

Public Schools of the Tarrytowns Fleet Electrification Plan

November 13, 2024

Prepared For:

Public Schools of the Tarrytowns

210 North Broadway
Sleepy Hollow, New York
10591



N|V|5

32 Old Slip, Suite #401
New York, NY
10005

859823-2303101

EXECUTIVE SUMMARY



The Public Schools of the Tarrytowns (“Tarrytown” or “District”) is exploring the transition of its fleet to battery electric vehicles to meet the District’s emission goals and New York State regulations. This fleet electrification plan was developed by NV5 and District staff to chart a path to zero-emission transportation for the District and to ensure compliance with New York’s zero-emission vehicle regulations. This study is funded by the New York State Energy Research and Development Authority (NYSERDA) and provides a roadmap to a zero-emission fleet, including vehicle-level modeling to identify suitable vehicles and a transition schedule, charging infrastructure concepts to fuel the vehicles, a review of grants and incentives, a financial analysis of capital and operating costs, and next steps for the District.

The District currently operates 52 vehicles, including 47 school buses and 5 passenger vehicles. By 2038, the District expects to add 5 vehicles to the fleet, for a total size of 57 vehicles. These vehicles are housed at 210 North Broadway, Sleepy Hollow. An electric vehicle (EV) transition schedule was developed in coordination with District staff to meet New York State zero-emission fleet regulations and the goal of full fleet electrification by 2035.

Based on an analysis of the daily usage and the resulting EV transition schedule, EV charging infrastructure concepts were developed for the 210 North Broadway site.

The vehicle purchase schedules and charging station infrastructure plans were used to estimate total cost of ownership (TCO) for the electrified fleet. The table below summarizes difference in ownership cost of an internal combustion engine (ICE) fleet versus the electrified fleet. The cost comparison includes infrastructure costs and awarded grants and incentives.

20-Year Cost for each Scenario	Cost of buying and operating 57 EVs in fleet by 2035	Cost of buying and operating 57 ICE vehicles that would have been replaced by EVs by 2035	Incremental savings of fleet electrification
Nominal Cost	\$(10,591,000) ²	\$(13,893,000)	\$3,302,000
NPV¹ Cost	\$(8,750,000)	\$(10,841,000)	\$2,092,000

¹ NPV is net present value with 2.5% annual discount rate.

² Numbers in brackets denotes cost.

KEY FIGURES

Planned Electrified Fleet Information	
Buses	52 active vehicles in 2024: 46 ICE buses, 1 zero-emission bus 3 ICE white fleet vehicles, 2 zero-emission white fleet vehicles 57 active vehicles by 2035: 52 zero-emission buses 25 Type A w/ 88 kWh battery 19 Type C w/ 226 kWh battery 8 Type C w/ 315 kWh battery 5 zero-emission white fleet vehicles
Chargers	In 2024: 1 L2 charger (16.6 kW) Planned by 2035: 1 L2 charger (16.6 kW) 50 L2 chargers (19.2 kW) 4 L3 chargers (30 kW) 2 L3 chargers (60 kW)
Routes	32 Routes, 100% can be electrified with current technology
Bus Storage/Charging Locations (repeat information for multiple locations)	Address: 210 North Broadway, Sleepy Hollow, New York, 10591 Number of vehicles at this depot location: 57 (52 buses, 5 white fleet) Number of chargers at this location: 57 Ownership of the depot: District Owned
Vehicle ownership	District Owned
Utility Requirements & Impacts	
Peak Demand	Peak Demand w/o Charge Management: 1,219 kW Peak Demand w/ Charge Management: 283 kW % reduction in peak demand through CMS: 77%
District-side Infrastructure Required	Expansion of depot to the south New electric service, switchgear and transformer
Utility-side Infrastructure Required	New electric service and transformer
Cost Summary 2024 - 2044	
Bus Costs	Vehicle CapEx: \$12.3M Electricity: \$1.1M Maintenance (incl. battery replacement): \$6.2M
Charger Costs	19.2 kW Hardware: \$239k 30 kW Hardware: \$82K 60 kW Hardware: \$61K EVSE Software and O&M: \$570K

Infrastructure Costs	Behind-the-Meter Infrastructure: \$1.43M To-the-Meter Infrastructure: To be determined by ConEd
Total Cost without Incentives	\$22.0M *Sum of the above numbers
Estimated Incentives	EV incentives: \$9.3M - Includes IRA, EPA, NYSBIP vouchers and NYSERD ZEB CapEx Incentive EVSE Incentives: \$2.1M - Includes NYSBIP vouchers & NYSERD ZEB CapEx Incentive
Total Cost of Ownership	\$10.6M over 20 years (vs. \$13.9M in ICE scenario) - Vehicle CapEx: \$12.3M before incentives (vs. \$4.2M) - Vehicle Maintenance: \$6.2M (vs. \$6.9M) - EVSE Infrastructure CapEx: \$1.8M before incentives (vs. \$0) - Electricity: \$1.1M (vs. \$2.8M in fuel) - EVSE Software & O&M: \$570K (vs. \$0) - Grants & Incentives: \$11.4M (vs. \$0) Note: Maintenance includes cost of battery replacement at the 10th year of vehicle life.

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1.0 BACKGROUND INFORMATION

1.1 EMISSIONS AND OPERATIONAL GOALS

The Public Schools of the Tarrytowns (“Tarrytown” or “District”) is exploring fleet electrification to meet New York’s requirements for zero-emission fleets and to reduce greenhouse gas (GHG) emissions associated with operating their fleet. NV5 is supporting the District by developing this fleet electrification plan to review the vehicle, infrastructure, capital, and operational implications of this transition.

Through discussions with District staff, a target of 2035 was identified as the target date to transition all school buses and passenger vehicles to EVs. This goal meets New York State regulations as shown in Table 1, as school districts are required to adopt a zero-emission bus fleet by 2035.

1.2 VEHICLE CLASSIFICATIONS

Zero-emission transition rules reference Federal Highway Administration (FHWA) classifications for vehicles based on their gross vehicle weight rating (GVWR), or the vehicle manufacturer’s specification of the vehicle’s loaded weight. A high-level overview of the District’s total fleet by class is shown in Section 2.1 Table 4.

1.3 REGULATORY ENVIRONMENT

New York is pursuing innovative and accelerated EV adoption goals through regulations and incentives to reduce greenhouse gas emissions and improve air quality. Transportation GHG emissions is the second highest source of emission for the state of New York.¹ Therefore, electrifying the transportation network is critical to achieving GHG reduction targets to reduce emissions by 40% by 2030 and 85% by 2050 from 1990 levels. For many public agencies, these regulations are a primary driver for zero-emission vehicle (ZEV) adoption.

Table 1. Summary of New York Regulations Governing EV Adoption.

Regulation	Vehicle Type	Regulates	Description
Advanced Clean Car II	Class 1-2a	Sellers	- Starting in 2026, manufacturers must sell an increasing percentage of ZEV Class 1-2A vehicles. - By 2035, 100% of new passenger cars and light duty trucks and SUVs sold must be zero emission.
Advanced Clean Truck	Class 2B-8	Sellers	- Starting in 2024, manufacturers must sell an increasing percentage of ZEV Class 2B-8 vehicles. - By 2035, Class 2B-3 vehicles must be 55% of sales, Class 7-8 tractors must be 40% of sales, all other Class 4-8 vehicles must be 75% of sales.
New York Consolidated Laws Education Section 3638	School Buses	Buyers	- Beginning 2027, all new school buses purchased or leased under new contracts must be zero emission vehicles. - By 2035, all school buses in operation must be zero-emission.

¹ Table ES.3 of 2023 Statewide GHG Emission Report <https://dec.ny.gov/sites/default/files/2023-12/summaryreportnysghgemissionsreport2023.pdf>

The District will be impacted by the above regulations. Advanced Clean Cars II and Advanced Clean Truck will make it progressively more challenging to purchase ICE replacements for the District's vehicles. And the Consolidated Laws Education Section 3638 regulation on buying all zero emission school buses by 2027, and a complete adoption of zero-emission school bus fleet by 2035, is particularly stringent.

