs	Azure, Navistar eStar	< 15 minutes
Down East	Fresh Seafood	15	2 EVs	Smith Newton	< 15 minutes
Duane Reade	Convenient Store Supplier	52	14 EVs	Smith Electric	30-60 minutes
Fresh Direct	Grocery Delivery	270	4 EVs, 19 eTRUs[21]	Smith Newton, Zanotti	> 2 hours
Frito-Lay	Snack Food Distribution	21,000 (nationwide)	15 EVs	Smith Newton	15-30 minutes
North Shore-LIJ	Medical Services	100	~10 electric standby systems		1-8 hours
UPS	Package Delivery	1,100	2 EVs	Boulder Electric, Custom	
USPS	Package Delivery		10 EVs	Solectria EV	15-30 minutes

[21] Electric refrigeration units. See Section Electric Refrigeration 4.3

One of the key issues discussed in interviews was which factors were limiting the use of EVs. The major concerns were that the excessive cost of an EV was far too great to recoup through operations, that current vehicle ranges were insufficient and NYC traffic too unpredictable (i.e., range anxiety), and that the makes and models of EVs currently available were not suitable for the operations of some respondents. A majority of fleets thought positively of GLZ designation, indicating they would be as important as subsidies in regards to purchasing or leasing additional zero-emission vehicles. All representatives interviewed indicated that enforcement and impossible-to-miss signage are important factors to make the GLZ policy work, with some suggesting a tripling of parking fines and others aggressive towing or passive systems to help the enforcement and dissipate knowledge of GLZs.

The fleet representative interviews additionally covered the vehicles' power requirements while at a destination site and whether they felt charging infrastructure at that location would be beneficial. Only Fresh Direct and North Shore-LIJ expressed a strong current demand for curbside power for their long-dwelling vehicles, to power electric refrigeration units and onboard medical systems respectively. Frito-Lay, USPS, and Fresh Direct acknowledged that they would consider reducing the size of on-board batteries if they could be guaranteed that EVs could regularly and often charge en route, but did not feel that providing power was necessary for their current operations. All of the fleets indicated that a widespread implementation with guaranteed access would be necessary for them to consider changing their current use of EVs, e.g. expanding their route or purchasing an EV with a smaller battery pack.

2.2 Fleets Summary

2.2.1 Duane Reade

Duane Reade played an integral role in the selection of locations for case studies. With nearly 250 stores in the NYC area, a Duane Reade store is found nearby in most of NYC's denser areas, making a good partner for GLZs. Not only are Duane Reade stores located throughout the city, but 25 percent of Duane Reade's fleet is comprised of Smith Electric trucks.[22] The company also worked with Mission Electric NYC on a campaign giving customers the opportunity to help decide which Duane Reade stores their electric trucks would deliver to.[23] When asked how meaningful the designation of a GLZ would be near one or more of their delivery locations to their business, Duane Reade's Fleet Operations Manager, Charles Hayward, responded "extraordinarily useful."

[22] Tucker, Joanne M. "The Urban Maze: Making Deliveries Count in NYC." Business Fleet. N.p., Nov. 2012. Web. 6 Jan. 2014. http://www.businessfleet.com/article/story/2012/12/the-urban-maze-making-deliveries-count-in-nyc.aspx

[23] Tucker, Joanne M. "The Urban Maze: Making Deliveries Count in NYC." Business Fleet. N.p., Nov. 2012. Web. 6 Jan. 2014. http://www.businessfleet.com/article/story/2012/12/the-urban-maze-making-deliveries-count-in-nyc.aspx

Deliveries by Duane Reade's own fleet generally take 30-60 minutes depending on the store size and delivery frequency. A unique feature of these deliveries is the use of plastic totes and wheeled carts—arriving delivery trucks simply wheel in inventory and leave totes and carts behind reducing delivery time—though this requires a return visit to pick up those tools left behind. Nevertheless, this double delivery further suggests locating GLZs around Duane Reade stores, in addition to the Duane Reade fleet making 80 percent of deliveries during off hours.[24] Duane Reade's position is also unique as receiver of several additional fleets including Frito-Lay.

2.2.2 Frito-Lay

Frito-Lay's fleet consists of 15 Smith Newton trucks in the NYC region with the near-term expectation of more. Every retail store is a potential destination for their fleets with bulk deliveries going to 3-5 stores per day and town trucks hitting 12-20 stores per day. Steve Hanson, Alternative Vehicle Program Manager at Frito-Lay, specified that bulk deliveries take between 2 and 2.5 hours while town delivery trucks take 30 minutes or less, generally taking place between 6 a.m. and 3 p.m.

When asked how meaningful would the designation of a GLZ near one or more of their delivery locations be for their business, Hanson said, "I don't know if I can overstate how critical this would be for us in NYC to add more EVs. Frito-Lay and other fleets operating in NYC have a challenge in NYC. [The] NYC drive cycle is perfect for EVs, but routes are short so the payback is harder for more expensive EVs."

Hanson continued, "Parking tickets are a large concern and if this could help address that, it would add a significant benefit to having EVs." In addition to an anticipated reduction in parking summonses, other benefits included a potential reduction in damage to vehicles followed by the anticipated reduction in fuel consumption due to the elimination of circling to locate parking. Overall Hanson indicated that a GLZ designation would be as important as subsidies in regards to decisions of purchasing or leasing additional zero-emission vehicles.

2.2.3 Down East Seafood

Down East Seafood operates two Smith Newton electric trucks that deliver to locations Manhattan, generally making deliveries in less than 15 minutes. Down East Seafood specified that their most important benefit from a GLZ would be the anticipated reduction in overall delivery/unloading time, followed by convenience for drivers, and the anticipated reduction in parking summonses issued.[25]

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[24] Hayward, Charles and Michael Fowles. "Questionnaire for Fleet Operators to Support a Study on the Feasibility of Green Loading Zones in New York City." Interview by Paul Lipson.

[25] Taylor, Ed. "Questionnaire for Fleet Operators to Support a Study on the Feasibility of Green Loading Zones in New York City." Interview by Paul Lipson.

As a member of the Department of Finance's Fleet Program, described in Section 3.2.1.5, Down East Seafood receives 20 percent off citations. However, they still receive several hundreds of dollars in tickets a week.[26] Ed Taylor, President, suggested a time limit be implemented at GLZs, specifically 45 minutes, with the best time for GLZ window as between 7 am and 1 pm.

2.2.4 Con Edison

Con Edison, NYC's predominant energy provider, operates 12 EVs overall, consisting of five battery EVs (eStars and Miles Electrics), and seven extended-range vehicles (Chevy Volts, Azure Dynamics, and Plug-in Priuses). Con Edison's John Shipman specified that the odds would be very low that any GLZ location would happen to coincide with their vehicles' providing service repair across NYC.

However, being part of a utility company, Shipman was able to provide detailed information and a range of potential issues in a GLZ implementation that included charging infrastructure. One specific implementation suggestion was to extend electrical service through receiver sites such as Duane Reade. Street lamps, which are in the process of being upgraded citywide, are another option for pass-through.

2.2.5 Fresh Direct

Fresh Direct delivers groceries to households and businesses seven days a week from 6 a.m. to 11 p.m. Fresh Direct currently operates four Smith Electric trucks with 80 kW batteries and six more on order, expected to be placed into service during the first quarter of 2014. These electric trucks deliver solely to addresses outside of the so-called Manhattan Core, which are primarily residential.[27] Fresh Direct indicated that GLZs would not be suitable to service these vehicles' haphazard routings.

In the Manhattan, Core Fresh Direct relies on a depot model for deliveries for which they expressed greater excitement regarding the GLZ concept. Under this model trucks park in one location for an extended period, 4-8 hours, from which runners make deliveries within a 10-block radius. Once trucks empty they are replaced by another immediately. There are over 20 depot locations, which are informally designated spots (primarily legal) that are served by between 80 and 100 trucks. While the trucks themselves are not electric-powered, their refrigeration units have the capability to be, as they are in Fresh Direct's main facility. Currently, these depot trucks must run their engines continuously to maintain refrigeration.

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[26] Taylor, Ed. "Questionnaire for Fleet Operators to Support a Study on the Feasibility of Green Loading Zones in New York City." Interview by Paul Lipson.

[27] Generally defined as below 110th St on the West and 96th on the East. See http://www.nyc.gov/html/dcp/html/mn_core/index.shtml

Fresh Direct indicated some flexibility in locating depot spots to where electricity was made available. In contrast to Down East Seafood's suggestion of a GLZ time limit of 45 minutes, Fresh Direct preferred that GLZs be available for the entire day. In response to the question of the most important benefit to their company of a GLZ, Fresh Direct acknowledged that community relations—showcasing the ability to eliminate noise potentially gaining community acceptance—was their key concern.

2.2.6 North Shore Long Island Jewish Health Systems

North Shore Long Island Jewish Health Systems (North Shore-LIJ) fleet currently consists of 100 emergency vehicles in the NYC region. North Shore-LIJ specified that currently none of these vehicles operate on electric power, but a half-dozen are currently wired to accept 110V electricity to power computers, radio, heating, ventilation and air condition (HVAC) systems, and other onboard equipment, with the remainder of the fleet quickly upgraded if curbside electricity were available: "Ambulance service is a money-losing operation and if GLZs were available we'd install onboard technology today," quipped Paul Powers.

Powers stated that the number one benefit to North Shore-LIJ if a GLZ was implemented would be the anticipated reduction in fuel consumption, followed by providing the health benefits accorded by emission reductions (GLZs would greatly mitigate complaints from residents about ambulances idling) and then improved conditions for drivers, primarily due to the reduction vibration caused by engines that must remain running. Similar to Fresh Direct, North Shore-LIJ's ambulances have designated standing locations from which they respond to emergencies. Powers estimated that ambulances average 12 hours a day at these locations. Powers further indicated a willingness to share a GLZ with fleet vehicles, especially during the day when most of their calls occur.

2.2.7 United States Postal Service

United States Postal Service (USPS) operates 10 Solectria EV 2-ton trucks that drive to post offices and large mail recipients. Deliveries take place every day but Sunday, between 10 a.m. and 7 p.m., with trucks generally dwelling between 15 and 30 minutes per destination. Though USPS did not express a great need for GLZ, they indicated the anticipated reduction in overall delivery/unloading time would be the most important aspect to their business followed by peace-of-mind/reduction of variability. Additionally, USPS mentioned potential concern with multiple businesses sharing the space, and pointed out that as a federal agency, their fleet was not subject local parking regulations.

2.2.8 United Parcel Service

United Parcel Service (UPS) has 1,100 vehicles operating in NYC delivering throughout all five boroughs from 7 a.m. to 8 p.m. with hubs in The Bronx, Lower Manhattan, and Manhattan's West Side.

UPS ranked the anticipated reduction in parking summonses as their main and only benefit from a GLZ. UPS suggested that participation in a GLZ program allow their overall fleet to receive financial incentives such as re-categorizing summons as business expense rather than penalties so they are become tax-deductible. In this case, a GLZ would be as important as cash subsidies and UPS would be willing to put 75 electric trucks on NYC streets if this or other GLZ program expansions such as a more sweeping placard program that allowed zero-emission vehicles to be exempted from fines related to double-parking, bus stops, hydrants, and bike lanes. For them, the number of electric trucks purchased would equal the amount saved from summons reduction/elimination. UPS was, however, particularly averse to the idea of sharing a GLZ with other businesses.

2.3 Summary

Fleets currently employing EVs are generally excited about the idea of GLZs being placed throughout NYC and most specified that the reduction in citations, along with enhanced community image, and reduction in delivery time would be of great benefit to their company, and lead them to convert more of their fleet to EVs. The responses indicate several differences between those fleets delivering to retail, such as Duane Reade and Frito-Lay, and parcel delivery fleets i.e., USPS, UPS, and Fresh Direct, who are unwilling to share a potential GLZ space with multiple fleets. All interviewed fleets indicated that enforcement would be critical to a successful GLZ along with clear, unmistakable signage, while selecting locations to accommodate multiple fleets and their individual preferences is likely to be a challenge. One important gap of this analysis that should be highlighted is the lack of inclusion of fleets that currently do not employ electric vehicles—constituting well over 99 percent of fleets in NYC—however, the overall positive response to the GLZ concept from those interviewed suggests an opportunity for this cutting edge policy to benefit the future of freight in NYC.

3 Policy Review

3.1 Introduction

Diminishing public sector resources and a waning federal role in subsidizing clean fuel technologies necessitate a more nimble and localized approach to broaden EV adoption and the complementary build-out of EVSE infrastructure. In this climate, it is anticipated that the role of municipal governments in identifying and implementing viable and cost-effective clean fuel incentive strategies will only grow.

Private fleets interface with municipal governments in manifold ways and managing the fleet/municipality relationship is a significant concern and cost-center for most large transportation companies active in dense, highly-vertical cities like New York.

For policymakers, approaches that are both revenue-neutral and not overly reliant on direct public subsidies are especially appealing. An incentives-driven approach (utilizing both the carrot of preferential loading zone designations for EV adopters and the stick of parking summonses and potentially newer fees) holds the promise of stoking private sector demand without draining public sector treasuries.

While oversight of the transportation industry largely rests with the federal government, cities themselves have a number of leverage points that have proven effective in influencing fleet behavior. These points include tolling, high-occupancy vehicle (HOV) lanes, loading zone designations, night-time parking regulations, parking summonses, and idling restrictions. Among these policy tools, parking summonses are among the most onerous to fleets, resulting in penalties exceeding $1 million per quarter for the largest NYC operators.

Due in part to its density, traffic congestion, high fuel costs, status as an EPA non-attainment area, and comparatively aggressive summonsing strategy, NYC is especially well-positioned to pilot a GLZ approach to incent EV adoption. NYC has increasing competition for limited curb space, commercial activity, and a public imperative to reduce congestion and generate revenue from its streets. In addition, jurisdictions face competing economic and social factors to balance public and private interests while managing traffic flow. The effort to achieve the right balance requires careful policymaking by agencies, government bodies, and quasi-governmental entities.

Setting aside curb space for zero emission fleets—as the GLZ model proposes—is one alternative, though this strategy poses efficiency challenges that will be explored in the following sections. Issuing EV identifiers such as electronic pass devices, official placards, decals, or providing special reductions on parking summonses are other complementary measures that can facilitate a preferential approach to zero-emission freight movement. As future technologies and technical specifications evolve policy debates will continue to transform in the years ahead.

3.2 Policy Actors/Regulations

Transportation policymaking is carried out at all levels of government but coordination, direction, and oversight of most transportation spending, the shaping and administration of broad safety regulations, and the financing of many state and local projects largely rests with the federal government. State transportation agencies such as NYSDOT uphold and enforce statewide safety standards and licensing and establish transportation priorities for each state. State agencies also assist in the development, operation, and maintenance of transportation facilities, highways, railroads, mass transit, ports, waterways, and airports. Cities, meanwhile, establish and enforce policies such as speed limits, as well as parking and loading regulations on the municipal roadways within their jurisdiction. City transportation agencies have great latitude in designing policies to improve traffic mobility, reduce congestion and air pollution, and enhance pedestrian safety. In an era of decentralization, cities have become thriving laboratories for experimentation in transportation policymaking.

3.2.1 New York City

3.2.1.1 New York City Department of Transportation

The NYC Department of Transportation (NYCDOT) is responsible for the safe, efficient, and environmentally responsible movement of people and goods in the City of New York. In that role, NYCDOT is the city agency owning the public right-of-way, including streets, sidewalks, and plazas. NYCDOT enforces regulations related to commercial vehicles and their use of city streets. These regulations can be found in Section 4 of Title 34 of the Rules of New York.[28]

3.2.1.2 Policy Context and Rationale

To ensure the uninterrupted flow of goods and services in the most crowded and congested commercial districts in the United States, NYCDOT has instituted a number of curbside management strategies aimed at reducing the number of double-parked vehicles and decreasing the dwell time of commercial vehicles in NYC's busiest loading zones, generally improving traffic flow.[29] Foremost is the clear designation of curbside loading zones providing exclusive access to delivery vehicles and limiting other vehicles access to such prime street real estate during operating business.[30] Tiered pricing strategies accompanying the deployment of Muni meters throughout Midtown Manhattan have been integral to the NYCDOT strategy as well; escalating commercial parking rates are used to discourage extended curbside dwell times and thereby encourage turnover in loading zones. The use of Muni meters also ties in with the City goal of maximizing the monetary value of curbside space.

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[28] Rules of the City of New York, Chapter 4, Title 34, New York City Traffic Rules and Regulations. http://www.nyc.gov/html/dot/downloads/pdf/trafrule.pdf

[29] US Department of Transportation, Federal Highway Administration, Office of Freight Management and Operations. 2009. "Urban Freight Case Studies: New York." http://ops.fhwa.dot.gov/publications/fhwahop10019/fhwahop10019.pdf

[30] The full legal rule under Section 4-08(k) can be found in Appendix B.

According to NYCDOT, this tiered pricing structure for commercial vehicles has proven to be an effective tool for improving parking availability for commercial loading. Beginning in 2000, NYCDOT began to introduce paid parking with hourly escalations for commercial vehicles on busy midtown blocks. The following year paid commercial parking was expanded to cover most commercial spaces south of 60th Street in Manhattan.[31]

3.2.1.3 Loading Zone Establishment

In addition to implementing tiered pricing strategies, NYCDOT also works collaboratively with establishments receiving deliveries (receivers) in targeted retail strips to identify favorable delivery windows and allocate curb space accordingly. By creating a receiver-responsive process for designating loading zone locations and specifying delivery windows, NYCDOT seeks to maximize opportunities for relieving congestion and double-parking in key retail corridors. Established loading and commercial zones for much of NYC are shown in Figure 1.

The creation of loading zones, their location and boundaries, time limits, and manner of operation can be codified in a city's official rules and regulations. In New York State, the legislative body of any city or village—the City Council in NYC, for instance—may create zones that control parking or standing through local law, ordinance, rule or regulation.[32] In NYC, Community Boards can play an essential role in the designation process by bringing local loading zone requests to the attention of the relevant NYCDOT Borough Commissioner. Support letters are typically solicited from the Community Board by applicant businesses and help bolster the case for a designation. Community Board transportation subcommittees are often the first points of contact for a business seeking a loading zone designation.

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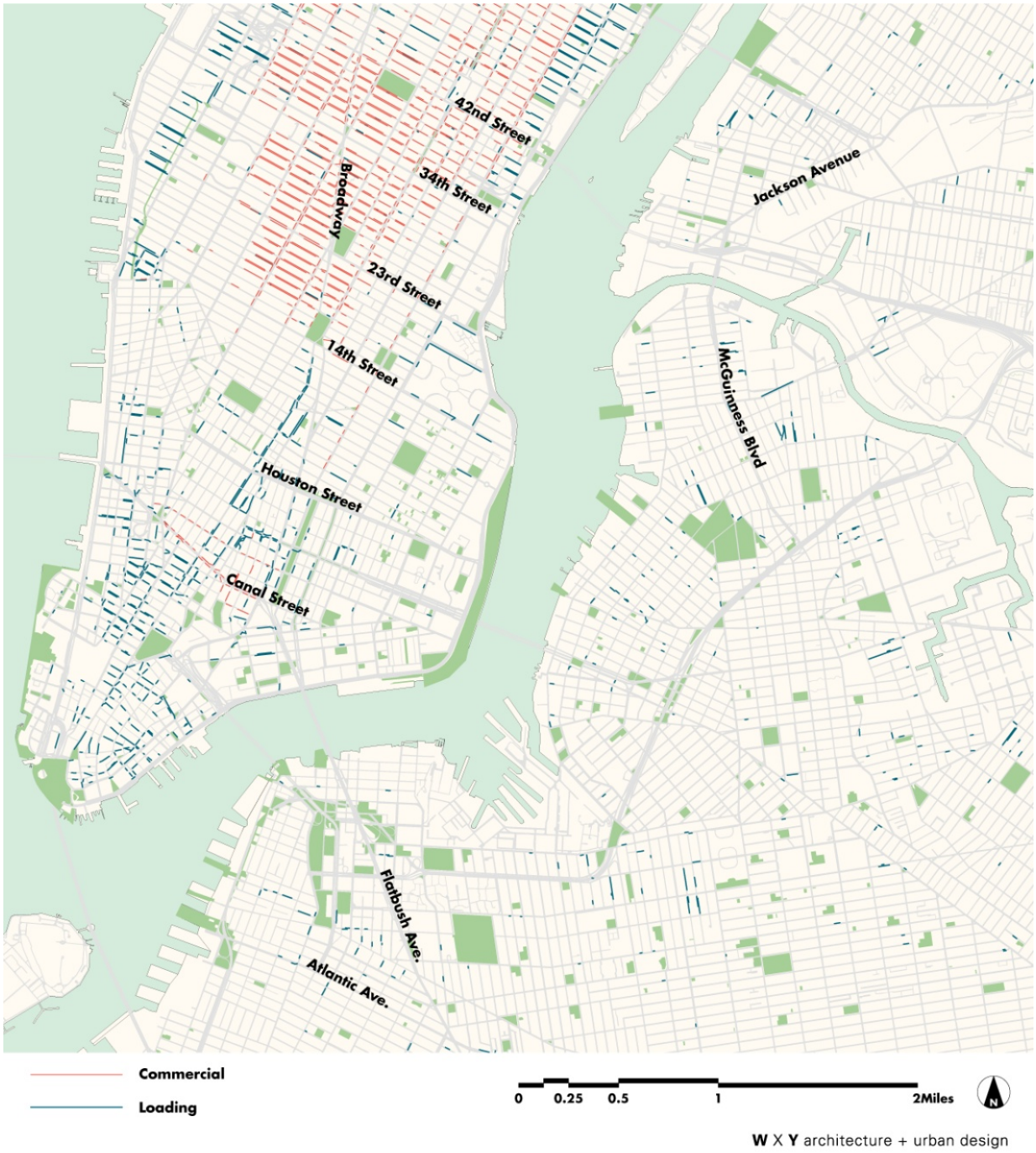
[31] Parking Pricing and Curbside Management in New York City: Schaller, Maguire, Stein, Ng, Blakeley, NYC Department of Transportation, November 15, 2010. Submitted to TRB 2011 Annual Meeting

[32] See New York State Vehicle and Traffic Law, Title VIII, Article 39, Sections 1640 and 1642, and Appendix B.

Figure 1. NYC Commercial Loading Zones



3.2.1.4 NYCDOT and Curbside Electric Vehicle Infrastructure

Though it is not clear whether all or some potential GLZs would include charging infrastructure, NYCDOT will play a key role in setting the policy related to EVs and development of EVSE in NYC. In December 2013, NYC enacted Local Law 122, which created an Electric Vehicle Stand Advisory Committee. The purpose of the Advisory Committee is to make recommendations to the City "on ways to promote the usage of electric vehicles among the general public, which shall include consideration of methods to enhance the availability of electric vehicle charging methods and of parking, regulatory, technical and fiscal issues surrounding the increased use of electric vehicles in NYC."[33]

During the final years of the Bloomberg Administration, NYCDOT voiced its concerns about curbside or sidewalk charging in the city. In its testimony submitted to the NYC Council related to the proposed EV Advisory Committee, NYCDOT stated that such charging would present regulatory and policy problems: "[S]idewalk-based charging stands for public use would require curbside parking policy changes, and would need to compete with commercial loading, hotel zones, rush hour regulations and standard metered parking, among other curbside needs."[34] Liability is another potential concern, whether related to the tripping hazard of any wayward cables or the high-powered charge in that cable.

