

Fleet Electrification Assessment for Broome County, NY

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Broome County

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1. Executive Summary

Broome County, NY is interested in converting some of its fleet to electric vehicles (EVs) and in installing EV charging ports for these vehicles. Fleet electrification may reduce operating costs for the County and support emissions reduction goals.

The County operates a fleet of 429 vehicles, including 241 light duty vehicles (LDV). LDV are under review in this report. The rest of the fleet consists of medium and heavy duty (MDHD) vehicles, including speciality vehicles such as mowers, dump trucks and others.


Taking into account vehicle age, odometer reading, annual vehicle miles traveled (VMT), vehicle type and availability of operational data, Cadmus has identified 14 LDV that can be prioritized for electrification in the near term, consisting of sedans (7), minivans (4), pick-up trucks (2) and an SUV (1). The vehicles are based at four departments: Department of Social Services, Health Department, Parks Department – Cole Park, and the County Office Building.

The average mileage of these vehicles is approximately 7,663 miles per year and average age is 12 years. Broome County pays a flat rate of \$.16/kWh for electricity. Given the price that Broome County pays for gasoline (modeled at \$3.59/gallon) and available incentives, several vehicles are expected to provide a total cost of ownership (TCO) savings were the vehicles to be electrified. An example of a recommended EV can be found in Table 1. An example of the TCO analysis provided for each priority vehicle is shown in Figure 2.



Figure 1. Example EV Charger

Table 1. Example Replacement EV

 <p>Chevrolet Equinox</p>	MSRP	\$32,000
	Availability	Fall 2023
	Range (miles)	250
	Seats	5
	https://www.chevrolet.com/electric/equinox-ev	

Equinox EV vs Ford Escape, 10-year NPV

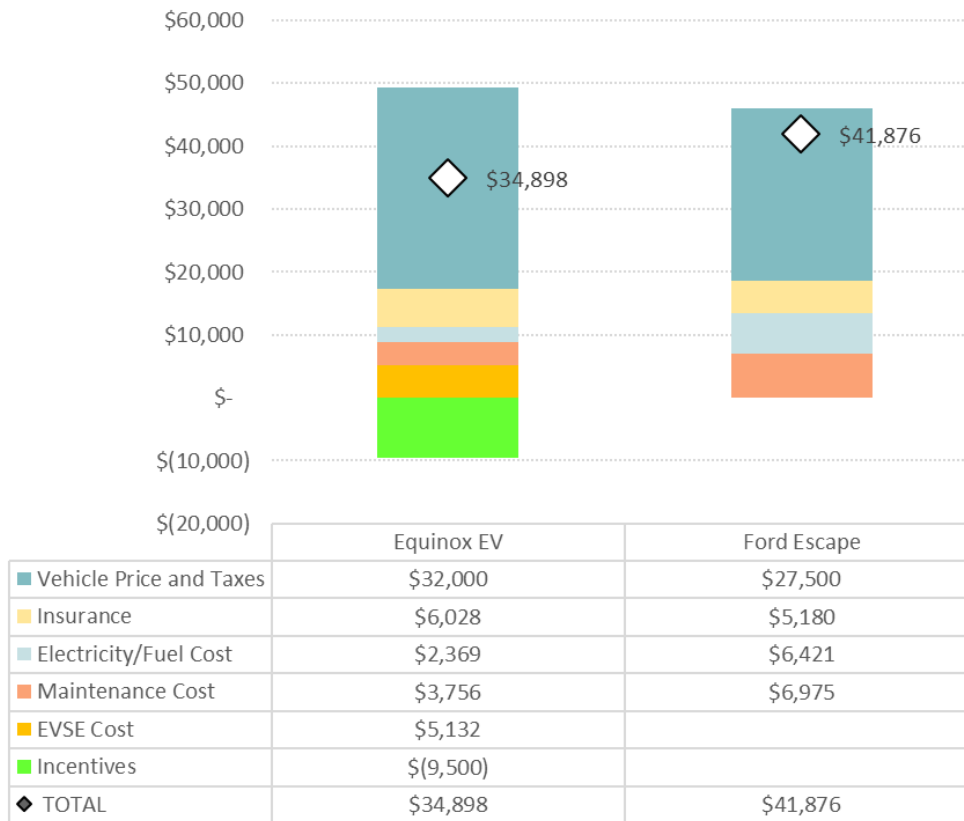


Figure 2. Example TCO Assessment (Vehicle 72676)

Two vehicle types, pickup trucks and minivans, are not expected to provide a TCO savings for Broome County at this time. The recommended EV truck replacement, the F-150 Lightning, has a base price over \$16,000 higher than the base F-150. It is possible that with additional incentives and grants, Broome County might achieve a more favorable TCO for these truck purchases. The EV options for the minivan class also have a cost premium that is not offset by estimated operational savings and incentives. Broome County may wish to purchase the vehicles for reasons of environmental stewardship. If not, Cadmus recommends delaying the purchases until EV prices decline, or closely consider downsizing to SUVs, which have more vehicle options and are closer to cost parity with ICE SUVs today.

These selections are based upon the data made available to Cadmus; it should be noted that a large number of vehicles did not have operational data or did not have a known parking location. It is recommended that Broome County consider adopting vehicle telematics systems to improve tracking of vehicle data and enable a more detailed assessment in the future. A detailed assessment of each recommended vehicle in the Broome County fleet can be found in Section 3.

For the EV charging infrastructure to support the identified vehicles, Cadmus recommends installing seven 7.6 kW dual port charging pedestals across four identified locations, as show in Table 2. Each vehicle would have a dedicated charging port at the time of vehicle procurement and would be expected to charge overnight. However, based upon the operational profile of these vehicles, each charging port would be capable of serving a minimum of two vehicles in the future if vehicle parking can be rotated. The seven charging pedestals should be capable of serving 28 total EVs in the future. Broome County may also choose to install “stub-outs” (pre-wiring) for future expansion of its charging infrastructure, depending on evaluation of utility electrical capacity at the site.

Table 2. Recommended EV Infrastructure

Location	Total Vehicles	Total Priority EVs	Charger Type and Number	Pedestal QTY	Total Ports	Stub-Outs
DSS Fleet Cage	28	6	7.6 kW dual port pedestal mount	3	6	4
Health Department	11	4	7.6 kW dual port pedestal mount	2	4	2
Parks Department – Cole Park	6	2	7.6 kW dual port pedestal mount	1	2	1
County Office Building	7	2	7.6 kW dual port pedestal mount	1	2	2

2. Transportation Electrification Market and Policies

The recent passage of federal policies, such as the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA), promises major investments in EV incentives and infrastructure. By 2030, the federal government wants 500,000 charging stations and a 50 percent market share of new electric light-duty vehicle sales. Auto manufacturers are rapidly expanding their offerings in response. For example, GM plans to produce 30 battery electric vehicle (BEV) models by 2025, and Volvo will produce only BEVs by 2030. Demand for EVs is very high and many EV orders take months or even years to be filled depending on the model.

Section 177 state of the Clean Air Act states that New York has the option to follow the vehicle regulations implemented by California, including the Advanced Clean Cars II standard, which New York adopted in December 2022. This regulation requires a percentage of new light-duty vehicle sales to be zero-emission vehicles, starting with 35 percent ZEV sales in model year 2026 and increasing to 100 percent ZEV sales by 2035.

Although battery costs have dropped significantly, currently EVs are generally more expensive than comparable internal combustion engine (ICE) vehicles. Cost parity is expected by the end of the decade, if not before. The benefits of EVs include the following:

- *Cost Less to Power* – EVs are over three times more efficient than ICE vehicles. This leads to much lower energy use and cost.
- *Less Maintenance* – Depending on vehicle class and usage, EVs are estimated to cost roughly 50% less in maintenance and repair costs. EVs have far fewer moving parts, and do not require most of the drivetrain maintenance seen in ICE vehicles. EVs also use regenerative braking, greatly reducing brake wear.
- *Zero Emissions* – EVs have no direct emissions, and green power options can provide carbon-free electricity for EV charging.
- *Air Quality* – EVs do not produce any of the harmful pollutants that are linked to asthma, allergies, respiratory illness, and chronic obstructive pulmonary disease (COPD).
- *Equity* – Studies show that vulnerable populations, young children, and the elderly are more impacted by negative health effects of traffic pollution.¹
- *Convenience* – Avoid navigating to gas stations during the active hours of fleet operation. Vehicles can be charged whenever they are not in service.

¹ <https://www.lung.org/clean-air/outdoors/who-is-at-risk/highways>

3. Vehicle Analysis

This section provides an overview of fleet vehicles operated by Broome County, identification of priority vehicles for electrification and TCO analysis results for each priority vehicle in the fleet.

3.1. Fleet Description and Duty Cycle

Broome County operates a fleet of 428 vehicles. Of these, 241 are LDVs, primarily consisting of sedans, pickup trucks and SUVs. Given the limited EV offerings currently available, medium- and heavy-duty vehicles are not under consideration for electrification at this time. The vehicles are distributed across 22 sites, with the largest concentrations of LDVs at the Department of Social Services (DSS) Fleet Cage (28 LDV), Cole Park (11 LDV), Highway Department (19 LDV) and the Police Department (72 LDV). In addition, there are 35 LDV currently operated by Broome County that did not have an associated parking location.

While the Police Department currently has the highest concentration of LDVs operated by Broome County, due to the limited availability of pursuit rated vehicles and variability in costs, police vehicles have not been considered as part of this analysis. However, relevant information about current deployment of EVs for police use in other jurisdictions has been provided in section 3.7.

No estimated replacement year was provided for vehicles in the Broome County fleet, and therefore Cadmus determined eligible vehicles using a set of selection criteria, which is described here.

First, Cadmus removed all police vehicles, vehicles without a parking location and vehicles without relevant annual mileage data. Cadmus identified a total of 109 LDV to complete this analysis as a result. Due to limited availability and high cost of long-range EV pickup trucks, Cadmus also removed all large pickups such as the Ford F250, F350 and the Ram 2500. This resulted in a list of 86 vehicles to be further assessed.

Cadmus looked to identify vehicles that were approaching the end of operational life (over 8 years of operation) and had an annual usage of at least 5,000 miles per year. In addition, Cadmus looked for those locations which had concentrations of at least 4 LDV in order to facilitate greater deployment of electric vehicles at recommended sites in future years. This resulted in the identification of six potential sites with LDV suitable for electrification: DSS Fleet Cage, Parks Department - Cole Park, SRE Building (aviation), County Office Building, Health Department and Highway Department.

Due to the significant number of MDHD vehicles operated by the Highway Department, Cadmus determined that delaying the deployment of vehicle charging at this site would be

advantageous to Broome County. It is expected that the charging demands of these vehicles will require the installation of DCFC charging infrastructure, which is significantly more expensive than level 2 charging. Because the NYSEG Make Ready Program is limited to one application per project site, it is recommended that the county wait until there is more market availability of MDHD vehicles to reflect charging demands more accurately in the future. Similarly, the SRE building primarily hosts primarily large trucks that are used as snowplows; it is also recommended that Broome County delay electrification at this site until more vehicles enter the market capable of meeting operational requirements.

This resulted in a priority list of 14 LDVs that may be considered by Broome County for electrification in the near term. An overview of these vehicles can be found in Table 3.

Table 3. Priority Vehicles for Electrification

Vehicle #	Department	Vehicle Location	Make	Model	Year	Odometer	Annual VMT
72676	CLERK/REAL PROPERTY	COUNTY OFFICE BUILDING	CHEVROLET	MALIBU	2007	105851	6,264
74531	DSS	DSS FLEET CAGE	DODGE	GRAND CARAVAN	2014	82309	7,128
74533	DSS	DSS FLEET CAGE	DODGE	GRAND CARAVAN	2014	84438	6,912
74513	DSS	DSS FLEET CAGE	DODGE	GRAND CARAVAN	2013	82131	5,364
74823	DSS	DSS FLEET CAGE	CHEVROLET	IMPALA	2015	63342	8,292
74555	DSS	DSS FLEET CAGE	CHEVROLET	IMPALA	2015	65613	6,264
74523	DSS	DSS FLEET CAGE	CHEVROLET	IMPALA	2014	71766	5,316
73363	ENGINEERING	COUNTY OFFICE BUILDING	CHEVROLET	TAHOE	2009	110472	7,891
73382	HEALTH	HEALTH DEPARTMENT	FORD	FUSION	2012		9,312
73969	HEALTH	HEALTH DEPARTMENT	DODGE	GRAND CARAVAN	2010		8,544
74509	HEALTH	HEALTH DEPARTMENT	CHEVROLET	IMPALA	2013		12,000
74831	HEALTH	HEALTH DEPARTMENT	CHEVROLET	IMPALA	2013		12,000
72524	PARKS	COLE PARK	CHEVROLET	1/2 TON	2005	114490	6,361
73966	PARKS	COLE PARK	FORD	F150XL	2010	73162	5,628








In addition, it should be noted that during review of the Broome County fleet, Cadmus identified 23 LDVs that are estimated to operate at very low annual mileage, <2,400 miles per year, or <200 miles per month. Seven of these vehicles are operated by DSS, and eight of these vehicles are operated by the Health Department. Broome County should consider employing a motor pool for these vehicles to increase utilization and increase the potential economic benefit of electrification of these vehicles in the future.

3.2. Overview of Available EV Options

Broome County did not express a preference for a specific EV Original Equipment Manufacturer (OEM) for EVs. However, there are limited EV options for certain vehicle types, such as pickups. New models are entering the market in 2023, and numerous additional models are expected in 2024 and 2025. In addition, prices for existing models frequently change.

Table 4 presents a list of electric vehicles that Cadmus recommends for replacement of the existing ICE vehicles in the Broome County fleet. This list includes both EV and PHEV options for those vehicle classes where both options are available today and in the near future.

Table 4. Recommended EVs for Broome County

 Chevy Bolt EUV	MSRP	\$25,500
	Availability	Immediately
	Range (miles)	247
	Seats	5
	https://www.chevrolet.com/electric/bolt-ev	
 Chevy Equinox	MSRP	\$30,000
	Availability	Fall 2023
	Range (miles)	247
	Seats	5
	https://www.chevrolet.com/electric/equinox-ev	
 Volkswagen Buzz	MSRP	\$40,000 (est)
	Availability	Fall 2024
	Range (miles)	233
	Seats	7
	https://www.vw.com/en/models/id-buzz.html	
 Chrysler Pacifica PHEV	MSRP	\$49,995
	Availability	Immediately
	All-Electric Range (miles)	32
	Seats	7
 Ford F-150 Lightning	MSRP	\$49,995
	Availability	Immediately
	Range (miles)	240
	Seats	5
	https://www.ford.com/trucks/f150/f150-lightning/	
 Kia EV9	MSRP	\$56,000
	Availability	Late 2023
	Range (miles)	223
	Seats	7
	https://www.kia.com/us/en/ev9	
 Ford Escape PHEV	MSRP	\$40,500
	Availability	Immediately
	Range (miles)	247
	Seats	5
	https://www.chevrolet.com/electric/bolt-ev	

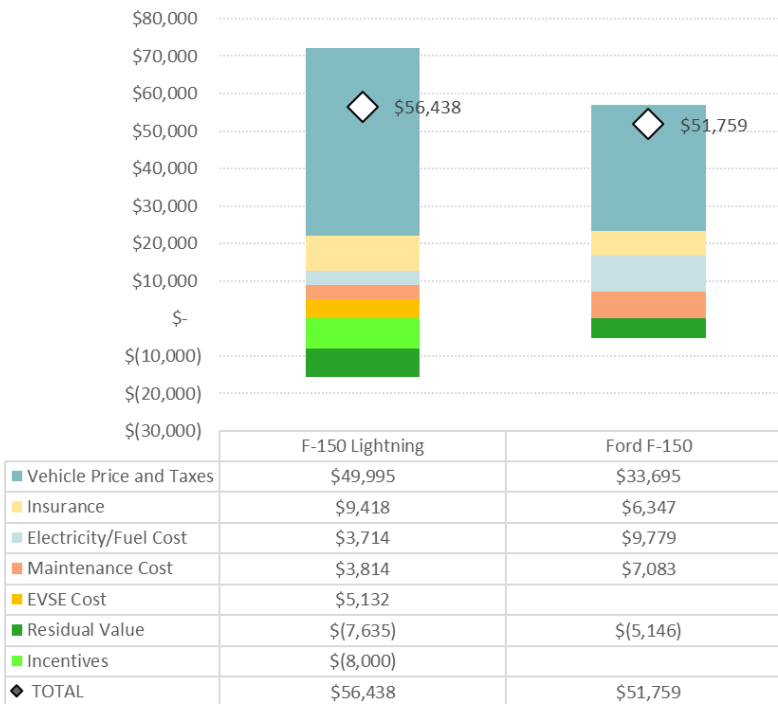
3.3. TCO for Broome County Vehicle Recommendations

Cadmus has developed a preliminary TCO estimate for replacement EVs for the 14 priority vehicles, as shown in Figure 3 through Figure 16. These account for the existing vehicles' varying mileage and operations. For each vehicle, a similar ICE vehicle has been used as a point of comparison. For those vehicles for which both an EV and PHEV alternative exist, both options have been included as a reference.