1.4 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE) TYPES

EVSE refers to the electric vehicle chargers and associated electrical infrastructure to supply the chargers. EVSE is typically categorized into three levels (which generally correspond to increasing levels, or speeds, of power supply): Level 1, Level 2, and direct current fast chargers (DCFC, or Level 3). An electric vehicle charging station delivers either alternating current (AC) or direct current (DC). Levels 1 and 2 deliver AC electrical power, while Level 3 provides DC electrical power. The power level supplied to the vehicle is dependent on the type and power level of the charger, available electrical circuit capacity, and vehicle/battery architecture (e.g., operating voltage, operating current, and capacity).

Table 2. Summary of Charging Levels.

Charging Level	Typical Power Input	Power Output	Plug Types	Project Relevance
Level 1	120V	1-2 kW-AC	J1772, NACS	Not applicable for fleet charging. Typically, a standard electrical socket with user supplied cord. Low to no cost, slow charging.
Level 2	208V or 240V Single Phase	3.9-19.2 kW-AC	J1772, NACS	Commonly used for fleet applications with long dwell times such as overnight charging windows. Moderate cost to install/operate, moderate charging speed. Some electric school buses do not allow Level 2 charging.
Level 3 (DCFC)	480V, 3 Phase	24-350+ kW-DC	CCS1, NACS	Typically used for public charging and fleet charging with higher mileage needs, shorter dwell times or for backup charging. High cost to install/operate, fastest charging speed. Currently, Level 3 is the only option that allows Vehicle-to-Grid energy export.

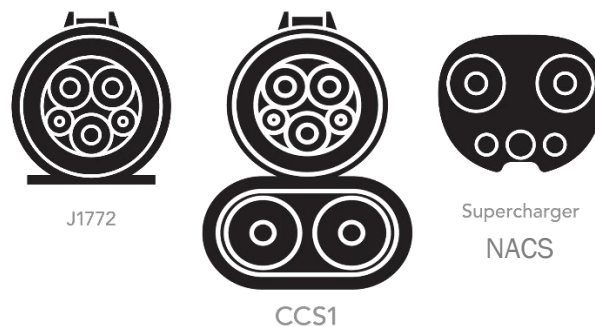


Figure 1. Common EVSE Plug Types in North America.

Presently, there are two primary plug types in the North American market: J1772/CCS1 and NACS. The J1772/CCS1 outlet is currently the standard on all non-Tesla vehicles, and NACS outlets are found only on Tesla vehicles. However, most North American vehicle original equipment manufacturers (OEM) for light-duty vehicles have announced that they will be converting to the NACS standard with new vehicles as early as 2025 model years. Most school bus manufacturers continue to utilize the J1772/CCS1 standard, however this may change in the future. Adapters from one standard to the other do exist and are low in cost.

Most EVSE OEMs are also now producing chargers with cables that can easily be swapped to the NACS cables in the future. A decision on plug type for the District's EVSE will need to be reviewed and selected during design of the charging infrastructure.

1.5 CHARGE MANAGEMENT SYSTEMS (CMS)

A charge management system (CMS) is the software that controls charging stations at a site. One of the key features of a CMS is to optimize charging times to take advantage of time-of-use utility tariffs rates, with a goal of minimizing the cost of electricity (fuel). Another feature of a more sophisticated CMS is automated load management, a feature that can help avoid or reduce the scale of utility upgrades by managing the EV charging loads to keep the site's total power demand under a limit, while ensuring the vehicles are charged by the time they are needed. Other CMS capabilities include charging session scheduling and reporting, managing access to chargers (typically via RFID card), recording vehicle telematics, and participating in utility demand response programs.

NV5 recommends selecting a single CMS vendor to control all electric vehicle supply equipment (EVSE) across a client's sites to reduce service fees, ensure ease of asset management, and reduce redundancy. CMS contracts are long-term commitments with monthly fees per dispenser, so NV5 recommend a careful screening of CMS providers prior to contracting. We also recommend selecting a simple and low cost CMS initially, then adding sophistication when a clear benefit from additional features is shown.

1.6 EV AND EVSE INTEROPERABILITY

In an EV charging system, there are multiple components that need to work together. They are 1) the EV charging station, 2) the CMS, and 3) the vehicle itself. There are standards that each component can comply with to ensure interoperability with the other components. Choosing an interoperable platform allows flexibility to choose different hardware and software solutions now and in the future. NV5 recommends procuring equipment that complies with the following standards:

Table 3. Interoperability Standards to Consider

Standard Name	Description
Open Charge Point Protocol 2.0	Ensures interoperability between EVSE and CMS.
Open Charge Point Interface	Ensures interoperability between EV and EVSE.
ISO-15118	- Enables vehicle-grid-integration capability, such as EV energy export to the grid. - Enables plug-and-charge capability thereby avoiding need for payment cards. Standard will be ISO-15118 PnC.

Presently, New York State does not require EV chargers to comply with ISO-15118 standards. However, the New York School Bus Incentive Program (NYSBIP) may require compliance for NYSBIP Charging Voucher eligibility in the future.²

Some vendors have integrated proprietary hardware and software offerings that are not compatible with third-party services. These bundled offerings are often referred to as closed charging networks. Closed networks tend to work well because the hardware and software entity are the same; however, selection of a closed system reduces options in the future to switch hardware or software providers without a full replacement of the charging equipment.

1.7 NYSBIP EVSE REQUIREMENTS

NYSBIP is one of the largest source of incentives that school districts in New York can benefit from. Receipt of incentives from this program requires adherence to its EV charger requirements. Of particular importance:

- Must be able to dispense at least 19.2kW per charging port simultaneously.
- Must be compatible with school buses purchased.
- Must be Energy Star and National Recognized Testing laboratory (NRTL) certified, [listed here](#).
- CMS recommended with energy management, and achieve OCPP v1.6 or newer. Networked (through 4G LTE, Ethernet, or wireless).
- ISO-15118 parts 2, 3 and 20 may be required at a later date.

² <https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/Electric-School-Bus/NYSBIP-Implementation-Manual.pdf>

2.0 PRELIMINARY ANALYSES

2.1 FLEET CHARACTERIZATION & VEHICLE REPLACEMENT SCHEDULE

Existing Fleet

The current 52 operational fleet vehicles owned by the District are stationed at 210 North Broadway. Over the next 10 years, the District expects to grow its fleet by 5 vehicles, 3 Type A buses and 2 Type C buses. All 57 vehicles will be transitioned to electric vehicles by 2035. A summary of vehicles by class is shown in Table 4. In addition, 6 Type A buses will be replaced by Type C buses with longer range needed for their routes.

Table 4. Vehicles by Class for Replacement Schedule.

Fleet Size	White Fleet Vehicles			School Buses			Total Vehicles
	Class 1	Class 2B	White Fleet	Type A	Type C	School Buses	
Current Fleet	2	3	5	28	19	47	52
Expected Change	+2	-2	-	-3	+8	+5	5
Total in 2035	4	1	5	25	27	52	57

Within the 5 current white fleet vehicles, there are currently 3 Chevrolet Suburban SUVs, and 2 Chevrolet Bolt EVs. The District wishes to replace 2 of the Suburban SUVs with Bolt EVs, and 1 of the Suburban SUVs with a Ford e-Transit.

Electric Vehicle Replacement Options

Table 5 provides example EV replacements for a selection of vehicle types owned by the District. These are not NV5's recommendations, but are examples of vehicles currently in the market. Prior to purchase of a new EV, the District should review the battery capacity and interoperability to ensure the vehicle comfortably meets the District's desired use case.

Table 5. Example EV Replacement Options (As of Summer 2024).