Although NYCDOT has reservations about public charging on curbs and sidewalks, it is less clear how it (or the NYC Department of Finance) would assess the use of permits or decals granting preferential treatment for zero emission vehicles for commercial loading. This question is further explored in Section 3.5.2.

3.2.1.5 New York City Department of Finance

The NYC Department of Finance (NYCDOF) adjudicates and collects parking tickets and also acts as the City's chief civil law enforcement officer, among other tasks. Money collected by the NYCDOF from enforcing city rules goes directly to the City. In 2013, NYC collected $600 million from parking violations, with large fleets such as FedEx and UPS paying several million dollars each.[35]

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[33] Local Law 122 of 2013, (Proposed Int. 844-A) http://legistar.council.nyc.gov/LegislationDetail.aspx?ID=1123808&GUID=D1C5A1D1-B594-41DB-8B94-DA689EC3FA35&Options=ID|Text|&Search=advisory+committee+on+electric+vehicles

[34] Department of Transportation testimony submitted to the New York City Council Committee on Transportation, November 12, 2013. http://legistar.council.nyc.gov/LegislationDetail.aspx?ID=1123808&GUID=D1C5A1D1-B594-41DB-8B94-DA689EC3FA35&Options=ID|Text|&Search=advisory+committee+on+electric+vehicles

[35] David Stein, NYCDOT, December 16, 2013, personal communication.

The NYCDOF offers the NYC Delivery Solutions program for delivery fleets whereby businesses participating in this program waive their right to challenge parking tickets and agree to pay a preset, reduced fine amount for each offense. The type of violation determines whether the ticket will be dismissed or reduced. NYCDOF estimates that this program potentially eliminates one million hearings a year.

One expansion of the GLZ concept discussed in interviews with fleets that could further enhance their appeal would be to provide a further reduced penalty rate for EVs. However, this approach, more than a simple curbside designation, may garner pushback as a corporate giveaway. It would also require formal rulemaking by the NYCDOF.

3.2.2 New York State

3.2.2.1 Public Service Commission

Part of the mission of the New York State Public Service Commission (NYSPSC) is to ensure safe, secure, and reliable access to electric services for residential and business consumers across New York State, at just and reasonable rates. In 2013, the NYSPSC ruled that it did not have jurisdiction over public charging stations, alleviating concerns that direct EVSE charging for electricity would be judged as energy resale. In making this decision, the NYSPSC considered comments from the City of New York and NYSERDA, who identified the need for utility test piloting projects involving EVs to better determine rates for consumers. For the full Declaratory Ruling on Jurisdiction over Publicly Available Electric Vehicle Charging Stations, refer to Appendix B.

3.2.2.2 Public Authority Law and Public Benefit Corporations

New York's Public Authority Law governs some of the State's major public authorities. There are only 11 authorities subject to the Public Authorities Control Board's (PACB) oversight, including NYSERDA, the New York Power Authority, and the Long Island Power Authority. Public authorities are created through acts of the State legislature to advance public priorities. In New York State, public authorities develop and operate facilities, infrastructure, and publicly-owned properties.

In NYC, the Roosevelt Island Operating Corporation (RIOC) was created through an act of the State legislature in 1984. While RIOC has a broad public mandate, like many other public authorities in the state, it is exempt from many State and local regulations. The RIOC, for example, establishes and enforces its own parking and loading regulations on Roosevelt Island, giving it great latitude to manage the Island's roadways and curbs.

3.2.2.3 Metropolitan Planning Organization

The New York Metropolitan Transportation Council (NYMTC) is a regional council of governments, comprised of the NYCDOT and Department of City Planning in NYC; the lower Hudson Valley counties of Putnam, Rockland and Westchester; the Long Island counties of Nassau and Suffolk; the New York State Department of Transportation; and the Metropolitan Transportation Authority. NYMTC serves as the Metropolitan Planning Organization for the NYC, Long Island, and the Lower-Hudson Valley. While NYMTC does not have a direct regulatory role in policy implementation, it is a crucial player in the allocation of federal resources and planning expertise, including development of regional plans for the metropolitan area.

When asked whether it would be feasible to apply federal Congestion, Mitigation and Air Quality funding toward the implementation of GLZs, NYMTC Planning Director Gerry Bogacz, said it is possible, but the proposal would need to demonstrate reduction of emissions: "You would need to show measurable improvement." Congestion Mitigation and Air Quality Improvement Program funds, which are typically utilized to reduce vehicular emissions in non-attainment areas, have been applied to projects as varied as diesel retrofits for private fleets, bike share systems, congestion-reduction planning, and the purchase of hybrid buses.

3.2.3 Federal

3.2.3.1 The Manual on Uniform Traffic Control Devices (MUTCD)

The implementation of a GLZ will require appropriate signage to ensure safety, efficiency, and to maximize its benefits. The Manual on Uniform Traffic Control Devices (MUTCD) is administered by the FHWA and serves as the national standard for all traffic control devices installed on any street, highway, bikeway, or private road open to public use.[36] Traffic control devices include any signage, lightings, and street markings. Meaningful implementation of GLZs will require new, specialized signage to delineate the GLZ's restrictions as well as the potential inclusion of electrical charging infrastructure. Some jurisdictions may deem such signage appropriate for pilot testing or experimentation, as per the MUTCD permittance process. More details on the standards and guidance, and intermediate approach to incorporating traffic control devices can be found in Appendix B.

[36] The official MUTCD can be found here: http://mutcd.fhwa.dot.gov/

3.3 Nongovernmental Actors

A number of nongovernmental entities are positioned to play roles in a GLZ implementation strategy, including Con Ed, local business improvement districts (BIDs), community groups, and merchants associations.

In an EVSE-equipped GLZ, charging equipment can be connected to the grid under several different scenarios. Con Ed's John Shipman identified two likely nearby sources for electrical service with sufficient electrical capacity for a curbside EVSE: pulling a cord through a street light or extending service from an adjacent metered property, especially one housing a receiver, such as a Duane Reade store. In both cases, electrical service would likely require submetering, which could be accomplished in the EVSE itself. Shipman has stated that the utility has no desire to own the charging equipment—"Let the free market own them"—and has suggested an "adopt-a-charger" model as a potential financing strategy for acquisition and installation of new curbside EVSE.

The adopt-a-charger model could rely on other nongovernmental actors such as outdoor advertising firms seeking ad placement and co-branding opportunities or on merchant associations seeking to differentiate their commercial districts. Many business or community groups might be invested in the implementation of GLZs, both for marketing purposes and to help meet sustainability objectives. In Bremen, Germany, the city's Chamber of Commerce was instrumental in planning and advocating for an "environmental loading point," a less-restrictive GLZ concept, near a pedestrian-only commercial district. In NYC, BIDs are well-positioned to play the crucial role of change agents by educating receivers and the general public about the use of the zones and by partnering with the NYCDOT on implementation strategies. Though commercial fleets are likely the primary beneficiaries of a GLZ implementation, to avoid appearance of provisioning public space for private use, firms are not ideal instigators of public EVSE installations.

3.4 International Models

3.4.1 Bremen's Environmental Loading Point

As noted in the prior section, Bremen, Germany is one of a small cluster of cities in the European Union (EU) that have piloted restricted parking zones for clean fuel delivery vehicles. The city's Environmental Loading Point (ELP) initiative was launched in November 2007 to help reduce levels of PM_{10} and NO_x connected to freight movements in and around Bremen's Low Emission Zone (Figure 2). The project was planned in partnership with DHL, a major local fleet; the city's Chamber of Commerce; and municipal agencies. Capital costs for the initiative were underwritten in equal parts by the Bremen municipal government and the EU.

Figure 2. Bremen's Environmental Loading Point (ELP)

Source: Michael Glotz-Richter granting permission for use

The ELP consists of two designated truck unloading spaces adjoining a pedestrian-only commercial district. Delivery vehicles meeting the following standards can register to use the ELP: vehicles must be 40 feet in length or less and also meet the Euro V or Enhanced Environmental Vehicles standards set forth by the EU. A transponder and traffic signal system manage space usage—vehicles without the proper transponder will prompt a steady dark orange light indicating a violation.[37] Noncompliant vehicles are barred from delivering in the area after 11 a.m. each day. Michael Glotz-Richter, Bremen's senior project manager for sustainable mobility, reports that "technically, [the zone] works well." The successful implementation of the ELP was both a tangible outcome of policymaking and a triumph of an ongoing private-public conversation and partnership. As Glotz-Richter recounts:

> There was a working group for low-carbon delivery vehicles that helped initiate this concept. [It] came out of a wish list from members that wanted an added privilege in this area to purchase more expensive delivery vehicles. Working groups were employed to determine how this could be done including a city-owned parking agency that was surveyed to find the best place to do this. No feasibility study was necessary because it is a small city and all the players were willing to sit down together and solve the problem. This concept had common ground for a number of groups, and the Chamber of Commerce helped promote this concept to businesses, instead of providing subsidies, [members of the working group] saw the ELP as an additional perk for these adopters of clean technology.

Crucial to the success of the initiative was the engagement of Western Europe's dominant player in parcel delivery. DHL, an iconic fleet with a highly-publicized sustainability agenda, provided expertise to the working group and ultimately purchased ELP-compliant CNG delivery trucks. "You need a fleet like DHL to make this happen," Glotz-Richter continued, adding:

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[37] Dark orange was used because it is a close approximation of red, which is a color with restricted use.

> [A] delivery partner is needed to ensure that [the ELP] is used by companies and not a wasted effort that might not align with the technology or operations used by the delivery companies. Specifically, [DHL] wanted a place where clean vehicles could unload and dirty vehicles would not be allowed. Technology helped to successfully implement this.

While the Bremen example of an environmentally restrictive action offers some lessons to NYC policymakers—operational costs and route optimization are key drivers of fleet decision-making in both cities—some significant differentiators between the two markets were underscored by Glotz-Richter. "Environmental reports and sustainability efforts by large companies (like "Go Green" by DHL) help drive business. [We're] finding more acceptance of cleaner vehicles because of this," he said. In the U.S., such reporting is not mandatory nor is it yet a principal driver of consumer or business-to-business demand.

3.4.2 Related EU Initiatives

Low-Emission Zones (LEZs)—generally, areas or thoroughfares where vehicles that fail to meet current EU emissions standards are banned or in some cases tolled—are found in 14 EU countries. Germany alone currently has 139 separate LEZ designations. Nearly all LEZs regulate the movement of medium- and heavy-duty trucks (usually over 3.5 metric tons Gross Vehicle Weight [GVW]), and most buses and coaches (usually defined as more than 5 metric tons GVW). GLZs, by comparison, are a more light-touch approach.

Urban Consolidation Centers (UCCs), which reduce freight transport inefficiency by consolidating partial loads into more fully-utilized, more agile, and less-polluting vehicles for last-mile delivery, are located throughout the continent, generally on the outskirts of urban centers. Le Petit Reine in Paris, which employs electric-powered bicycles; Cityporto in Padua, which uses both electric and natural gas-powered trucks; and the Paris Chronopost and Bordeaux Nearby Delivery Area, which rely on electric trucks, all offer models that are instructive. These facilities minimize diesel truck impacts in their respective city centers by deploying environmentally-friendly technologies for last-mile service. Unlike Bremen's ELP or the proposed NYC GLZ, these models require cross-docking or some level of double-handling prior to curbside delivery, adding some incremental cost and time penalty to the process.

While great variations in land cost and availability as well as approaches to municipal governance may not invite a strict comparison between EU cities and New York, the pairing of a European-style UCC and proposed NYC GLZs might offer a powerful inducement to freight handlers to accelerate the transition to zero and near-zero emission urban delivery.

3.5 Policy Options for GLZ Designation

According to policymakers at NYCDOT, even a pilot GLZ designation would be fraught with complexity. Currently, the only vehicle differentiation made for parking in NYC is commercial versus passenger, with some curb space allocated for taxi standing zones. “The more you dedicate curb space to a particular vehicle type, [the more] you will either not have enough vehicles to occupy the space or you will have two green vehicles at the same time trying to occupy the space,” explained Stacey Hodge, director of NYCDOT’s Office of Freight Mobility. “You may need to open up the access to these spots for many different vehicles (taxis, passengers)— [and n]eed to maximize use throughout the day.”

Offering preferential treatment to a highly specific vehicle type is unusual for municipal and regional transportation agencies, but not unprecedented from a policy perspective. “Effectively, any kind of premium service incents something—like HOV lanes, toll reductions, any discounted space,” offered Gerry Bogacz. On-street parking discounts and preferential parking locations for hybrids and clean fuel vehicles are provided by cities as diverse as Sacramento, CA; Miami Beach, FL; and New Haven, CT. A NYC counterpoint to these policies was provided by Howard Mann, manager of freight planning for NYMTC, who asserted that “curb space management always seeks to manage traffic rather than incentivizing a particular technology. [The GLZ] encompasses other goals as well.”

3.5.1 Operationalizing GLZ Policy

The demand-driven nature of the loading zone designation adds another layer of complexity to the policy conversation. “[We] carve up the curb space based on demand; delivery windows are typically picked for peak times, [since] a receiver must get deliveries in before customers arrive,” Hodge continued. Observations of current loading zones for potential to incorporate future GLZ indicate that opportunities exist to optimize these curbside spaces for greater numbers of vehicles, possibly including EVSE. The potential segmentation of the loading zone itself—between EVs and non-EVs—with striping and signage provides a further complexity. Policymakers at NYCDOT expressed great concern about such a segmentation between “green” and conventional users. According to Tom Maguire, assistant commissioner of project development at NYCDOT: “Cutting up pavement,” carving up a single loading zone for different vehicle types “decreases efficiency,” leaving too much margin for error, confusion, and conflict.

The relative scarcity of fleet EVs in NYC—fewer than 100 electric trucks at the end of 2013—and small number of receivers served by EVs presents a further challenge, especially if a pure demand-driven case for a GLZ designation were required. Several approaches are possible for GLZs in order to minimize the impact on current freight operations while still providing a tangible incentive to entice potential EV truck purchases such as:

- Implement GLZs as a narrow segment of existing loading zones both in terms of curbside space and time period, e.g., limiting to the size of one box truck, and between 7 a.m. and 10 a.m.[38]
- Target GLZ locations to current and anticipated market demand, in particular locations projected to have the longest dwell times based on existing dwell times as well as locations that can serve multiple receivers.
- Do not site GLZs in NYC's most contentious loading zones and commercial traffic areas.
- Expand the range of vehicles eligible to use the GLZ to include not only zero emission but also low emission trucks, or allow zero emission light-duty commercial vehicles.

These approaches could be phased over periods of years dependent on the market adoption of EV trucks.

3.5.1.1 EVSE Charging Considerations

Another method for enticement is the inclusion of EVSE for potential in-route recharging. Given that current EV fleets oversize their batteries as a precautionary measure, the current demand for such a benefit is minimal; however their presence would allow fleets to integrate them into future purchasing plans. Steve Hanson at Frito-Lay indicated, with several caveats, that GLZs incorporating charging would potentially allow Frito-Lay to purchase electric trucks with 20 kWh battery packs rather than 80 kWh, significantly reducing their upfront cost. Among the conditions of his statement were that the curbside space of the GLZ would have to be guaranteed at a particular time, potentially reservable, and with a no-hassle charging interface.

Meanwhile, Ari Kahn, Electric Vehicle Policy Advisor at the Mayor's Office of Long-Term Planning and Sustainability, indicated one complication in balancing the incorporation of EVSE with other approaches: any curbside space with installed charging infrastructure would have to be restricted as EV-only, as is the intention for any other curbside charging provision elsewhere.

3.5.2 The Enforcement Challenge

Ultimately, whether a GLZ is designated within a defined delivery window or as a discrete pavement allocation within a pre-existing zone, enforcement will be a critical component of effective policymaking. "Like other on-street tools that are available, its efficacy depends on the degree of enforcement," stated NYMTC's Mann. "Might be successful if it had the back-up of police enforcement." NYCDOT's Hodge agreed: "Yes, the caveat is that this [enforcement] is always requested. […] The best policies need to align well with use so the places will be occupied and not invite others to violate policy because that is the only open space. Curb regulations need to match natural patterns of supply and demand."

[38] Fleet interviews suggested time period segmentation would have to be staggered across different GLZs so that individual trucks could take advantage of multiple GLZs.

Key enforcement tools cited by policymakers include signage, Muni meters, as well as decals and sensors to identify eligible vehicles. "Very clear signage that conveys in limited words exactly what the zone is for," Hodge continued. "[It] needs to be descriptive enough to be clear to the enforcement officers who should be in these spaces." Gerry Bogacz, Planning Director at NYMTC, cited a recent precedent linking striping and other pavement markers with efficacy. EV best practices suggest solid green-colored pavement to designate EV-only spaces.[39] "With Select Bus Service," Bogacz explained, "color pavement has added to the success of the initiative. Some coloration of pavement and signage would improve visibility and likelihood of success for the program."

Creating identifiers for a new class of vehicle might compel a move toward the use of vehicle sensor technology, several policymakers suggested. NYCDOT's Hodge suggested electric delivery trucks "may need permits or decals on the vehicle so they can be accurately treated." She cited a new NYCDOT permit system for intercity buses that load on city streets as a useful model with very clear decals. "CleanPasses are the best example," advised Bogacz, referencing New York State's clean vehicle decal permitting HOV-lane access on certain New York highways. "Technology could help reinforce the message. Initially, it should be a sticker and highly visual to enforcement personnel; perhaps a similar technology to Green Pass (a discounted version of E-ZPass) and a handheld device that could articulate with the CleanPass to verify."[40] Hodge provided the example of London as an enforcement model where license plate readers throughout the city manage truck enforcement. This technology could be enhanced or facilitated by a special license plate for EVs. Hodge affirmed that "tickets issued via technology are always more accurate." Bremen's ELP provides a useful example of passive enforcement enabled by RFID technology where a majority of unregistered vehicles vacated the ELP spaces due to the alighting of a disconcerting dark orange light.

One complication in NYC's consideration of the electronic enforcement model is New York State's Municipal Home Rule Law, which grants authority to municipalities to act by local law with respect to their "property, affairs, or government," but also limits the municipality's range of motion in certain areas. The phrase "matter of state concern" emerged from court cases regarding the State's grants of home rule and has been interpreted to encompass a number of matters—including transportation—in which the State limits municipal authority. It is assumed that automated ticketing devices, like license plate readers or traffic enforcement cameras, would fall under Home Rule provision and require a Home Rule Message, as well as a special grant of authority from the State.[41]

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[39] WXY architecture + urban design, and Energetics Incorporated. 2012. Siting and Design Guidelines for Electric Vehicle Supply Equipment. http://www.transportationandclimate.org/sites/default/files/EV_Siting_and_Design_Guidelines.pdf

[40] Both Green Pass and CleanPass are available to vehicles meeting California's Super Ultra Low Emission Vehicle standard and highway fuel economy rating of 45 miles per gallon or more.

[41] The issue of automated traffic enforcement using speed cameras is a frequent source of contention between NYC and the State: http://www.capitalnewyork.com/article/city-hall/2014/03/8542940/de-blasio-promises-further-action-speed-cameras

Optimally, both automatic and passive enforcement strategies could be combined for GLZ, and enhanced by strong and clear signage. One scenario in jurisdictions where such an approach is possible, the reserving of spaces in advance for curbside loading could be managed by smartphone apps linked to enforcement agencies. Muni meters for commercial vehicles can play a role in enforcement as well—albeit small—though one that has quickly become "a very important source of revenue for the city," according to NYCDOT's Hodge. In a GLZ scenario, a two-tiered rate structure could offer preferential terms to EVs while locking out conventional vehicles from accessing the Muni meter system. However, no fleet interviewed indicated Muni meter pricing as a strong lever, nor would one expect it to be for fleets already failing to observe double-parking or hydrant restrictions.

Overall, clear communication to the public, to fleets, and most critically, enforcement personnel will be essential.

3.5.2.1 EPA SmartWay

Launched in 2004, EPA's SmartWay Transport is an important effort to improve fuel efficiency and reduce emissions of the national supply chain. Operating as a collaboration between freight shippers, carriers, logistics companies, and other stakeholders, to voluntarily reduce impacts associated with freight transport, the program has saved over 100 million barrels of fuel since its inception, and simultaneously reducing emissions of carbon dioxide (CO_2), $PM_{2.5}$, and NO_x.[42] Vehicles and fleets participating in the program are able to utilize tools to analyze their environmental performance, as well display a SmartWay decal indicating participation in the program. Both the analysis tools and decal have proven to be strong marketing measures for developing client relationships and demonstrating commitment to sustainability goals.

3.5.2.2 Empire Green Fleets

In 2013, Empire Clean Cities (ECC) launched their fleet certification program Empire Green Fleets (EGF). EGF recognizes public and private fleets that are leading the way in transitioning the New York region into a low-carbon, sustainable economy. According to ECC Executive Director Christina Ficicchia, ECC works in coordination with fleet managers to track individual vehicle use information measuring five pollutants from all of the fleets' vehicles, including on- and off-road, for the previous year. The five key pollutants measured are CO_2, $PM_{2.5}$, NO_x, carbon monoxide (CO), and volatile organic compounds (VOC), measured using the U. S. Department of Energy's (DOE) emissions calculators.[43]

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[42] SmartWay Transport Overview, http://www.epa.gov/smartway/about/documents/basics/420f14006.pdf

[43] Respectively, these pollutants are carbon dioxide, fine particulate matter, nitrogen oxides, carbon monoxide, and volatile organic compounds

Fleets whose emissions are measured as lower than expected by a standard diesel vehicle of the same class are awarded points and can become a certified EGF by implementing alternative fuels like natural gas and biodiesel, advanced vehicle technologies like hybrid and electric vehicles, as well as utilizing off-hour delivery, reducing idling time, utilizing route management systems, improving vehicle use efficiency, or installing diesel filters.[44] The EGF program itself, or something similar may be utilized to manage GLZs, incorporating the program's existing decals. Opening up a GLZ for EV trucks as well as EGF vehicles may provide optimal usage at a GLZ and reduce the amount of time a GLZ is left unoccupied.

3.5.3 Off-Hours Delivery/Delivery Window Policy and the GLZ

For NYCDOT, congestion and local air quality impacts attributable to freight movement are best addressed through off-hours delivery, which the agency has been pursuing with the Off-Hour Delivery Program since 2009. According to NYCDOT's Hodge, off-hours delivery—generally defined as in-city freight movements that take place between 7 p.m. and 6 a.m.—could also provide relief from ticketing for fleets. GLZs and off-hours delivery "could accomplish [the] same thing, since off-hours delivery vehicles need to be quieter—perhaps EVs should be used," Hodge offered. "New Deal Logistics, for instance, uses electric trucks for off-hour deliveries. Maybe it could be stipulated that participating fleets in off-hours delivery program use only EVs."