For each vehicle, a purchase with 10-year ownership period and 5-year lease TCO assessment has been provided, including the federal and state incentives for the purchase of a new EV (see section 4 for more detail). The applicable incentives in the figures below include the federal section 45W Commercial Clean Vehicle tax credit of \$7,500, the NYSERDA Drive Clean Rebate Program incentive of \$500 for those vehicles with an MSRP over \$42,000 and \$2,000 for those vehicles under \$42,000 and the NYSEG Make Ready Program incentive of 50% of make-ready infrastructure costs.

Several of the recommended vehicles offer beneficial economics for electrification today. However, economics do not offer a compelling case for converting pickup trucks or minivans at this time. Broome County may wish to seek out additional grants and incentives to lower the purchase price, await new market entrants, price reductions, or consider downsizing of vehicles. If it wishes to procure vehicles for reasons of environmental stewardship despite the disadvantageous economics, then the recommended EV is a viable option for those vehicle types.

F-150 Lightning vs Ford F-150, 10-year NPV



F-150 Lightning vs Ford F-150, 5-year lease NPV

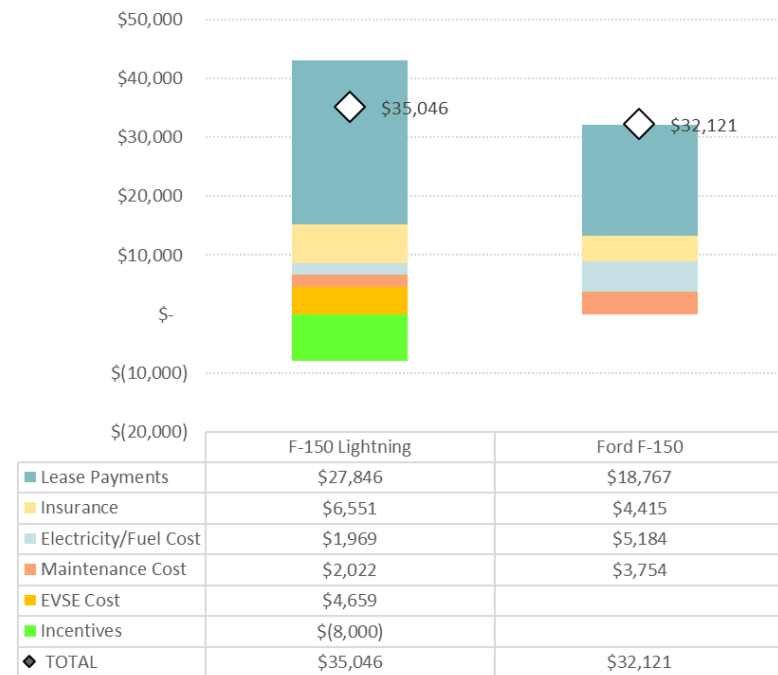
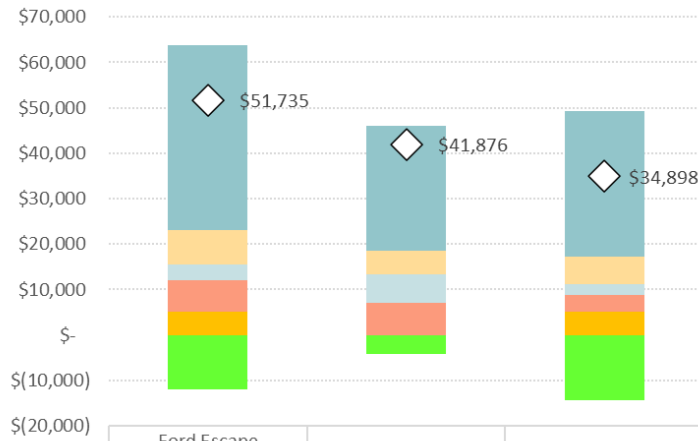


Figure 3. TCO for Vehicle 72524 (2005 Chevy ½ ton Pickup)

Estimated Annual Milage: 6,361

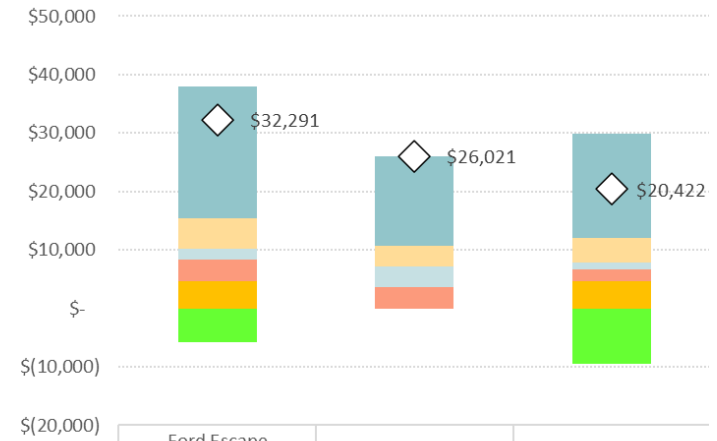
Estimated Cost: \$4,680

Ford Escape PHEV vs Ford Escape vs Equinox EV, 10-year NPV



	Ford Escape PHEV	Ford Escape	Equinox EV
Vehicle Price and Taxes	\$40,500	\$27,500	\$32,000
Insurance	\$7,629	\$5,180	\$6,028
Electricity/Fuel Cost	\$3,434	\$6,421	\$2,369
Maintenance Cost	\$6,975	\$6,975	\$3,756
EVSE Cost	\$5,132		\$5,132
Incentives	\$(5,750)		\$(9,500)
Residual Value	\$(6,185)	\$(4,200)	\$(4,887)
◇ TOTAL	\$51,735	\$41,876	\$34,898

Ford Escape PHEV vs Ford Escape vs Equinox EV, 5-year lease NPV



	Ford Escape PHEV	Ford Escape	Equinox EV
Lease Payments	\$22,558	\$15,317	\$17,823
Insurance	\$5,307	\$3,604	\$4,193
Electricity/Fuel Cost	\$1,820	\$3,404	\$1,256
Maintenance Cost	\$3,697	\$3,697	\$1,991
EVSE Cost	\$4,659		\$4,659
Incentives	\$(5,750)		\$(9,500)
◇ TOTAL	\$32,291	\$26,021	\$20,422

Figure 4. TCO for Vehicle 72676 (2007 Chevrolet Malibu)

Estimated Annual Milage: 6,264

Estimated Savings: \$6,978

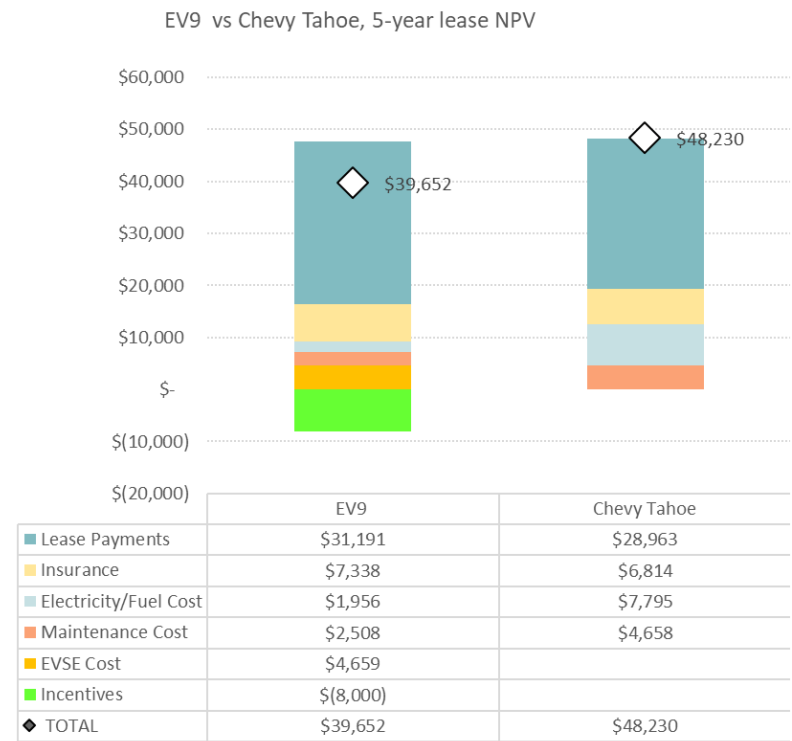
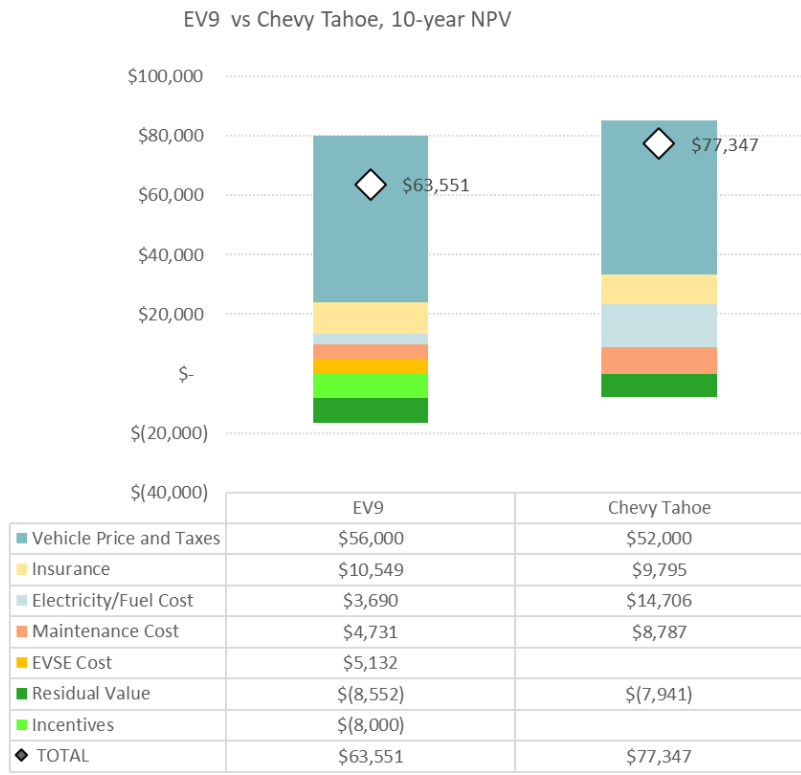


Figure 5. TCO for Vehicle 73363 (2009 Chevrolet Tahoe)

Estimated Annual Milage: 7,891

Estimated Savings: \$13,796

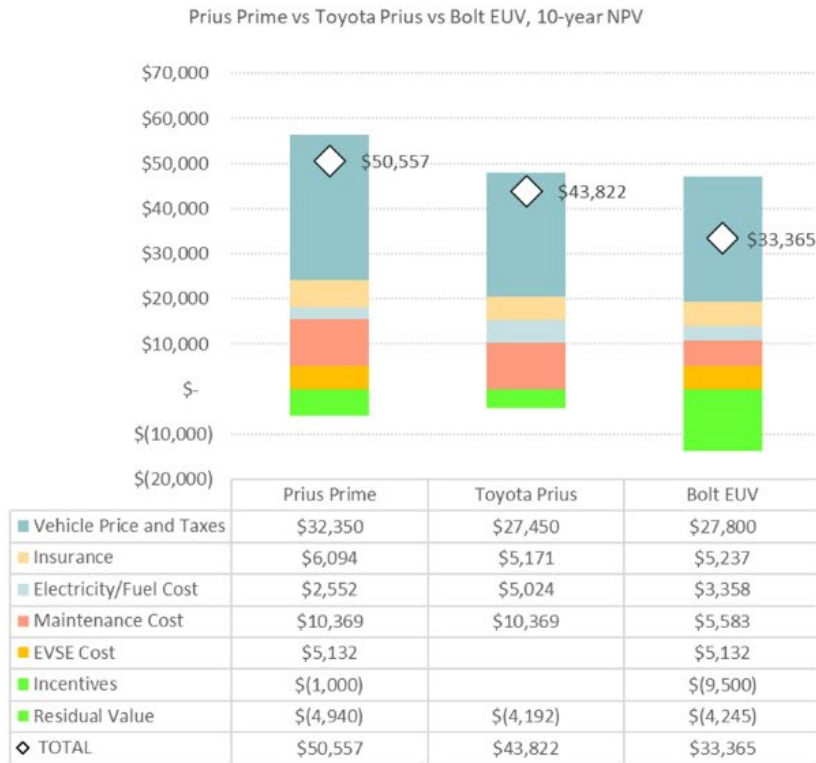
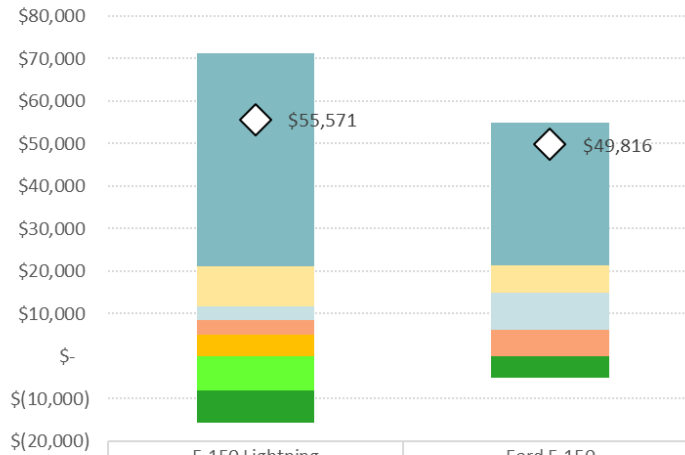


Figure 6. TCO for Vehicle 73382 (2012 Ford Fusion)

Estimated Annual Mileage: 9,312

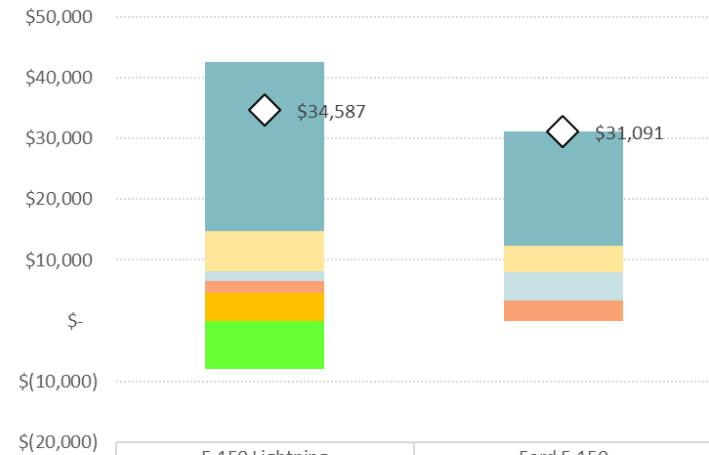
Estimated Savings: \$10,457

F-150 Lightning vs Ford F-150, 10-year NPV



	F-150 Lightning	Ford F-150
Vehicle Price and Taxes	\$49,995	\$33,695
Insurance	\$9,418	\$6,347
Electricity/Fuel Cost	\$3,286	\$8,653
Maintenance Cost	\$3,374	\$6,267
EVSE Cost	\$5,132	
Residual Value	\$(7,635)	\$(5,146)
Incentives	\$(8,000)	
◆ TOTAL	\$55,571	\$49,816