Replacement Vehicle Class	Sample Existing Vehicle	Example Replacement Vehicles	Current Vehicle Count	Rated Max Range (mi)	Rated Battery Capacity (kWh)	EV MSRP (\$)
Class 1	Chevrolet Bolt EV	Chevrolet Bolt EV	2	247	65	\$35,000
Class 2B	GM Suburban	Ford E-Transit	3	93	54	\$50,000
Type A Bus	Blue Bird Micro Bird G5	Blue Bird Micro Bird G5 EV ²	28	80	88	\$275,000
Type C Bus – Typical Range	Blue Bird Vision	Thomas Saf-T-Liner C2 EV	14	110	180	\$367,500
Type C School Bus – Long Range	Blue Bird Vision	IC CE EV 315 kWh	5	160	315	\$400,000

EV and battery technology is expected to improve as the market continues to develop, including range, vehicle efficiency, cost, and reliability. For example, Blue Bird announced a future model of the Micro Bird Type A school bus capable of 200 miles with a 175 kWh battery. Therefore, actual vehicle replacement vehicles may not correspond in range or price to the ones identified above in Table 5. The modeling uses conservative assumptions in modeling EV performance, as seen in Table 6. Electric Vehicle Modelling AssumptionsTable 6.

Table 6. Electric Vehicle Modelling Assumptions

Electric Vehicle Modeling Assumptions	Value
Modelled vehicle efficiency versus manufacturer's claims	85%
Modelled vehicle usable battery	80%
Typical Overnight Dwell Time (hrs)	12 (6pm – 6am)
Charging window (hrs)	8h for white fleet (9pm – 5am) 10h for buses (7:30pm – 5:30am)

One of the most impactful inputs to the analysis is the size of the vehicle battery, daily mileage, and available charging time. To prevent vehicles from being stranded on-route, the analysis reduces the rated capacity of the battery to 80% and assumes that EVs' fuel efficiency is 85% as efficient as manufacturers' claims. The conservative estimate allows additional battery capacity to serve as a safety buffer in case there are any major variations to the usage of the vehicles and helps account for battery degradation that may occur overtime. This is also in line with industry recommendations for preserving the lifespan of the battery.

2.2 EV TRANSITION TREND

A vehicle replacement schedule was developed in coordination with District staff. This transition schedule was created to align and surpass New York State regulations. The District current policy is to retire vehicles when they reach 15 years old. However, for this analysis, since all vehicles must transition to zero-emission school buses by 2035, a 10 year retirement age was applied to the fleet.

NV5 reviewed the various fleet vehicle types, typical daily routes, general operational usage patterns, and potential EV replacement vehicles. The analysis determined that all the vehicles in the existing fleet were suitable for electrification.

Below is a summary of the transition schedule from 2024 to 2035. A vehicle-by-vehicle breakdown is available in Appendix 3.

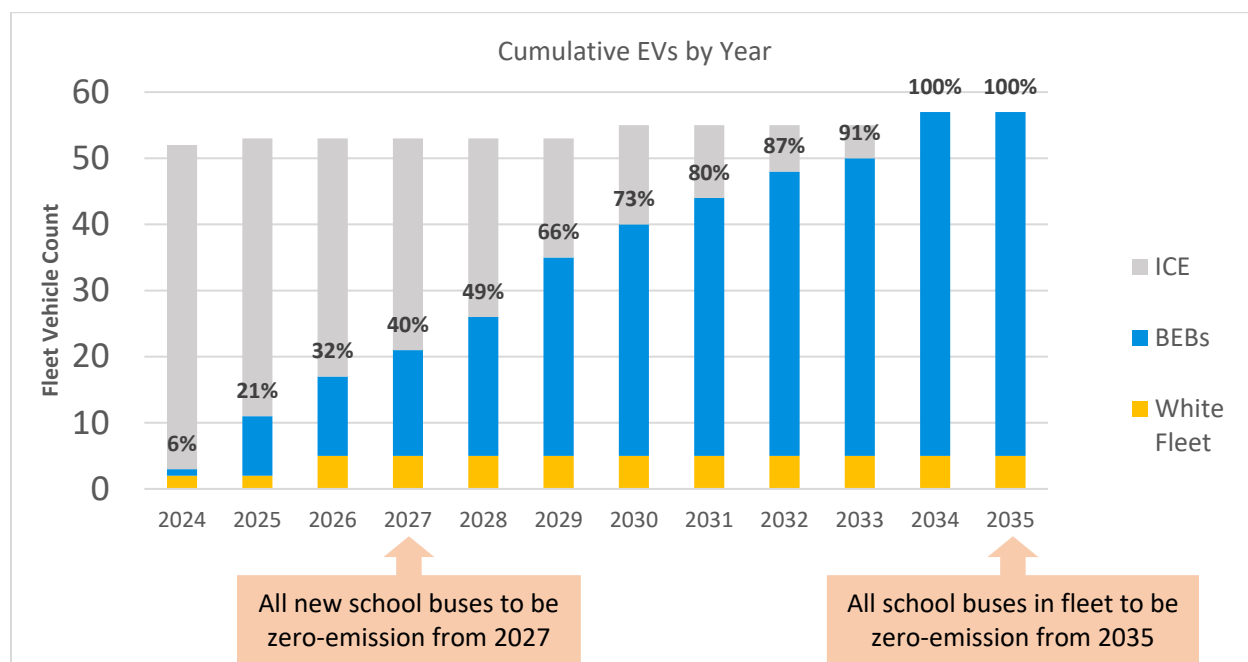


Figure 2. Cumulative EVs by Year.

2.3 ROUTE AND CHARGER POWER LEVEL ASSESSMENT

The District provided NV5 with bus route data, including mileage per day, hours of bus operations, and bus types. Accordingly, NV5 performed a bus route analysis to determine appropriate EV replacements for each bus and recommended charger power.

To determine the required charging station power level, NV5 modeled the typical daily usage of the vehicles, including the District provided daily mileage, number of trips, and hours stationed at the depot. The following conservative assumptions were used in the charger power level assessment:

Table 7. Charger Power Level Modeling Assumptions.

Charger Power Modeling Assumptions	Value
ConEd Off-Peak Pricing Hours (charging encouraged)	8pm – 4pm (day after)
Charging Station Ratio (port to vehicle)	1:1
Charger Conversion Efficiency (%)	97%
Voltage Supplying Chargers (V)	240V, 1 Phase for L2 480V, 3 Phase for L3

Table 8. School Bus Routing and Charger Power Assessment Results.

Vehicle ID	Class/Type	Typical Daily Mileage	Typical Daily kWh	EV Suitability	EVSE Level	EVSE Power
1	2B	35	24	Yes	Level 2	19.2
2	Type A	45	46	Yes	Level 2	19.2
5	Type A	30	31	Yes	Level 2	19.2
6	Type C	5	10	Yes	Level 2	19.2
8	Type A	15	16	Yes	Level 2	19.2
9	Type A	20	21	Yes	Level 2	19.2
13	Type A	10	10	Yes	Level 2	19.2
14	Type A	18	19	Yes	Level 2	19.2
15	Type A	10	10	Yes	Level 2	19.2
16	Type A	15	16	Yes	Level 2	19.2
17	Type A	12	12	Yes	Level 2	19.2
18	Type A	95	176	Upgrade*	Level 3	30
19	Type C	15	29	Yes	Level 2	19.2
20	Type C	18	35	Yes	Level 2	19.2
21	Type C	5	10	Yes	Level 2	19.2
22	Type A	35	36	Yes	Level 2	19.2
23	Type A	95	176	Upgrade*	Level 3	30
24	Type A	18	19	Yes	Level 2	19.2
25	Type C	67	124	Yes	Level 2	19.2
26	Type C	23	44	Yes	Level 2	19.2
27	Type A	28	29	Yes	Level 2	19.2
28	Type A	35	36	Yes	Level 2	19.2
29	Type A	15	16	Yes	Level 2	19.2
30	2B	40	11	Yes	Level 2	19.2
31	2B	79	23	Yes	Level 2	19.2
32	Type A	52	54	Yes	Level 2	19.2
33	Type A	22	23	Yes	Level 2	19.2
34	Type C	51	95	Yes	Level 2	19.2
35	Type C	40	74	Yes	Level 2	19.2
36	Type C	38	73	Yes	Level 2	19.2
37	Type C	31	60	Yes	Level 2	19.2
38	Type A	57	59	Yes	Level 2	19.2
39	Type A	114	211	Upgrade*	Level 3	30
40	Type C	18	35	Yes	Level 2	19.2
41	Type A	42	43	Yes	Level 2	19.2
42	Type A	86	166	Upgrade*	Level 3	30