Fleet operators also see merit in NYCDOT's argument. Charles Hayward, fleet operations manager for Duane Reade, and Steve Hanson, national fleet sustainability manager for Frito-Lay, emphasized the potential synergy of coupling GLZs with off-hours delivery and the attendant air quality and congestion-reduction benefits for New York State. Duane Reade already participates in NYCDOT's program and has found that the near-silent operation EVs provide is crucial to maintaining harmonious relations in the largely residential communities where these deliveries are occurring. GLZs in these communities would ensure that dedicated curb space near Duane Reade locations would be reserved for EVs in the off-hours delivery window.

For Frito-Lay, the off-hours opportunity would enable local fleet managers to optimize use of their electric trucks in the night-time hours, when the EV offers a clear differential advantage over its internal combustion engine (ICE) competitor. Currently, the firm is only using the trucks for one "turn" or a single route each day. By reallocating some of Frito routes to night-time delivery, roadway congestion during the day would be reduced and route managers would be able to swap more of their conventional ICE vehicles for electric trucks. One challenge to off-hour delivery in general, of course, is persuading receivers to staff their locations for off-hours delivery, change their hours of operation, or enable unmonitored delivery, any of which would need to be incentivized.

[44] "Empire Clean Cities Launches Green Fleets Certification Program." http://www.empirecleancities.org/latest-news/

"Not being from NY, it is easy for me to forget the scope of the issue there, but I think that a GLZ plus some type of merchant incentive/recognition program *along with a robust after hours EV program* is the ideal solution, [emphasis added]" offered Frito-Lay's Hanson. By linking the GLZ with an after-hours program and "for only the cost of some lost ticketing revenue, allocation of some curb space, and some manner of incentivizing merchants, the number of EVs go up, the effectiveness of those [EVs] is doubled with 2-times-a-day routing, congestion is reduced and delivery company efficiency goes up tremendously." Hanson concluded that "if we had this robust solution, we would be looking at cutting our total vehicle population by at least 50 percent, probably more, and planning on how to convert most/all of our NYC trucks to EVs over the next 5 years. There is no 'corporate welfare' stigma attached and it allows the city to focus additional resources on other areas."

In addition to off-hours delivery, NYCDOT has also experimented with other forms of delivery window scheduling for commercial loading zones—which have clear applicability to the GLZ. As the Select Bus Service (SBS) program was launched across NYC, NYCDOT instituted delivery windows in commercial strips to help mitigate the loss of curb access due to the lane restrictions that SBS imposes. Time-limited, mid-morning and mid-day delivery windows have helped provide curb access for business loading and delivery activity. In The Bronx, for example, midday delivery windows have been instituted along the Fordham Road Select Bus Service route to facilitate freight movement in the late morning and early afternoon.[45]

3.6 The GLZ and Non-Delivery Applications

A number of non-delivery fleets are potential users of curbside electricity such as in a GLZ, in particular emergency vehicles, food trucks, and refrigerated vehicles used for grocery deliveries. In each case, NYC has an abiding policy interest in reducing fossil fuel consumption and localized emissions of these fleets, providing designated zones for them, and facilitating grid connections to power essential on-board functions.

3.6.1 Emergency Vehicles

North Shore-LIJ, which operates ambulances in the five boroughs and throughout the region, routinely receives complaints regarding its idling vehicles. Though the practice is technically prohibited, ambulances idle their engines to power auxiliary systems that maintain the stability of on-board medications as well as interior climate. North Shore-LIJ's ambulances often idle up to 12 hours per day at their designated waiting locations around the city which include street corners, locations in Central Park, and emergency bays at hospitals. "The idling impacts from

[45] VREF Center for Transportation Center of Excellence for Sustainable Urban Freight Systems. Case Study #2: Columbus Avenue, First and Second Avenues, Manhattan, NY, 2014

ambulances are substantial," reported Paul Power, assistant director of operations for North Shore-LIJ, "blasting exhaust into high-density residential areas and emergency rooms (often filled with environmentally sensitive patients)." This presents both a public health challenge and a public relations debacle for a health care institution. Plugging into curbside power sources, as is being pursued by FDNY (from Section 1.4.2), would reduce environmental impacts, minimize fuel consumption, and enhance driver health by limiting exposure to exhaust and engine vibration.

At present, Power reports that North Shore-LIJ itself currently has 100 ambulances with systems that could plug into curbside electrical service. Power suggested that North Shore-LIJ's ambulances could share space in a GLZ with green delivery vehicles during daylight hours when first responders are more active so their vehicles are less likely to be stationary. Power additionally presented ambulettes as a vehicle segment that could be powered in a similar manner, providing comparable public benefits.

3.6.2 Refrigerated Vehicles

A second category of non-delivery vehicles that could benefit from curbside electrical service are refrigerated vehicles, such as those used by Fresh Direct, the grocery delivery service. A subset of these vehicles function as curbside distribution hubs for Fresh Direct, serving teams of handcart-equipped "runners" who execute last-mile delivery within a 10-block radius of the stationary truck. This "depot" model utilizes existing commercial loading zones throughout the delivery day—6 a.m. to 11p.m.—with individual trucks serving as warehouse, and replacement trucks arriving as soon as soon as one is emptied. Manhattan currently has 22 curbside "depot" locations served by 80-100 Fresh Direct trucks, which each remain in place for shifts of 4-8 hours.

Stationary depot trucks consume large amounts of diesel fuel for refrigeration and are the catalyst for regular noise and air quality complaints by residents living near these hubs (non-depot Fresh Direct trucks are subject to similar complaints). Powering the refrigeration with an on-street grid connection would provide a reduction in fossil fuel consumption while nearly eliminating local emissions and noise impacts. This, according to Fresh Direct's fleet management team, would be a crucial element in improving community relations.

Given Fresh Direct's model of perpetual occupation of curbside space and presumed use of any installed electrical infrastructure, joint utilization of GLZ with delivery fleets would be a challenge. Installing curbside EVSE specifically for their fleet would be politically untenable, except perhaps if the space could be utilized for off-hour delivery. A further challenge is that Fresh Direct's current "depot" operation is not an example of the demand-driven, optimized use of curbside loading zones espoused by Stacey Hodge in Section 3.5.2. One city employee suggested that a superior option would be for Fresh Direct to lease off-street space such as a warehouse, which could integrate electrical power supply. This option would leave the curbside loading zones open for their intended use.

3.6.3 Food Trucks

A final category of vehicles potentially served by curbside electrical service are food trucks and carts, which rely on fossil-fuel generators to power on-board cooking appliances and refrigeration systems. They have proliferated in recent years catering to neighborhoods with large numbers of office workers and tourists. In response to the thriving business model and associated complaints of noise, emissions, and unfair occupation of curbside, one bill introduced in New York's City Council in August 2013 would authorize the NYCDOT to create "food truck zones" and issue permits for up to 450 food truck spaces in Manhattan. The proposed food truck zones would help NYCDOT monetize and rationalize the use of its pavement by mobile food enterprises. But the zones also offer a point of leverage to incentivize vendors to install grid connections and shed their diesel generators. By establishing "green" criteria for prime locations, NYCDOT could compel successful applicants to meet their on-board power needs via Simply Grid-type infrastructure, as explored in Section 1.4.1.

The GLZ and the proposed food truck zone have overlapping missions and could function synergistically, given the complementary schedules that typify the NYC delivery market and the food truck sector. By incorporating grid-connected food trucks in a GLZ, NYCDOT could optimize the use of the loading zone and spread the cost of grid connectivity over multiple fleets and multiple initiatives. Further, because it is assumed that uptake on fleet EVs will continue to proceed slowly in the near term, additional users for charging infrastructure will help accelerate return on investment and improve the business model for EVSE manufacturers and distributors.

3.7 GLZ Ecosystem and Companion Policy Measures

During the course of this study, the research team identified a number of opportunities and challenges to operationalizing a GLZ in NYC. Though some fleets suggested that the guarantee of curbside space is an appealing component of GLZ, equal to the value of financial subsidies, others' sentiments suggested that the GLZ alone will not be sufficient to boost EV adoption in the delivery sector. Fleet operators and policymakers cited a number of companion measures that will help to create an "ecosystem-wide" incentive for adoption, including:

- Robust support and incentives for off-hours delivery.
- Merchant incentive/receiver recognition program for participation in GLZ or off-hours delivery program.
- City-sponsored badge system to identify zero emission vehicles.
- Continued and expanded subsidies for EVs.
- Curbside charging availability at certain GLZs.
- Re-terming parking fines incurred by EVs as "business expenses" rather than penalties.

4 Technology Background and Analysis

This section investigates current and evolving technologies of electric vehicles, as well as those complementing the implementation of GLZ. It then assesses their utility and feasibility based on technical requirements. Primary among these technologies is electrification of vehicle drivetrains and auxiliary systems in addition to the necessary infrastructure, which can further augment the benefits of GLZs for electric trucks and their fleets. Curbside electrical infrastructure can power idle reduction systems, compartment refrigeration (electric transport refrigeration units [eTRUs], or electric reefers), or food trucks, in each case providing fuel, cost, and emissions savings. Additional technologies and concepts may be used with GLZs to help enforce their proper use or in conjunction with other congestion reduction strategies.

The range of electrified technologies with varying power requirements and incompatible connectors that could be potentially used in GLZs does not support a single electrical infrastructure solution. Electrical infrastructure in a GLZ must accommodate the specific type of technology that will use that space. Electric vehicles, electric refrigeration, and idle reduction technologies all have different power requirements. Different connectors are used with these technologies, and can even vary among the same type of electrification technology or application. Due to the high potential for incompatibility, electric infrastructure should not be installed in a GLZ until the users are identified and the infrastructure can be designed to accommodate that specific equipment. Future technology developments, such as wireless energy transfer and DC fast charging, may provide additional and possibly better electrical supply options.

4.1 Electric Trucks

Electric trucks, because they produce zero onsite emissions and minimal noise, are often prime candidates for urban areas where vehicles make frequent stops or often idle. However, they are limited by driving ranges that top out at 100 miles, substantial purchase costs, and both limited and slow refueling opportunities compared to ICE vehicles. A primary cause of these limitations is vehicle batteries, which add significant weight and cost—currently over 25lbs and $650 per kilowatt-hour (kWh) on average[46]—generally ranging in size between 20 kWh and 120 kWh. Electric trucks' larger batteries and greater weight than personal EVs necessitate higher power EVSE installations for replenishing the vehicles' batteries. The inclusion of charging infrastructure could be a valuable feature of GLZ implementations, potentially extending electric trucks' range and/or reducing the necessary battery size for trucks by providing charges during delivery routes, thereby lowering operating costs. Currently available medium- and heavy-duty electric trucks are presented in Table in Appendix C.

[46] Roy, Bryan et al., Conversations with Smith Electric, January 2-31, 2014.

4.1.1 Economic Considerations

The costs of purchasing a new electric truck have decreased in recent years but are still substantial. Based on estimates from the NYT-VIP, new all-electric delivery trucks have an average upfront cost of approximately $158,000, resulting in an average incremental cost of $97,000 above diesel trucks.[47] However, after that incentive voucher is applied, that increment is reduced to approximately $38,000. The full list of vehicles eligible under this program and their specific cost information is included in Table D-1 in Appendix D. The significant costs of additional battery capacity cause considerable variance in cost between different versions of the same truck.

A further cost to fleets purchasing electric trucks is the installation of EVSE and associated electric infrastructure where they are domiciled. In most scenarios, each truck would require a designated EVSE, new electrical conduit and potentially electrical service upgrades. Together these costs can add up to $25,000, though funding is generally available to offset some of these costs as well.

One important area that electric trucks perform better than conventional gasoline or diesel trucks is in operation and maintenance costs, which are lower due to fuel cost savings and reduced maintenance requirements. As an example, for a Smith electric truck the estimated cost per mile is approximately $0.22 versus $0.67 per mile for conventional trucks. [48] EV maintenance costs are estimated to be a quarter of those of a similar diesel truck.

4.2 Electrical Infrastructure and Connectivity

Electric trucks would benefit from the additional charging opportunities available at GLZs, with nearly all charging solely where they are domiciled. Different chargers and connectivity technologies are required for each type of equipment that might use a GLZ, including electric trucks and other EVs, electrified refrigeration units, and idle reduction or other auxiliary equipment. Standardized connectors and charge levels have been established for many of these applications, in addition to existing proprietary and developing infrastructure solutions.

4.2.1 Electric Vehicle Supply Equipment

For the general EV market, public charging stations or EVSE have been designed and deployed to provide charging opportunities in non-home or work use. These EVSE are generally more robust and may provide higher power than home or workplace chargers to expedite vehicle charging because of shorter parking or dwelling times. The Society of Automotive Engineers (SAE) has classified EVSE levels by the type of electrical power that is supplied and its

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47 NYSERDA. NYSEV-VIF "All-Electric" Vehicle Eligibility List. https://truck-vip.ny.gov/NYSEV-VIF-vehicle-list.php

48 Assuming 6 miles per gallon for diesel delivery trucks and a fuel cost of $4.00 per gallon. Electric truck efficiency is estimated at 2.2 kWh per mile, source: NREL. Smith Newton Vehicle Performance Evaluation - 3rd Quarter 2012. www.nrel.gov/docs/fy13osti/58108.pdf

approximate charge rate. Charging times vary depending on battery technology, state of charge, battery capacity, the vehicle's onboard charger, and especially EVSE level. The existing EVSE levels are AC Levels 1 and 2, and DC Levels 1 and 2, ranging from 120 V and 12 amps AC to 450 V and 200 amps DC. These standards are further described in Appendix C.

The EVSE connector plug has been standardized by SAE to allow owners of various EV vehicle models to utilize the same charging infrastructure and provide safety elements and shock-proof design. Though many fleets use proprietary plugs, and electric-powered auxiliary systems have yet to adopt connector standards, existing plugs can be replaced and future fleet vehicles and systems can adopt these standards; an outcome beneficial to the entire EV ecosystem. The standard connector and port, SAE J1772, as well as the "combo" charger that adds positive and negative terminals for DC power flow are shown in Figure and Figure in the Appendix C.

4.2.2 Electric Truck Charging

A fully electric medium- or heavy-duty vehicle will require more power from a GLZ EVSE than is provided by AC Level 1 charging—refilling only 1-2 miles per hour of charging. Higher power AC Level 2 and DC "fast charge" stations are better suited for their larger battery packs. Several different AC Level 2 charging station manufacturers and models are available, varying in shape/size, mounting approach, networking capability, number of cord sets, and cord management strategies, along with thousands of installation for different parking space configurations and ways of connecting to grid power. Only a few of these configurations are appropriate for GLZs however, in particular those hardy enough to operate curbside. An example electric truck charging system is shown in Figure 3. .

Figure 3. A Frito-Lay Truck Plugging Into a Standard Level 2 EVSE

Source: Richard Piellisch granting permission for use [49]

[49] 100 More Smith EVs for Frito-Lay, http://www.fleetsandfuels.com/fuels/cng/2012/05/100-more-smith-evs-for-frito-lay/

A list of Level 2 EVSE, including those able to provide more than 40 A to meet the power requirements of the larger electric trucks, is available in Figure in Appendix C. One current limitation is that most electric trucks, even newer models, may not have the capability to automatically adjust to a power level different from what is used at their base location potentially leading to tripped circuit breakers. Manufacturers are working on this capability for future models. Also, while the SAE J1772 connector is most common for electric trucks, unlike with light-duty vehicles, many other trucks do use other standard or proprietary connectors, particularly those in fleets using three-phase 208 VAC at their base locations.

It should be noted that no current medium- or heavy-duty electric truck has the capability to use DC Fast Charging, which is only recently standardized. Because electric trucks need significant energy in a short time period, DC Fast Charging would be a beneficial technology for future electric trucks to accommodate and GLZs to incorporate. Currently available truck models are shown in Appendix D.

4.2.3 Accessibility, Liability & Security

The GLZ's public setting implies that any EVSE and electrical connections would be vulnerable to vandalism, tampering, and unauthorized use, as well as the threat of personal injury and associated litigation. Public EVSE geared to light-duty vehicles typically have system security and mechanisms to deter such occurrences, providing a secure cable management and requiring authorized activation before plug release and the power is turned on. However, outlets and cords for refrigerated trucks, idle reduction and auxiliary systems, and some electric trucks do not currently have these securities, which are recommended for any GLZ implementation. Truck stop electrification infrastructure, which is typically a 110 VAC outlet, provides a model for user and payment interface that could be utilized at GLZs, but that infrastructure does not include any cable management.

Figure 4. Cable Retractor System Example

Source: EVoCharge granting permission for use [50]

To further improve security a protective cable retractor system could be employed at GLZ along with a lockbox to protect the end of the power cable, accessible by RFID or other electronic system. EVoCharge currently offers a light-duty EVSE system, seen in Figure 4, providing an automatically retracting cord once charging has been completed. However, this system is limited to 30 A, not ideal for GLZ applications. Another strategy to incorporate safety and security measures may be mounting the EVSE higher so it is out of the public's reach, but can be accessed from the truck or with an automatic recoil system.

4.2.4 Connection to Existing Infrastructure

Using existing electrical infrastructure could assist in the deployment of charging stations in GLZs by decreasing the cost and effort required to install the equipment. This tactic may eliminate some of the permitting and licensing required to install new structures and provide access points where high power electrical lines are available. For example, lampposts or existing power poles may provide ideal candidates for mounting EVSE as well as sourcing the electrical power. NYCDOT's current plan to upgrade all street lighting to LED fixtures by 2017 is an ideal

[50] Industrial and Fleet Charging Station Applications, https://www.evocharge.com/industrial.html

opportunity to incorporate charging infrastructure.[51] Phone booths may also be repurposed as charging station locations as they are being phased out, although the power to operate them is much lower than what is needed for EVSE, suggesting these would not be ideal power sources.[52]

4.2.5 Wireless Charging

Wireless EVSE is an emerging technology that allows power transfer across an air gap, using a magnetic field to charge EVs without cables. It uses technology similar to that found in automatic toothbrush chargers, induction cook tops, and some cell phone chargers. The use of this technology requires units to be installed on both the vehicle and ground, along with a method to ensure proper vehicle alignment over the charging pad as shown in Figure 5. Wireless charging systems claim several distinct advantages over the conventional wired chargers including convenience, safety, weather proofing, and lowered maintenance. With power capacity that can match that of wired systems, their key disadvantage lies in charging efficiency; performing at around 90 percent efficiency compared to 96 percent for wired systems. The low margin of error required in vehicle-charger alignment required to reach that 90 percent efficiency presents a second disadvantage, and will likely require a combination of driver education and clear pavement markings.

Figure 5. EV Over a Wireless Charging Pad

Source: Wikimedia user NJo. Permission under Creative Commons License v. 3.0[53]

51 Official Website of the City of New York. http://www1.nyc.gov/office-of-the-mayor/news/343-13/mayor-bloomberg-transportation-commissioner-sadik-khan-all-250-000-street-lights-in/#/0

52 Autoblog Green. http://green.autoblog.com/photos/edta-2008-chargepoint-station/1203545/

53 Electic [sic] car wireless parking charge closeup. http://upload.wikimedia.org/wikipedia/commons/7/78/Electic_car_wireless_parking_charge_closeup.jpg

Wireless charging systems' ability to conceal infrastructure beneath the street is promising for use in the public realm—HEVO Power is most notably investigating integrating that infrastructure in manhole covers. The lack of a required physical interaction can address the concerns of fleet managers worried about their drivers interfacing with EVSE. Wireless charging would be advantageous for use in GLZs scenarios, but no commercial product is available that has been fully tested in an outdoor environment for an extended period. Several wireless charging manufacturers are currently in operation and their systems are summarized in Table C-4 in Appendix C. Additional organizations are developing this technology, but have not released commercialized models or specifications.[54]

4.3 Electric Refrigeration

Truck refrigeration units (also known as reefers) with electric standby allows—without the use of diesel fuel—for the maintenance, of fresh produce, frozen goods, and other cargo that must be thermally controlled while stationary. A GLZ with electrical infrastructure would support the expanded use of this technology curbside. By cooling the trucks with electricity when parked rather than running diesel engines, approximately 1 gallon of fuel is saved per hour. Trucks that are parked for the majority of day to make deliveries, such as Fresh Direct, could experience significant fuel savings and the affected community could experience significant improvement in air quality if these units plugged in.

4.3.1 Electric Refrigeration Technologies

A number of manufacturers offer an electric standby option on their current truck refrigeration units. In transit, these units are either powered by a dedicated diesel engine or directly off the vehicle's engine. When stationary and plugged in, the units are able to run completely on electric power for zero-emission operation onsite. In some all-electric truck applications, refrigeration units are able to be fully charged at the same time as the propulsion batteries to provide cooling throughout the workday with minimal draw on the vehicle's energy storage. Three primary manufacturers currently offer electric standby refrigeration systems including Johnson Truck Bodies, Carrier, Thermo King, and Zanotti. More detailed specifications for these models are shown Appendix D.

[54] These organizations include Primove, Momentum Dynamics, Qualcomm Halo, Toyota, Volvo, Wireless Advanced Vehicle Electrification, Conductix-Wampflier, and NTU Energy Research Institute.

4.3.2 Power Infrastructure

The most common power requirement for electrified reefers on box trucks is three-phase 208 VAC, while the larger refrigerated trailers use either 460 VAC at 30A or 208 VAC at 60A because of the high power levels required. The commonly used connectors for electric reefers do not include extensive safety or charge protection as in the J1772 standard, though it is unlikely that a driver would leave without unplugging the power cord since reefers must be manually switched from electric standby to diesel operation before departure. An example of a common reefer plug, which is used by Fresh Direct, can be found online.[55]

The challenge in potentially satisfying the infrastructure needs of electric reefers and GLZ delivery vehicles would be significant. The majority of truck refrigeration systems operate at three-phase 208 VAC at 60 A, which is an output power level higher than required for delivery trucks, and not compatible with the 240 VAC, single-phase supported by standard EVSE. The plethora of connector options is a further deterrent, though there is a possibility to create an adapter to convert from one type to another if necessary.

4.3.3 Economic Considerations

Most new refrigeration units come equipped with electric standby as standard, so there is little-to-no additional cost to fleets in having this capability. The major challenge inhibiting more widespread use is providing and connecting to the electrical infrastructure. Potential fuel savings depend on a number of factors (ambient temperature, interior set point, cargo type, etc.) but can be approximated at 1 gallon per hour. With a diesel fuel cost of $4.00 per gallon, this fuel saving would result in approximately a $2.92 reduction in hourly operating cost.[56] Maintenance cost savings from the use of electric standby power should be expected due to decreased diesel engine runtime.