F-150 Lightning vs Ford F-150, 5-year lease NPV



	F-150 Lightning	Ford F-150
Lease Payments	\$27,846	\$18,767
Insurance	\$6,551	\$4,415
Electricity/Fuel Cost	\$1,742	\$4,587
Maintenance Cost	\$1,789	\$3,322
EVSE Cost	\$4,659	
Incentives	\$(8,000)	
◆ TOTAL	\$34,587	\$31,091

Figure 7. TCO for Vehicle 73966 (2010 Ford F-150)

Estimated Annual Mileage: 5,628

Estimated Cost: \$5,755

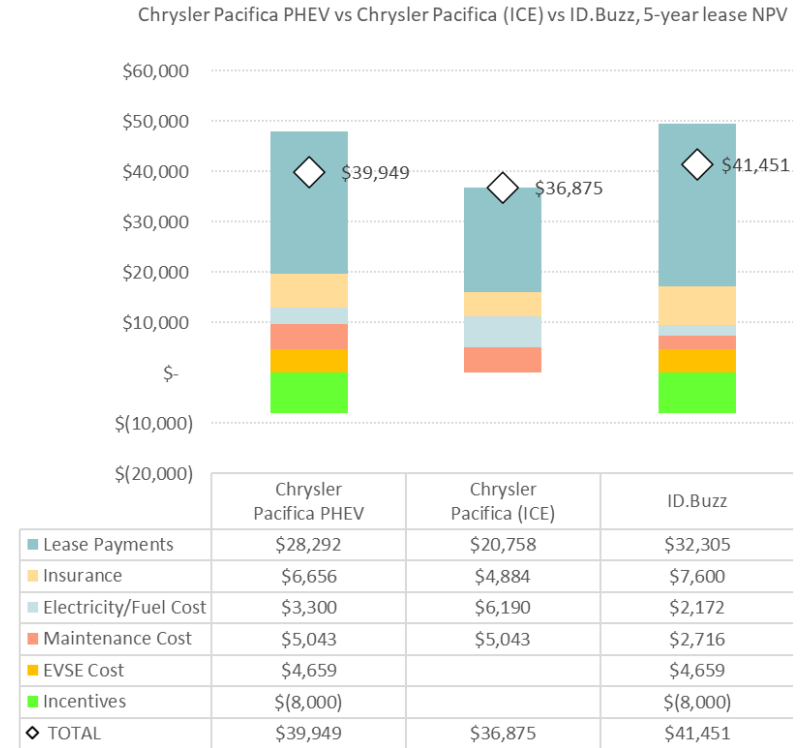
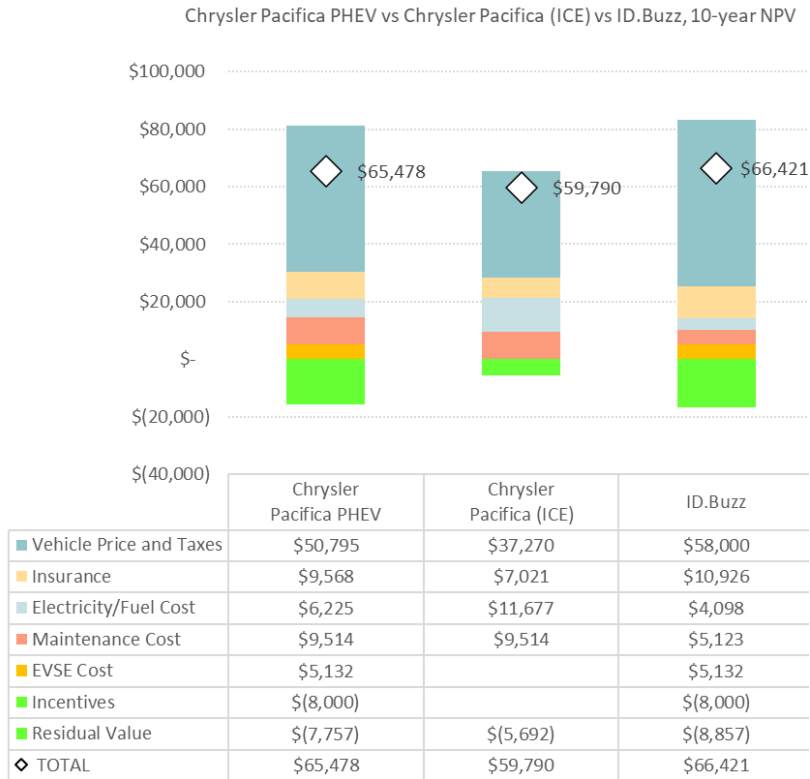


Figure 8.TCO for Vehicle 73969 (2010 Dodge Grand Caravan)

Estimated Annual Mileage: 8,544

Estimated Cost: \$6,631

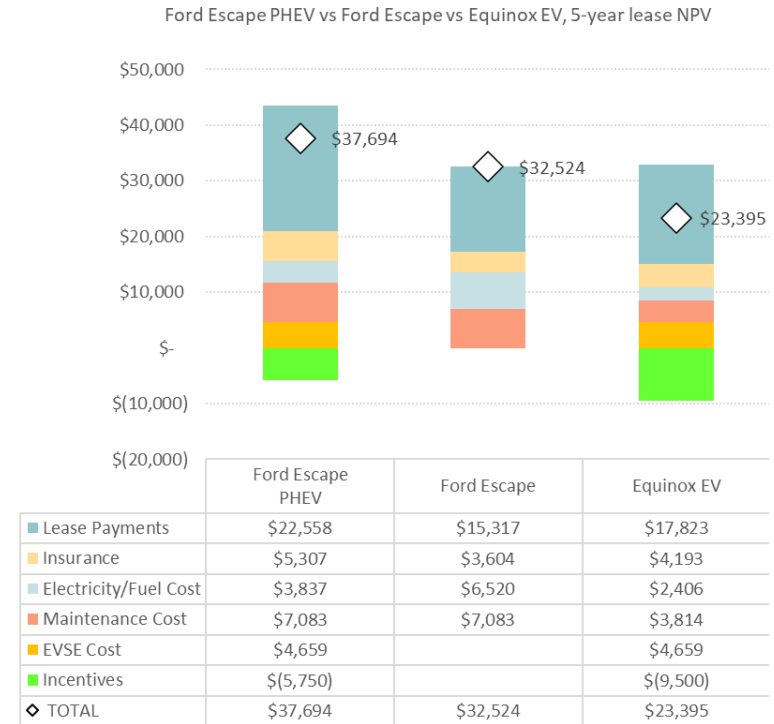
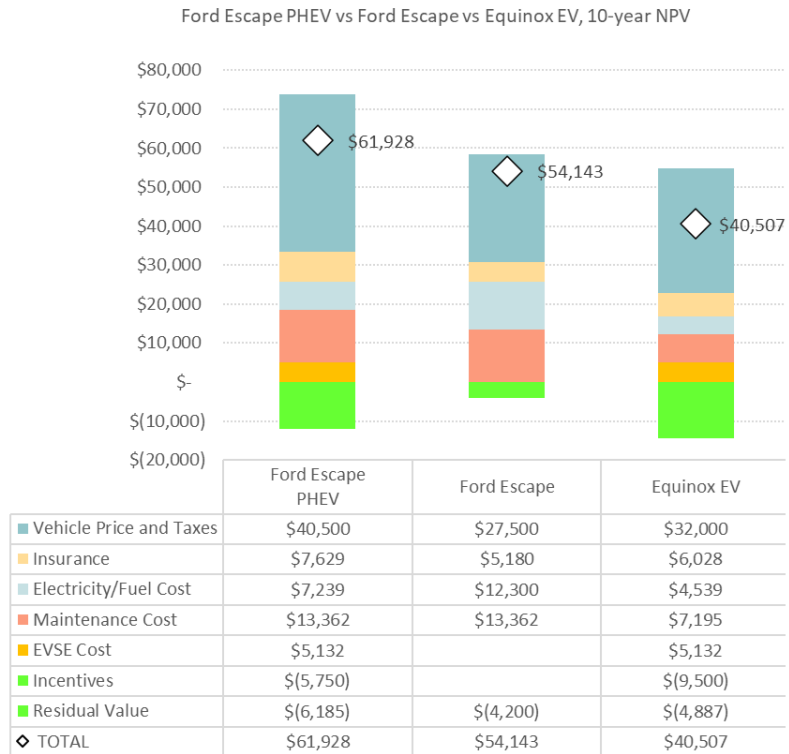


Figure 9.TCO for Vehicle 74509 (2013 Chevrolet Impala)

Estimated Annual Mileage: 12,000

Estimated Savings: \$13,636

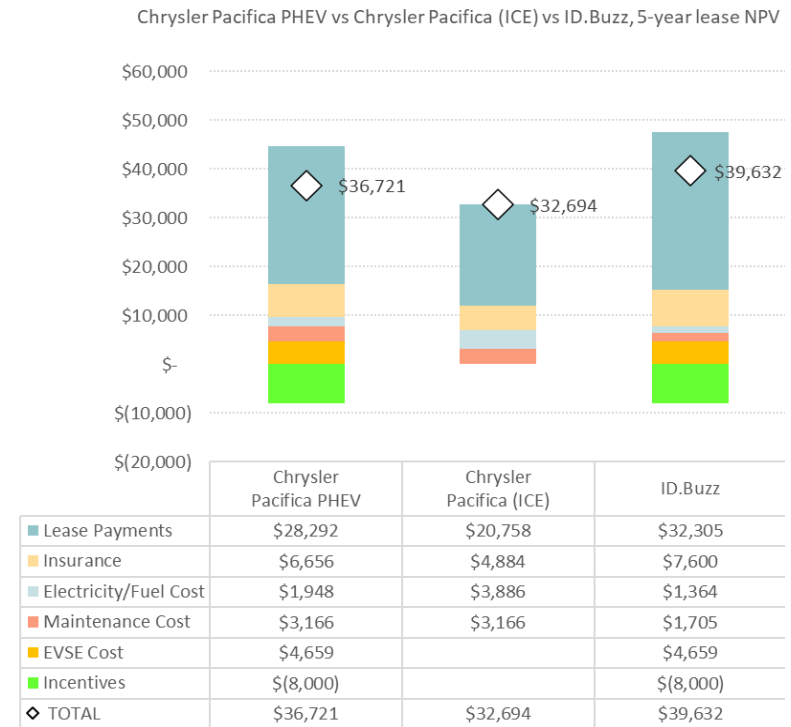
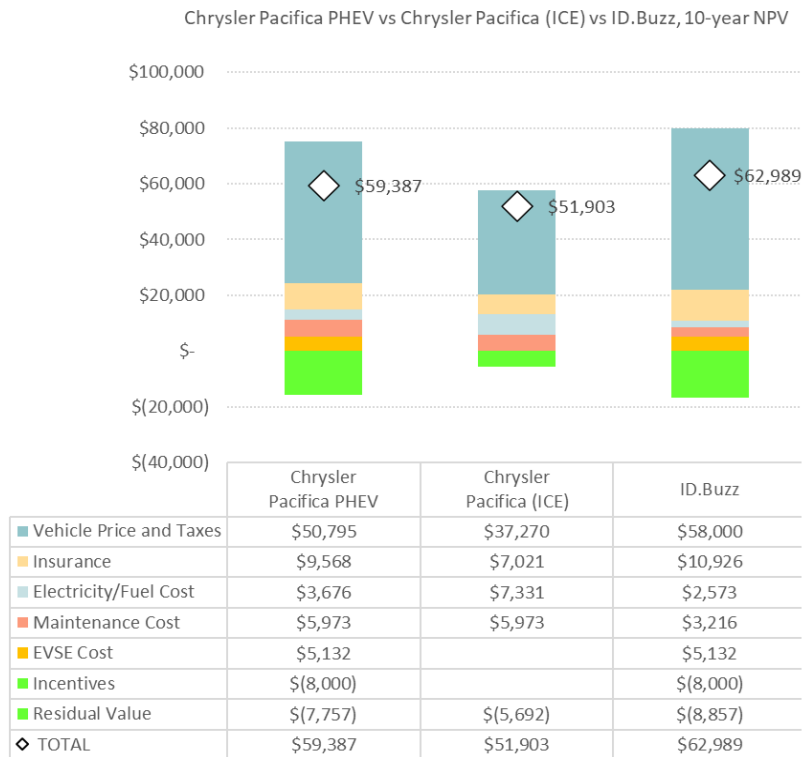


Figure 10. TCO for Vehicle 74513 (2013 Dodge Grand Caravan)

Estimated Annual Mileage: 5,364

Estimated Cost: \$7,484

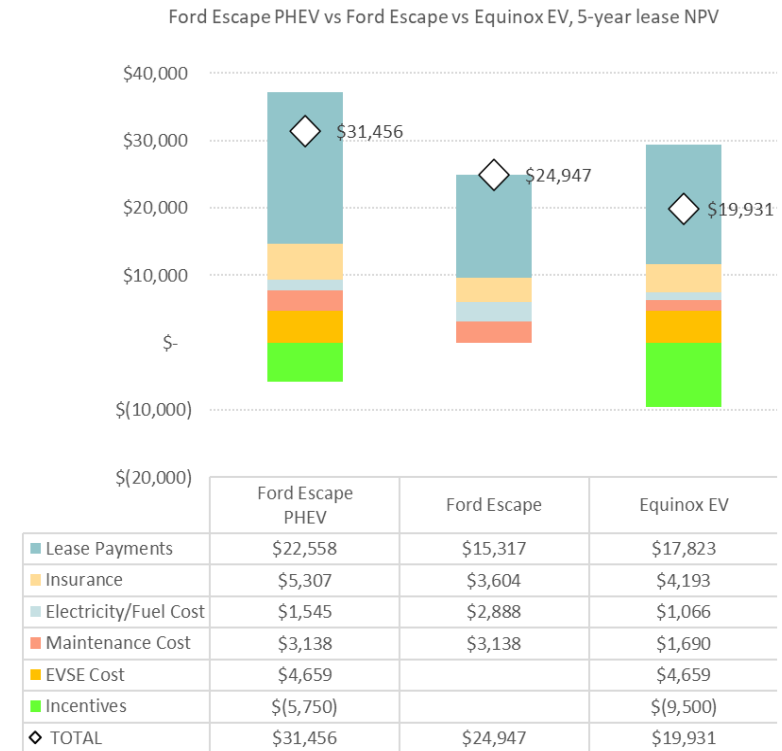
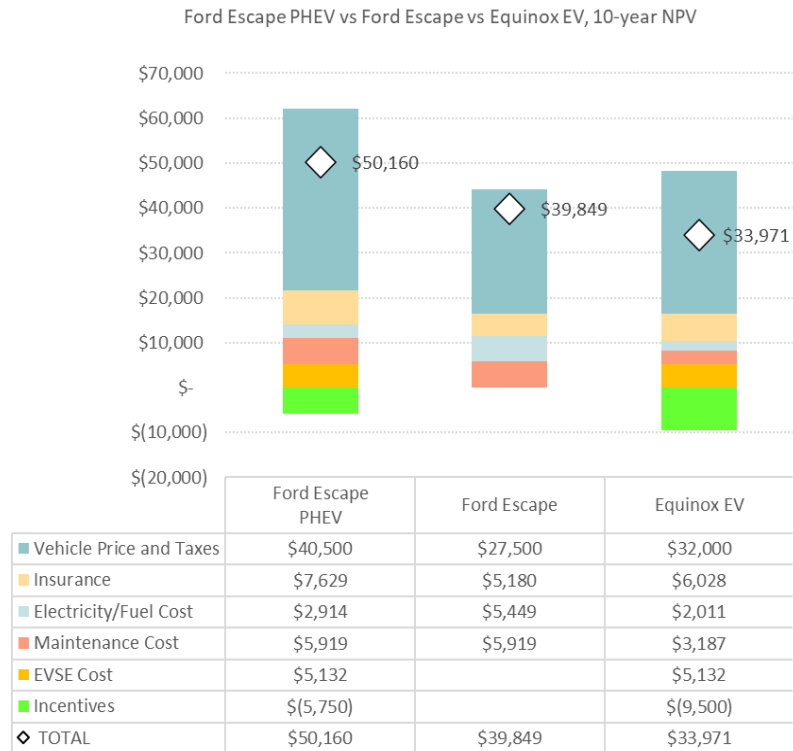