Vehicle ID	Class/Type	Typical Daily Mileage	Typical Daily kWh	EV Suitability	EVSE Level	EVSE Power
43	Type A	75	145	Upgrade*	Level 2	19.2
44	Type A	36	37	Yes	Level 2	19.2
45	Type C	30	58	Yes	Level 2	19.2
46	Type A	72	139	Upgrade*	Level 2	19.2
47	Type C	47	87	Yes	Level 2	19.2
48	Type C	36	67	Yes	Level 2	19.2
49	Type C	27	52	Yes	Level 2	19.2
50	Type C	15	29	Yes	Level 2	19.2
51	Type C	25	48	Yes	Level 2	19.2
52	Type C	20	39	Yes	Level 2	19.2
53	1	49	14	Yes	Level 2	19.2
54	Type A	24	25	Yes	Level 2	19.2
55	Type A	56	58	Yes	Level 2	19.2
56	Type A	38	40	Yes	Level 2	19.2
57	Type C	25	48	Yes	Level 2	19.2
58	1	20	6	Yes	Level 2	19.2

*Upgrade: Type A electric school buses commercially available as of the writing of this report do not have the range for these routes. These buses are upgraded to a Type C bus with larger battery for this report.

The following should be noted about the charging levels noted in Table 8:

1. Some bus manufacturers only offer Level 3 charging (most notably Thomas Bus).
2. We typically recommend at least 1 or 2 higher power Level 3 chargers (often a dual port 100+ kW charger) be installed for fleet applications to provide flexibility with unforeseen conditions, such as an overnight charging error)

Given that all vehicles must be ready to operate every morning, NV5 assessed the EV charging demand for the District's whole fleet, and recommend the EV charging port count shown in Table 9.

Table 9. Recommended Charger Port Count by Power Level for fully electrified fleet in 2035.

Existing Level 2 Port 16.6kW (80A)	Future Level 2 Ports 19.2kW	Future low-power DCFC Ports 30kW	Future high-power DCFC Ports 60kW	Total Ports	Total Connected Load (kW)
1	50	4	2 ¹	57	1,217

¹NV5 recommends installing a dual port 120kW DCFC in this case, which will allow 60kW to each vehicle when two vehicles are plugged in, or 120kW to one vehicle when only one vehicle is plugged in. This provides operational flexibility if an issue arises on an overnight charge or where a quicker charge is needed for a longer trip, such as a field trip.

Note that all Level 2 ports are lumped into the same quantity regardless of the minimum power level in Table 9. The cost difference between various Level 2 power levels is small (Recent costs from a

leading OEM for Level 2 hardware: \$5,500 for 9.6kW vs \$6,200 for 16.6kW), and the additional power provides additional operational flexibility. CMS can also be employed to reduce total utility power supply needs by accounting for the software's ability to limit maximum demand from the EVSE infrastructure, further mitigating the cost of selecting higher power levels.

NV5 therefore recommends that the District purchase and install the highest power Level 2 port (19.2kW at 240V and 80A) for all Level 2 ports to provide additional charging capacity and flexibility for a slight price addition. We also recommend this preliminary equipment list be revisited prior to design. The District may want to consider a higher proportion of Level 3 ports if their preferred buses only accept Level 3 charging, or if there is a driver to implement Vehicle-to-Grid energy export capabilities.

Additionally, NV5 recommends a vehicle-to-charger ratio of 1:1 for school bus fleets that mainly rely on L2 charging. This is achieved by having 57 charging ports for the 57 vehicles in the District's fleet. A ratio of 1:1 removes the need for a staff to swap vehicles when they are fully charged. Instead, vehicles can all be plugged in at the same time, and the District can use the CMS (explained in Section 1.5 above) to modulate power flow to the vehicles. The CMS can also reduce the power demand from the utility company by spreading out the charging demand throughout the night.

3.0 RESULTS

3.1 EVSE PHASING

NV5's analysis assumes that construction will be performed in phases so EV chargers are not installed too far ahead of EV purchases and incur unnecessary operating costs. Table 10 provides an overview of potential EVSE installation phasing for each transition plan scenario. Under direction from the District, each phase of construction is set four to five years apart.

Table 10. EVSE Phasing Plan.

Phase	Year	Added Level 2 Ports	Cumulative Level 2 Ports ¹	Added DCFC Ports	Cumulative DCFC Ports	Cumulative Charging Ports (L2 & L3)
Phase 1	2025	30	31	6	6	37
Phase 2	2030	20	51	0	6	57

¹ Includes one (1) existing Level 2 port.

As allowed by funding and any restrictions with secured incentives and grants, the District should consider futureproofing the site during Phase 1 of the project by performing construction work for future phases, such as trenching, laying additional conduits, and procuring the switchgear and transformer sized for a fully electrified fleet. This way, the District can avoid digging and repaving the parking lot in the future, and avoid procuring additional electrical equipment with long lead times.

3.2 POWER SUPPLY & PRELIMINARY UTILITY COORDINATION

When installing charging stations, a separate, dedicated EV service is often recommended due to the significant power levels required to supply a fully electrified fleet. This also has the benefit of a separate utility meter which may qualify for an EV specific utility tariff. Alternatively, an existing service occasionally has sufficient additional capacity.

The following table summarizes salient points regarding power supply for the EVSE infrastructure:

Table 11. Key Utility Coordination Details

Electrical Utility Serving Site	Consolidated Edison (ConEd)
Utility Contact	Marlana Williams, WilliamsMar@coned.com Jessica Nunziata, NunziataJ@coned.com Elliot Ward, WardE@coned.com
NYSERDA Contact	Mike Bangert-Drowns, mike.bangert-drowns@nyserda.ny.gov
Applicable Utility Make-Ready/ Incentive Program(s)	Refer to Section 3.3 of this report
Site Address	210 North Broadway, Sleepy Hollow, New York, 10591
Existing Service	Main Service (Also serves F and G Bldgs): 480V/1200A, 3P Subpanel (Bus lot building and sports field): 480V/100A, 3P
Additional Capacity on Existing Subpanel	All remaining capacity is reserved for upcoming field lighting project
Preliminary New Service Transformer & Switchgear Size/Capacity	No CMS – 1,000 kVA, 480V/1600A 3P Switchgear With CMS – 500 kVA, 480V/800A 3P Switchgear

NV5 recommends a nameplate capacity of chargers of 1,217 kW. Under nominal operations and using a CMS to spread charging load overnight, NV5 determined that a peak load of 283 kW is needed. Therefore, a 500 kVA service from the electric utility is likely sufficient for the electric school bus charging infrastructure, assuming the CMS will manage charging loads overnight.

Site Visit

NV5 conducted a site visit on 5/15/2024. Based on our site visit, the parking area at the 210 North Broadway site is powered by a subpanel located at the adjacent maintenance building. The subpanel serves the bus lot building and a nearby sports field. The subpanel has one existing 80A Level 2 charger, and currently some additional capacity. However the additional capacity is well below what is needed to supply the anticipated EVSE buildout. The additional capacity is also earmarked for future field lighting at adjacent playing fields. While some additional EVSE could be implemented on the existing subpanel, the chargers would be temporary and may need to be removed or curtailed once the field lighting is implemented. Based on these findings, we recommend the District pursue a new, dedicated 800A (with CMS) or 1600A (no CMS) service from ConEd to supply the anticipated EVSE buildout.