4.4 Idle Reduction

Idle reduction technologies provide heating, cooling, and electric power for onboard equipment from grid electricity instead of engine heat and power from the engine alternator while idling. Several types of vehicles could benefit from idle reduction technologies in GLZs that would provide convenient parking locations with electrical power. These technologies offer opportunities to reduce emissions and fuel consumption.

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[55] ESL Power Systems. Intermodal/Reefer Online Catalog. http://eslpwr.com/catalog.asp?app=catalogmanager&product=intermodal-reefer-plug-32a-1800-03p1a

[56] Assuming an average power draw of 6 kW and an electricity cost of $0.18 per kWh. Sources: Operating Cost Data Comparison. Truck Transport Refrigeration, LLC. http://trucktransportrefrigeration.com/Data%20Comparison.pdf and EIA. Electric Power Monthly. www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a

4.4.1 Idle Reduction Technologies

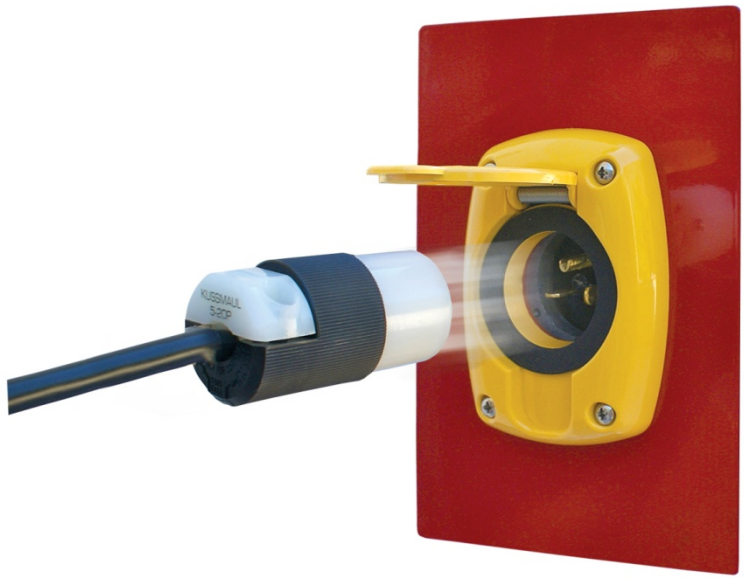
Battery-based auxiliary power units (APUs) include an energy storage component to operate electronic equipment for a short time without being plugged in or having the engine idling. The battery is charged from the vehicles alternator with excess power from the vehicle while it is driving or from the grid if stationary and plugged in. Infrastructure requirements for these systems are often minimal: a 110 VAC/20 A (Level 1) outlet to provide power for electrical accessories and minor equipment while stationary. However, larger vehicle applications that desire fully electrified climate control capability may need higher 240 VAC/30 A (Level 2) power. This is the case for NYC's emergency response vehicles which can power all onboard computers, lights, medicine refrigeration, HVAC, and communication systems with Level 2 grid power, but with Level 1, not all of these components can be accommodated. Basic specifications of some battery-based APUs are included in Table in the Appendix C.

4.4.2 Idle Reduction Infrastructure

While some idle reduction implementation would suffice with a standard 110 V outlet such as food carts, electrical infrastructure used by emergency vehicles pose a potential complication due to the requirement of a quick exit. Emergency vehicles must depart immediately once a call is received, so potential situations where the operator must delay departure to manually unplug a cable are untenable. Driving away while still plugged in similarly decreases the system's utility. To remedy this issue, many ambulances are equipped with auto-eject receptacles that use spring pressure to eject the plug once the vehicle's engine is started. After the plug is ejected and the emergency vehicle has driven away, a cable retraction system can automatically retract the cord so it is not a tripping or other hazard to the public. An example of this technology is shown in Figure 6. Though charging emergency vehicles would be a logical application of wireless charging to alleviate cord management issues and concerns, the technology has not been piloted in idle reduction scenarios.

Figure 6. Super Auto-Ejecting Cord and Outlet

Source: Colin Chambless at Kussmaul Electronics granting permission for use



Similar to the vehicles with electrified refrigeration units, vehicles with plug-in idle reduction technology are likely to have a single regular stop and remain there for long periods of time. Therefore GLZs designed for these vehicles will accommodate the specific equipment that will be used in those locations such as the cable retraction / auto-eject system for emergency vehicles. Otherwise, electrical infrastructure consisting of both 110 VAC and 240 VAC outlets can serve idle reduction equipment that typically has its own cord coming from the vehicle. Incorporating a 110 VAC outlet at GLZs, regardless of the vehicles they are designed to serve, is a valuable consideration to maximize flexibility of the electrical infrastructure. This addition would add minimal cost to an installation, but could serve vehicles with idle reduction equipment, EVs with portable Level 1 chargers, or food trucks with plug-in capability when not in use by larger commercial trucks.

4.4.3 Economic Considerations

The cost of battery-based APUs depends on energy capacity and capabilities. Costs range between $5,000 for light-duty cars and police vehicles and $12,000 for larger systems that may incorporate a diesel powered generator for back-up. As with reefer systems, the primary system cost for emergency and other idle reduction vehicles is the electrical infrastructure; many emergency vehicles can be equipped with plug-in capabilities for little or no additional cost. Meanwhile the additional safety, security, and durability features required to install in a public setting may increase costs. Potential fuel savings of approximately 1 gallon per hour can be expected for the larger emergency vehicles, whereas light-duty vehicles may only save half a gallon per hour by using plugging in instead of idling.

4.5 Other Considerations

4.5.1 Nighttime Deliveries

Electric technologies complement off-peak deliveries in residential areas due to their lower noise levels. In addition to the fuel cost savings of these technologies, nighttime deliveries have the ability to decrease delivery times on a more precise schedule because of less congestion, which increases overall productivity. Diesel refrigeration units are currently the largest contributor to noise emissions during nighttime delivery duties and electric refrigeration technology would be silent while at the GLZ if plugged in. Additional strategies and technologies that may further reduce noise include quieter lift gates, low noise tires, noise absorbing coating, and driver training (to reduce maneuvering and be conscious of noise that they are making), which might allow night deliveries by electric trucks in areas where they are typically prohibited without detrimentally affecting nearby residents.

The use of drop boxes or secure delivery areas may also complement nighttime deliveries by reducing the economic impact on the receiving entity. By eliminating the need for a paid attendant to be available during nighttime hours, the benefits of off-peak deliveries may be realized without additional inconvenience to the buyers. This concept would require each delivery location to develop a suitable solution depending on location, type of items to be delivered, and available infrastructure.

4.5.2 Maintaining Curbside Space Availability

To maximize success, the GLZ must be available when needed by eligible users and not occupied by other non-eligible commercial or private vehicles. GLZs may be deployed where there is great competition for limited parking space and may need some form of parking enforcement to ensure that the GLZ is available for the intended users. Municipal police could accomplish such enforcement through more intense patrolling, but would require additional manpower and officer trainings. A simpler option to assist with enforcement is automated technologies such as RFID to control indicators or signaling systems. Potentially this implementation would have authorized vehicles place an RFID tag in their windows and onsite equipment would detect the RFIDs to illuminate a light when an eligible vehicle is present. Should a non-authorized vehicle park in the GLZ, a violation light or automated communication would alert local law enforcement and tow trucks of the infraction. As shown in Figure 7, this type of solution technology was used at an Environmental Loading Point in Bremen, Germany.

Figure 7. Bremen ELP's Enforcement Technology Including RFID Reader and Indicator Light

Source: Michael Glotz-Richter granting permission for use

GAO RFID inc. offers customized solutions for automated parking enforcement and management applications. One additional implementation could be to use RFID or transponders to open a gate or lower bollards for eligible vehicles to enter the GLZ. Another enforcement technology could be the use of license plate reading cameras to monitor the GLZ, and also automatically issue citations infracting vehicles. Both of these options have issues in NYC; physical enforcement objects would require additional space, additional cost, and would be prone to damage, while license plate readers require unobstructed views of the license plates in question. Some wireless charging technology incorporates proximity sensors and can provide notification of occupancy by a vehicle that is not using its service. Beyond enforcement, many of these technologies could also provide information on the utilization of GLZ for evaluation purposes as well as real time availability for other potential GLZ users.

A GLZ reservation system could be implemented that would allow registered GLZ users to reserve a specific parking area for a particular time of day or duration. This system could operate similarly to current EVSE reservation systems that allow users to reserve chargers for a period of time. A large number of organizations offer reservation systems designed for event parking and large parking structures that allow users to place a reservation via their smart phone or online. Some of these systems include Chelsea Information Systems, Skidata, and CTR Parking, to name a few. The use of a reservation system for the GLZ could have potential issues enforcing reservation availability as parking in NYC is at a premium.

5 Case Studies

5.1 Introduction

This section represents a receiver-side analysis, complementing the fleet-side analysis presented in Section 2. When analyzing potential locations for a GLZ, various components of the market were assessed including potential fleets, potential receiver businesses and non-fleet vehicles. Fleets were assessed primarily in interviews with the aid of a survey. The survey included a variety of questions including the specific benefits that a GLZ would confer on their fleet, their value, whether access to GLZs would entice the purchase of additional electric vehicles, current impediments to their fleet operation, and questions about the operational elements of a potential GLZ. Interviews were conducted with fleet management professionals from Con Ed, Down East Seafood, UPS, Duane Reade, Fresh Direct, Frito Lay, and the USPS; see Section 2 for fleet descriptions.

While the GLZ was initially conceived as catering to delivery trucks of various sizes and capacities, our research revealed a number of other scenarios and interested parties that would benefit from designated "green" curbside locations. Conversations with Con Ed, North Shore-LIJ, and the RIOC indicated the potential for long-term idling or standing vehicles such as ambulances, paratransit, and food trucks and stalls.

5.2 Potential Case Study Locations

5.2.1 Contexts

Examination of potential case study sites for GLZ focused on the following contexts:

- Existing loading and commercial-only zones.
- Central business districts.
- Commercial corridors with multiple delivery points.
- Existing electric fleet deliveries.
- Private land ownership.
- User behavior.
- Location operations.
- External infrastructure.
- Host/public benefit capture.

Potential sites identified in the previously outlined process were evaluated in person through site visits. Observations took place during current loading zone times. If there were no existing commercial loading zone then visits took place when deliveries frequently occur, generally before 11a.m.

While onsite we observed the number of delivery trucks that a particular location receives, how long a truck stayed in a loading zone, how deliveries were made (i.e. are trucks delivering to one location or multiple while parked), double parking or other potential infractions, citations given, and which fleets are delivering goods. We also assessed current street infrastructure such as pay phones, kiosks, subway grates, and street lights. We plan to visit selected sites twice for their entire loading zone period. Through interviews and analysis of their current operations,

Duane Reade came away as the strongest fleet partner for a GLZ implementation, and nearly all potential case study locations have Duane Reade Stores adjacent or nearby. Among the many reasons for this decision were: its position as both fleet operator and receiver, ubiquity in NYC, the lengthy duration of its deliveries, existing commitment to EVs, adjacency to other retail establishments, existing usage of alternative delivery methods such as off-hour delivery, and willingness and flexibility to alter delivery routes and schedules for future use of a GLZ.

5.2.2 Location Selections

The 16 case study locations are indicated in Figure 8. Initial selection rationales and overall scoring are provided in Table 3 (in the next section) and Figure 9. Further information on each case study location can be found in Appendix F.

Table 2. Selection Criteria

DECISION-MAKING FACTORS BY CATEGORY	NOTES ON APPLICATION OF THE CRITERIA
MARKET NEEDS (FLEET)	
Density of Use (Volume)	Describes the volume of vehicles delivering at a site
Intensity of Use (Throughput)	Describes clusters in which frequency of use is a consideration
Vehicle Miles Traveled	GLZs where trip length is a consideration in assessing truck routes
Dwell Time	Describes the length of stay for deliveries that is typical of the proposed locations
Diversity of Experience	GLZs where drivers have access to more than one activity in order to dwell long enough to achieve a beneficial charge
GOVERNMENT (POLICY + OPERATIONS)	
Plans and Policy	EVSE can fit within existing planning frameworks and can also be bolstered by them where appropriate
Sustainability Goals	GLZ helps a government, institution or business meet standards, such as for emissions or green practices
Political Sensitivity	Favorable support from local political groups
Compatibility With NYCDOT	Potential GLZ fits within NYCDOTs existing loading zones
Congestion Concerns	Location has a minimal effect on traffic congestion
Compatibility of Off Hours	Works well with existing NYCDOT off hours delivery program
INNOVATION (TECHNOLOGY)	
User Demographics	Location where favorable demographic profile factors into the implementation of a GLZ with EVSE
Curbside Revenue Generation	
Regulatory Ease: Permitting, Zoning	Local regulations will impact decisions to install a GLZ; in some locations, a more typically smooth regulatory pathway will help the feasibility of a GLZ and EVSE infrastructure project.
Location Ownership	Where a landlord-EVSE host relationship is an asset
NEIGHBORHOOD CONTEXT	
Public Health	Direct benefit to residential and commercial neighborhoods due to replacing more harmful emission producing vehicles
Marketing Opportunity	Assesses whether the installation of a GLZ can be seen as a green branding asset or a marketing platform, adding financial or identity incentive
Internal Interests	Describes support from participating businesses and businesses sustainability policies
Geography	Favorable geographic conditions, such as wide streets, or offer an advantage, or where factors such as routes and range are important
Business Improvement Districts (BIDs)/Local Groups	GLZs where favorable demographic profile factors into the institutional/host decision to implement a GLZ and EVSE

Figure 8. Case Study Locations

Figure 9. GLZ Evaluation Matrix

Source: WXY

GREEN LOADING ZONE EVALUATION MATRIX

○ LOW relevance
◑ MEDIUM relevance
● HIGH relevance

	Fulton Mall	Roosevelt Island (Main St.)	Roosevelt Island (West Rd.)	95 Wall Street	Flatbush Ave. & Park Pl.	1 Penn Plaza	Park Ave. & 22nd Street	Union Square West	Union Square Green Market	North Shore LIJ - Lenox Hill Hospital	Broadway & 111th Street	E. 125th St. & Lexington Ave.	Broadway & Morris Street	North Shore LIJ - Forest Hills Hospital	4th Avenue & 14th Street	Yankee Stadium
MARKET NEEDS (FLEET)																
Density of Use (Volume)	●	●	●	●	●	●	●	●	●	◑	●	●	●	●	●	●
Intensity of Use	●	◑	◑	◑	◑	◑	◑	●	●	●	●	●	●	●	●	●
Vehicle Miles Traveled	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
Dwell Time	●	●	●	●	●	●	◑	●	●	◑	●	●	●	◑	●	●
Diversity of Experience	●	◑	●	◑	◑	●	◑	●	●	○	●	●	●	○	●	●
GOVERNMENT (POLICY + OPERATIONS)																
Plans and Policy	●	●	●	●	●	●	◑	●	●	◑	◑	●	●	○	●	●
Sustaina bility Goals	●	●	●	●	●	●	○	●	●	●	●	●	●	●	●	○
Compatibility With DOT	◑	○	○	◑	◑	◑	◑	◑	◑	○	○	◑	○	○	◑	○
Congestion Concerns	○	○	●	◑	●	◑	○	◑	◑	●	●	◑	◑	●	◑	◑
Compatibility of Off Hours	●	○	○	○	○	○	○	○	○	○	○	○	○	○	●	○
INNOVATION (TECHNOLOGY)																
User Demographics	●	●	●	●	○	●	○	●	●	●	◑	◑	●	●	●	○
Curbside Revenue Generation	◑	●	◑	●	●	◑	◑	◑	◑	◑	●	●	●	◑	●	○
Regulatory Ease: Permitting, Zoning	●	○	●	◑	◑	○	○	○	●	○	○	○	◑	○	◑	○
Location Ownership	◑	◑	◑	◑	●	●	○	●	●	●	◑	◑	◑	●	◑	○
NEIGHBORHOOD CONTEXT																
Public Health	◑	◑	◑	◑	●	○	○	◑	◑	●	○	●	○	●	●	●
Marketing Opportunity	●	●	●	●	●	●	◑	●	●	●	◑	◑	◑	●	◑	●
Internal Interest	●	◑	●	●	◑	●	●	◑	◑	●	●	◑	◑	●	◑	●
Geography	●	◑	●	●	◑	○	○	○	◑	○	◑	○	○	◑	◑	●
Business Improvement Districts (BIDs)/Local	●	●	●	●	●	●	○	●	●	○	○	●	●	○	●	●

5.2.3 Site Scoring

Figure 9 was developed to aid in ranking the initial list of case study locations. The matrix is broken down into four contexts: Market Needs (Fleet); Government (Policy + Operations); Innovation (Technology); and Neighborhood Context. A total of 19 criteria under the four contexts were given values of low, medium, or high relevance. A filled circle represents high relevance and one point, a half-filled circle represents medium relevance and half a point, and a hollow circle represents low relevance and zero points. These values were added to provide a total score for each location, which is found in Table 3.

Table 3. Case Study Descriptions

Case Study Location	Description / Rationale	Score
Fulton Mall	Site has local business and political support, a dense concentration of businesses, visibility, and current regulations restricting private vehicles.	**15.5**
Roosevelt Island (Main Street)	Site has the densest concentration of retail, residential, and institutional buildings on Roosevelt Island. Current parking signage restricts dwelling 45 minutes, and is nearby existing Commercial Loading Zone.	**11.5**
Roosevelt Island (West Road)	Site suggested during meeting with Technical Advisory Committee due to proximity to Duane Reade and less contention than Main Street.	**14.5**
95 Wall Street	Multiple fleets indicated site as high citation location. Adjacent to Duane Reade.	**14**
Flatbush Ave. & Park Pl.	Duane Reade location was selected as one of five to receive deliveries from electric delivery trucks in Mission Electric competition. Local neighborhood of Park Slope seen as an appreciative of GLZ.	**13**
1 Penn Plaza	Site is used by nearly all current electric fleets interviewed, and reported as a high citation location as well. 1 Penn Plaza is viewed as a potential partner given its LEED Certification and Energy Star rating.	**12**
Park Ave. & 22nd Street	Site was suggested by an EV truck driver as a single location from which multiple deliveries could be made, as well as a high citation location.	**6**
Union Square Green Market	This site is ideal for a food truck or delivery truck working with the Green Market. The Market receives 60,000 shoppers and 140 regional farmers, fishermen, and bakers during peak season.	**14**
Union Square West	Like a site internal to Union Square, this site can potentially link to Green Market as well as dense concentration of restaurants and businesses.	**13**
North Shore-LIJ - Lenox Hill Hospital	Manhattan location suggestion of emergency vehicle fleet operator with likely appreciative neighbors in predominantly residential neighborhood.	**11**

Table 3 continued

Broadway & 111th Street	This site was selected primarily due to its selection as a winning Mission Electric Duane Reade location already receiving EV deliveries.	**10.5**
E. 125th Street & Lexington Ave.	The local neighborhood's high asthma rate was as well as dense concentration of national and local retail along 125th Street Corridor spurred this site selection.	**12.5**
Broadway & Morris Street	Selected as a highly visible location to office workers and tourists. Fleets indicated specific intersection and several nearby as high citation locations.	**12**
North Shore-LIJ - Forest Hills Hospital	This location was selected due to a fleet suggestion and likely appreciative neighbors in residential location.	**11**
4th Avenue & 14th Street	This centrally located loading zone has potential to serve both Duane Reade and Walgreens on 4th Ave; the former already receiving off hour deliveries. Dense concentration of other retail provides opportunity to accomplish multiple deliveries.	**15**
Yankee Stadium	This high-visibility, off-street site was selected for its overlap of a high number deliveries and requirement for ambulances to idle during games.	**11**

5.3 Selected Case Studies

Using the scoring system described in the previous section, three final case study locations were selected for in-depth analysis: Roosevelt Island's West Road, Fulton Mall, and 4th Avenue & 14th Street.

These analyses additionally incorporate study of site-specific design issues and suggestions. Selecting a site for implementing a GLZ required a combination of factors. While every site is unique and every GLZ host has priorities for installation, common physical elements relate to sites hosting EVSE, particularly the urban interface. The urban interface includes the larger-scale systems and patterns that relate to traffic, frequency of GLZ use and accessibility, as well as the fine-grained details of how the GLZ, EVSE, and electric truck drivers interact with the streetscape.

5.3.1 Roosevelt Island West Road

Roosevelt Island is a narrow island located between Manhattan and Queens in the East River. In 1969, the New York State Urban Development Corporation signed a 99-year lease for the island, and housing was constructed for 20,000 residents.[57] In 1984, the Roosevelt Island Operating Corporation (RIOC) was established by the New York State Legislature as a public benefit corporation appointed with control over the operation, maintenance, and development of the island.[58] RIOC's control over its streets, as described in Section 3.2.2.2, was the primary rationale for selecting a case study site on the island, providing an opportunity to pilot the GLZ concept on a small scale. A GLZ on the island would require approval by the island's board. The 2-mile-long island is most noted for

[57] Roosevelt Island Operating Corporation of the State of New York. http://rioc.ny.gov/

[58] Roosevelt Island Operating Corporation of the State of New York.http://rioc.ny.gov/

the Roosevelt Island Tramway, the Coler-Goldwater Specialty Hospital and Nursing Facility, the recently completed Franklin D. Roosevelt Four Freedoms Park and the planned Cornell NYC Tech campus. Especially due to the latter, residents, developers, and retailers expect a surge in activity on the island in coming years.[59]

Main Street is the island's primary commercial corridor, running north-south along most of the island's length. The street's high level of activity, narrowness, and key role for island residents make Main Street a challenging GLZ location. The presence of emergency vehicles and escalating construction traffic bound for the new campus add further challenges. These factors led the study team to select a second site along the island's West Road instead.

The proposed GLZ on West Road is adjacent to the Riverwalk Development, a mixed-use development consisting of 6 mixed use buildings that at build-out will have 2,000 residential units disbursed throughout nine buildings. Retailers consist of a Duane Reade with a large grocery section, Starbucks, Nonno's Focacceria & Pizzeria, Fuji East Restaurant, and the River Walk Bar and Grill. The incorporation of a GLZ into an existing mixed used development may demonstrate an ideal model of how effective a GLZ could be for freight delivery to retail stores and residents in an urban context.

West Road provides multiple benefits as a GLZ site. First, it provides convenient access to retail and residential units. Second, the area has sufficient parking such that a loading zone could be created in place of parking spaces without effecting residents. Third, the sidewalk provides adequate space for deliveries and the possible addition of EVSE or inductive charging for delivery trucks to charge while unloading. Locating the GLZ along West Road will benefit the Roosevelt Island community by not blocking traffic along Main Street and supporting a company (Duane Reade) that already uses EVs for their deliveries.

Conventional fuel trucks, if eliminated from Roosevelt Island's streets and replaced by EVs, will benefit residents from reduced congestion, noise, and harmful particulate emissions, while citizens in NYC and farther afield may benefit from reduced emissions but are unlikely to encounter the GLZ.