Figure 11.TCO for Vehicle 74523 (2014 Chevrolet Impala)

Estimated Annual Mileage: 5,316

Estimated Savings: \$5,878

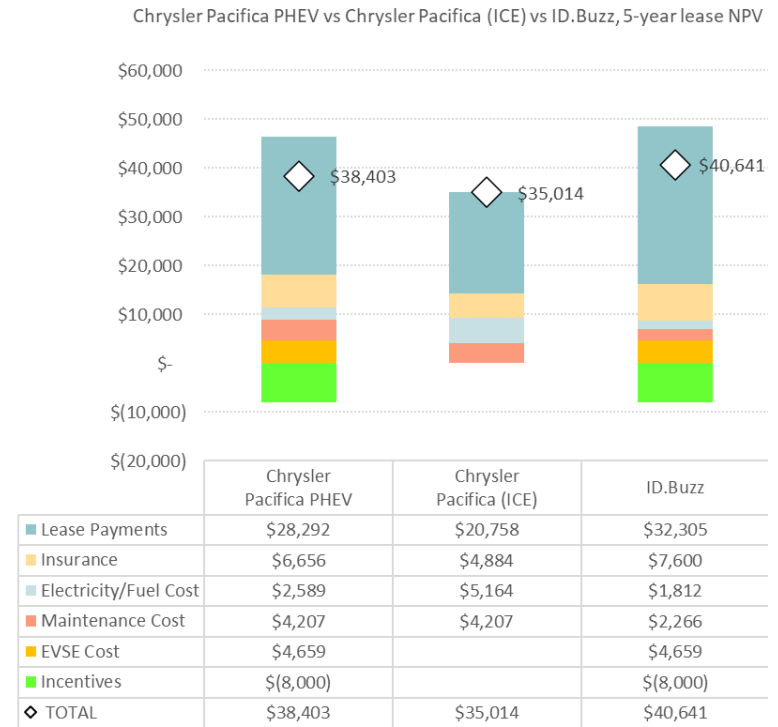
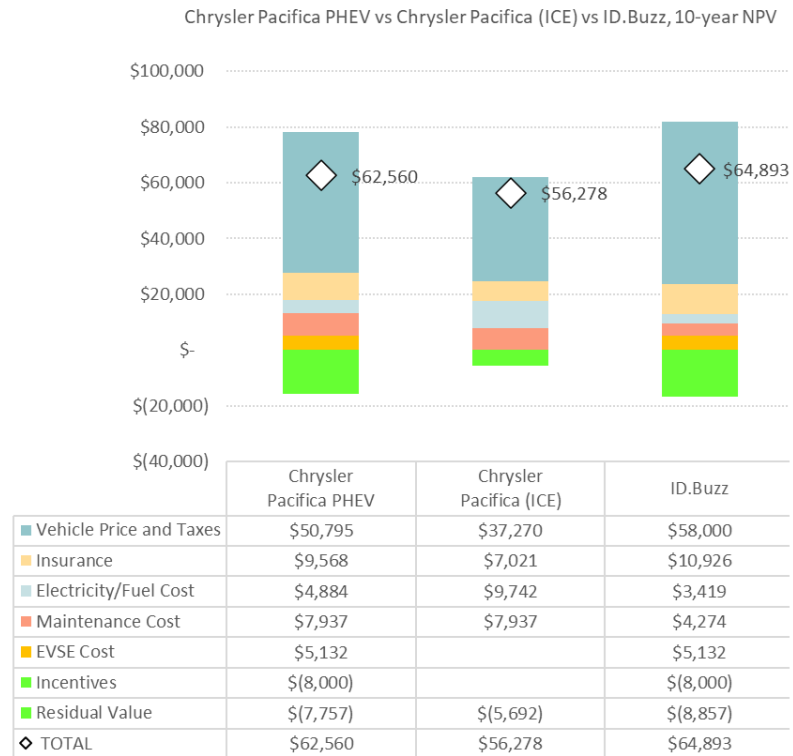


Figure 12. TCO for Vehicle 74531 (2014 Dodge Grand Caravan)

Estimated Annual Mileage: 7,128

Estimated Cost: \$6,282

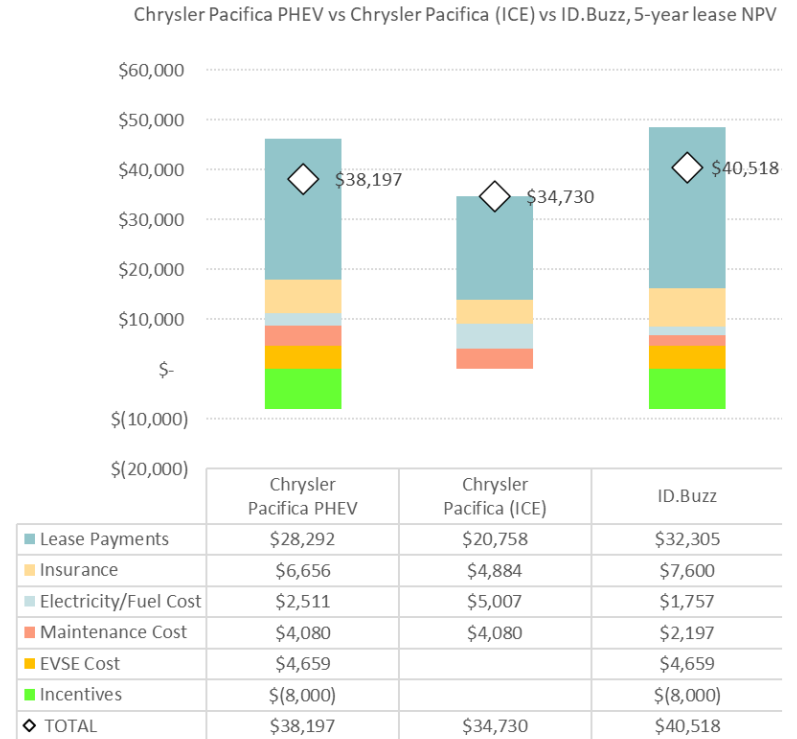
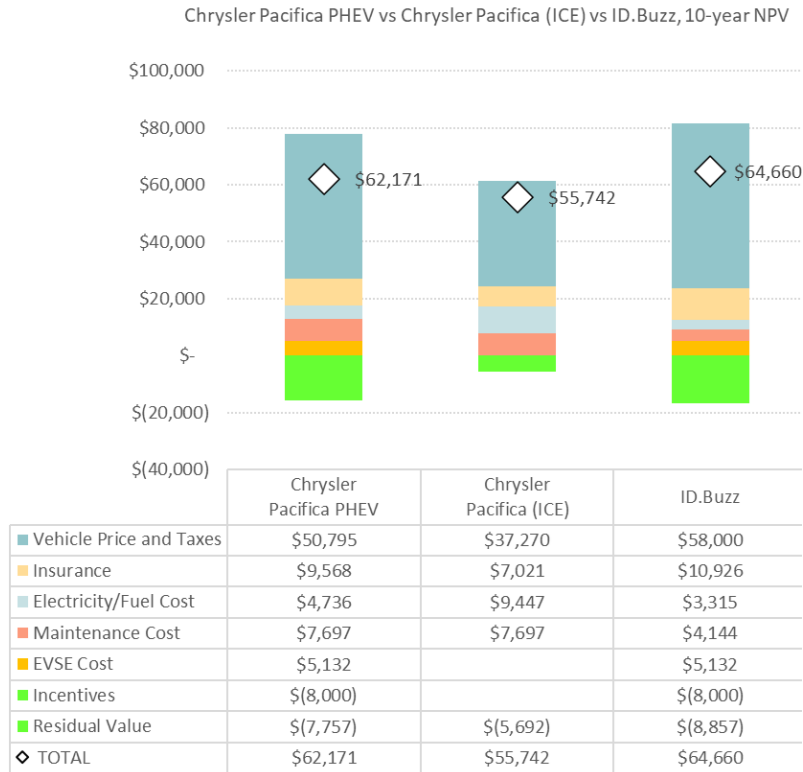


Figure 13. TCO for Vehicle 74533 (2014 Dodge Grand Caravan)

Estimated Annual Mileage: 6,912

Estimated Cost: \$6,429

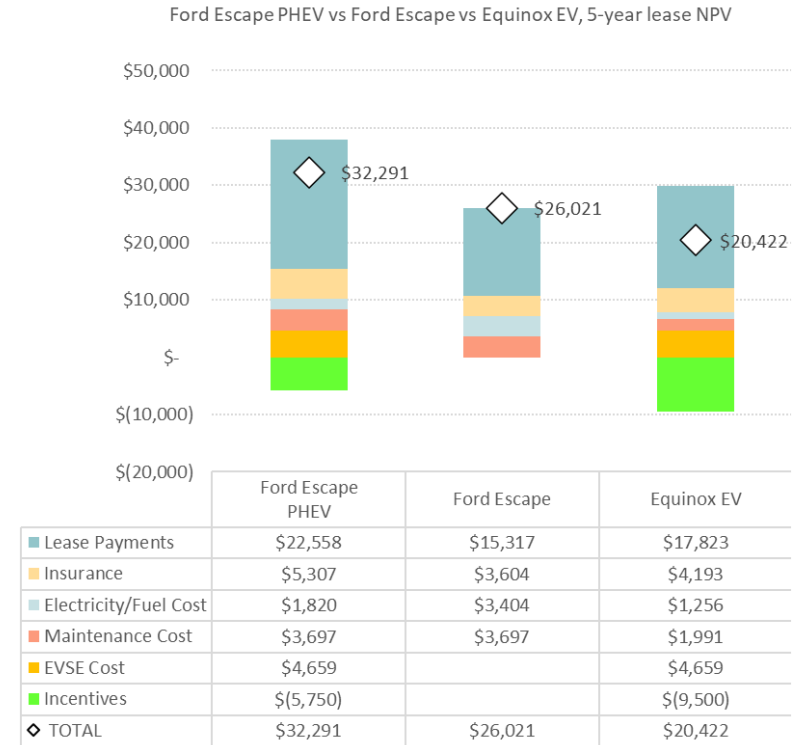
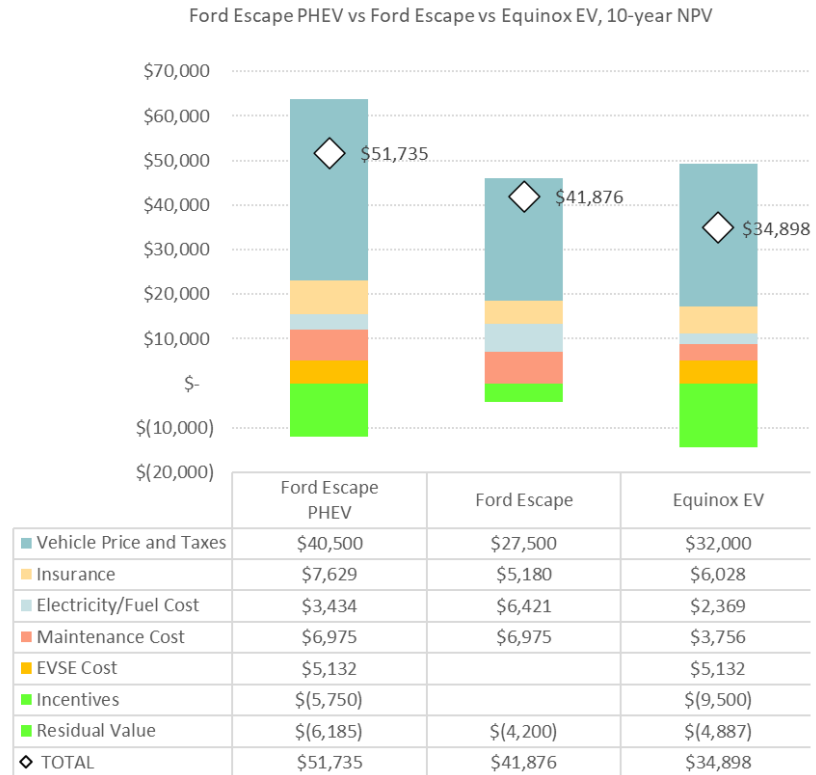


Figure 14.TCO for Vehicle 74555 (2015 Chevrolet Impala)

Estimated Annual Mileage: 6,264

Estimated Savings: \$6,978

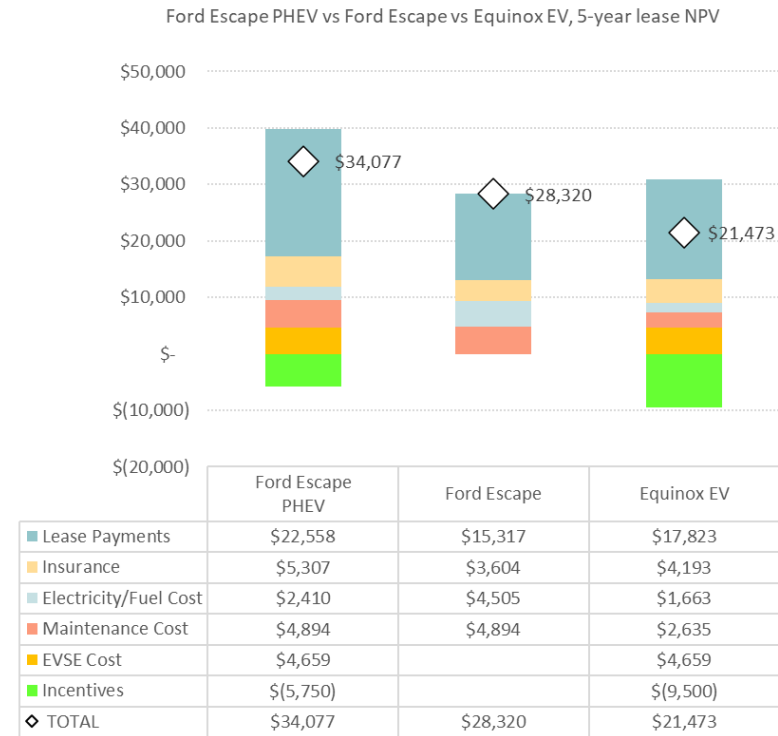
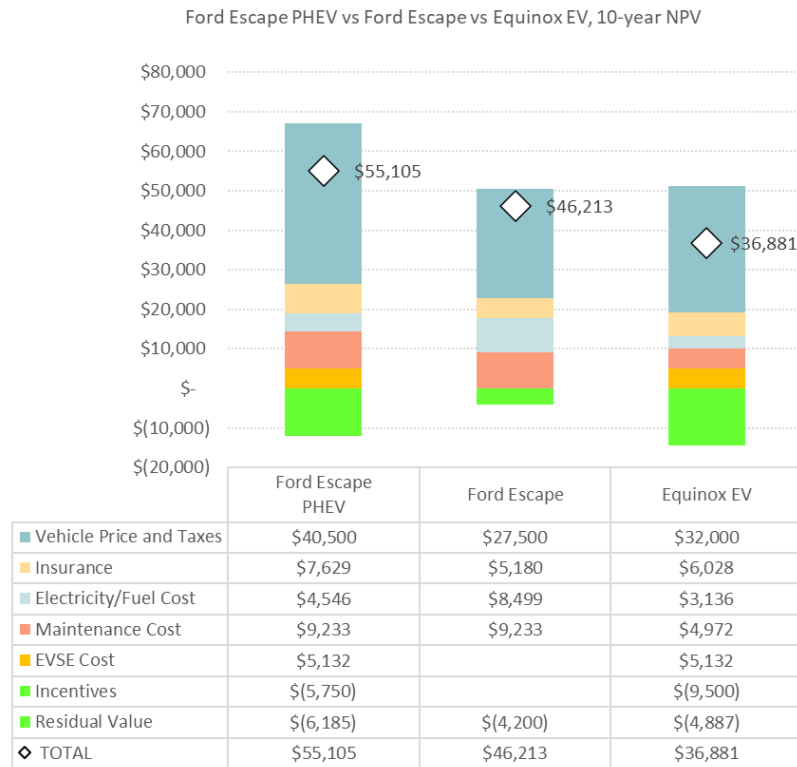
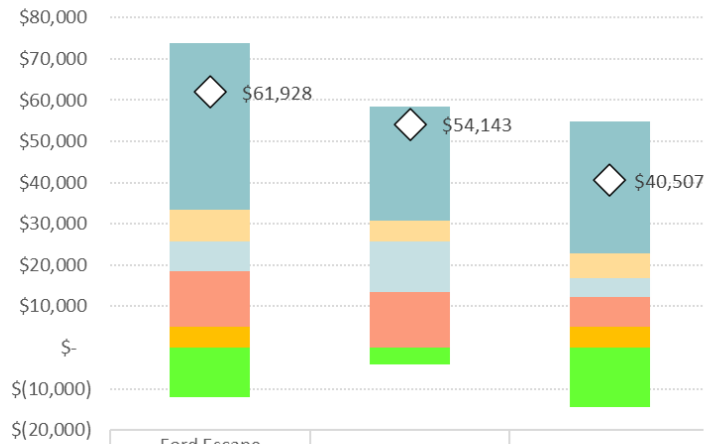