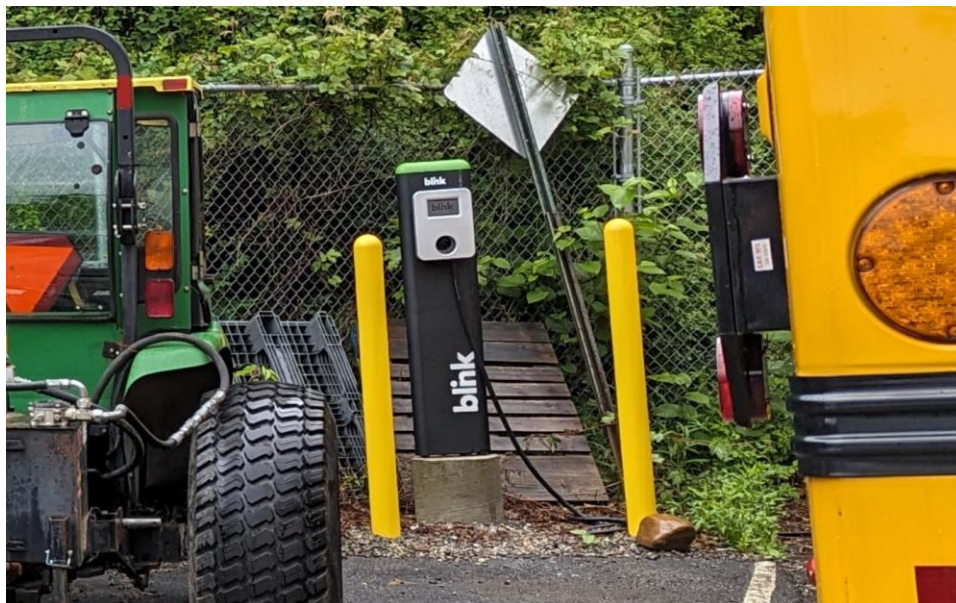


Figure 3. Existing EV Charger at 210 North Broadway

Utility Coordination

NV5 and the District met with ConEd on 6/18/2024. The District's electrification plans and anticipated power needs were discussed with ConEd. The utility explained the Medium and Heavy Duty Vehicle Make-Ready program, and provided a list of required documents to request a new service, namely:

- Letter of Authorization
- Site Plan
- Single Line Diagram
- Load Letter Form
- EV Charger cut sheet

ConEd confirmed that sufficient power is available for the first phase of chargers, but future phases might require a utility distribution line upgrade. ConEd also set up a monthly meeting with District staff to sync up on the fleet electrification journey and provide advisory support. The ConEd EV specialists identified above in Table 11 have been assigned to the District. During the design phase, close coordination should be maintained with the utility to ensure power supply.

A preliminary site layout concept for 210 North Broadway is available in Appendix 2. The site concepts include preliminary EV charging station siting, the assumed point of interconnection, and potential EVSE phasing.

3.3 GRANTS, INCENTIVES AND REBATES

As relatively nascent technologies that require high capital investments, EV and EV chargers for the moment require funding from external sources to pencil out financially. As EV adoptions become mandatory with various state regulations, NV5 anticipates that grants and incentives will lessen over

time and therefore NV5 recommends pursuing available near-term opportunities. These analyses are conservative by their omission of some funding opportunities that are not 100% guaranteed to be awarded.

Potential near-term funding opportunities include:

1. EPA Clean School Bus Rebate (2023)

- District has applied for, and was awarded \$1,020,000 in rebates for 5 Type C buses.
- Buses will need to be in service by 2026.
- Considered in TCO as funding is secured.

2. NY State Education Department (NYSED) Transportation Aid

- NYSED Transportation Aid will be dispensed to the District based upon 60% of project costs, less all other rebates and grants received by the District (from EPA Clean School Bus, NYSBIP, etc).
- This Transportation Aid will be paid to the district over a 12-year amortization period in 12 equal payments and our assumptions are based upon the guidance provided by NYSED in the Zero Emission Bus Charging Infrastructure (State Aid Q/A) document dated February 22nd, 2024.³
- The District can also claim this aid for interest on loans taken to fund this project. To simplify this assessment and be conservative, NV5 did not include reimbursement of interest costs in the TCO.
- Considered in TCO as this funding is dedicated to school districts and Tarrytown will receive this funding if it applies.

3. NYSERDA School Bus Incentive Program (NYSBIP)

- Rebates for new electric school buses.

Bus Type	Base Voucher	Priority District Bonus	Scrappage Bonus	V2G Bonus	Wheelchair Bonus
Type A	\$114,000	\$28,500	\$47,500	\$9,500	\$8,000
Type C	\$147,000	\$36,750	\$61,250	\$12,250	\$8,000

- As a school district that has a fleet electrification plan (this document), Tarrytown is eligible for rebate vouchers to replace 14 school buses.
- Rebates for EV chargers, as a prioritized school district that has a fleet electrification plan, Tarrytown is eligible for up to \$65,000 per charger. Charger rebates are tied to the number of electric buses added to the fleet that year.
- Considered in TCO as this program is available to all school districts in New York.
 - TCO considers Base Voucher + Priority District Bonus + Scrappage bonus

4. IRS Commercial Clean Vehicle Credit

³ https://stateaid.nysed.gov/trans/calculated_capital.htm

- Provides up to 30% of the cost basis, or up to \$40,000 per vehicle in tax credits, based on weight, cost basis and incremental cost as determined by IRS.
 - Considered in TCO as the funding is secured until 2032.
5. IRS Alternative Fuel Vehicle Refueling Property Credit (Section 30C)
- Tax credits up to 30% of eligible project costs or \$100,000 per EV charger, whichever is less. The address 210 North Broadway is in an eligible census tract for this tax credit through 2029.
 - Considered in TCO for Phase 1 chargers.
6. ConEd Medium Heavy-Duty Vehicle Charging Infrastructure Pilot
- Covers 90% of utility-side EV charging infrastructure upgrades or \$116/kW of charging power (approximately \$39,000 for Phase 1 in 2025)
 - Covers 50% of customer-side EV charging infrastructure upgrades or \$490/kW of charging power (approximately \$116,000 for Phase 1 in 2025)
 - Not considered in TCO as pilot program funding may run out before Tarrytown is ready to commit to this program. This is also not a significant source of funding, as the total potential funding is \$155,000 and will not measurably swing the TCO.

3.4 TOTAL COST OF OWNERSHIP (TCO) ANALYSIS

The EV transition modeling, the charging power level modeling, and the infrastructure scoping results were collated to estimate total cost of ownership (TCO) comparisons between internal combustion engine (ICE) vehicles and the EV transition scenario. A summary of key modeling assumptions is outlined below:

Table 12. TCO Modeling Assumptions.

TCO Assumption	Value
Funding Type	District Cash Purchase
Vehicle Costs	Per Table 5 EVs price reductions at 1-3%/yr ¹ ICE vehicles increase at 0.2-0.5%/yr ¹
EV Charging Hardware: Level 2 (kW)	19.2
EV Charging Hardware: Level 3 (kW)	30 and 60
BEB Battery Replacement Intervals (Years)	10
Level 2 Charger Cost per Port (\$)	\$4,500 for pedestal \$22,000 for infrastructure
Level 3 Charger Cost per Port (\$)	\$20,000 for 30kW pedestal \$30,000 for 60kW pedestal \$50,000 for infrastructure
Discount Rate (%)	2.5%
ConEd Electricity Rate for Future EV Service	SC 9

TCO Assumption	Value
ConEd Peak Period (Tarrytown)	4 - 8 pm
ConEd Electricity Volumetric Cost (\$/kWh) ¹	\$0.07
ConEd Electricity Demand Charge (\$/kW)	\$41.63
Annual Utility Escalator, %	3%
Annual Consumer Price Index (%)	2%
Active Fleet Days Per Year	220
Managed Charging using CMS	Yes
Includes Project Soft Costs	Yes
Fuel Costs - Gas (\$/gallon)	\$3.77 ²
Fuel Costs - Diesel (\$/gallon)	\$4.52 ²
ICE Bus Maintenance Cost (\$/mile)	\$0.88 ³
BEB Maintenance Cost (\$/mile)	\$0.62 ³
White Fleet ICE Maintenance Cost	\$0.50 ⁴
White Fleet EV Maintenance Cost	\$0.35 ⁴

¹ Source for light-duty EV price trends: <https://theicct.org/wp-content/uploads/2022/10/ev-cost-benefits-2035-oct22.pdf>

¹ Source for medium/heavy duty EV price trends: <https://theicct.org/wp-content/uploads/2023/03/cost-zero-emission-trucks-us-phase-3-mar23.pdf>

² Based on White Plains metro area fuel prices as of April 2024, as reported by <https://gasprices.aaa.com>

³ California Energy Commission study on Cost Effectiveness of Battery Electric School Buses (https://www.energy.ca.gov/sites/default/files/2020-04/Cost-Effectiveness_ada.pdf)

⁴ Based on NV5 aggregated client fleet data

Table 13. Incentives Included in TCO.