5.3.1.1 Site-Specific Design

West Road provides the opportunity to place a GLZ in close proximity to a Duane Reade, a retailer who already receives frequent deliveries and operates EV delivery trucks. Placing the GLZ on West Road rather than Main Street avoids interference with adjacent traffic. There are no existing street trees or lamps obscuring accessibility and visibility of any signage. In addition, the West Road site review considered building entries, pathways, street crossings, existing loading zone location, and pedestrian congregation points. The proposed location has sufficient space for drivers to maneuver hand trucks along the sidewalk and street making West Road a model case study (Figure 10).

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[59] Cohen, Joyce. "New Lures Promised for Shoppers on an Urban Island." *The New York Times*. 01 May 2012.. http://www.nytimes.com/2012/05/02/realestate/commercial/roosevelt-island-to-upgrade-shopping-strip.html?_r=0

Figure 10. West Road Proposed GLZ Design

Source: Google Street View[60]

5.3.2 Fulton Mall

Fulton Mall is a 17-block transit mall in Downtown Brooklyn with 150+ retail businesses serving more than 100,000 shoppers a day, making it the third largest commercial center in NYC after Herald Square and a portion of Madison Avenue. Fulton Mall has been Brooklyn's marketplace since the early 19th century and is well positioned to become a dense center of retail served by a GLZ. In the hub for business and cultural activity for Brooklyn and the surrounding region, a GLZ at Fulton Mall would serve a diversity of retailers and EV delivery operations. The diversity of retail includes national and local chains, department stores, and a host of other restaurants and retailers.[61] This range of retailers and restaurants provides opportunities for multiple fleets to use a GLZ, and the potential for multiple deliveries from single trucks.

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60 The photo is for illustratative purposes only and does not reflect current street conditions. Base street view captured on May 2012 and is copyright of 2014 Google. Street view used per Google's noncommercial and academic use permission. Original street view available at: https://www.google.com/maps/@40.759369,-73.953327,3a,75y,65.6h,74.82t/data=!3m4!1e1!3m2!1sd2jV4V99DVsswqjJDBshRg!2e0

61 Gonzalez-Rivera, Christian. State of the Chains, 2013. Rep. New York: Center for an Urban Future.

Fulton Mall is unique in New York as it is only open to buses, commercial, and emergency vehicles during business hours, and receives local deliveries between 7 pm and 7 am. Integral to the agreement turning Fulton Mall into a bus and pedestrian only plaza was ensuring that deliveries could continue to be made to local businesses with ease. To accommodate this need, planners developed delivery routes on side streets.[62] The regulation allowing special access for loading along the mall was the principal reason for the selection of the Fulton Mall case study.

Another key consideration for successful deployment is having the support of local advocates. Fulton Mall is managed by the Fulton Mall Improvement Association (FMIA), a nonprofit Business Improvement District (BID) that works to improve the economic health and quality of life for Fulton Street and may well be a partner to manage the GLZ. FMIA is itself managed by the Downtown Brooklyn Partnership, a not-for-profit local development corporation. Both organizations have stated goals of working to attract new businesses and improving the environment for existing companies, facilitating the construction of public spaces and streetscapes that promote an active and cohesive community, supporting and promoting Downtown Brooklyn's cultural assets, and encouraging a unified sense of place and an engaged civic community.[63] Most of these goals would support a GLZ installation.

For fleet operators, even ignoring the priority access, Fulton Mall's density of businesses, various delivery drop-off points, and congestion make it an ideal location to incentivize EV truck operation to gain preferential parking. A GLZ located around one of the two Duane Reade Stores on Fulton Mall would be preferential.
One final benefit for the community and adjacent area would be from the decrease in emissions and noise brought by vehicles transitioning to zero-emission, likely to be greater than most other case study locations given the density of pedestrians on the mall.

5.3.2.1 Site-Specific Design

Fulton Mall's operation as a part-time limited-access road is both a challenge and an opportunity for siting a GLZ on the mall itself. One benefit is that it is unlikely to affect on-street parking, yet it is unclear if the roadway dimension is sufficient to accommodate buses passing one another in addition to a parked electric truck. In that situation, a GLZ may only operate during off-hours. Placement on one of the side streets is another opportunity; though one made difficult by bus stops at nearly every street corner. Fulton Mall also provides strong opportunities to install EVSE given its high pedestrian counts and few private vehicles to block views. The street's many retailers provide opportunities for power access, though specialty light posts were recently installed along the mall and are unlikely power sources (Figure 11).

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62 Kazis, Noah. "The Fulton Street Mall: Retail Success on NYC's Original Transitway." 14 March 2011. http://www.streetsblog.org/2011/03/14/the-fulton-street-mall-retail-success-on-nycs-original-transitway/

63 "Fulton Mall Improvement Association." Downtown Brooklyn. http://downtownbrooklyn.com/about/fulton-mall

Figure 11. Fulton Mall at Jay Street

Source: Google Street View[64]

5.3.3 4th Avenue & 14th Street

4th Avenue and 14th Street is a strong candidate for a GLZ because of its location near Union Square, one of NYC's great public spaces and a vibrant, diverse residential and commercial community, with over 900 retailers in the area, including both a Duane Reade store and a Walgreens store on the same block of 4th Avenue.[65] The location's centrality and applicability for electric charging has already been suggested by NYC's electric taxi pilot, though the location was ultimately not selected.[66]

64 The photo is for illustrative purposes only and does not reflect current street conditions. Base street view captured on October 2013 and is copyright of 2014 Google. Street view used per Google's noncommercial and academic use permission. Original street view available at: https://www.google.com/maps/@40.691649,-73.987342,3a,75y,159.02h,77.49t/data=!3m4!1e1!3m2!1slyt_xwE5FfAYSklJjPuVQQ!2e0

65 "Union Square Partnership." Explore... http://unionsquarenyc.org/explore/

66 John Shipman. Interview by Paul Lipson et al.

The location's streetscape is managed by the Union Square Partnership. This BID's stated mission is to enhance the neighborhood's quality-of-life by creating a cleaner, safer and more enjoyable environment, indicating an ideal partner for GLZ. Two additional features of the area further suggest support environmental projects such as a GLZ: first is Simply Grid's food cart electrification pilot in Union Square, discussed in Section 1.4.1; second is the Union Square Green Market, which according to GrowNYC brings 60,000 shoppers to visit 140 farmers' stalls on market days.[67]

5.3.3.1 Site-Specific Design

Providing a GLZ along 4th Avenue is complex due to the high traffic levels in the area, but the suggested location on the west side of the street may be less in demand due to its fronting of a predominantly blank wall. Supporting both the Duane Reade and Walgreens provides opportunity for multiple, lengthy dwell times, suggesting an opportunity for incorporating EVSE, as well as off-hour deliveries if peak time delivery must be cut.

GLZ charging may additionally support food trucks that can be found all around Union Square. On-Street EVSE may be provided in partnership with owners of nearby businesses or buildings, or alternately from existing street lamp. The absence of street trees along 4th Avenue provides clear views of potential GLZ signage and branding. Signage and wayfinding is crucial for locating and designating a GLZ in such an urban context. As shown in Figure 12, street markings can help identify spaces, but should be distinct from "no parking" or bike lane designations.[68]

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67 "Union Square Greenmarket." GrowNYC. http://www.grownyc.org/greenmarket/

68 WXY architecture + urban design. Siting and Design Guidelines for Electric Vehicle Supply Equipment. Rep. Transportation and Climate Initiative, Nov. 2012. http://www.transportationandclimate.org/sites/default/files/EV_Siting_and_Design_Guidelines.pdf

Figure 12. 4th Avenue & 14th Street

Source: Google Street View[69]

[69] The photo is for illustrative purposes only and does not reflect current street conditions. Base street view captured on July 2011 and is copyright of 2014 Google. Street view used per Google's noncommercial and academic use permission. Original street view available at: https://www.google.com/maps/@40.734085,-73.989842,3a,75y,245.19h,88.86t/data=!3m5!1e1!3m3!1sXvlvTYQaGzOU4GWJNTHnkw!2e0!5s2011-06

6 Conclusion

GLZs represent a low-cost policy solution for incentivizing electric truck adoption by fleets, an undeniable public benefit in emissions/air quality and noise. Numerous challenges to realization include changing fleet behavior, standardizing electrical systems used by fleet, and especially the hurdles to implementation on a policy front that is recognized by both drivers and enforcers alike. However, GLZs and other innovative solutions are valuable tools that should be supported, studied, and implemented. The inclusion of charging is a further challenge to full implementation. On more than one occasion those interviewed for this study suggested finding off-street locations to provide charging rather than deal with the anticipated difficulties of finding mechanisms for supporting on-street charging. The provision of on-street charging represents a long-term goal of this study.

6.1 Key Findings and Recommendations

This report investigated GLZ from several perspectives—market, government, and innovation. An implementation of GLZs would require balancing and integrating the needs and requirements of fleets, policymakers, and electric vehicle infrastructure and technology. Key findings for each perspective are provided below and overall recommendations are provided in later sections.

6.1.1 Fleet Needs

The current difference in suggested retail price of fleet EVs versus diesels are far too great to recoup through operations so policy solutions are necessary to promote adoption. Current subsidy programs such as NYT-VIP may not be sufficient on their own, and non-cash subsidies such as GLZs reflect an alternate pathway to accelerate the technology investment returns, recouping costs through more efficient vehicle usage and reduced parking fines. Fleets confirmed that a well-implemented GLZ could be as, or potentially more, valuable than cash subsidies.

Matching GLZ locations with fleet use is critical, in particular finding locations: along existing routes, with proximity to multiple receivers, and in areas where a high volume of summonses are incurred. Assuring those locations will be available when expected is even more essential. The limited number of electric delivery trucks currently in use are not sufficient, on their own, to justify converting curbside space exclusively to GLZs. The concept of allotting time windows is one available strategy, but to be successfully used by fleets would require staggering those times. GLZs can have ancillary benefits for fleets, such as serving as a branding tool. Inclusion of easy-to-use charging infrastructure, such as wireless technology, will add enormous future value for fleet purchasing, but are not critical at this point.

6.1.2 New York City's Policy and Regulation

NYCDOT expressed many concerns with the GLZ concept, among them the segmentation of curb space and added restrictions likely to cause confusion for drivers, receivers, and enforcement officers. Broadly speaking though, GLZs are well-aligned with NYCDOT's fleet goal of more efficient freight movement. GLZs can represent an optimization of curbside space, as well as a route towards further optimization through the use of vehicle identification and reservation opportunities. For GLZs and future enhancements to succeed, the best efforts must be made to ensure congestion doesn't increase and new restrictions are properly enforced through enhanced monitoring solutions, which may require State approval. New parking fees must be incorporated as well; parking summonses are a substantial revenue stream for the City, and GLZ would by design safeguard certain vehicles from such fines. BIDs are ideal candidates to assume many of the responsibilities of management, maintenance, and education required for a GLZ implementation.

Several current initiatives are relevant to GLZs and may present opportunities for shared operation. First, NYCDOT's Off-Hours Delivery program has had success in attracting fleets to deliver during off-peak times, and this program would be enhanced by the near-silent operation of EV delivery trucks. Enabling the EV trucks to run multiple routes per day provides a better value for fleet operators incentivizing further purchases and multiplying emissions impacts. Meanwhile, efforts in food truck electrification and idle reduction for emergency vehicles will

soon provide designated public space for electrification. These efforts are more palatable because of single vehicle use, fewer enforcement concerns, and a more direct view of environmental benefits. Yet they are a first step toward GLZ, and those implementing them should be strongly encouraged to incorporate additional outlets and cords to enable usage by other EVs, whether at adjacent locations or during off-hours.

6.1.3 Technology

Electric trucks are generally paired with EVSE that provide a higher power output than those for light-duty EVs. If GLZ were to incorporate charging, a high-powered AC Level 2 EVSE would be best for replenishing most quickly, while still useable by most applications. The development of DC Fast Charging usage by fleets should be monitored, but at present remains unused for commercial vehicles.

The nonstandard use of plugs is a concern for on-street charging. J1772 plugs are used to power a majority of electric trucks, though far from universally. Many fleet owners should be able to upgrade or utilize converters if need be. GLZ implementations would help standardize fleet electrification interfaces. Different applications are likely to continue to use separate plugs, especially emergency vehicles requiring auto-eject functionality, reefer units, and auxiliary systems able to subsist off of a standard 120V charge. Wireless charging systems hold promise of seamless convenience and potentially the ability to leapfrog plug standardizations, but the technology is unproven in the public realm.

Sourcing the electricity to power EVSE is a final challenge in the urban environment of NYC. Existing street infrastructure such as lampposts, utility poles, phone booths, or event retractable bollards may provide a minimally invasive source.

6.2 Green Loading Zone Implementation and Design

Given the small footprint of electric trucks in the overall NYC freight system, as discussed throughout this report, curbside space solely devoted to GLZ may make for a difficult policy and political sell. Several opportunities to combine GLZs with other curbside uses, including charging, are available. Previously discussed were the potential to carve out specific hours out of a commercial loading zone for GLZ operation, as well as off-hour delivery, combining GLZ with other on-street charging implementations such as refrigerated trucks, food trucks, and emergency vehicles. Refrigerated trucking as with Fresh Direct would only allow for GLZ off-hour usage, but the more limited time requirement for both food trucks and emergency vehicles should allow GLZ operation closer to peak delivery hours (i.e., 7-11a.m).

Pairing GLZ with charging for personal EVs is another opportunity. Since no on-street charging stations currently exist in NYC, such a combination may provide greater usage of the charging infrastructure, providing fewer opportunities for complaints and non-EVs to improperly park in an EV-only space, which is a current concern for EV owners and those installing charging stations.[70] One final combination that may be applicable for Fulton Mall, as described in Section 5.3.2, is pairing GLZ with pedestrian-only areas. This scenario, which is common is European cities, can enable walkable street malls that shift deliveries to early-morning or off-hours. Given Fulton Mall's usage as a bus corridor, only off-hour GLZ would be appropriate. These six potential combinations are illustrated in Figure 13, while more detailed illustrations of GLZ implementations at the curbside can be found in Figure 14 and Figure 15.

[70] In the EV community, such improper use of an EV-only space by an internal combustion engine (ICE) vehicle is known as being "ICEd."

Figure 13. Curbside Sharing Opportunities for GLZ

Source: WXY

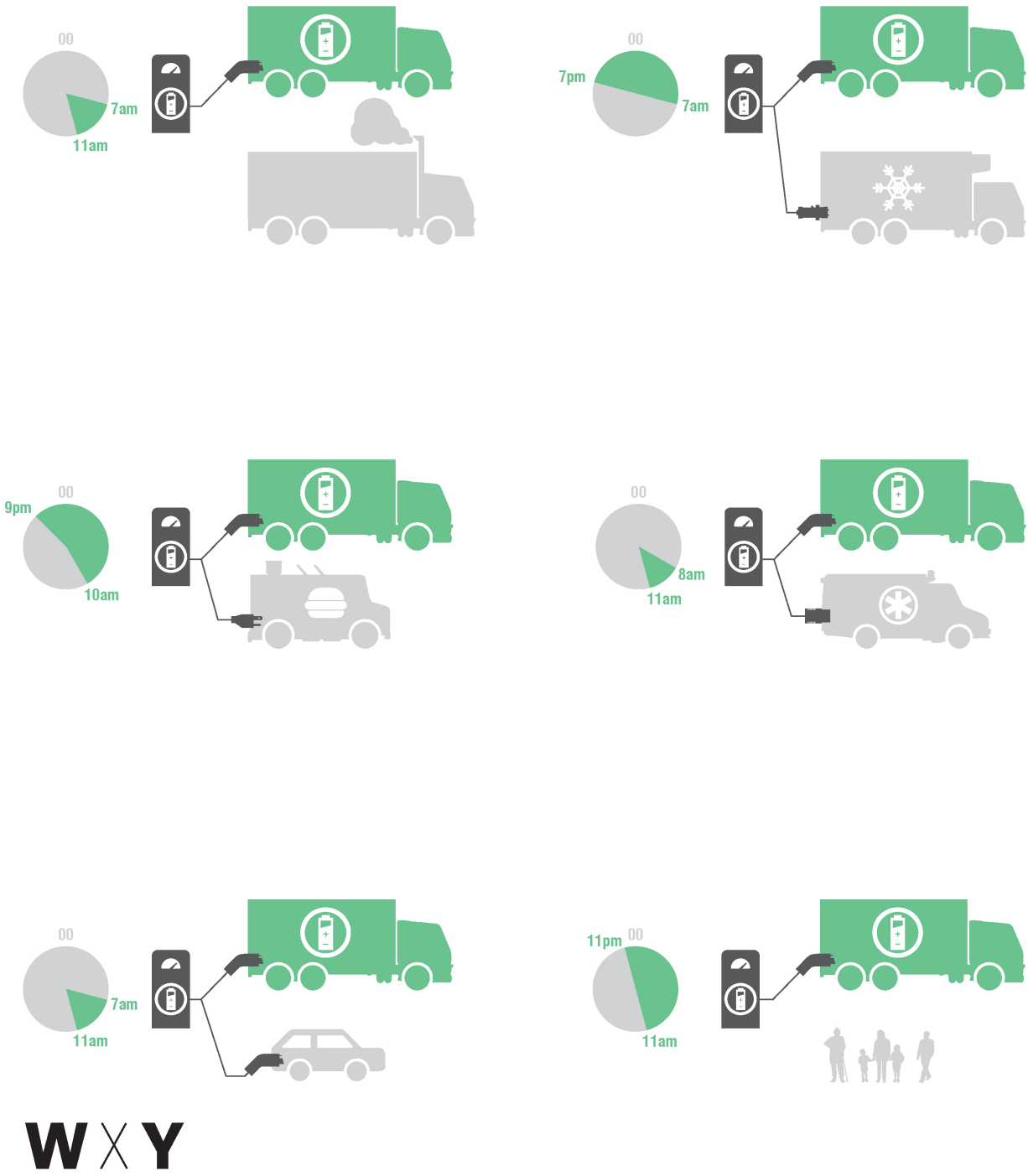
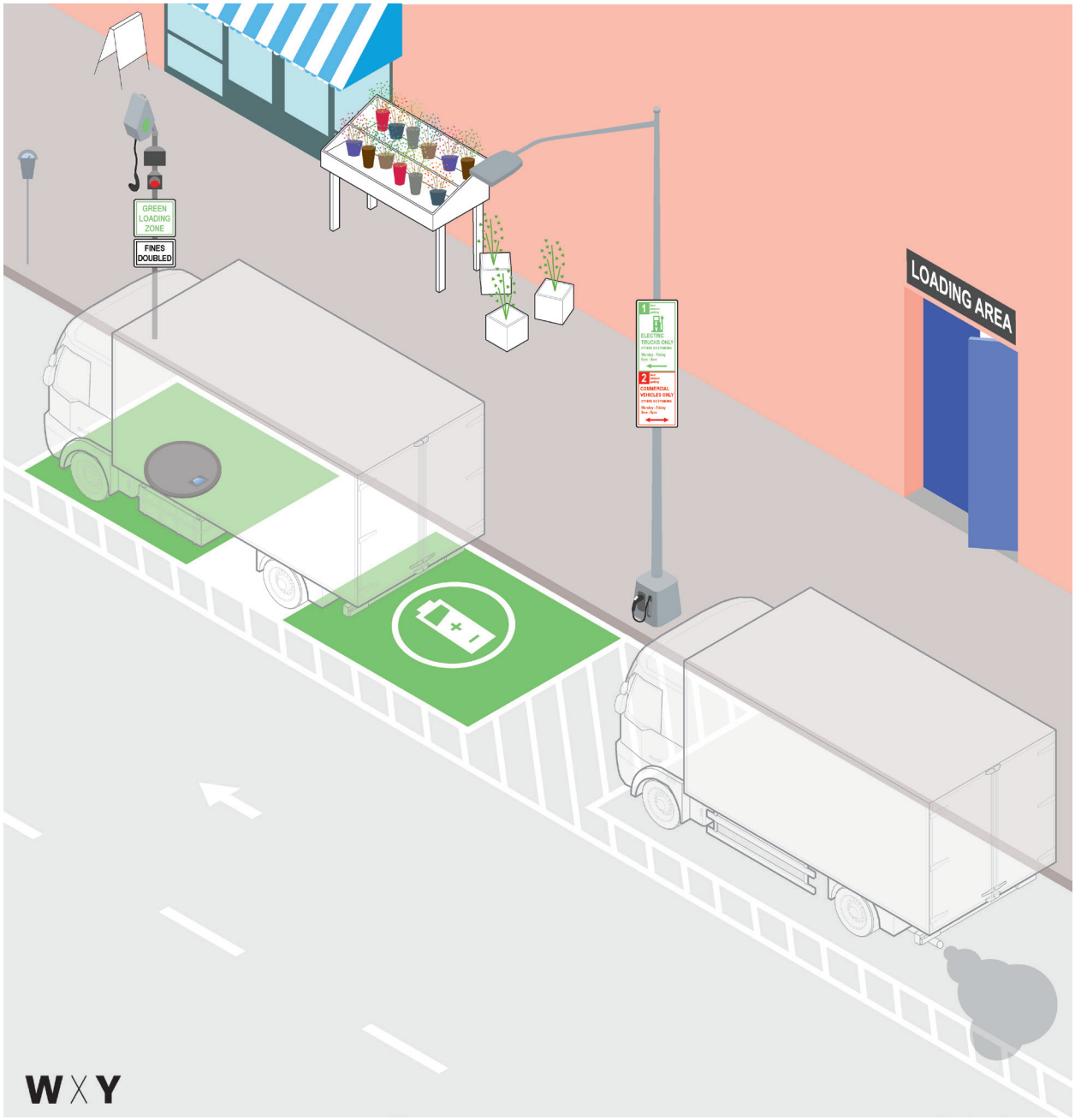
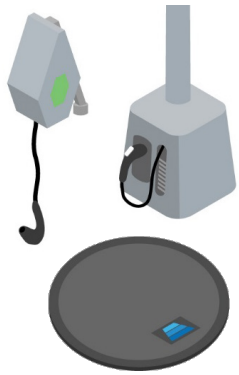


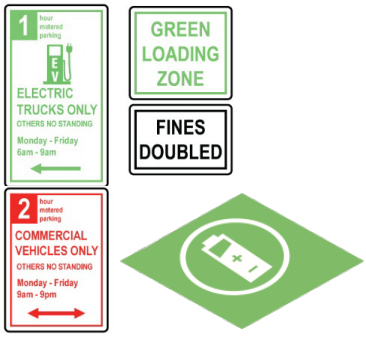
Figure 14. Daytime Scenario and Key Elements

Source: WXY





Multiple Charging Options



Clear Signage and Markings

Automated Enforcement

Figure 15. Nighttime Scenario

Source: WXY

6.3 Next Steps

The challenges to adoption of GLZ are significant though far from insurmountable. High-level political support would find quick implementation. A plan for phased implementation should be the primary goal at present. This report has presented three suggested case studies for GLZ, Roosevelt Island, Fulton Mall, and 4th Avenue & 14th Street, each of which could be implemented in some form—exclusive, off-hour, and delivery window, respectively—in the near term while causing minimal disruption. Other paths are possible as well: installation in concert with other electrification efforts; expanding the range of vehicles eligible to use GLZ, phasing in tougher requirements; or a receiver-led approach to asking for curbside space and installing infrastructure, likely Duane Reade, despite the potential pitfalls in public opinion in providing public space for a single firm.