Figure 15. TCO for Vehicle 74823 (2015 Chevrolet Impala)

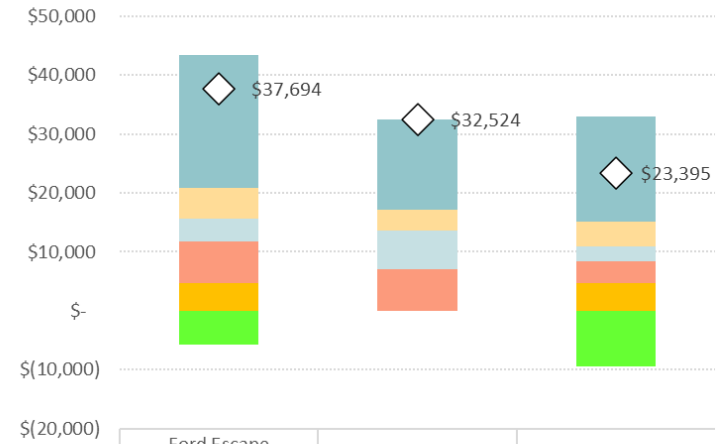
Estimated Annual Mileage: 8,292

Estimated Savings: \$9,332

Ford Escape PHEV vs Ford Escape vs Equinox EV, 10-year NPV



Ford Escape PHEV vs Ford Escape vs Equinox EV, 5-year lease NPV



	Ford Escape PHEV	Ford Escape	Equinox EV
Vehicle Price and Taxes	\$40,500	\$27,500	\$32,000
Insurance	\$7,629	\$5,180	\$6,028
Electricity/Fuel Cost	\$7,239	\$12,300	\$4,539
Maintenance Cost	\$13,362	\$13,362	\$7,195
EVSE Cost	\$5,132		\$5,132
Incentives	\$(5,750)		\$(9,500)
Residual Value	\$(6,185)	\$(4,200)	\$(4,887)
◇ TOTAL	\$61,928	\$54,143	\$40,507

	Ford Escape PHEV	Ford Escape	Equinox EV
Lease Payments	\$22,558	\$15,317	\$17,823
Insurance	\$5,307	\$3,604	\$4,193
Electricity/Fuel Cost	\$3,837	\$6,520	\$2,406
Maintenance Cost	\$7,083	\$7,083	\$3,814
EVSE Cost	\$4,659		\$4,659
Incentives	\$(5,750)		\$(9,500)
◇ TOTAL	\$37,694	\$32,524	\$23,395

Figure 16.TCO for Vehicle 47831 (2013 Chevrolet Impala)

Estimated Annual Mileage: 12,000

Estimated Savings: \$13,636

3.4. Sensitivity Analysis Tables

To provide greater clarity regarding changing dynamics of vehicle and fuel costs on TCO, Cadmus has provided Table 5 through Table 7. These tables show the relative TCO benefit or cost over a 10-year operational life of a Ford Lightning in comparison to a Ford F-150. This vehicle has been selected given its current cost differential and applicability to a large portion of the Broome County fleet. All tables use the current MSRP of a base model ICE Ford F-150 as a point of comparison, modeled at 7,200 miles traveled per year, which is the average mileage of all light duty vehicles in the Broome County Fleet not operated by the Sheriff’s Department. These tables have been provided to provide a reference for Broome County to assess additional vehicles in the future based upon current market dynamics at that time.

Table 5 shows the relative cost of benefit of replacement of vehicle in the Broome County fleet with a Ford Lightning at a range of MSRP and electricity prices at current gas prices, \$3.59/gal.

Table 5. Relative TCO Impact: Current Gas Prices (\$3.59)

		Electricity Price (\$/kWh)				
		\$0.10	\$0.13	\$0.16	\$0.19	\$0.22
Vehicle Price (\$)	\$39,995	\$9,986	\$9,198	\$8,409	\$7,621	\$6,833
	\$44,995	\$3,308	\$2,519	\$1,731	\$943	\$154
	\$49,995	-\$1,871	-\$2,660	-\$3,448	-\$4,236	-\$5,025
	\$54,995	-\$7,049	-\$7,837	-\$8,626	-\$9,414	-\$10,202
	\$59,995	-\$12,227	-\$13,015	-\$13,804	-\$14,592	-\$15,380
TCO Savings > \$500			TCO +/- \$500		TCO Cost >\$500	

Table 6 shows the relative cost of benefit of replacement of vehicle in the Broome County fleet with a Ford Lightning at a range of MSRP and electricity prices at high gas price scenario of \$4.59/gal.

Table 6. Relative TCO Impact: High Gas Prices (\$4.59)

		Electricity Price (\$/kWh)				
		\$0.10	\$0.13	\$0.16	\$0.19	\$0.22
Vehicle Price (\$)	\$39,995	\$13,070	\$12,281	\$11,493	\$10,705	\$9,916
	\$44,995	\$6,391	\$5,602	\$4,814	\$4,026	\$3,237
	\$49,995	\$1,213	\$424	-\$364	-\$1,152	-\$1,941
	\$54,995	-\$3,965	-\$4,754	-\$5,542	-\$6,330	-\$7,119
	\$59,995	-\$9,144	-\$9,933	-\$10,721	-\$11,509	-\$12,298
TCO Savings > \$500			TCO +/- \$500		TCO Cost >\$500	

Table 7 shows the relative cost of benefit of replacement of vehicle in the Broome County fleet with a Ford Lightning at a range of MSRP and electricity prices at low gas price scenario of \$2.59/gal.

Table 7. Relative TCO Impact: Low Gas Prices (\$2.59)

		Electricity Price (\$/kWh)				
		\$0.10	\$0.13	\$0.16	\$0.19	\$0.22
Vehicle Price (\$)	\$39,995	\$6,902	\$6,114	\$5,326	\$4,538	\$3,750
	\$44,995	\$2,929	\$2,141	\$1,353	\$565	-\$223
	\$49,995	-\$4,954	-\$5,742	-\$6,530	-\$7,318	-\$8,106
	\$54,995	-\$10,132	-\$10,920	-\$11,708	-\$12,496	-\$13,284
	\$59,995	-\$15,311	-\$16,099	-\$16,887	-\$17,675	-\$18,463
TCO Savings > \$500			TCO +/- \$500		TCO Cost >\$500	

3.5. Reference Vehicles

This section provides additional data regarding TCO of electric vehicles for additional use cases and vehicle options.

3.5.1. Alternative Electric Vehicle Types

To provide additional context regarding EV costs, Cadmus has provided a TCO analysis for several reference vehicle comparisons that can be used by Broome County to assess vehicle electrification in the future. These reference vehicles include:

- Sedan Tesla Model 3 vs. Chevy Impala
- AWD Midsize crossover SUV: Volkswagen ID4 Pro AWD vs. Ford Escape AWD
- Van: Ford E-Transit vs Ford Transit
- Medium Duty Pickup: Ford Lightning Extended Range vs. Ford F-150 XL 4x4

Vehicle information is found in Table 8. Each vehicle is shown using an annual mileage of 7,200 miles, similar to the average annual miles traveled for all vehicles in the Broome County LDV fleet. For each reference vehicle, TCO assessment has been provided for vehicle purchase and 5-year lease, including federal and state incentives (see section 4 for more detail).

Table 8. Additional Reference Electric Vehicles





 Tesla Model 3	MSRP	\$39,090
	Availability	Immediately
	Range (miles)	272
	Seats	5
	https://www.tesla.com/model3	
 Volkswagen ID.4 Pro AWD	MSRP	\$49,090
	Availability	Immediately
	Range (miles)	255
	Seats	5
	https://www.vw.com/en/models/id-4.html	
 Ford E-Transit	MSRP	\$45,995
	Availability	Immediately
	Range (miles)	126
	Seats	2
	https://www.ford.com/commercial-trucks/e-transit/	
 Ford Lightning Extended Range	MSRP	\$69,995
	Availability	Immediately
	Range (miles)	320
	Seats	5
	https://www.ford.com/commercial-trucks/e-transit/	

Figure 17 shows the TCO for a Tesla Model 3 at 7,200 miles a year. As shown, the Tesla Model 3 offers a savings of over \$8,000 in comparison to a similar ICE vehicle. While this vehicle has a higher MSRP than the recommended EV for conversion of ICE sedans (Chevy Equinox EV) and has a lower TCO savings, it has been shown as a reference if Broome County wishes to maintain the sedan body style for existing fleet vehicles.

Figure 18 presents the VW ID.4 AWD at 7,200 miles per year, which is recommended as the most cost-effective AWD SUV that is currently available. This vehicle may be a suitable downsizing option for those use cases that do not require the functionality of a large truck but do require AWD capabilities. The analysis shows an increased cost of approximately \$4,800 over a similar ICE vehicle.

Figure 19 shows the TCO for a Ford E-Transit at 7,200 miles a year. As shown, the Ford E-Transit offers cost savings of almost \$15,000 over the lifetime of the vehicle. This vehicle does not match the operational profile of the priority vehicles in this assessment; however it is a suitable replacement for vans in the Broome County fleet in the future. The Ford E-Transit is available in cargo van, cutaway and chassis cab configurations; however it is not currently offered in an AWD format.

Figure 20 shows the TCO for a Ford Lightning Extended Range at 7,200 miles a year. While there is not currently an EV replacement for medium and heavy duty pick-up trucks, this is the current market offering that most closely aligns with this vehicle type. As shown, the Ford Lightning Extended Range is expected to increase TCO costs by over \$15,000 at this time.

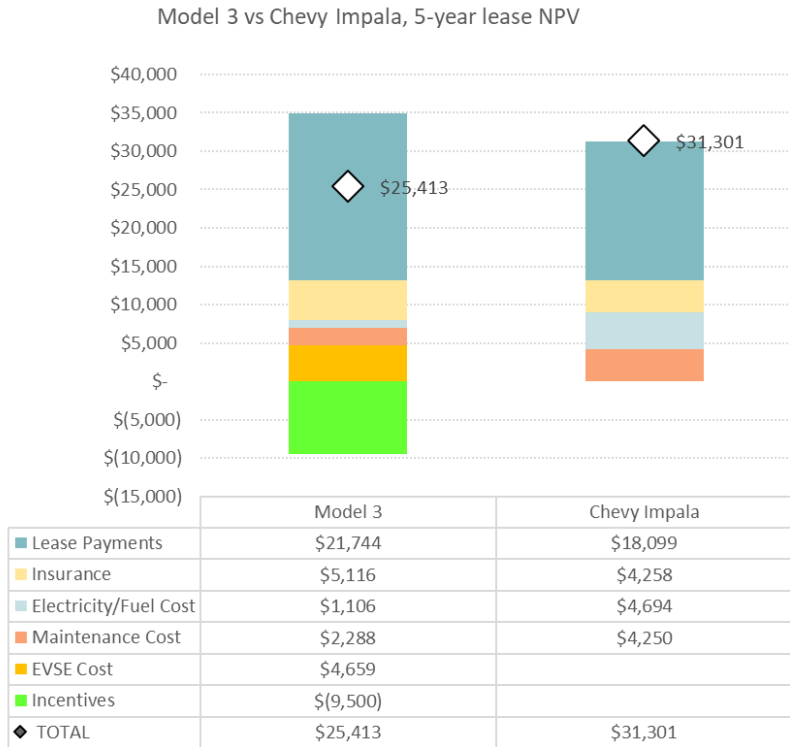
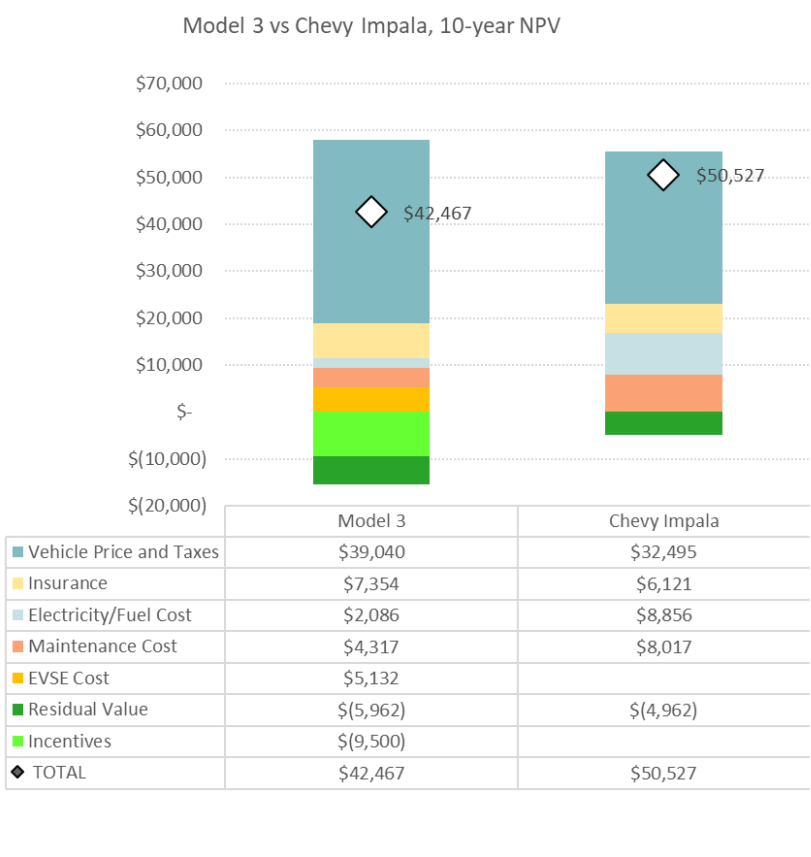