Incentive	Scope of Funding	Total Value	Considerations
EPA Clean School Bus Rebate	Vehicles and EVSE	\$1,020,000	5 buses; to be used by 2026
NY State Education Department Transportation Aid	Vehicles and EVSE	\$4,767,000 in EV \$1,025,000 in EVSE	Disbursed over 12-years from year when cost is incurred.
NYSBIP	Vehicles and EVSE	\$2,839,000 in EV \$686,000 in EVSE	
IRS Commercial Clean Vehicle Credit	Vehicles	\$717,000	Credits available for EVs purchased until 2032
IRS Alternative Fuel Vehicle Refueling Property Credit	EVSE	\$372,000	

Table 14. 20-Year Lifetime TCO Summary. Full detailed cash flows are available in Appendix 1.

Metric	ICE Value	BEB Value
Vehicle CapEx	\$(4,211,000)	\$(12,334,000)

EVSE Infrastructure CapEx	\$-	\$(1,810,000)
Grants & Incentives	\$-	\$11,427,000
20-yr Operating Costs	\$(9,682,000)	\$(7,873,000)
Lifetime Costs, Nominal	\$(13,893,000)	\$(10,591,000)
Lifetime Costs, NPV (@2.5 % DR)	\$(10,841,000)	\$(8,750,000)
Lifetime Incremental Savings, Nominal	n/a	\$3,302,000
Lifetime Incremental Savings, NPV (@2.5 % DR)	n/a	\$2,092,000

¹ Operating costs include fuel or electricity, maintenance, EVSE software, and charger O&M.

² NPV is net present value, DR is discount rate

3.5 AVOIDED FOSSIL FUEL CONSUMPTION

The follow greenhouse gas (GHG) emissions reduction only considers operational emission reductions (Scope 1 and Scope 2). There are additional GHG emission from the manufacturing of the vehicle, extraction and processing of fossil fuels, that are not considered in this calculation. Additionally, the emission factor for electricity in New York is expected to be zero at 2040, per the 2019 Climate Leadership and Community Protection Act. This assessment models the reduction in emission as a linear reduction over time.

Table 15. GHG Reduction from 2024 to 2044.

Metric	Avoided Gasoline	Avoided Diesel	Added Electricity	Emission Saved
Volume	479,000 gal	86,000 gal	8,792,000 kWh	-
Emission Factor	8.78 kg/gal ¹	10.19 kg/gal ¹	0.4 kg/kWh ^{2,3}	-
Emission (metric tons CO₂)	(4,209)	(876)	+ 935	(4,150)

¹ EIA data: https://www.eia.gov/environment/emissions/co2_vol_mass.php

² eGrid data. 885.2 lbs/MWh converts to 0.4kg/kWh: <https://www.epa.gov/egrid/power-profiler#/NYCW>

³ Emission expected to reduce linearly until zero at 2040 per New York State Climate Leadership and Community Protection Act (2019) <https://climate.ny.gov/-/media/Project/Climate/Files/CLCPA-Fact-Sheet.ashx>

4.0 RECOMMENDATIONS & NEXT STEPS

4.1 COORDINATE WITH ELECTRIC UTILITY

New service connections will take significant coordination between the District and electric utility provider ConEd. From application to energization, the timeline may range from 12 months to 18 months. This will likely be the critical path to getting EVSE energized in time for electric school buses arrival.

4.2 SELECT A CHARGE MANAGEMENT SYSTEM (CMS) PROVIDER

The District currently has a Level 2 Blink charger installed at the bus depot and has purchased 5 years of network and warranty beginning 2022. NV5 recommends using a single entity to provide charge management software (CMS) for its entire fleet to reduce the number of operating agreements, dashboards, maintenance coordination, and overall cost burden. We also recommend carefully vetting hardware and operating costs prior to making a selection, as the operating costs can be significant over time. Therefore, two potential pathways for hardware/software include:

1. Expand the services of Blink by procuring additional Blink chargers and adding them to the District's CMS agreement with Blink. The District already has a service contract with Blink, and Blink has the second highest EV charger deployment count in the US behind ChargePoint.
2. The District could select a new hardware and CMS provider. The District may choose to keep the current Blink charger, or remove and replace that charger with equipment that matches the new hardware. Replacement would be a nominal cost as part of the larger construction project.

Note, the existing Blink charger is on the existing service. A decision during design should be made whether to keep that charger on the existing service or move it to the new EV service. NV5 recommends grouping all EV chargers under a single EV-dedicated electric meter. Moving the existing charger to the new EV service will give it access to lower electric tariffs under an EV-only electric meter.

A detailed summary of CMS providers is available in Appendix 5, including key considerations, pros, cons, and recommendations. If the District elects to switch providers, NV5 suggests a careful vetting of a new provider a determination on the process for contracting. Many public clients leverage cooperative buying agreements such as Sourcwell for software and operating agreements with EV service providers. These agreements have negotiated pricing for EV charger hardware, software, and operations agreements.

4.3 SELECT A CHARGING STATION MANUFACTURER

Following the decision regarding CMS providers, the District will need to select a charging station manufacturer. In some cases, the District's procurement procedures may limit whether a single manufacturer may be selected as the basis of design, or whether the procurement needs to be vendor agnostic and only include performance specifications.

In general, key considerations when selecting charging stations include the following:

- **Open Network:** Interoperable networks allow for mixing of hardware and software. The Open Charge Point Protocol (OCPP) is the common standard needed for interoperability. Further investigation is typically warranted before selecting charging stations to vet how well the software associated with the CMS provider will work with different charging stations.
- **Interoperability with Vehicles:** Prior to purchasing either charging stations or the actual EVs, the team should confirm that all the components will interoperate. Some battery electric buses, such as the Thomas Jouley bus, only charges on DC fast charging and thus would require DCFC charging stations. Other large EVs require a minimum charging voltage to initiate charging.
- **DC Fast Chargers:** Selecting a charging station manufacturer that offers both Level 2 chargers and DCFC chargers in the District's preferred power levels is advised. DC power levels and voltage should also be matched appropriately with the vehicles.
- **Cable Retractors:** NV5 strongly recommends installations include cable retractors. Without retractors, cables are often left on the ground, become damaged, and are a tripping hazard.
- **V2X:** Vehicle-to-Grid or Vehicle-to-Building, often abbreviated V2X, refers to the capability of a charger to allow the vehicle to export electricity back to the grid or local electrical system. V2X is only currently available on DC fast chargers. While V2X has been implemented in limited pilot applications, there has not been widespread adoption. At this time, we recommend that the District only explore V2X if there is a clear financial or resiliency driver, or if a grant program requires the District to install V2X capable chargers.

4.4 PRELIMINARY PROJECT SCHEDULE

This schedule is highly dependent on ConEd's timeline on providing a new service to the bus depot.