Whatever the implementation path, benefits would be seen in phases. Fleets with existing EVs would quickly determine how to incorporate the GLZs into their existing routes and upgrade plugs to an adopted standard. Those on the fence about purchasing EVs would be swayed, while other fleets would see benefit of designated GLZ spots, calculate the potential benefits for themselves, and demand their own.

7 Afterword

Prior to submission of this Final Report, the team organized a wrap-up meeting and presentation at the offices of WXY architecture + urban design on July 10th, 2014. Conducting such a meeting is a requirement of NYSERDA and NYSDOT for completion of work under the relevant contract.

In addition to NYSERDA and NYSDOT's project managers Joe Tario and Bob Ancar, the session was attended by several transportation and electrified mobility practitioners in the New York City region, most of whom had participated previously in advisory meetings and interviews. These participants included: Steve Dorn at Milea Truck Group, Penny Eickemeyer at UTRC, Charles Hayward at Boulder Electric Vehicle, Stacey Hodge and Mike Marsico at NYCDOT, Jeffrey Hoffman and Ari Kahn of Move Systems, Jan Khan of NYSDOT, Howie Mann of NYMTC, Jeremy McCool of HEVO Power, Sean Singh at RIOC, and Dale Unglesbee at Smith Electric.

During the presentation Paul Salama presented six categories of next step strategies for pushing GLZ policies forward given current political, regulatory, and cultural realities in NYC. These categories, along with brief descriptions, are:

1. Low-Hanging Fruit – pursuing GLZs in conjunction with locations where plans are already in place to install on-street charging infrastructure, i.e. designated FDNY ambulance waiting locations
2. Growing Demand – integrating GLZs into conceptual plans for providing other vehicle types with on-street charging, e.g. food trucks, food carts, and refrigerated trucks
3. Off-Hour Delivery – multiply the benefits for EV truck purchasers, allowing vehicles to participate in both off-hour delivery and GLZ
4. Building the EV Ecosystem – grow the overall EV ecosystem by supporting EV passenger vehicles, and opportunities for them to charge on-street, which can be shared with GLZs
5. Shared Loading Zones – pilot GLZs as multi-hour windows within existing commercial loading zones
6. Underutilized Space – choose non-contentious locations for pursuing EV truck-only GLZ locations

In response to the presentation and ensuing discussion, attendees made several key insights regarding the implementation of GLZs in NYC. Chief among these was Stacey Hodge's point that not only is reserving public curbside space contentious, but many others are vying for the same valuable resource including city agencies and departments within NYCDOT. These other uses include those discussed previously like ambulances and food trucks, but also pedestrian areas, bus stops, passenger EV spaces, car share spaces, and bike facilities. Coordinating GLZ adoption among other demands will require a multi-agency effort. One suggested way to distinguish GLZ from other uses, or at least ensure it is considered alongside them, is to incorporate the GLZ concept into larger planning efforts such as NYMTC's Regional Freight Plan as a key strategy for reducing pollution and carbon emissions. Such legitimacy facilitates adoption by municipal agencies.

Hodge suggested that given the new mayoral administration, it is a good time to push larger curb management and freight optimization strategies that could enable GLZ spaces. These should include the latest available technologies such as license plate readers, RFID tokens, cameras, in-street monitors and weigh stations, as well as updated regulations and procedures to charge and incentivize truck movements. In particular, framing these strategies as improving road safety, for example by reducing truck traffic during peak periods, would allow coverage under NYC's Vision Zero initiative. Specifically, curbside management and off-hour delivery would be viable recommendations under the new Truck Safety Task Force. In the short term, piloting implementations of these technologies can be useful to get around New York State's jurisdiction of on-street lighting and enforcement, as discussed in Section 3.5.2.

Finally, a number of additional points were made by those in attendance. Some are listed below:

- Jeffrey Hoffman suggested clarifying the language to distinguish between food trucks and food carts—food trucks require on-street space and are the subject of the tabled City Council legislation that proposed 450 on-street parking permits, whereas food carts operate on the sidewalk. Given these different space requirements there is potential to share charging points between GLZs and food carts simultaneously, in addition to GLZs sharing curbside space with food trucks in different time windows.
- Charles Hayward indicated that "legitimate" fleets, i.e. those following the laws, would not be opposed to additional fees and restrictions required for freight optimization strategies, understanding that in the end these would be in their best interests. Instead, the key concern is fairness in terms of enforcement—that any strategies implemented would have to impact all fleets.
- Joe Tario reminded the group that the energy generation in New York City and State is already clean, and it's only going to get cleaner. Therefore the rationale for incentivizing EV trucks is only going to get stronger.
- Bob Ancar suggested investigating other cities for implementing GLZs given the difficulties in NYC. Buffalo and Ithaca were proposed as particularly amenable to such green initiatives.

Appendix A. NYC Parking Regulation Maps

Previously, Figure 1 showed established loading and commercial zones in NYC. As part of the case study selection process, our team investigated other NYC street and parking regulations including 1- and 2-Hour Parking Zones, Nighttime Loading Zones, and established truck routes. Maps indicating these regulations are below in Figures A-1, A-2, and A-3, respectively.

Figure A-1. 1- and 2-Hour Parking Zones

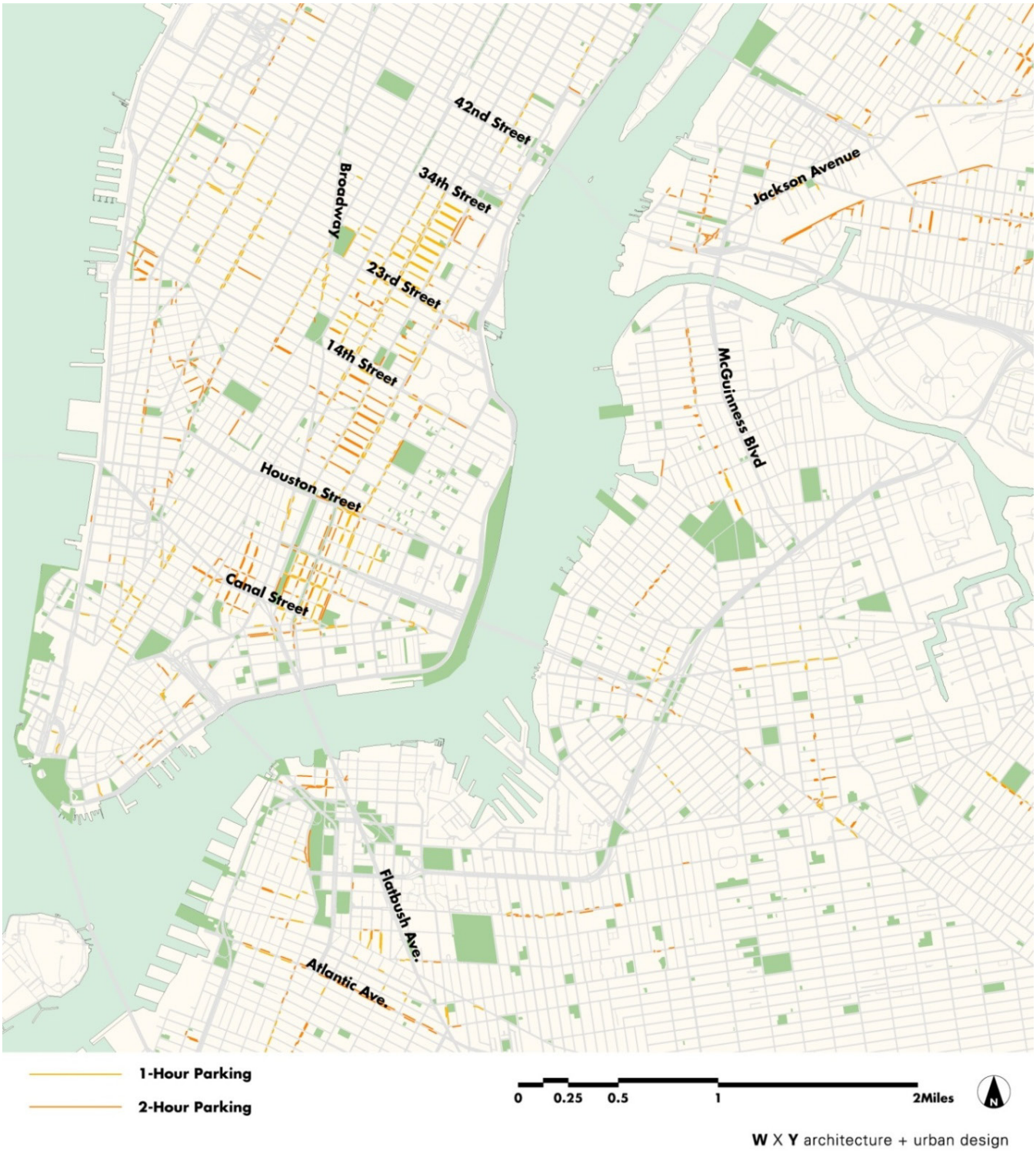


Figure A-2. Nighttime Loading Zones

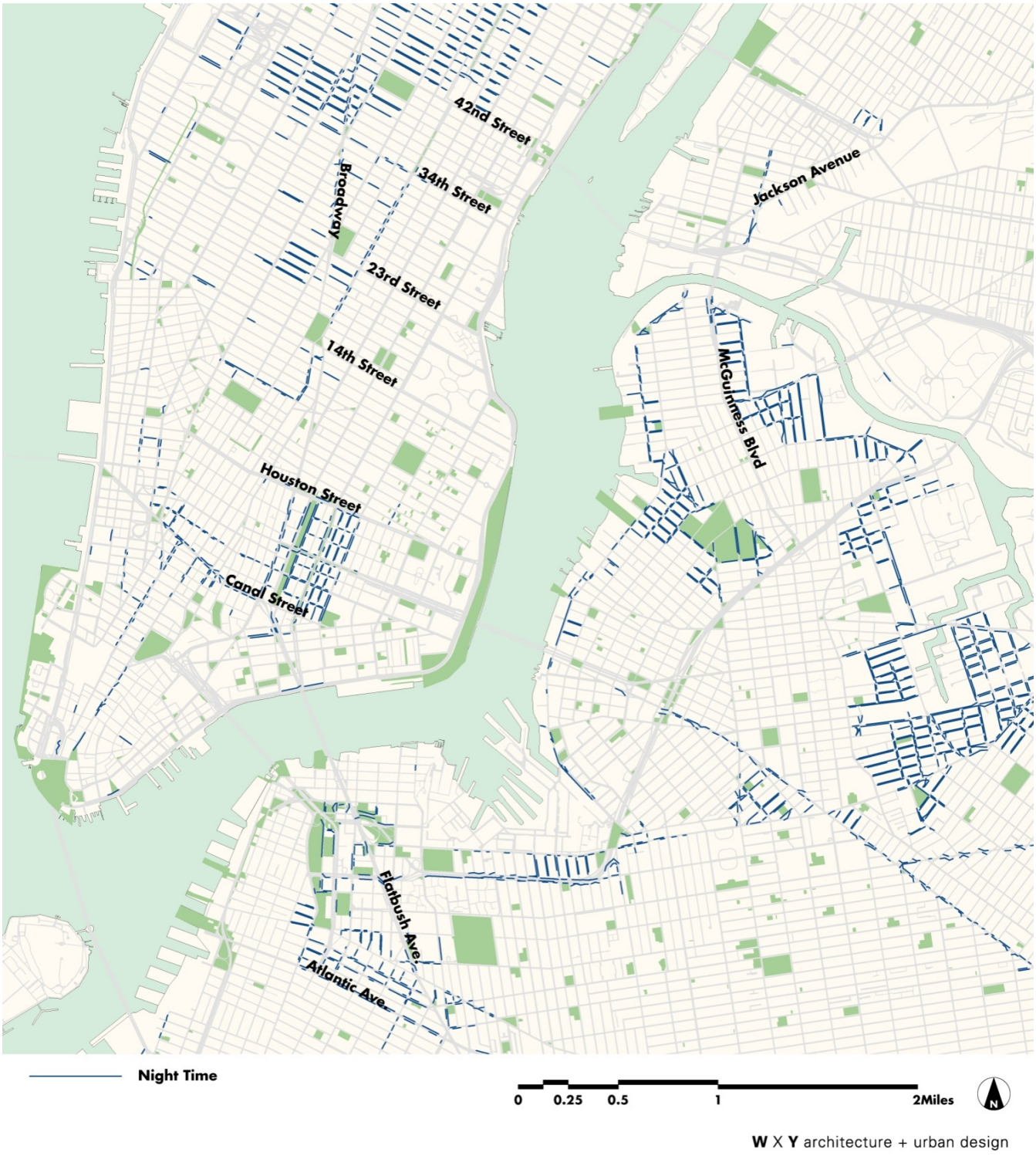
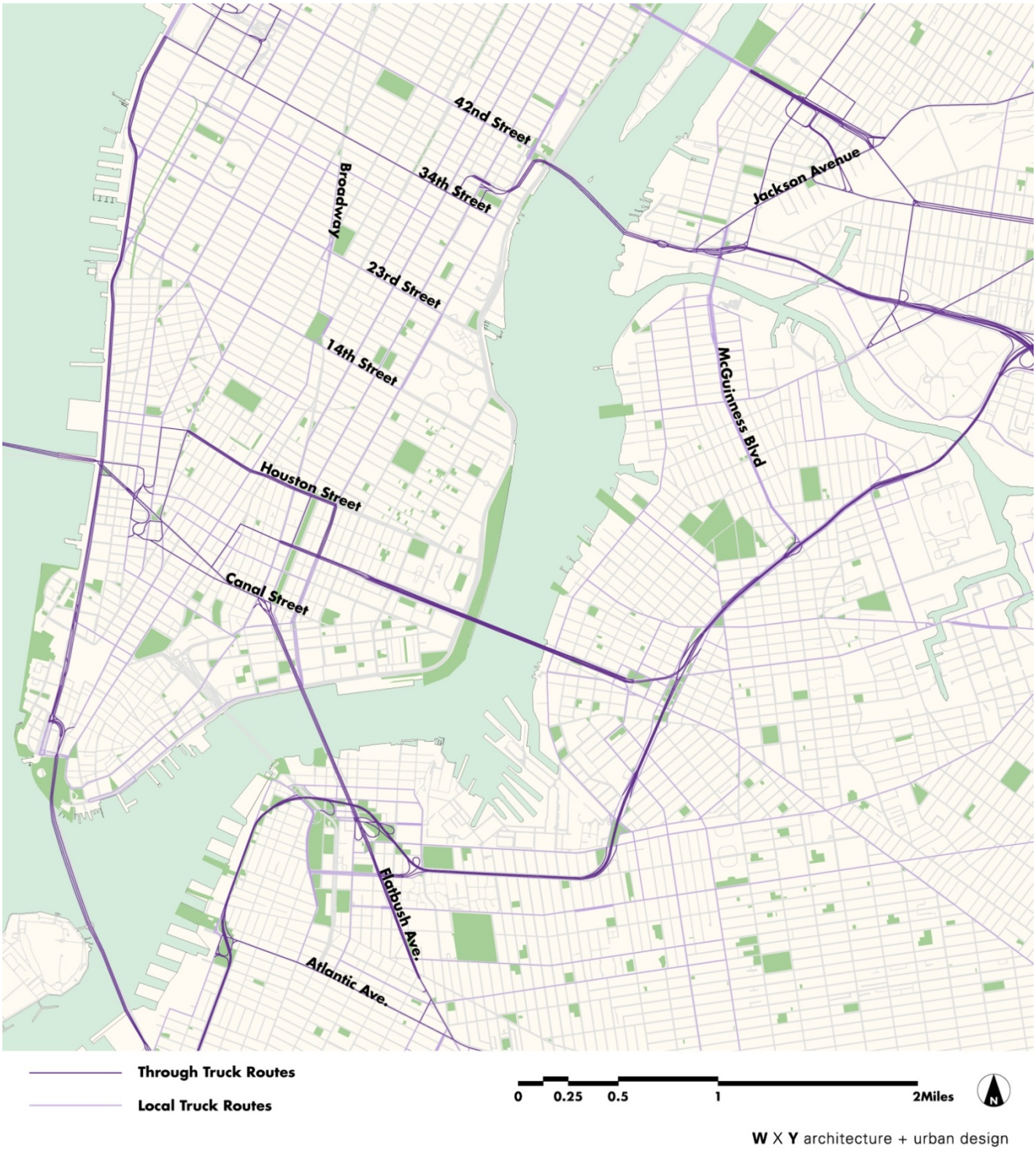


Figure A-3. NYC Truck Routes



Appendix B. Relevant Regulations

B.1 City Administrative Procedure Act

In NYC, rules regarding loading zones promulgated by NYCDOT take effect by following the requirements of the City Administrative Procedure Act (CAPA). Each city agency is empowered to adopt rules necessary to carry out the powers and duties delegated to it by or pursuant to federal, state or local law. CAPA Section 1043(a). Under CAPA, an agency identifies an issue and drafts a rule to address it. The agency then notifies the public of the draft rule, and hearings to be held related to it. CAPA Section 1043(b).

The agency must give notice to the members of the city council, the corporation counsel, media, community boards and civic organizations. CAPA Section 1043(b) (2). The proposed rule is subject to review by the Corporation Counsel and the Mayor's Office. CAPA Section 1043(c). The agency follows a public hearing process that allows for public comment on the proposed rule. CAPA Section 1043(e). After governmental review and public comment, if there are no problems with the rule drafting process or delegated authority to adopt the proposed rule, the agency publishes a final rule and then formally adopts the final rule. CAPA Section 1043(f).

B.2 MUTCD

Recommendations for parking or standing signage are covered by Sections 2B.46-.48 of the MUTCD.[71] These sections provide general guidance, illustrated examples as well as guidance on design and placement of such signs. This guidance has been used by jurisdictions for the design of traffic control devices related to EV charging on streets, parking facilities and other locations. An established GLZ will likely follow those models for signage. The MUTCD also provides guidance on Pavement and curb markings.[72] Pavement and curb markings may be required if infrastructure such as wireless charging is imbedded in pavement.

An ideal GLZ implementation would require signage and markings beyond what's included in the MUTCD. For its part, the FHWA acknowledges that allowing for new developments in the transportation sector will require updates to the MUTCD.

[71] Federal Highway Administration. 2009 Edition Chapter 2B. Regulatory Signs, Barricades, and Gates. http://mutcd.fhwa.dot.gov/htm/2009/part2/part2b.htm

[72] Federal Highway Administration. MUTCD Sections 3B.19 Parking Space Markings, 3.B.23 Curb Markings and Figure 3B.21 Examples of Parking Space Markings. http://mutcd.fhwa.dot.gov/htm/2009/part3/part3b.htm

> Continuing advances in technology will produce changes in the highway, vehicle, and road user proficiency; therefore, portions of the system of traffic control devices in this Manual will require updating. In addition, unique situations often arise for device applications that might require interpretation or clarification of this Manual. It is important to have a procedure for recognizing these developments and for introducing new ideas and modifications into the system.[73]

Authorities seeking interpretations or to implement pilots or experiments are directed to submit such plans to the MUTCD team in the Office of Transportation Operations at the FHWA at MUTCDofficialrequest@dot.gov.

B.3 Declaratory Ruling on Jurisdiction over Publicly Available Electric Vehicle Charging Stations

New York Public Service Commission, *Declaratory Ruling On Jurisdiction Over Publicly Available Electric Vehicle Charging Stations*, Case Number 13 -E-0199, November 22, 2013. The NYSPSC followed the recommendations of responders it solicited such as NYSERDA, NYPA and the City of New York, who suggested that the NYSPSC refrain from asserting jurisdiction over publicly accessed charging stations. These responders also acknowledged the need for utility test piloting projects involving EVs to better determine rates for consumers. See, In the Matter of Electric Vehicle Policies Case 13-E-0199, Comments of New York State Energy and Research Authority, Comments of the City of New York, Comments of New York Power Authority, July 8, 2013, New York Power Authority Comments.[74]

The NYSPSC qualified its ruling by stating that it acknowledged the recommendation in some of the submitted comments that it should maintain its ability to respond to the market as it evolves, and that its ruling does not diminish its ability to respond to changes in the market in which charging stations operate. It also maintained continuing jurisdiction over the transactions between electric distribution utilities and the owners and operators of charging stations. Also, the NYSPSC noted that other entities may assert oversight of safety issues, such as installation and connection of charging equipment. Thus, at this point, the use of charging infrastructure in GLZs would generally not involve jurisdictional issues with the NYSPSC. There may be the exception when a distribution utility is involved. Finally, this is subject to the evolution of the EV and EVSE market.

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[73] Federal Highway Administration. MUTCD Section 1A.10(02) (Interpretations, Experiments, Changes and Approvals). October 2013. http://mutcd.fhwa.dot.gov/htm/2009/part1/part1a.htm

[74] New York State Public Service Commission. Matter Master: 13-00989/13-E-0199. N.d. http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=13-E-0199&submit=Search+by+Case+Number

B.4 Rules of New York: Section 4-08(k)

(2) No standing except trucks loading and unloading. Where a posted sign reads "No Standing Except Trucks Loading and Unloading," no vehicle except a commercial vehicle or a service vehicle as defined in §4-01(b) of these rules, may stand or park in that area, for the purpose of expeditiously making pickups, deliveries or service calls, and except that in the area from 35th St. to 41st St., Avenue of the Americas to 8th Avenue, inclusive, in the Borough of Manhattan, between the hours of 7 a.m. and 7 p.m., no vehicle except a truck as defined in §4-13(a)(1) of these rules may stand or park for the purpose of expeditiously making pickups, deliveries, or service calls.

B.5 New York State Code: New York State Vehicle and Traffic Law[75] Article 39 - Regulation of Traffic by Cities and Villages

§ 1640. Traffic regulations in all cities and villages. (a) The legislative body of any city or village, with respect to highways (which term for the purposes of this section shall include private roads open to public motor vehicle traffic) in such city or village; subject to the limitations imposed by section sixteen hundred eighty-four may by local law, ordinance, order, rule or regulation:

1. Designate through highways and order stop signs, flashing signals or yield signs erected at specified entrances thereto or designate any intersection as a stop intersection or a yield intersection and order like signs or signals at one or more entrances to such intersection.
2. Prohibit or regulate the turning of vehicles or specified types of vehicles at intersections or other designated locations.
3. Regulate the crossing of any roadway by pedestrians.
4. Designate any highway or any separate roadway thereof for one-way traffic.
5. Exclude trucks, commercial vehicles, tractors, tractor-trailer combinations, tractor-semitrailer combinations, or tractor-trailer-semitrailer combinations from highways specified by such legislative body. Such exclusion shall not be construed to prevent the delivery or pickup of merchandise or other property along the highways from which such vehicles and combinations are otherwise excluded.
6. Prohibit, restrict or limit the stopping, standing or parking of vehicles; provided, however, that a vehicle may
7. not be found to be in violation of a parking regulation if it is parked at a broken parking meter at a time when metered parking is authorized.
8. Determine those highways or portions of highways which shall be marked to indicate where overtaking and passing or driving to the left of or crossing such markings would be especially hazardous in accordance with the standards, minimum warrants and sign or marking specifications established by the department of transportation.
9. Designate safety zones.
10. Provide for the installation, operation, maintenance, policing, and supervision of parking meters, establish parking time limits at such meters, designate hours of operation of such meters, and, except as provided in section twelve hundred three-h of this chapter, fix and require the payment of fees applicable to parking where such meters are
11. in operation. Such fees shall be paid to such city or village and credited to its general fund, unless a different disposition prescribed by local law or ordinance enacted prior to or after the effective date of this section.