Figure 17. TCO of 7,200 mi/yr Tesla Model 3
Estimated Savings: \$8,060

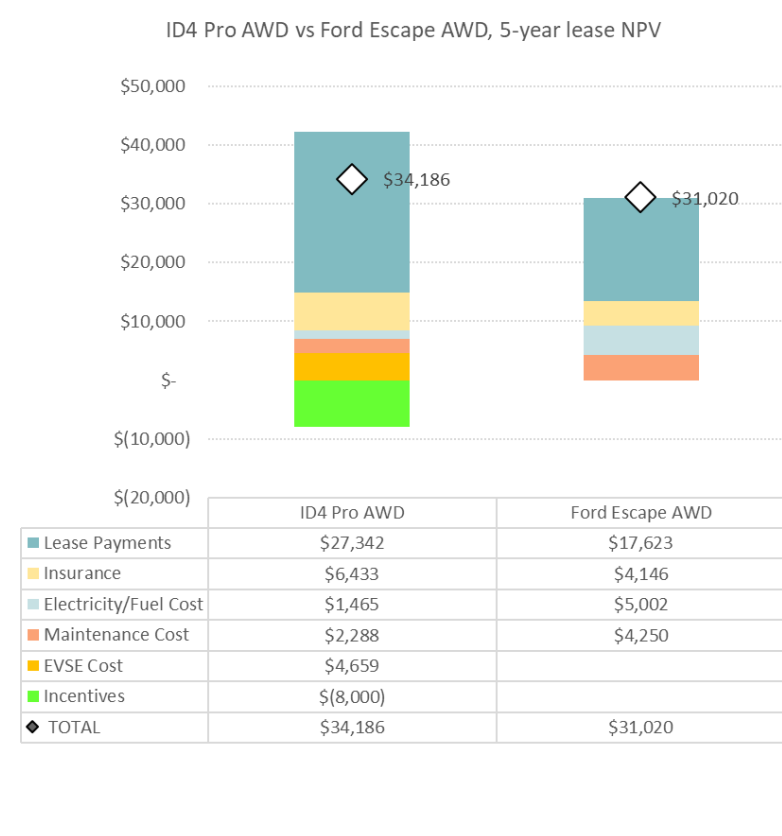
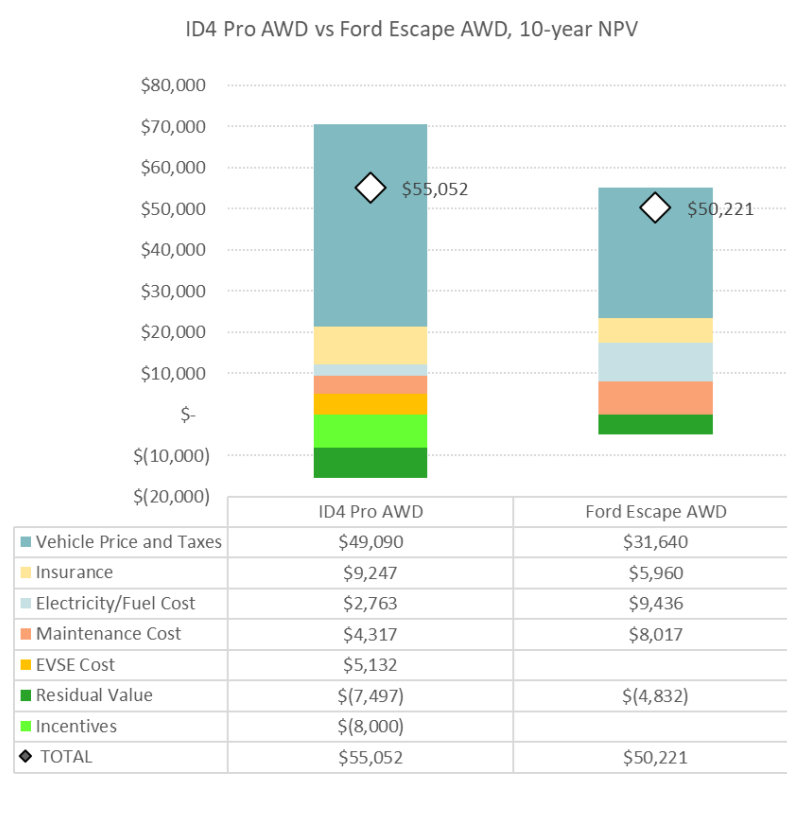


Figure 18. TCO of 7,200 mi/yr VW ID.4 AWD
Estimated Cost: \$4,381

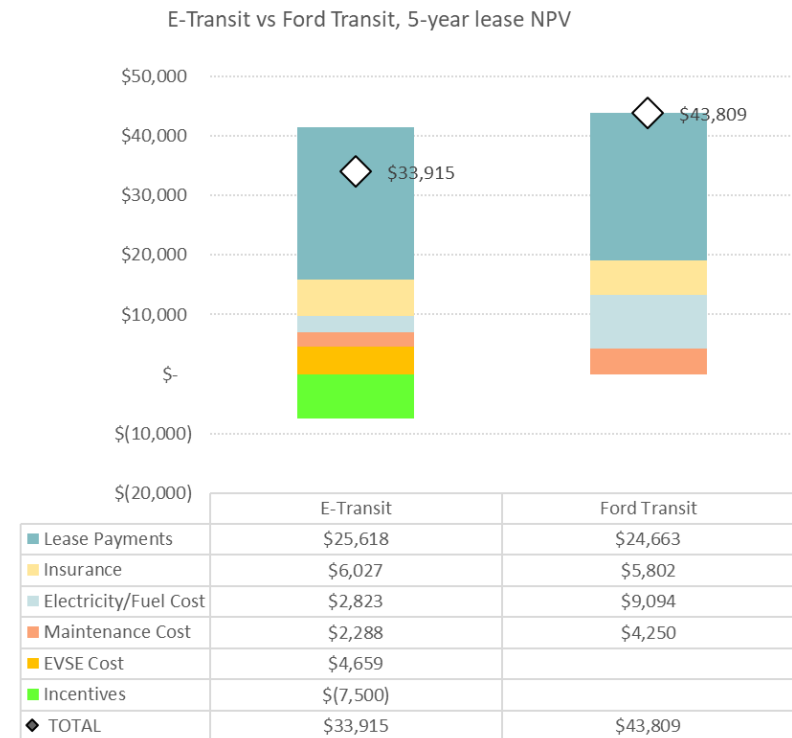
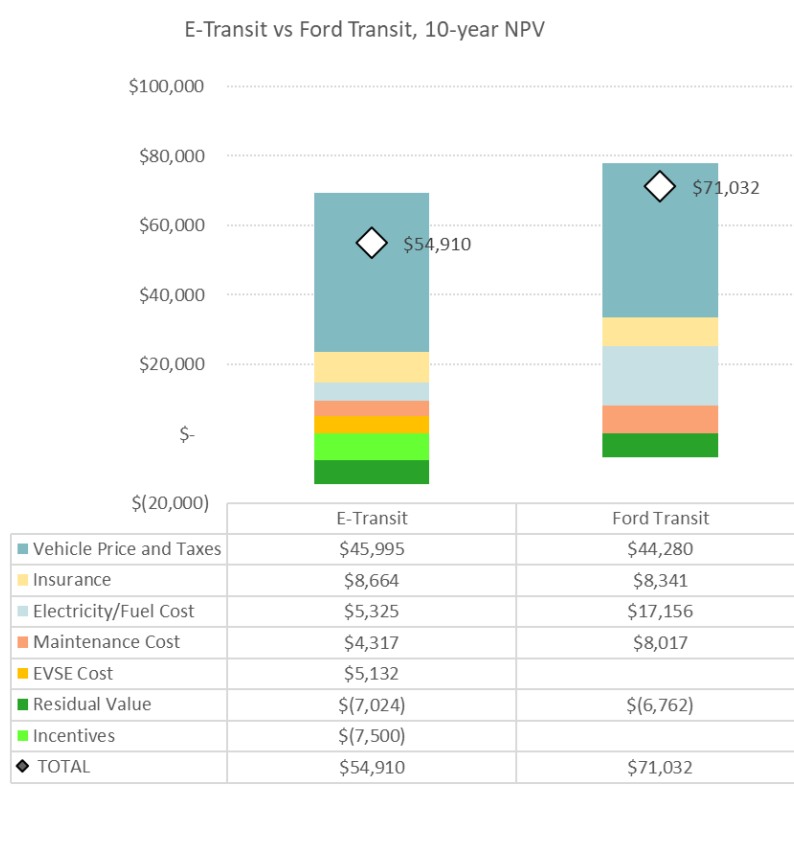


Figure 19. TCO of 7,200 mi/yr Ford E-Transit
Estimated Savings: \$16,122

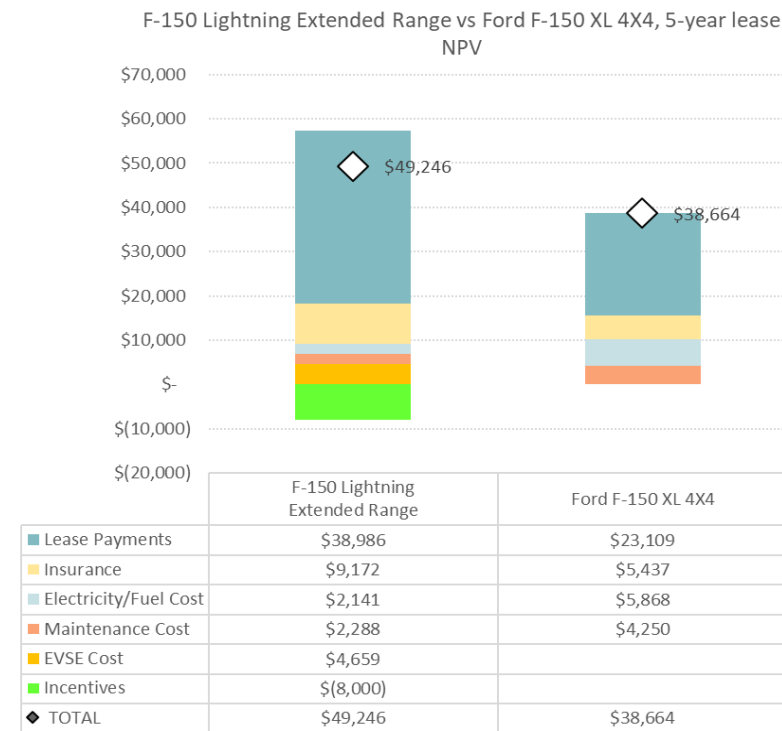
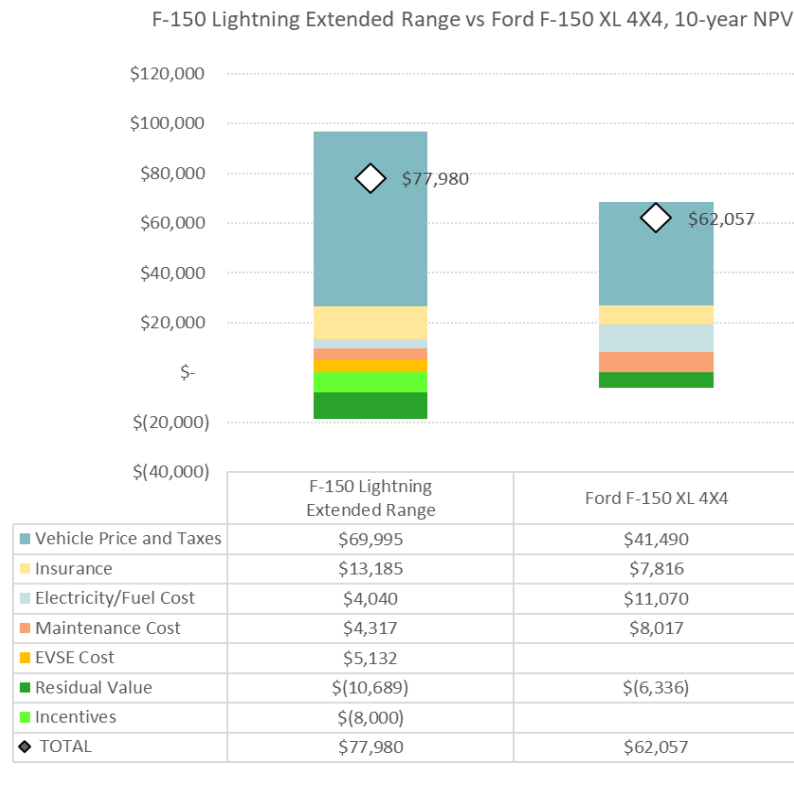


Figure 20. TCO of 7,200 mi/yr Ford Lightning Extended Range

Estimated Cost: \$15,923

3.5.2. Annual Vehicle Milage Impacts on TCO

Operational savings from conversion from an ICE to an EV is influenced directly by the annual miles traveled, as EVs have greater fuel efficiency. To provide insight regarding vehicle use, Cadmus has provided Table 9, which shows the “break even” point for annual milage for each category of vehicle presented at current MSRP. This represents the total mileage required to be driven for an EV to reach cost parity with a similar ICE vehicle based upon the current costs of electricity and fuel in Broome County.

Those vehicles with an annual mileage of zero cost less to purchase than a comparable ICE vehicle after available incentives. Adoption of these vehicles at any mileage are expected to result in a cost savings for Broome County.

Table 9. Estimated VMT to Achieve TCO Parity with Comparable ICE Vehicle

EV Name	Annual Mileage
Chevy Bolt	0
Chevy Equinox*	250
VW EV Buzz*	13,300
Ford Lighting	16,500
Kia EV9*	700
Tesla Model 3	1,700
VW ID.4 Pro AWD	10,500
Ford E-Transit	0
Ford Lightning Extended Range	18,000
*The Kia EV9, Chevy Equinox and VW EV Buzz are not yet commercially available and therefore MSRP is estimated.	

3.6. EV Batteries

At the request of Broome County, Cadmus has provided the following information regarding EV battery warranties and lifecycle.

Currently, most OEMs offer an eight-year, 100,000-mile warranty on battery systems. In other markets, such as California, EV battery warranties are required to be extended to 10 years and 150,000 miles. As a comparison for ICE vehicles, powertrain warranty coverage is typically 5 years or 60,000 miles. The expected life of an EV battery is 200,000 miles of operation before replacement. EV battery capacities are expected to degrade by approximately 2% per year during the vehicle lifetime, which could result in an EV range being reduced by 80-85% after 10

years of operations.² However, Tesla has reported that its batteries on its model S/X vehicles have experienced an 88% decline in capacity after 200,000 miles of operation³.

EV battery range has been shown to be impacted by cold weather operation and recharge times can also increase. Data collected has shown that range may fall by as much as 20% relative to rated range at temperatures below 32 degrees, and 50% in temperatures below zero.⁴

No vehicle in the Broome County fleet has a daily operational profile that would be negatively impacted by reduced range from either battery degradation or cold weather constraints. However, it may be necessary to increase charging frequency to more than once per week. The range of EV batteries has also increased significantly in recent years, from an average of less than 200 miles in 2017 to 291 miles in 2022.⁵ It is expected that average EV range will exceed 300 miles in 2023 and many MY2024 vehicles have a range exceeding 400 miles. As vehicle range increases, charging frequency may be reduced in the future.

3.7. Police Vehicle Applications

While not included in this assessment, at the request of Broome County Cadmus has provided information about current and planned electric vehicles for use in police applications.

There are currently four electric vehicle models that have been deployed in police fleets in the US to date, however none of these vehicles are pursuit rated. The Tesla Model 3 and Model Y (Figure 22) have both been deployed in police fleets nationally, including in California, Texas, Indiana, Wisconsin and other states. Tesla does not offer versions of its vehicles for police use; the vehicles are customized by aftermarket providers. For example, a company based in Cincinnati, OH, [Model PD](#), offers custom upfits of the Tesla Model Y for sale to police departments nationally.

² <https://www.geotab.com/fleet-management-solutions/ev-battery-degradation-tool/>

³ https://www.tesla.com/ns_videos/2019-tesla-impact-report.pdf

⁴ <https://www.geotab.com/blog/ev-range/#:~:text=As%20you%20turn%20up%20or,out%20heat%20is%20also%20culpable.>

⁵ <https://www.bloomberg.com/news/articles/2023-03-09/average-range-for-us-electric-cars-reached-a-record-291-miles#xj4y7vzkg>



Figure 21. Tesla Model 3 (left) and Model Y (right) Police Vehicles

In September 2021, the Ford Mustang Mach-E passed the Michigan State Police evaluation test, the first all-electric vehicle to do so.⁶ Since that time, the Mustang Mach-E has begun to be deployed in police departments, including the New York Police Department, which placed an order for 184 Mustang Mach-E vehicles in 2022, and the Bellevue Police Department in Nebraska which placed an order for 55. As of April 24, 2023, 24 Mustang Mach-E vehicles had been deployed in New York City (Figure 21). This vehicle has also been deployed by federal agencies including the Federal Bureau of Investigations (FBI)⁷ and the Department of Homeland Security (DHS).⁸ This vehicle is expected to be manufactured specifically for police use but will require upfits from independent suppliers.