Table 16 provides a preliminary high-level project schedule, assuming the District decides to move forward with a project targeting a Summer 2025 build to meet Phase 1 EVSE needs. This schedule is highly dependent on ConEd's timeline on providing a new service to the bus depot.

Table 16. Preliminary Project Schedule for Phase 1 EVSE, Targeting Summer 2025 Build, assuming Design-Bid-Build process.

Milestone	Schedule
Task 1: Design and Permit	Q1 2025
Task 2: Procurement/Contracting (Design-Bid-Build)	Q2 2025
Task 3: Construction (Phase 1 & Trunk Infrastructure)	Q3 2025
Task 4: Commissioning & Closeout	Q3 2025
Task 5: EVSE Online	Q4 2025

This schedule is highly dependent on ConEd's timeline on providing a new service to the bus depot. Unless ConEd has switchgears in stock, switchgear timeline is approximately one year from ordering, which may make push the project to be built in Summer 2026.

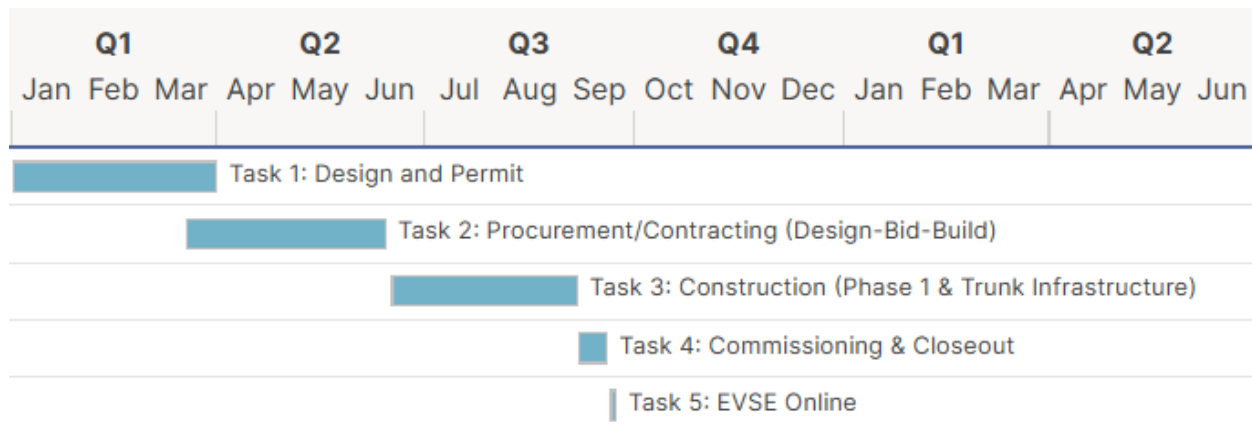


Figure 4. Gantt Chart of Project Timeline.

4.5 ADDITIONAL NEXT STEPS

1. Review estimated capital needs and discuss project funding with relevant District stakeholders. Determine preferred project delivery method (Design-Bid-Build or Design-Build) and begin process per the sample schedule shown above to install chargers in Summer 2025. The next step per the schedule is to select a design entity and advance the charging concepts to preliminary design phase in coordination with the steps outlined above while engaging with ConEd to request a new service.
2. Based on the CMS provider decision, determine preferred charging station manufacturer(s) and procurement pathway (self-procure EVSE and CMS, or allow EV project developer to procure them).
3. Continue monitoring potential grants and incentives for opportunities available to the District. Pursue the likely opportunities with noted above with NYSERDA and ConEd for Phase 1 implementation.
4. Prepare for incoming EVs through workforce development and training efforts. Training will be needed to successfully operate BEBs, complete regular maintenance on electric engines and battery systems, make effective use of the CMS platform and charging schedules, and operate and maintain the charging stations. Additionally, equipment necessary to work on EVs in maintenance shops will change as ICE vehicles are replaced.

APPENDIX 1 TCO CASH FLOWS

Table 17. Estimated Total Cost of Ownership for ICE Vehicle Baseline.

Year		Estimated Annual Miles	ICE Vehicle CapEx	ICE Fuel Costs	ICE Maintenance Costs	ICE Total Costs
0	2024	15,000	\$-	\$-	\$(13,000)	\$(13,000)
1	2025	45,000	\$(743,000)	\$(10,000)	\$(40,000)	\$(794,000)
2	2026	95,000	\$(452,000)	\$(27,000)	\$(87,000)	\$(566,000)
3	2027	138,000	\$(201,000)	\$(47,000)	\$(129,000)	\$(377,000)
4	2028	160,000	\$(252,000)	\$(58,000)	\$(152,000)	\$(463,000)
5	2029	237,000	\$(850,000)	\$(97,000)	\$(230,000)	\$(1,178,000)
6	2030	265,000	\$(251,000)	\$(107,000)	\$(263,000)	\$(621,000)
7	2031	300,000	\$(203,000)	\$(126,000)	\$(303,000)	\$(632,000)
8	2032	325,000	\$(602,000)	\$(141,000)	\$(335,000)	\$(1,078,000)
9	2033	338,000	\$(202,000)	\$(152,000)	\$(355,000)	\$(709,000)
10	2034	380,000	\$(455,000)	\$(169,000)	\$(407,000)	\$(1,031,000)
11	2035	380,000	\$-	\$(172,000)	\$(415,000)	\$(587,000)
12	2036	380,000	\$-	\$(175,000)	\$(424,000)	\$(599,000)
13	2037	380,000	\$-	\$(179,000)	\$(432,000)	\$(611,000)
14	2038	380,000	\$-	\$(182,000)	\$(441,000)	\$(623,000)
15	2039	380,000	\$-	\$(186,000)	\$(450,000)	\$(636,000)
16	2040	380,000	\$-	\$(190,000)	\$(459,000)	\$(648,000)
17	2041	380,000	\$-	\$(194,000)	\$(468,000)	\$(661,000)
18	2042	380,000	\$-	\$(197,000)	\$(477,000)	\$(675,000)
19	2043	380,000	\$-	\$(201,000)	\$(487,000)	\$(688,000)
20	2044	380,000	\$-	\$(205,000)	\$(496,000)	\$(702,000)
TOTAL		6,094,000	\$(4,211,000)	\$2,817,000)	\$(6,864,000)	\$(13,893,000)

ICE Baseline is modelled based on equivalent cost of an ICE bus if an EV bus were purchased in the transition schedule. Therefore, buses are only purchased from 2024-2034 to meet the New York Consolidated Laws Education Section 3638 requirements.

Table 18. Estimated Total Cost of Ownership for EV.