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[75] New York State Legislature. Laws of New York: VAT – Vehicle and Traffic. N.d. http://public.leginfo.state.ny.us/LAWSSEAF.cgi?QUERYTYPE=LAWS+&QUERYDATA=@SLVAT0T8A39+&LIST=LAW+&BROWSER=BROWSER+&TOKEN=04905081+&TARGET=VIEW

12. Establish a system of truck routes upon which all trucks, tractors, and tractor-trailer combinations having a total gross weight in excess of ten thousand pounds are permitted to travel and operate and excluding such vehicles and combinations from all highways except those which constitute such truck route system. Such exclusion shall not be construed to prevent the delivery or pick up of merchandise or other property along the highways from which such vehicles and combinations are otherwise excluded. Any such system of truck routes shall provide suitable connection with all state routes entering or leaving such city or village.
13. Regulate traffic by means of traffic-control signals.
14. License, regulate or prohibit speed contests, races, exhibitions of speed, processions, assemblages or parades. Whenever such a speed contest, race, exhibition of speed, procession, assemblage or parade authorized by a local authority will block the movement of traffic on a state highway maintained by the state, or on a highway which connects two state highways maintained by the state to make a through route, for a period in excess of ten minutes, such authority must, prior to such blocking, provide and designate with conspicuous signs a detour adequate to prevent unreasonable delay in the movement of traffic on said highway maintained by the state.
15. Prohibit or regulate the operation and the stopping, standing or parking of vehicles in cemeteries and in public parks.
16. Provide for the removal and storage of vehicles parked or abandoned on highways during snowstorms, floods, fires or other public emergencies, or found unattended where they constitute an obstruction to traffic or any place where stopping, standing or parking is prohibited, and for the payment of reasonable charges for such removal and storage by the owner or operator of any such vehicle.
17. Provide for the establishment, operation, policing and supervision of a prepaid parking permit system, establishing parking time limits for such permits and fix and require the payment of fees applicable to parking where such a prepaid permit parking system is in operation. Such fees shall be paid to the city of Albany and credited to its general funds, unless a different disposition prescribed by local law is enacted. A prepaid parking permit system may not be established at any location at which parking is subject to a parking meter fee. The provisions of this paragraph shall only be applicable for the city of Albany.
18. Adopt such additional reasonable local laws, ordinances, orders, rules and regulations with respect to traffic as local conditions may require subject to the limitations contained in the various laws of this state.
19. Make special provisions with relation to stopping, standing or parking of vehicles registered pursuant to section four hundred four-a of this chapter or those possessing a special vehicle identification parking permit issued in accordance with section one thousand two hundred three-a of this chapter.
20. Declare a snow emergency and designate any highway or portion thereof as a snow emergency route.
21. Prohibit vehicles engaged in the retail sale of frozen desserts as that term is defined in subdivision thirty-seven of section three hundred seventy-five of this chapter directly to pedestrians from stopping for the purpose of such sales on any highway within such city or village, or on all such highways. Nothing herein shall be construed to prohibit the operator of such vehicle from stopping such vehicle off of such highway, in a safe manner, for the sole purpose of delivering such retail product directly to the residence of a consumer or to the business address of a customer of such retailer.
22. Exclude trucks, commercial vehicles, tractors, tractor-trailer combinations, tractor-semitrailer combinations, or tractor-trailer-semitrailer combinations in excess of any designated weight, designated length, designated height, or eight feet in width, from highways or set limits on hours of operation of such vehicles on particular city or village highways or segments of such highways. Such exclusion shall not be construed to prevent the delivery or pickup of merchandise or other property along the highways from which such vehicles or combinations are otherwise excluded.
23. Serve notice of a violation of any provision of local law or ordinance relating to the prevention of noise pollution caused by an audible motor vehicle burglar alarm and over which the city or village has jurisdiction upon the owner of a motor vehicle by affixing such notice to said vehicle in a conspicuous place.
24. Prohibit or regulate the stopping, standing and parking of vehicles in designated areas reserved for public business at or adjacent to a government facility.

- (b) Such a legislative body also may by local law, ordinance, order, rule or regulation prohibit, restrict or limit the stopping, standing or parking of vehicles upon property owned or leased by such city or village.
- (c) Each such legislative body shall cause to be determined, for all bridges and elevated structures under its jurisdiction, the capacity in tons of two thousand pounds which the bridge or structure will safely carry. At bridges or structures of insufficient strength to carry safely the legal loads permissible by section three hundred eighty-five, the legislative body of such city or village shall cause signs to be erected to inform persons of the safe capacity.
- (d) Each such legislative body of a city or a village shall cause signs to be erected to inform persons of the legal overhead clearance for all bridges and structures on highways under its jurisdiction. The legal clearance shall be one foot less than the measured clearance. The measured clearance shall be the minimum height to the bridge or structure measured vertically from the traveled portion of the roadway. On bridges or structures having fourteen feet or more of measured clearance, no such signs shall be required.
- (e) No legislative body of a city or a village shall enact any law that prohibits the use of sidewalks by persons with disabilities who use either a wheelchair or an electrically-driven mobility assistance device being operated or driven by such person.

§ 1642. Additional traffic regulations in cities having a population in excess of one million. (a) In addition to the other powers granted by this article, the legislative body of any city having a population in excess of one million, may by local law, ordinance, order, rule, regulation or health code provision prohibit, restrict or regulate traffic on or pedestrian use of any highway (which term, for the purposes of this section, shall include any private road open to public motor vehicle traffic) in such city. The provisions of section sixteen hundred shall be applicable to such local laws, ordinances, orders, rules, regulations, and health code provisions, provided, however, that such local laws, ordinances, orders, rules, regulations and health code provisions shall supersede the provisions of this chapter where inconsistent or in conflict with respect to the following enumerated subjects:

1. Weights and dimensions of vehicles.
2. Parking, standing, stopping and backing of vehicles.
3. The prohibition or regulation of the use of any highway by particular vehicles or classes or types thereof or devices moved by human power.
4. Charging of tolls, taxes, fees, licenses or permits for the use of the highway or any of its parts, where the imposition thereof is authorized by law.
5. Establishment of minimum speed limits at which vehicles may proceed on or along such highways.
6. Operation of authorized emergency vehicles.
7. Control of persons and equipment engaged in work on the highway.
8. Hitchhiking and commercial activities.
9. Use of medial strips and dividing malls or sections and use of shoulders of the highway.
10. Right of way of vehicles and pedestrians.
11. Use of the highway by pedestrians, equestrians and animals.
12. Turning of vehicles.
13. Regulation of the direction of the movement of traffic and the use of traffic lanes.
14. Regulation of the use of horns, lights and other required equipment of vehicles.
15. Towing and pushing of vehicles, including, but not limited to, the establishment of minimum insurance levels for and the licensing and regulation of persons engaged in the business of towing, and the fixing of maximum charges to be made by such persons for the towing and storage of disabled vehicles.
16. Objects projecting or hanging outside or on the top of vehicles.
17. Entering and driving off the highway, its roadways, medial strips, dividing malls and shoulders.
18. The prohibition or regulation of speed contests, races, exhibitions of speed, processions or parades.

19. Littering the highway.
20. Vehicles illegally parked, stopped or standing, or vehicles involved in accidents, including, but not limited to, the removal and storage of such vehicles, the fixing of reasonable charges, to be paid by the owner, operator or person entitled to possession, for such removal and storage and for other expenses incurred in connection therewith, the creation of liens on such vehicles for such charges and expenses, the enforcement of such liens, the determination of ownership or right to possession of such vehicles, the time before such vehicles are deemed abandoned vehicles pursuant to section twelve hundred twenty-four of this chapter, and the disposition of the proceeds of sales held pursuant to said section.
21. Transportation of combustibles, chemicals, explosives, inflammables, or other dangerous substances, articles, compounds or mixtures, including, but not limited to, dangerous articles, as defined in section three hundred eighty of this chapter.
22. Traffic signal legend applicable to pedestrians and use of arrows.
23. Prohibit, restrict or regulate the operation of limited use vehicles on any street or highway.
24. Prohibition of the operation of motorcycles during the period between nine post meridian through eight ante meridian along designated streets or parts of streets on which the properties fronting thereon are zoned for residential uses. Provided that notice of such prohibition shall be given by the posting of suitable signs at the entrance to each such street or part thereof and that no such prohibition shall apply to a motorcycle being operated thereon for the purpose or as a direct incident of law enforcement; crime prevention; detection; prevention or relief of any condition which may threaten the health, safety or welfare of persons or property; or direct travel to or from employment.
25. Parking, standing and stopping of vehicles registered pursuant to section four hundred four-a of this chapter or those possessing a special vehicle identification parking permit issued in accordance with section one thousand two hundred three-a of this chapter.
26. (a) Establishment of maximum speed limits below twenty-five miles per hour at which motor vehicles may proceed on or along designated highways within such city for the explicit purpose of implementing traffic calming measures as such term is defined herein; provided, however, that no speed limit shall be set below fifteen miles per hour nor shall such speed limit be established where the traffic calming measure to be implemented consists solely of a traffic control sign. Establishment of such a speed limit shall, where applicable, be in compliance with the provisions of sections sixteen hundred twenty-four and sixteen hundred eighty-four of this chapter. Nothing contained herein shall be deemed to alter or affect the establishment of school speed limits pursuant to the provisions of section sixteen hundred forty-three of this article. For the purposes of this paragraph, "traffic calming measures" shall mean any physical engineering measure or measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users such as pedestrians and bicyclists.
    (b) Any city establishing maximum speed limits below twenty-five miles per hour pursuant to clause (i) of this subparagraph shall submit a report to the governor, the temporary president of the senate and the speaker of the assembly on or before March first, two thousand two on the results of using traffic calming measures and speed limits lower than twenty-five miles per hour as authorized by this paragraph. Such report shall include, but not be limited to the following: (i) a description of the designated highways where traffic calming measures and a lower speed limit were established and (ii) a description of the specific traffic calming measures used and the maximum speed limit established.
    (b) The police commissioner of any such city may, in any emergency, suspend within such city or any part thereof, for a period of forty-eight hours, any provision of title seven of this chapter or any local law, ordinance, order, rule or regulation adopted pursuant to this article. In the event of any such suspension, the police commissioner shall forthwith give notice thereof to the official, board or agency of such city having jurisdiction to promulgate traffic regulations in relation to any place affected by such suspension.

Appendix C. Electric Charging Options

Table C-1. Electric Truck Options

	Model	Driving Range	Battery Size	On-Board Charger	Recharge Time	GVWR
AMP/ Workhorse	W42	80 miles	85 kWh	240-208 VAC (70 A)	8 hours	12–14,500 lbs.
	W62	100 miles	100 kWh	240-208 VAC (70 A)	8 hours	19–23,500 lbs.
Balqon Corporation	Nautilus MX30	150 miles	380 kWh	40 kW (100 kW opt.)	8-10 hours	50,000 lbs.
	Mule M100	100 miles	312 kWh	40 kW (100 kW opt.)	8-10 hours	8,000 lbs.
Boulder Electric	500 Series	100 miles	72 kWh		7-8 hours	10,500 lbs.
	1000 Series	100 miles	105 kWh		10-12 hours	15,500 lbs.
Electric Vehicle International	EVI-MD	90 miles	99 kWh	J1772	6-12 hours	16-23,000 lbs.
	EVI-WI	90 miles	99 kWh	J1772	6-12 hours	16-23,000 lbs.
Smith	Newton	100 miles	40-120 kWh	J1772	6-8 hours	14-26,400 lbs.
ZeroTruck	ZeroTruck	65-75 miles	50 kWh	J1772	8-10 hours	12-19,500 lbs.

EVSE Levels

AC Level 1 EVSE provides alternating current (AC) at 120 volts (V). This is typically comprised of a residential ground fault interrupter (GFI) three-prong outlet on a dedicated circuit with a portable charging unit that can be plugged into both the outlet and the vehicle. Almost all light-duty EVs have Level 1 charging capabilities (up to 1.9 kilowatts [kW]) that can be used at home or in emergency situations. As battery technology allows increased capacity to expand the vehicle's range, the use of Level 1 charging is becoming less practical. This is especially true for commercial electric trucks that have much larger battery packs and higher power requirements compared to light duty car applications.

AC Level 2 EVSE operates at either single phase 240 VAC (most common) or three-phase 208 VAC (found in some commercial and industrial applications). AC Level 2 infrastructure must be hardwired into a dedicated circuit with the unit permanently mounted. At allowable power ratings up to 19.2 kW, this is the most popular choice for public EV charging applications. Most public EVSE have incorporated restricted access or payment capabilities, some of which are proprietary to the EVSE manufacturer. The car, and corresponding onboard charger, dictates the final charging rate, which will also depend on the specific battery chemistry used, current state of charge, ambient conditions, and other factors. Today, most light duty vehicles will only accept a power rating up to 6.6kW, which means that most commercially available charging stations are limited at 7 kW to reduce costs. The majority

of commercial electric trucks utilize AC Level 2 charging, but at much higher power levels. A list of currently available Level 2 charging stations capable of charging at more than 7 kW is included in Figure C-3.

DC Level 1 and Level 2 EVSE utilizes a direct-current (DC) energy transfer to the battery pack from an off-board charger at 200-500 V. DC Level 1 can provide power ratings up to 40 kW, while DC Level 2 can go up to 100 kW. DC Fast Charging provides extremely rapid charges (80 percent recharge for some EVs in as little as 20 minutes) and is suited for rest stops off highways or heavily used charging areas where the EVs don't park long (taxi stands in NYC are experimenting with EVs and DC Level 1 chargers). A list of available DC Fast Charger models is included in Figure C-4.

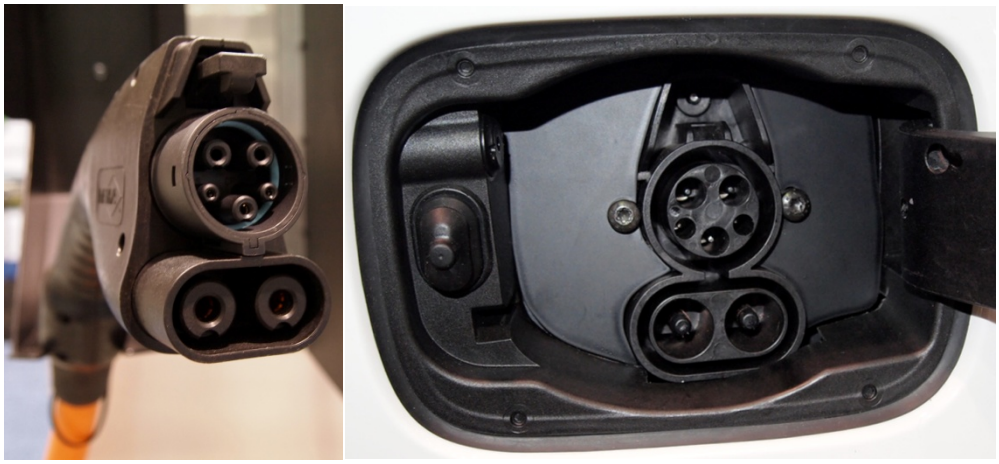
EVSE Plugs

Figure C-1. SAE-J1772 Standard Connector

Source: flickr user Michael Hicks, permission under Creative Commons v. 2.0[76]

Figure C-2. SAE-J1772 Combo DC Fast Charge Plug and Outlet

Source: Brad Berman / Plugincars.com granting permission for use



[76] img_5435. https://secure.flickr.com/photos/mulad/7058855567/

High-Powered EVSE Models

Figure C-3. LEVEL 2 (J1772) Charging Stations

Sources: ClipperCreek and Charge Point, granting permission [77]

ClipperCreek CS-40/CS-100

Voltage	240VAC
Max Current	100A
Cable Length	25ft
J1772	Yes
Max Power	19.2kW

Chargepoint CT4000 Series

Voltage	240VAC
Max Current	40A
Cable Length	18ft
J1772	Yes
Max Power	9.6kW

EVSE LLC EVSE Marquee

Voltage	240VAC
Max Current	70A
Cable Length	18ft
J1772	Yes
Max Power	13.4kW

EVSE LLC Curbside/Industrial

Voltage	240VAC
Max Current	100A
Cable Length	18ft
J1772	Yes
Max Power	19.2kW

Eaton Level 2 EVSE

Voltage	240VAC
Max Current	70A
Cable Length	18ft
J1772	Yes
Max Power	13.4kW

GE WattStation

Voltage	240VAC
Max Current	40A
Cable Length	18ft
J1772	Yes
Max Power	9.6kW

[77] Further information and images for all models described can be found at the following locations: http://www.clippercreek.com/products.html, http://www.chargepoint.com/stations, http://evsellc.com/, http://www.eaton.com/Eaton/ProductsServices/Electrical/ProductsandServices/index.htm, http://www.ecomagination.com/portfolio/wattstation

Figure C-4. DC Fast Charging Stations

Sources: Fuji Electric granting permission[78]

ABB Terra 53

Voltage	480VAC
Max Current	75A
Cable Length	15ft
CHAdeMO/ J1772 Combo	Both
Max Power	50kW

AeroVironment EV50-FS

Voltage	480VAC
Max Current	64A
Cable Length	N/A
CHAdeMO/ J1772 Combo	CHAdeMO
Max Power	50kW

Eaton DC Quick Charger

Voltage	208VAC
Max Current	200A
Cable Length	N/A
CHAdeMO/ J1772 Combo	Both
Max Power	50kW

Fuji Electric DC Quick Charger

Voltage	208VAC
Max Current	80A
Cable Length	N/A
CHAdeMO/ J1772 Combo	CHAdeMO
Max Power	25kW

EV Collective DC Fast Charger

Voltage	208VAC
Max Current	70A
Cable Length	N/A
CHAdeMO/ J1772 Combo	CHAdeMO
Max Power	160kW

Schneider Electric EV Link DC Quick Charger

Voltage	480VAC
Max Current	70A
Cable Length	N/A
CHAdeMO/ J1772 Combo	CHAdeMO
Max Power	33kW

78 Further information and images for all models described can be found at the following locations: http://www.abb.com/product/seitp332/691d99a8dd5ca7ba85257bef0064bd3f.aspx?productLanguage=us&country=US, http://www.chargepoint.com/products-chargepoint-stations.php, http://www.eaton.com/Eaton/ProductsServices/Electrical/ProductsandServices/ElectricalDistribution/ElectricVehicleChargingSolutions/index.htm, http://www.americas.fujielectric.com/systems/ev-charger/dc-quick-chargers-electric-vehicles-ev, http://www.evcollective.com/charger/UF.html, http://www.schneider-electric.com/products/us/en/50600-electric-vehicle-charging-stations/50630-fast-charging-electric-vehicle/61150-evlink-dc-quick-charger/

Electrical Systems Specifications

Table C-2. Truck Refrigeration Units

Manufacturer	Model	Electrical Voltage	Circuit Rating	Capacity (BTU/hour)
Johnson Truck Bodies	AE Series	208 VAC	60 A	5,600 - 19,600
	EMX Series	208 VAC	60 A	8,400 - 24,800
Carrier	Diesel Powered	208 VAC/460 VAC	60/30 A	5,700 - 31,000
	Vehicle Powered	208 VAC/240 VAC	60/30 A	2,900 - 13,000
Thermo King	T-80 Series	208 VAC	60 A	4,800 - 29,000
Zanotti	EFZ520	208 VAC	30 A	5,450 - 21,500

Table C-3. Battery APU Idle Reduction Technology Specifications

Manufacturer	Model	Weight (lbs.)	Energy Capacity	Generator	Heat/ AC	Grid Connectivity
Idle Reduction Tech[79]	Prodigy	220	5.1 kWh	8 kW	Yes	110 V / 15 A
Energy Xtreme[80]	Independence EMS4	380	4.0 kWh	N/A	Yes	110 V / 20 A
	Independence EMS6	490	6.0 kWh	N/A	Yes	110 V / 20 A
ZeroRPM IMS[81]	Class 1-2	165	1.3 kWh	N/A	Yes	110 V / 20 A
	Class 1-8	96	1.0 kWh	N/A	Yes	110 V / 20 A

Table C-4. Available Wireless Charging Technologies

	HEVO Power	Plugless Power	WiTricity WiT-3300
Voltage	240 VAC	240 VAC	240 VAC
Current	60 Amps	30 Amps	30 Amps
Max Gap	12 inches	4 inches	8 inches
Max Power	14 kW	3.3 kW	3.3 kW
Production	Pre	Yes	Yes

79 Idle Reduction Tech, "Prodigy." www.idlereductiontech.com/pdfs/Prodigy_2013Spec.pdf.

80 Energy Xtreme, "Ambulance / EMS Vehicle Independence Package® (EMS) Series." www.energyxtreme.net/solution/emsv/.

81 ZeroRPM, "Idle Mitigation Systems." www.zerorpm.com/assets/1822/ims.pdf.

Appendix D. Electric Truck Options

Table D-1. New York State Electric Vehicle – Voucher Incentive Fund[82]

VEHICLE ELIGIBILITY LIST					
OEM	**Vehicle Description**	**GVWR**	**Vehicle Cost**	**Incremental**	**Incentive**
AMP Trucks, Inc.	E-100 Workhorse Electric Walk In Van with 100 kWh	14,001 to 19,500	$133,000	$75,000	$60,000
Boulder Electric Vehicle	PS-500, Zero Emission MD Personal Shuttle with 72 kWh Lithium Battery	10,001 to 14,000	$155,000	$95,000	$56,000
Boulder Electric Vehicle	DV-500, Zero Emission MD Delivery Van with 72 kWh Lithium Battery	10,001 to 14,000	$130,000	$80,000	$60,000
Boulder Electric Vehicle	SB-500, Zero Emission MD Service Body Vehicle with 72 kWh Lithium Battery	10,001 to 14,000	$134,000	$74,000	$59,000
Boulder Electric Vehicle	FB-500, Zero Emission MD Flatbed Vehicle with 72 kWh Lithium Battery	10,001 to 14,000	$130,000	$70,000	$56,000
Electric Vehicle International	Zero Emissions Walk In Van with 99 kWh Lithium Battery	19,501 to 26,000	$185,000	$127,000	$60,000
Electric Vehicle International	Zero Emissions Walk In Van	14,001 to 19,500	$185,000	$127,000	$60,000
Electric Vehicle International	Medium Duty Zero Emissions Truck with 99 kWh Lithium Battery	19,501 to 26,000	$185,000	$118,000	$60,000
Electric Vehicle International	Medium Duty Zero Emissions Truck	14,001 to 19,500	$185,000	$118,000	$60,000
Smith Electric Vehicles	Smith Newton (60 kWh)	16,500 to 26,000	$136,442	$71,791	$60,000
Smith Electric Vehicles	Smith Newton (80 kWh)	16,500 to 26,000	$151,442	$86,791	$60,000
Smith Electric Vehicles	Smith Newton (100 kWh)	16,500 to 26,000	$166,442	$101,791	$60,000
Smith Electric Vehicles	Smith Newton (120 kWh)	16,500 to 26,000	$181,442	$116,791	$60,000

[82] https://truck-vip.ny.gov/NYSEV-VIF-vehicle-list.php

AMP/Workhorse Electric Vehicles[83]

AMP Holdings has two EV step van chasses for consumer purchase and is currently testing an all-electric paratransit bus with wireless charging capabilities (in partnership with Momentum Dynamics). Started as a light duty EV manufacturer, AMP entered the work truck market when it acquired Navistar's step van subsidiary Workhorse. AMP currently offers both conventional diesel and electric powertrains for their W42 and W62 lines of chassis.