Figure 22. NYPD Mustang Mach-E Police Vehicle

⁶ <https://media.ford.com/content/fordmedia/fna/us/en/news/2021/09/24/tough-enough-for-law-enforcement-mustang-mach-e.html>

⁷ <https://insideevs.com/news/605546/ford-mustang-mach-e-fbi/>

⁸ <https://www.dhs.gov/news/2022/09/19/dhs-electric-vehicle-program-accelerates-debut-first-fully-electric-law-enforcement#:~:text=The%20Ford%20Mustang%20Mach%2DE,to%20zero%2Demission%20electric%20vehicle s.>

The Ford Lightning Pro Special Service Vehicle (SSV) was announced in 2022 and began to be deployed in police departments in 2023. This vehicle is available in both the regular and extended range format. This vehicle is expected to be manufactured specifically for police use but will require upfits from independent suppliers.



Figure 23. Ford Lightning Pro SSV in Claremont, CA

The Chevrolet Blazer EV PPV is the only EV that has been announced that is expected to be pursuit rated for police use. The vehicle is based on the 2024 Chevy Blazer EV SS, which is expected to be available in early 2024. This vehicle is expected to be manufactured specifically for police use but will require upfits from independent suppliers.



Figure 24. Model Chevrolet Blazer PPV

3.8. Recommended Chargers

Figure 24 provides a comparison of the characteristics and performance of the various charger types available to Broome County.

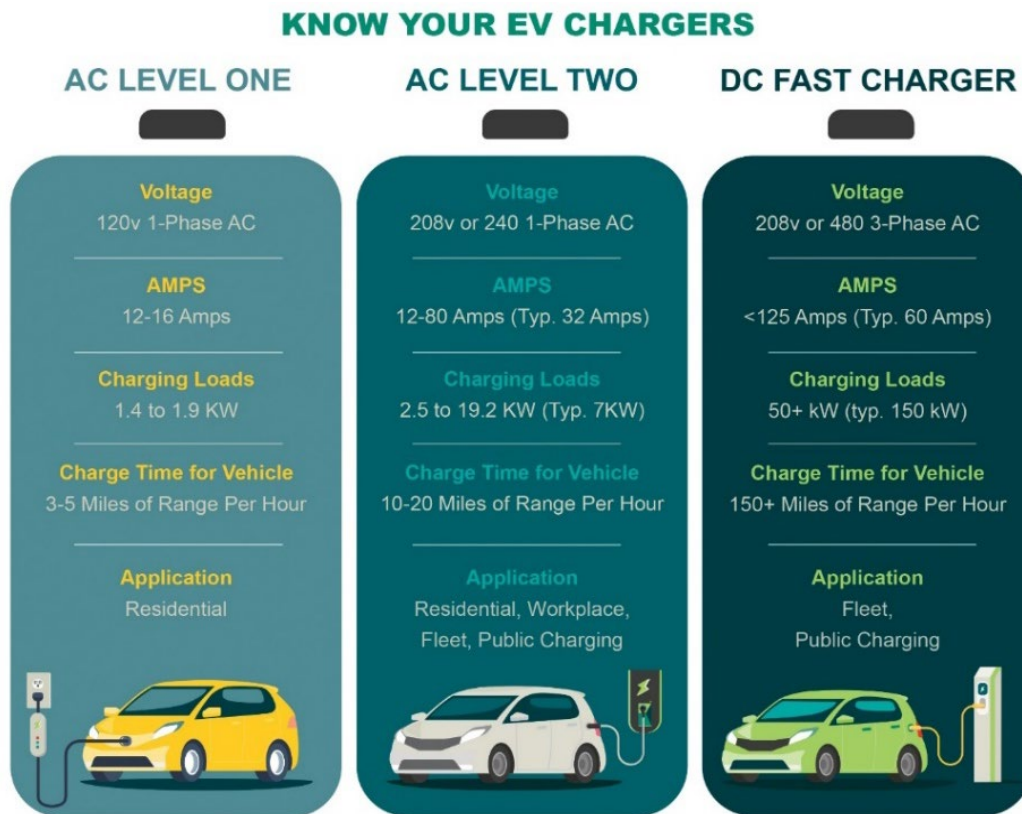


Figure 25. Comparison of charger types

In selecting the recommended chargers, Cadmus considered charger cost, functionality, and charge rate. A 7.6 kW level 2 charger will meet the operational needs of Broome County, though it may choose to select a higher power and higher cost level 2 charger if faster recharge times are desired. However, a lower power level 2 charger will meet the operational requirements for all light-duty vehicles in the Broome County fleet as they are expected to be charged overnight. For the purpose of generating a cost estimate, the team selected the BTCPower level 2 dual-port pedestal mount charging station as a mid-range model.

For the EV charging infrastructure to support the 14 identified priority vehicles, Cadmus recommends installing seven 7.6 kW dual port charging pedestals across four identified locations, as shown in Table 10. Each vehicle would have a dedicated charging port at the time of vehicle procurement and would be expected to charge overnight. However, based upon the operational profile of these vehicles, each charging port would be capable of serving a


minimum of two vehicles in the future if vehicle parking can be rotated. The seven charging pedestals should be capable of serving 28 total EVs. Broome County may also choose to install “stub-outs” (pre-wiring) for future expansion of its charging infrastructure, depending on evaluation of utility electrical capacity at the site.

Table 10. Recommended EV Infrastructure

Location	Total Vehicles	Total Priority EVs	Charger Type and Number	Pedestal QTY	Total Ports	Stub-Outs
DSS Fleet Cage	28	6	7.6 kW dual port pedestal mount	3	6	4
Health Department	11	4	7.6 kW dual port pedestal mount	2	4	2
Parks Department – Cole Park	6	2	7.6 kW dual port pedestal mount	1	2	1
County Office Building	7	2	7.6 kW dual port pedestal mount	1	2	2

Assuming 250 work days per year, the 14 priority vehicles have an average driving distance of about 30 miles per day and a maximum of 48 miles per day. The minimum range of any recommended EVs is 223 miles. As such, vehicles should need to charge less than once per week, so having 2 vehicles per charging port should be feasible.

Table 11: Sample EV Charger

Level 2

BTC Power Level 2 Charger, Pedestal-Mount, Dual-Port, Networked
30-40 AMP
208/240V
6.2-8.3 kW on 208V

4. Vehicle and Charger Incentives

There are federal, state and utility incentive programs for EV and charging infrastructure that may be used by Broome County to reduce the cost of electrification of its fleet. A summary of these incentive programs with links to relevant information can be found in Table 12 below, followed by additional details regarding each program.

Table 12: Eligible Vehicle and Charger Incentive Programs

Incentive	Amount	Details
Section 45W Federal Commercial Clean Vehicle Tax Credit – Elective Pay	\$7,500 for vehicles <14,000 lb, up to \$40,000 for vehicles >14,000 lbs	Tax-exempt entities eligible for “direct pay” option at time of tax filing.
Section 30C Federal Alternative Fuel Infrastructure Tax Credit – Elective Pay	Up to 30% of the cost of charging infrastructure, not to exceed \$100,000 per site.	Site must be located in a census tract that is not an urban area; be located in a census tract where the poverty rate is at least 20%; or in a census trach where the median family income is <80% of the state median family income.
NYSERDA Drive Clean Rebate	\$2,000 rebate for vehicles under \$42,000; \$500 for vehicles over \$42,000	Limited rebate for vehicles with MSRP over \$42,000. List of vehicles and incentives can be found in the
NYSEG Make Ready Program	Upon to 50% for non-public charging, Up to 90% for public charging and up to 100% for charging in disadvantaged communities or Multi-Unit Dwellings (MUDs)	Applies to Distribution Network, Transformers, Conductor, Panel, Boring, Trenching, and Conduit. Does not apply to EVSE, network equipment, signs, bollards, network and maintenance fees.
NYS DEC Municipal ZEV Rebate Program (assuming 2023 renewal)	\$2,500-\$7,500 depending on vehicle price and GVWR	Rebate for municipal vehicles
NYS DEC Municipal ZEV Infrastructure Grant Program (assuming 2023 renewal)	80-100% of system costs for public charging	Utility make-ready can be used as match

Federal Incentives

EVs are typically eligible for a federal tax credit; because Broome County is a government entity and does not pay taxes, it has historically been unable to take advantage of such tax credits. However, the IRA includes a provision allowing tax-exempt buyers to benefit from the Commercial Clean Vehicles incentive by receiving a payment from the Department of the Treasury.

On June 14, 2023, the Department of Treasury [released draft guidance](#) regarding how tax-exempt entities can claim the Section 45W Commercial Clean Vehicle Tax Credit and the Section 30C Alternative Fuel Infrastructure Tax Credit. Note that this guidance has not yet been finalized and may be amended following the ongoing public comment period.

Section 45W Tax Credit & Elective Pay

To utilize this option (also referred to as “direct pay”), tax exempt entities can receive a payment equal to the full value of the Clean Commercial Vehicle Tax Credit under IRS Section 45W. This credit is up to \$7,500 for vehicles with a GVWR up to 14,000 lbs or 30% for vehicles over 14,000 lbs up to \$40,000. The applying entity will need to complete a pre-filing registration with the IRS and file a tax return with vehicle registration information. The amount of the credit is treated as a payment of tax and any overpayment will result in a refund.

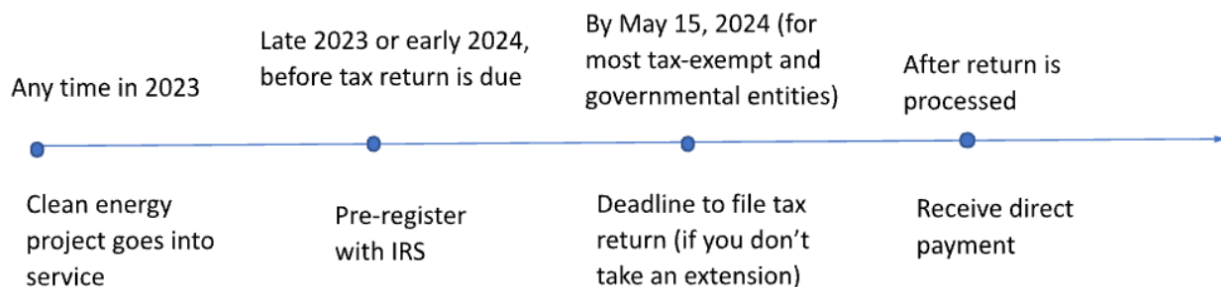


Figure 26. Estimated Timeline for Federal Tax Credit: Elective Pay Option

Guidance regarding the process for using the Elective Pay option has been provided by [The White House](#) and the [Internal Revenue Service](#), including [Frequently Asked Questions](#).

Section 30C Tax Credit & Elective Pay

The Section 30C Alternative Fuel Infrastructure Tax Credit is also eligible for the Elective Pay option. This credit provides up to 30% of the cost of EV charging equipment not to exceed \$100,000 per charging installation. However, there are specific location requirements for tax credit eligibility including:

Qualified fueling equipment must be installed in locations that meet the following census tract requirements:

- The census tract is not an urban area;
- A population census tract where the poverty rate is at least 20%; or
- Metropolitan and non-metropolitan area census tract where the median family income is less than 80% of the state medium family income level.

State Incentives

NYSERDA Drive Clean Rebate Program

The NYSERDA Drive Clean Rebate Program provides an incentive of \$500 for EVs with a base MSRP of over \$42,000, such as the Ford Lightning. This incentive is up to \$2,000 for vehicles under \$42,000 and an all-electric range of over 200 miles, such as the VW ID4. However, no AWD EV models will currently be eligible for the \$2,000 rebate.

New York State (NYS) Department of Environmental Conservation (DEC) Municipal Zero-Emission Vehicle Rebate Program

The NYS DEC Municipal Zero-Emission Vehicle Rebate Program offered municipalities \$2,500 - \$7,500 towards the purchase of a new electric vehicle in 2022. If this program is offered in 2023, Broome County may be able to utilize this program to decrease procurement costs. \$7,500 rebates were applicable to vehicles with the gross vehicle weight rating of up to 8,000 lbs and an all-electric range of over 200 miles, or vehicles with a GVWR of 8,000 – 14,000 lbs.

NYS DEC Municipal Zero-Emission Vehicle (ZEV) Infrastructure Grant Program

In 2022 the NYS DEC Municipal Zero-Emission Vehicle (ZEV) Infrastructure Grant Program offered municipalities incentives equaling 80%-100% of costs for charging infrastructure primarily for public use, depending on the municipality's median household income. Utility make-ready funding can provide the match. If such a program is offered in 2023, there may be opportunity for Broome County to leverage this program. The only costs included in the EVSE assessment in this case are network fees and O&M costs for the EVSE. The specific EVSE noted in this report may or may not qualify depending on the terms of the 2023 program.

Utility Incentives

NYSEG Electric Vehicle Charging Station Make-Ready Program

NYSEG offers an Electric Vehicle Charging Station Make-Ready Program, which provides incentives to cover a portion of electric vehicle charging infrastructure costs. Incentives are structured in three tiers, based upon the location and type of infrastructure project. Figure 26 provides a summary of eligibility and incentive levels for level 2 charging installations. DCFC

stations will require specific assessment to ensure ability to meet power demand and understand available incentives.

Incentive level	Up to 100%	Up to 90%	Up to 50%
Site characteristics			
Public		✓	✓
Non-public			✓
Disadvantaged Community	✓		
Multi-Unit Dwelling	✓		
Plug types			
Standard ≥ Proprietary	✓	✓	✓
Proprietary > Standard			✓

Figure 27. NYSEG Make-Ready Infrastructure Tiers

Participation in this program requires Broome County to work with an [approved contractor](#) to create a site design and determine suitable location(s) for charging infrastructure. This site design will be submitted along with a program application to NYSEG for approval, who will then work with the contractor to build necessary electrical infrastructure. Once the charging stations are installed and activated the incentive payment is provided by NYSEG upon submission of required documentation. The types of infrastructure covered by the NYSEG Make Ready Program incentives are show in Figure 27.





	Covered by Make-Ready incentives		Paid for by the customer	
	 Utility-side infrastructure	 Customer-side infrastructure	 EVSE hardware	 Other soft costs
Examples	<ul style="list-style-type: none"> • Distribution Network • Transformers • Conductor 	<ul style="list-style-type: none"> • Panel • Conductor • Boring • Trenching • Conduit 	<ul style="list-style-type: none"> • Charging Station • Network equipment 	<ul style="list-style-type: none"> • Signs • Bollard • Network • Maintenance fees
Paid for by	NYSEG reimburses up to 50%, 90% or 100% for eligible sites Customer is responsible for the remainder		Customer and/or NYSEDA*	
Owned by	NYSEG	Customer	Customer	

Figure 28. Eligible Infrastructure Components for NYSEG Make-Ready Incentives

5. Site Assessment and Costs

Cadmus recommends installing charging infrastructure at four sites in Broome County to support priority vehicles.

Site 1: Department of Social Services

Cadmus recommends installing three dual port dual-port level 2 chargers at the Broome County Public Works parking lot, which is located at 36-42 Main St, Binghamton, NY 13905 (Figure 28).