Year		EV Energy (kWh)	EV Vehicle CapEx	EV Electricity Costs (\$)	EV Maintenance Costs	EVSE Infra. Costs	EVSE Software & O&M	EV Grants & Incentives	EV Total Costs
0	2024	9,000	\$-	\$(1,000)	\$(9,000)	\$-	\$-	\$,000	\$(10,000)
1	2025	48,000	\$(2,295,000)	\$(4,000)	\$(28,000)	\$(1,709,000)	\$(21,000)	\$3,252,000	\$(805,000)
2	2026	97,000	\$(1,121,000)	\$(9,000)	\$(61,000)	\$-	\$(21,000)	\$1,072,000	\$(140,000)
3	2027	174,000	\$(1,204,000)	\$(17,000)	\$(91,000)	\$-	\$(21,000)	\$839,000	\$(494,000)
4	2028	198,000	\$(1,152,000)	\$(20,000)	\$(107,000)	\$-	\$(21,000)	\$205,000	\$(1,096,000)
5	2029	333,000	\$(2,466,000)	\$(34,000)	\$(162,000)	\$-	\$(21,000)	\$387,000	\$(2,296,000)
6	2030	372,000	\$(678,000)	\$(40,000)	\$(185,000)	\$(101,000)	\$(31,000)	\$459,000	\$(576,000)
7	2031	433,000	\$(890,000)	\$(47,000)	\$(214,000)	\$-	\$(31,000)	\$364,000	\$(819,000)
8	2032	482,000	\$(1,051,000)	\$(54,000)	\$(236,000)	\$-	\$(31,000)	\$577,000	\$(796,000)
9	2033	508,000	\$(435,000)	\$(59,000)	\$(250,000)	\$-	\$(31,000)	\$419,000	\$(356,000)
10	2034	558,000	\$(1,042,000)	\$(67,000)	\$(287,000)	\$-	\$(31,000)	\$441,000	\$(986,000)
11	2035	558,000	\$-	\$(69,000)	\$(471,000)	\$-	\$(31,000)	\$493,000	\$(78,000)
12	2036	558,000	\$-	\$(71,000)	\$(424,000)	\$-	\$(31,000)	\$493,000	\$(33,000)
13	2037	558,000	\$-	\$(73,000)	\$(427,000)	\$-	\$(31,000)	\$493,000	\$(38,000)
14	2038	558,000	\$-	\$(75,000)	\$(377,000)	\$-	\$(31,000)	\$408,000	\$(76,000)
15	2039	558,000	\$-	\$(77,000)	\$(601,000)	\$-	\$(31,000)	\$397,000	\$(313,000)
16	2040	558,000	\$-	\$(80,000)	\$(383,000)	\$-	\$(31,000)	\$358,000	\$(136,000)
17	2041	558,000	\$-	\$(82,000)	\$(426,000)	\$-	\$(31,000)	\$304,000	\$(235,000)
18	2042	558,000	\$-	\$(85,000)	\$(540,000)	\$-	\$(31,000)	\$191,000	\$(465,000)
19	2043	558,000	\$-	\$(87,000)	\$(413,000)	\$-	\$(31,000)	\$159,000	\$(372,000)
20	2044	558,000	\$-	\$(90,000)	\$(466,000)	\$-	\$(31,000)	\$116,000	\$(471,000)
TOTAL		8,792,000	\$(12,334,000)	\$(1,142,000)	\$(6,160,000)	\$(1,810,000)	\$(570,000)	\$11,427,000	\$(10,591,000)

Table 19. ICE vs EV Total Cost of Ownership Comparison

Year		ICE Total Costs	EV Total Costs	EV Cost Savings
0	2024	(\$13,000)	(\$10,000)	\$3,000
1	2025	(\$794,000)	(\$805,000)	(\$11,000)
2	2026	(\$566,000)	(\$140,000)	\$426,000
3	2027	(\$377,000)	(\$494,000)	(\$117,000)
4	2028	(\$463,000)	(\$1,096,000)	(\$633,000)
5	2029	(\$1,178,000)	(\$2,296,000)	(\$1,118,000)
6	2030	(\$621,000)	(\$576,000)	\$45,000
7	2031	(\$632,000)	(\$819,000)	(\$187,000)
8	2032	(\$1,078,000)	(\$796,000)	\$282,000
9	2033	(\$709,000)	(\$356,000)	\$353,000
10	2034	(\$1,031,000)	(\$986,000)	\$45,000
11	2035	(\$587,000)	(\$78,000)	\$509,000
12	2036	(\$599,000)	(\$33,000)	\$566,000
13	2037	(\$611,000)	(\$38,000)	\$573,000
14	2038	(\$623,000)	(\$76,000)	\$547,000
15	2039	(\$636,000)	(\$313,000)	\$323,000
16	2040	(\$648,000)	(\$136,000)	\$512,000
17	2041	(\$661,000)	(\$235,000)	\$426,000
18	2042	(\$675,000)	(\$465,000)	\$210,000
19	2043	(\$688,000)	(\$372,000)	\$316,000
20	2044	(\$702,000)	(\$471,000)	\$231,000
TOTAL		(\$13,893,000)	(\$10,591,000)	\$3,302,000

APPENDIX 2 VEHICLE TRANSITION SCHEDULE

Table 20. 20-Year EV Transition Schedule, Cumulative EVs.

Year	CY	Total Vehicle Count ¹	Cumulative EVs					Added EVs
			Class 1	Class 2B	Type A	Type C	Cumulative EVs	
0	2024	52	2	0	0	1	3	0
1	2025	53	2	0	4	5	3	0
2	2026	53	4	1	5	7	11	8
3	2027	53	4	1	7	9	17	6
4	2028	53	4	1	12	9	21	4
5	2029	53	4	1	15	15	26	5
6	2030	55	4	1	18	17	35	9
7	2031	55	4	1	20	19	40	5
8	2032	55	4	1	20	23	44	4
9	2033	55	4	1	21	24	48	4
10	2034	57	4	1	25	27	50	2
11	2035	57	4	1	25	27	57	7
12	2036	57	4	1	25	27	57	0
13	2037	57	4	1	25	27	57	0
14	2038	57	4	1	25	27	57	0
15	2039	57	4	1	25	27	57	0
16	2040	57	4	1	25	27	57	0
17	2041	57	4	1	25	27	57	0
18	2042	57	4	1	25	27	57	0
19	2043	57	4	1	25	27	57	0
20	2044	57	4	1	25	27	57	0

¹Includes only operational vehicles.

APPENDIX 3 EXAMPLE EVSE SITE LAYOUTS & PHASING

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SCOPE OF WORK

PRELIMINARY EVSE PORT COUNT, POWER LEVEL & PHASING

Color Code	Phase	Install Year	EV Charging Ports						Total Qty of Ports	Power (kW)
			Type A and White Fleet		Type C					
			L2 - 19.2kW	L3 - 30kW	L2 - 16.6kW	L2 - 19.2kW	L3 - 30kW	L3 - 60kW		
	Existing	-	-	-	1	-	-	-	1	17
	1	2025	20	-	-	10	4	2	36	816
	2	2030	10	-	-	10	-	-	20	364
	Total		30	0	1	20	4	2	57	1217

LEGEND

FLEET L2 EV STALL PHASE 1

FLEET L3 EV STALL PHASE 1 (30KW)

FLEET L3 EV STALL PHASE 1 (60KW)

FLEET L2 EV STALL PHASE 2

EXISTING L2 EV STALL

A NEW TRANSFORMER

B NEW ELECTRICAL SWITCHBOARD

C NEW STEPDOWN TRANSFORMER

D NEW PANELBOARD

NEW EV CHARGER

EXISTING 16.6KW L2 EV CHARGER

PROPOSED POWER CONDUIT/CABLE

GENERAL NOTES

1. NEW ELECTRICAL SERVICE REQUIRED FOR THE SITE. INITIAL CONVERSIONS WITH CONED INDICATED FEED FROM THE NORTH.

2. MOBILITY STUDY RECOMMENDED PRIOR TO DETAILED DESIGN TO COORDINATE VEHICLE MANEUVERING REQUIREMENTS ARE COORDINATED WITH INFRASTRUCTURE PLACEMENT. MAY REQUIRE SOME EXPANSION OF EXISTING PARKING LOT.

3. CHARGERS SHOWN INCLUDE CHARGING FOR DISTRICT'S LIGHT DUTY PASSENGER VEHICLES. IF LIGHT DUTY VEHICLES ARE TO BE CHARGED AT A DIFFERENT LOCATION, 5 X L2 STALLS CURRENTLY SHOWN WOULD NOT BE REQUIRED.

4. DISTRICT SHOULD CONSIDER SWAPPING EXISTING CHARGER TO MATCH SELECTED CHARGERS FOR FUTURE INSTALLATION. EXISTING CHARGER IS INSTALLED ON THE EXISTING ELECTRICAL SUBPANEL.



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SUBMITTALS

Revision:

Date:

Project No.: 5980823-2303101.00

Checked By: AFT

Designed By: AFT

Drawn By: VG

Date: 11/12/24

Project Title

TARRYTOWN PUBLIC SCHOOLS
210 NORTH BROADWAY,
SLEEPY HOLLOW, NY 10591

Sheet Title

PRELIMINARY SITE PLAN

Sheet No.

1

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