Figure D-1. Amp Electric Delivery Truck

Source: AMP Electric Vehicle granting permission

Balqon Corporation[84]

Balqon Corporation currently offers two on-road electric trucks: the Nautilus MX30 and Mule M100. The MX30 is an all-electric short-haul, class 8 tractor based on a Freightliner chassis. It is equipped with a 600 V, 240 kW electric drive system that allows a top speed of 70 miles per hour (mph) and an all-electric range of 150 miles (unloaded).

Figure D-2. Balqon MX30

Source: Balqon Corporation granting permission

The M100 is an all-electric, inner city short-haul delivery truck designed to transport up to 4 tons of cargo. The all-electric drivetrain architecture provides up to 100 miles of range on a full charge and can reach top speeds of 70 mph. These vehicles come standard with a 40 kW charger, which provides a full charge in 8-10 hours, or an optional 100 kW charger that can charge the vehicle is 3-4 hours.

Figure D-3. Balqon M100

Boulder Electric

Boulder Electric offers two chassis layouts, the 500 and 1000 series, with all-electric drivetrains that can be configured as a bare chassis, flatbed truck, delivery vehicle, or service body truck. Each variation of this vehicle is available for purchase with a 150-day lead time (with the exception of the shuttle bus option). Boulder Electric has also developed a 2 way DC charger for smart charging applications.

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83 Photo courtesy of AMP Electric Vehicle. www.ampelectricvehicles.com.

84 Photos courtesy of Balqon Corporation. www.balqon.com/electric-vehicles.

Electric Vehicle International

Electric Vehicle International (EVI) offers two all-electric models, the medium-duty (MD) truck and Walk-in Van (WI). Both the EVI-MD and EVI-WI have a 99 kWh battery and an on board charger with a J1772 connection. The EVI-MD model is intended for dry freight delivery, refrigerated freight, beverage, utility, construction, landscaping, and ground support. The EVI-WI is designed for parcel delivery, industrial linen, food and beverage, utility, construction, landscaping, and ground support.

Smith Electric[85]

Smith Electric offers their Newton line of electric trucks in the US which is available in a number of configurations ranging from a chassis cab to school bus. This vehicle is often configured for delivery purposes in short-haul applications. The Newton typically features a 12 kW on board charger with a J1772 connector for charging from an external single phase 240 VAC power source. However, it can also be specified with three-phase 208 VAC power capabilities, but this option is not as popular. Currently, Fresh Direct and Frito-Lay (only 5 trucks) operate the only fleets in NYC that have vehicles configured for three-phase power. Older Smith vehicles also required the charging rate to be manually set to match the available charging power at a specific station. However, newer vehicles will be equipped with an automatic charge rate adjustment configuration that will automatically alter the peak charging rate depending on the available current from the charger (for all chargers over 30 A). Battery sizes between 40 kWh and 120 kWh are available with 80 kW being the most popular choice.

Figure D-4. Smith Newton Electric Truck

Source: Smith Electric Vehicles granting permission

ZeroTruck[86]

The ZeroTruck is an US built all-electric work truck rated for 12,000 to 19,500 lbs GVWR. It can be configured for a variety of applications, including utility, dry freight, stake bed, tow, sweeper, and refuse. This vehicle uses a lithium ion battery pack to provide 65 to 75 miles of range on a full charge.

Figure D-5. ZeroTruck with Utility body

Source: ZeroTruck granting permission

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85 Photo courtesy of Smith Electric Vehicles. www.smithelectric.com/smith-vehicles/models-and-configurations/.

86 Photo courtesy of ZeroTruck. "ZeroTruck." www.zerotruck.com/ZeroTruck.html.

Appendix E. Refrigeration and Auxiliary Electrification Systems

Johnson Truck Bodies Refrigeration Systems[87]

Johnson Truck Bodies offers EMX100 and EM300 refrigeration system models for single temperature trucks. These systems feature free hanging cold plate technology with active blowers to provide high cooling capacities. The EMX220 and EMX230 models are also available for multi-temperature applications where a variety of product at different temperatures must be transported simultaneously.

Carrier Transicold Refrigeration Systems[88]

Carrier offers their Supra line of refrigeration systems in both diesel powered and vehicle powered applications for single and multi-temperature vehicles at a variety of cooling capacities. These systems are configured to provide ample cooling for truck applications from 12 to 28 feet long. All of these units are available with electric standby to allow zero onsite emission and near silent operation when electrical infrastructure is available.

Thermo King Refrigeration Systems[89]

Thermo King offers their T-80 series of refrigeration systems for truck transport. These units have smart reefer controllers, which maintain optimum temperatures for all products ranging from fresh to frozen. The units are also equipped with smartpower electric standby which allows the diesel motors to be shut down when stationary and electric infrastructure is available.

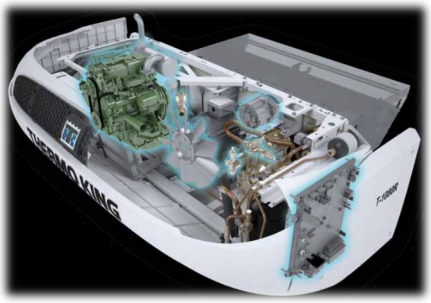

Figure E-1. Thermo King Refrigeration System

Source: Thermo King granting permission

87 Johnson Refrigerated Truck Bodies. Refrigeration Systems. www.johnsontruckbodies.com/refrige/index_emx.asp

88 Carrier Transicold North America. Truck Refrigeration. www.trucktrailer.carrier.com/Carrier+Brand+Sites/Carrier+Transicold+North+America+Truck+Trailer+Rail/Side+Bar+Links/Products/Truck+Refrigeration

89 Photo courtesy of Thermo King. T-80 Series. www.na.thermoking.com/content/dam/tki-na/pdf/brochures/truck/55685_T-80%20Series%20Bro.pdf

Idle Reduction Tech (IRT)[90]

IRT's Prodigy Idle Reduction system is a 220 pound compact (3 ft^3) hybrid engine accessory that can power heating, air conditioner, and auxiliary power with the engine off. This technology includes a 5.12 kWh battery, an 8 kW peak generator, and hybrid cab climate control module. The climate control module is capable of heat or AC output for 3+ hours. Regeneration during deceleration throughout a daily duty cycle provides charge for the battery. Requires an 110 V, 15 A plug to charge when stationary, requiring a maximum of 6.7 hours.

Energy Xtreme Independence Package[91]

Energy Xtreme's Independence Package systems are complete smart power management systems that operate a vehicle's auxiliary electrical loads, including beacon lights, air conditioner, heater, refrigerator, radio, computer, camera and power tools, without having to engage the vehicle's engine. These systems are used for police, ambulance and emergency medical services, utility, and military vehicle applications. The system can be charged through the vehicle's alternator or through shorepower via a standard wall outlet.

ZeroRPM Idle Mitigation System[92]

The ZeroRPM Idle Mitigation System powers the vehicle's heating and air conditioning system without having to have the engine running. The IMS controller automatically stops the engine when idle time reaches one minute and restarts the engine based on voltage and current. System provides extra batteries so that the system is fully operational throughout the day. The system is tied to the vehicles alternator, allowing it to recharge while the vehicle is in operation. If needed, the system can be plugged into a standard wall outlet to recharge. The system takes approximately 4-6 hours to fully recharge. A standard 110 V wall outlet plug at 20 A is required for charging.

Figure E-2. ZeroRPM Idle Mitigation System

Source: ZeroRPM granting permission

90 Photo courtesy of Idle Reduction Tech. "Prodigy." www.idlereductiontech.com/pdfs/Prodigy_2013Spec.pdf.

91 Photo courtesy of Energy Xtreme. "Ambulance / EMS Vehicle Independence Package® (EMS) Series." www.energyxtreme.net/solution/emsv/.

92 Photo courtesy of ZeroRPM. "Idle Mitigation Systems." www.zerorpm.com/assets/1822/ims.pdf.

Idle Free Electric APU[93]

The reefer-based Idle Free electric APU is an electric APU solution for sleepers and day cabs pulling a refrigerated trailer. Excess electrical energy is taken from the trucks alternator while traveling over the road and stores it in AGM batteries. Drivers can then use this energy when stationary to power AC and heat systems, provide 120 VAC electricity for televisions, microwaves, and other hotel needs, keep the truck engine warm, and provide backup alternator power for the truck's starter batteries in the event one or the other fails. Standard shore power outlet can also be used to recharge from an external power supply. An alternative configuration (called the Reefer-Based system) is designed for trucks hauling refrigerated trailers and takes excess electrical energy from the trailer refrigeration system's alternator to charge the batteries. Both systems offer similar driver amenities during stationary periods.

[93] Photo courtesy of Idle Free Systems. "Reefer-Based Idle Free electric APU." http://idlefreesystems.com/no-idle-elimination-systems-reefer.html.

Appendix F. Additional Case Study Locations[94]

Roosevelt Island (Main Street) – Manhattan[95]

559-573 Main Street

Potential Partner: Roosevelt Island Operating Corporation

Existing Regulation: 45 minute parking, $0.25 per 20 minutes

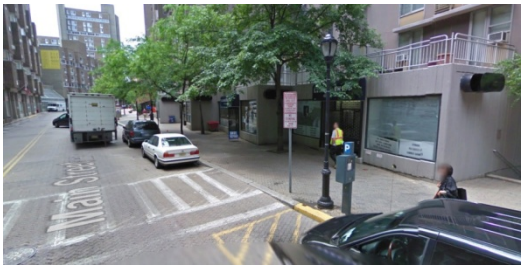

Figure F-1: Roosevelt Island Main Street

There is an opportunity to develop a GLZ along Roosevelt Islands, Main Street in front of 559-573 Main Street. Currently the parking restriction is "45 minute parking, $0.25 per 20 minutes," and is located south of an existing "Commercial Loading Zone pointed North." This specific location has a dense concentration of retail, residential, and institutional buildings on both sides of Main Street.

95 Wall Street – Manhattan[96]

95 Wall Street facing Water Street

Potential Partner: Downtown Alliance

Existing Regulation: 2 HOUR PARKING 8:30AM-10PM EXCEPT SUNDAY <----> (NYCDOT)

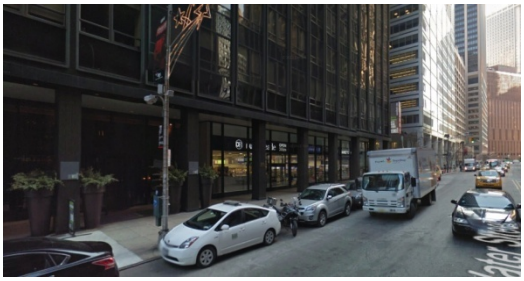

Figure F-2. 95 Wall Street, Duane Reade

Frito-Lay is receiving a large amount of citations at Duane Reade stores in Lower Manhattan. This specific location was receiving the highest amount of citations in the area and may provide an incentive for other Duane Reade stores in the area to install GLZs if this model proves to be successful. There is also the added benefit that Frito-Lay deliveries generally take place during normal work day hours 8 am - 5 pm while Duane Reade stores generally receive deliveries at night providing optimal usage for the GLZ.

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94 These photos are for illustrative purposes only and do not reflect current street conditions. Base street view captured on July 2011 and is copyright of 2014 Google, except where specified. Street view used per Google's noncommercial and academic use permission.

95 Original street view available at: https://www.google.com/maps/@40.762449,-73.949407,3a,75y,222.91h,63.93t/data=!3m4!1e1!3m2!1sL-aQgFxEfpFpuRvW5HuXLQ!2e0!6m1!1e1

96 Original street view available at: https://www.google.com/maps/@40.705015,-74.007623,3a,37.5y,207.24h,79.97t/data=!3m4!1e1!3m2!1swy8K24JgZK3ip33mJKYsUw!2e0

Broadway & Morris Street – Manhattan[97]

Between Exchange Pl. & Morris Street

Potential Partner: Downtown Alliance

Existing Regulation: NO STANDING EXCEPT TRUCKS LOADING AND UNLOADING 10AM-4PM MON THRU FRI

Figure F-3. Broadway & Morris Street

Located along the Manhattan Local Truck Route Network, Frito-Lay reported receiving high amounts of citations at 7 different locations along Broadway between Morris and Rector Streets. This location can serve the Duane Reade located along Broadway and is highly visible due to its prominent location along Broadway and heavy tourist presence. The large amount of businesses and pedestrians in the area will benefit from less noise/emissions while students from the six schools in the vicinity would benefit from cleaner operating vehicles producing less emissions.

Union Square West - Manhattan[98]

Between E. 17th & E. 16th Streets

Potential Partner: Union Square Partnership

Figure F-4. Union Square West

Located in one of NYC's great public spaces Union Square, 60,000 shoppers and 140 regional farmers, fishermen, and bakers descend upon Union Square during peak season. The proposed GLZ would be located along Union Square West which has 14 businesses located on it consisting of national retailers such as Staples, Diesel, McDonalds, Starbucks, Sketchers, Lululemon, and American Eagle among other restaurants and bars. There are also many retailers on East 14th, East 15th, East 16th, and East 17th that connect with Union Square West. Frito-Lay route 1280 specified that they receive high citations at the Duane Reade and Walgreens around this particular location.

[97] Original street view available at: https://www.google.com/maps/@40.706057,-74.013093,3a,37.5y,59.91h,95.2t/data=!3m4!1e1!3m2!1sA8wna1oSi02BKUrAG9ElJQ!2e0

[98] Original street view available at: https://www.google.com/maps/@40.737048,-73.990391,3a,75y,213.4h,80.65t/data=!3m5!1e1!3m3!1s51-ME5_MbydwF5Tlp2c_8g!2e0!5s2009-05

Park Avenue & 22nd Street - Manhattan[99]

Between E. 21st & E. 22nd Street

Potential Partner: Flatiron-23rd Street Partnership

Existing Regulation:

Figure F-5. Park Avenue & 22nd Street

A dense concentration of businesses and retail in the vicinity including a Duane Reade at 20th and Park, allow fleets to make multiple deliveries. Our site visit showed that deliveries generally take place between 7am -2pm with multiple stops made at Emma's Dilemma Deli and Morton Williams Supermarket. With frequent deliveries occurring in a two block radius fleets operating an EV truck would spend less time circling and double parking currently an existing issue.

1 Penn Plaza – Manhattan[100]

Between 7th Avenue & 8th Avenue

Potential Partner: 34th Street Partnership

Existing Regulation: NO STANDING EXCEPT

COMMERCIAL VEHICLES METERED PARKING

3 HR LIMIT 8AM-MIDNIGHT EXCEPT
SUNDAY W/ SINGLE ARROW

Figure F-6. 1 Penn Plaza

1 Penn Plaza is a LEED Certified and Energy Star rated building next to Madison Square Garden/Penn Station. This location was selected due to Frito-Lay reporting two different routes as receiving high amounts of citations and the ability to serve Down East Seafood and Duane Reade located on 8th Avenue and 33rd Street.

[99] Source: WXY

[100] Original street view available at: https://www.google.com/maps/@40.751158,-73.993124,3a,75y,344.92h,88.32t/data=!3m5!1e1!3m3!1s4Wk0ALTD1cTSUckeFJjspw!2e0!5s2011-07!6m1!1e1

Broadway & 111th Street - Manhattan[101]

Between W. 111th & W. 112th Street

Potential Partner: Columbia University

Exiting Regulation: NO PARKING

(SANITATION BROOM SYMBOL)

7:30-8AM EXCEPT SUN W/ SINGLE ARROW

Figure F-7. Broadway & 111th Street Duane Reade

Located along the Manhattan Local Truck Route Network, this site provides an opportunity to serve a Mission Electric winning Duane Reade location already receiving EV deliveries. This high traffic corridor has a dense concentration of businesses, restaurants, and retail in the vicinity allowing fleets to make multiple deliveries. The proximity to Columbia University provides an educational opportunity and possible partnership with the Columbia Climate Center.

E. 125th St. & Lexington Avenue – Manhattan[102]

Between E. 126th & E. 125th Street

Potential Partner: 125th Street BID

Existing Regulation: NO STANDING EXCEPT TRUCKS LOADING AND UNLOADING

Figure F-8. 125th St. & Lexington Avenue

The Duane Reade situated at 125th Street & Lexington Avenue, in Harlem a neighborhood plagued with high asthma rates is an ideal location for a GLZ. Duane Reade sits along the NYC Designated Truck Route, on the corner of E. 125th Street and Lexington Avenue. There is a dense concentration of national and local retail. On Lexington Avenue heading south from 126th Street where the existing loading zone exists there are nine stores with a mix of national retail and local stores.

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101 Original street view available at: https://www.google.com/maps/@40.804946,-73.96603,3a,75y,157.89h,75.58t/data=!3m4!1e1!3m2!1svbKlcS330vkeJW51ah4LHQ!2e0

102 Original street view available at: https://www.google.com/maps/@40.804453,-73.937578,3a,15y,71.01h,86.16t/data=!3m5!1e1!3m3!1swNjWTduHoGVUae3YRoD1Wg!2e0!5s2013-09

Flatbush Avenue & Park Pl. – Brooklyn[103]

Figure F-9. Flatbush Avenue & Park Place, Duane Reade

Between Prospect Pl. & 7th Avenue

Potential Partner: North Flatbush BID

Existing Regulation: NO STANDING EXCEPT

TRUCKS LOADING & UNLOADING 8AM-4PM

MON THRU FRI (SINGLE ARROW)

The Duane Reade located in Park Slope, Brooklyn on the corner of Flatbush Avenue and Park Place was selected for being one of five Mission Electric winning locations to receive deliveries from electric delivery trucks. The store is located along the designated NYC Truck Route Network on the southwest side of Flatbush Avenue leading into iconic Prospect Park, providing clear visibility along a high traffic corridor. The variety of stores will receive deliveries from various fleets that may not operate on an alternative fuel and could incentivize them to invest in this technology.

Union Square Green Market – Manhattan[104]

Figure F-10. Union Square Green Market

Union Square Park West Side

Potential Partner: Union Square Partnership

Existing Regulation: Park

Located in one of NYC's great public spaces Union Square, the Union Square Green Market receives 60,000 shoppers and 140 regional farmers, fishermen, and bakers during peak season. This site is ideal for a food truck or delivery truck working with the Green Market.

[103] Original street view available at: https://www.google.com/maps/@40.678178,-73.973182,3a,90y,197.08h,79.74t/data=!3m5!1e1!3m3!1se6AyDfuj3OZOCDHrH6k0rQ!2e0!5s2008-08!6m1!1e1

[104] Original street view available at: https://www.google.com/maps/@40.73614,-73.99106,3a,30y,31.45h,84.14t/data=!3m5!1e1!3m3!1shhYFZ7cTgCVzSJGh2ef5Dw!2e0!5s2011-05

North Shore-LIJ - Lenox Hill Hospital – Manhattan[105]

E. 77TH Street

Potential Partner: North Shore-LIJ

Existing Regulation: NO STANDING EXCEPT

AUTHORIZED VEHICLES

Figure F-11. North Shore LIJ – Lenox Hill Hospital, E 77th Street

Lenox Hill Hospital located at, 100 East 77th Street between Lexington and Park Avenues, is a 652-bed, acute care hospital located on Manhattan's Upper East Side. The main entrance of the hospital is located along E. 77th Street which is also where ambulances line up an idle. A GLZ in this location may incentivize ambulances to run on electric while parked emitting no harmful emissions.

North Shore-LIJ – Forest Hills Hospital – Queens[106]

102nd Street

Potential Partner: North Shore-LIJ

Existing Regulation: NO STANDING EXCEPT

AUTHORIZED VEHICLES

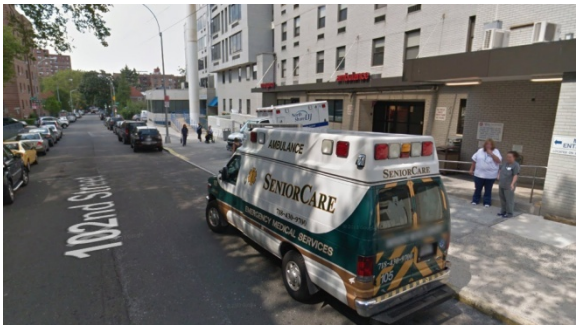

Figure F-12. North Shore LIJ - Forest Hills Hospital, 102nd Street

Forest Hills Hospital is locate in a dense residential area in Forest Hills, Queens. This location is ideal for a pilot project on installing EVSE at a GLZ site. There is an existing ambulance waiting zone along 102nd street near the emergency entrance. Operating cleaner vehicles will benefit hospital patients and residents of the area from emitting less greenhouse gas emissions and noise.

105 Original street view available at: https://www.google.com/maps/@40.773858,-73.960361,3a,75y,296.23h,75.48t/data=!3m5!1e1!3m3!1sXH4hdwuAYr0QpXDLetN_gw!2e0!5s2011-06

106 Original street view available at: https://www.google.com/maps/@40.728632,-73.851828,3a,75y,21.79h,73.3t/data=!3m4!1e1!3m2!1s_JEgcgHZHTEzxUmMkU8uKQ!2e0

Yankee Stadium – The Bronx[107]

1 E. 161st Street

Bronx, NY 10451

Potential Partner: New York Yankees/161st Street BID

Figure F-13. Yankee Stadium

During games at Yankee Stadium ambulances are required to sit outside of the stadium in case of emergencies. There is an opportunity to place a GLZ outside of the stadium that can be used by both, ambulances during games and delivery trucks making deliveries to nearby retailers.

[107] Source: Wikimedia user BuickCenturyDriver
http://upload.wikimedia.org/wikipedia/commons/2/25/New_Yankee_Stadium.JPG

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