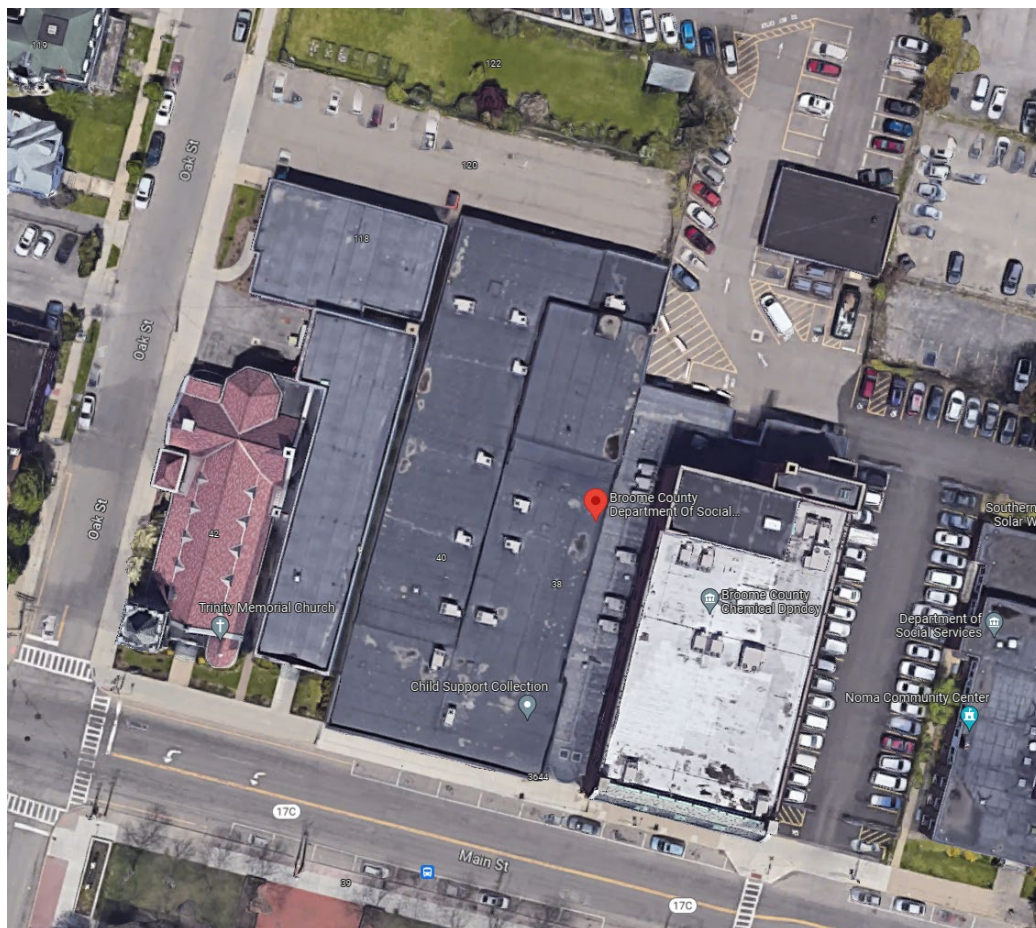


Figure 29. Broome County Department of Social Services Site

Three dual port chargers should be capable of supporting twelve vehicles in the Broome County fleet. Given the number of LDV that are maintained at this location (28), it is suggested that at least four additional stub outs are installed at the site. In total, seven dual port chargers should be capable of servicing the entire Broome County fleet at this site. The County should also consider installation of public or workplace charging at the site. An assessment of transformer at panel capacity will need to be completed by an approved contractor to fully understand

infrastructure upgrades required at the site, including existing transformer and panel capacity. It is recommended that Broome County reach out to NYSEG to begin review of this site.

Site 2: Nathaniel Cole Park

Cadmus recommends installing one 7.6kW dual port level 2 charger at the Parks Department – Cole Park site, located at 1674 Colesville Rd, Harpursville, NY 13787 (Figure 29).



Figure 30. Parks Department - Cole Park Site

This site does not host many vehicles (6), and therefore long-term fleet charging infrastructure requirements are minimal. It is recommended that one additional stub-out be installed at this site to service vehicles in the future. However, given the significant public parking at the site, it is recommended that this site be considered for public charging in conjunction with installation of fleet vehicle charging at the site. The NYSEG Make Ready program may offer a 90% cost share for installation of public charging infrastructure at the site. If public chargers can be sited in close proximity to fleet chargers, this could significantly reduce the costs required to install charging infrastructure to service County fleet vehicles at the site.

Site 3: Broome County Health Department

Cadmus recommends installing two 7.6 kW dual port charger at the Broome County Health Department located at 225 Front St, Binghamton, NY 13905 (Figure 30).



Figure 31. Broome County Health Department

This site hosts 11 LDV fleet vehicles, which are almost all sedans and minivans that are at least 10 years old. Due to the vehicle age and beneficial economics of the vehicle types at this site, it is expected that the majority of the vehicles may be prioritized for electrification in the near future. It is therefore recommended that a minimum of two additional stub outs be installed to enable at least 8 charging ports to be supported at the site. The County should also consider installation of public or workplace charging at the site. An assessment of transformer at panel capacity will need to be completed by an approved contractor to fully understand

infrastructure upgrades required at the site, including existing transformer and panel capacity. It is recommended that Broome County reach out to NYSEG to begin review of this site.

Site 4: Broome County Office Building

Cadmus recommends installing two 7.6 kW dual port charger at the Broome County Office Building located at 60 Hawley St, Binghamton, NY 13901 (Figure 31).

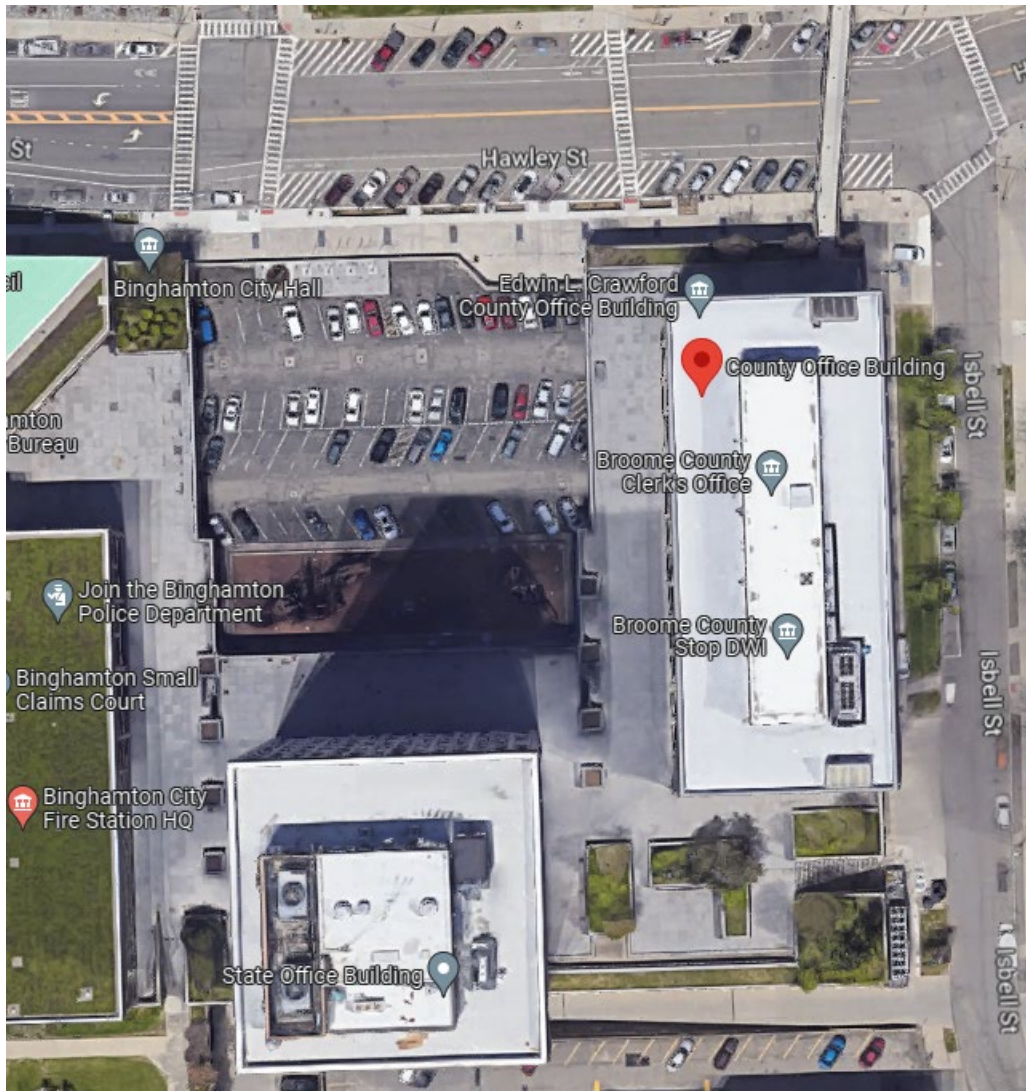


Figure 32. Broome County Office Building

This site hosts a total of four LDV, two of which are prioritized for electrification in the near term. The other two vehicles are expected to have many years of service life before replacement is necessary. As such, Cadmus recommends installing one additional stub-out capable of supporting an additional dual port charger in the future. This site may also be a good location for installation of public or private workplace charging to be co-located with fleet

charging. This may enable Broom County to leverage a 90% cost share through the Make-Ready program at this site.

As noted above, incentives for the NYSEG Make Ready Program and Section 30C federal tax credit are limited based upon the site of the proposed location being located in a disadvantaged community. In addition, while the NYSEG incentives are up to 90% for public charging infrastructure, private charging infrastructure is limited to 50% of project costs. Public charging in disadvantaged communities may be eligible for 100% cost share through the NYSEG Make Ready Program. Figure 32 provides a map showing designated [NYS Disadvantaged Communities](#).

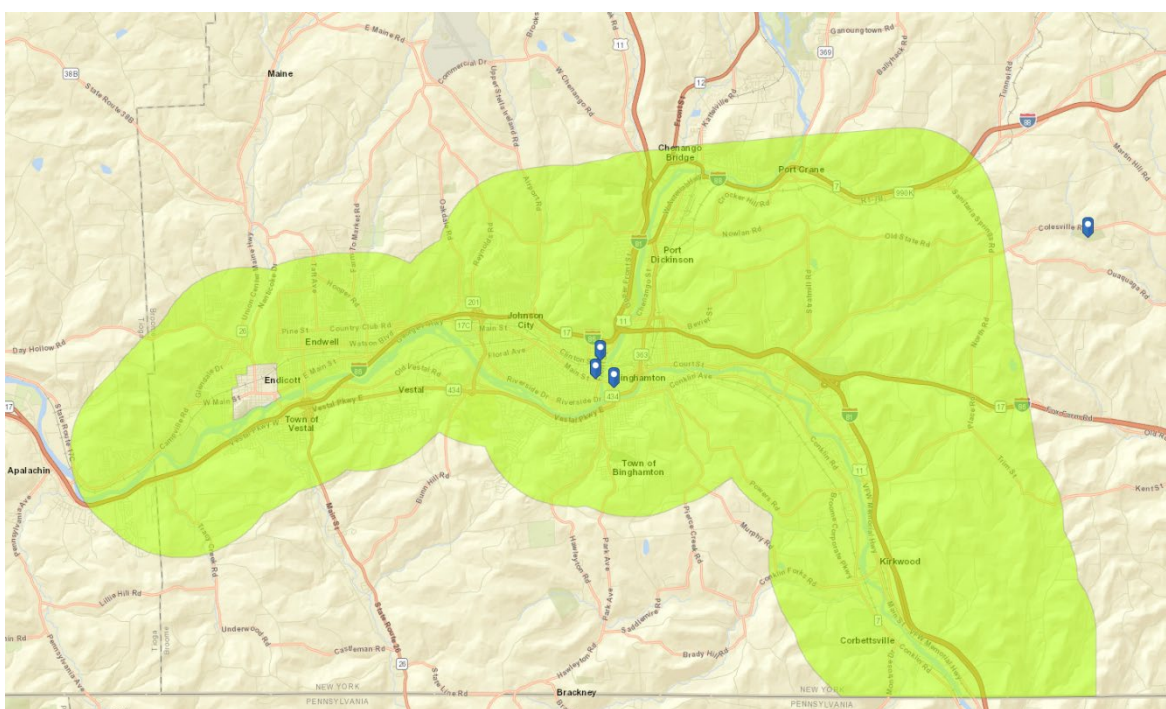


Figure 33. NYSEG Electric Vehicle Disadvantaged Communities Map

Three of the project sites (Health Department, Department of Social Services and the County Office Building) are located in NYSEG Electric Vehicle Disadvantaged Communities, shown with blue markers in Figure 32. However, because the chargers will not be publicly accessible, it is expected that the County will only be eligible to receive a 50% cost-share through the Make-Ready Program. Were the County to consider public charging at these sites, a 90% cost share may be available for charging infrastructure.

Three of the proposed projects sites (Health Department, Department of Social Services and the County Office Building) fall within a census tract with a [poverty rate above 20% as identified by US DOT](#). As a result, Broome County may be eligible to receive a Section 30C direct pay tax credit for EV chargers at the proposed project sites of 6% or up to 30% if certain prevailing wage requirements are met. This may result in a further reduction in costs for installation of charging infrastructure. It is recommended that Broome County work with a [NYSEG approved contractor](#) or Electric Vehicle Service Provider (EVSPs) to conduct a detailed site assessment to understanding project costs and program eligibility. Because this incentive will vary based upon location and prevailing wage requirements, it has not been included in the TCO assessments provided by Cadmus. This incentive would further improve TCO economics for the 12 vehicles located at the Health Department, Department of Social Services and the County Office Building sites. If all requirements are met, this incentive is estimated to be up to \$2,500 per charging port.

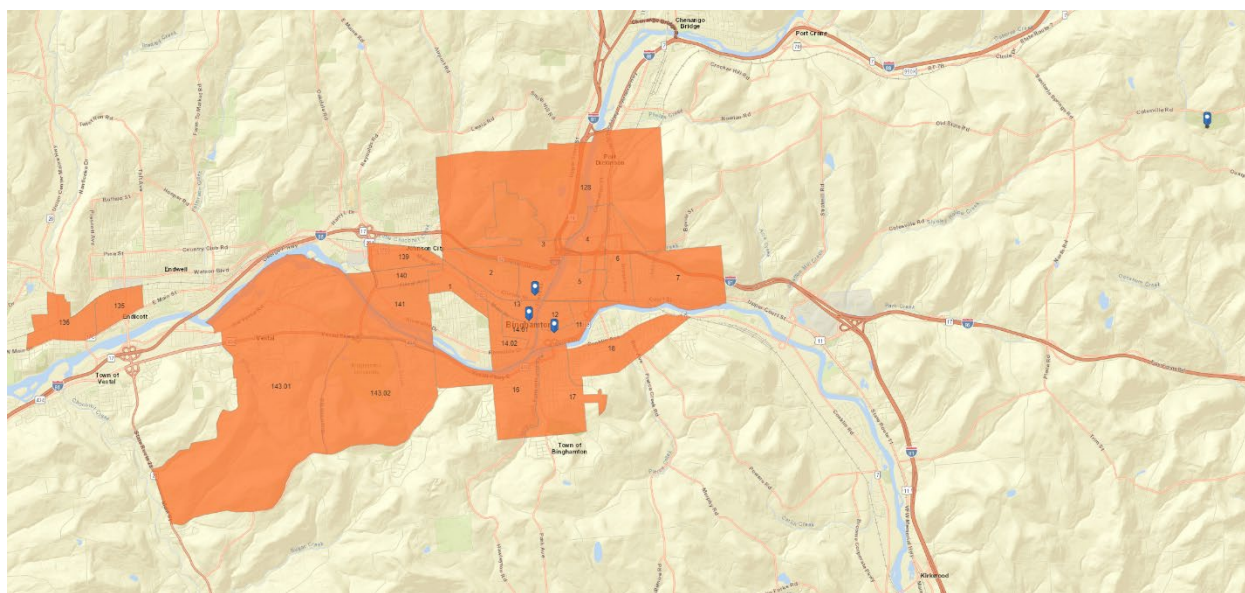


Figure 34. US Department of Transportation Disadvantaged Communities Map

Estimated costs for EVSE at the project site have been developed using national-level project cost data tracked by the National Renewable Energy Lab (NREL) and Argonne National Lab (ANL) and detailed cost data from over 100 charging projects for fleet operators in California evaluated by Cadmus. With a 50% cost share through the NYSEG Make Ready Program, Cadmus estimates the EVSE cost to Broome County to be approximately \$8,000 per charging pedestal, or \$4,000 per port.

As the NYSEG Make Ready Program is limited to one funding opportunity per site, Broome County should consider “stub-outs” for future charger installations given additional vehicles that will be suitable for electrification in the future (either because existing vehicles reach the end of their lease terms or new classes of vehicles feature EV options, such as medium-duty trucks). In addition, workplace charging for employees is an option that can enable EV ownership by those who do not have access to home charging.

Individual site costs will vary dependent upon the level of infrastructure upgrades required at each project site, including any necessary trenching, panel upgrades and transformer replacement. To minimize costs, Broome County should site EV chargers in close proximity to existing electrical infrastructure at each site.