

Integrating EVs into a City Fleet: Final Internship Report for City of Sequim, WA

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The author, Connor Holm, with his Chevrolet Bolt EV

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Introduction

As electric vehicle technology continues to mature and become more readily available, fleet managers around the world are faced with the decision of whether or not to integrate these EVs into their fleets. For those who pursue this, some choose to integrate these EVs as a result of policy while others adopt EVs in an effort to decrease pollution or to reduce maintenance and fuel costs. Regardless of the reason, the transition to electric vehicles is gradually becoming more and more common.

When deciding whether or not to integrate EVs into a fleet, numerous factors must be considered. This report summarizes and analyzes the applicable costs and needs associated with purchasing electric vehicles as well as covers the practical applications of these vehicles for a small city – and specifically for the City of Sequim, population 7,000, on the North Olympic Peninsula of Washington State. While EVs are inherently unable to replace certain specialty vehicles, this report demonstrates that, with certain compromises, it may be entirely possible to integrate numerous electric vehicles into city fleets.

This report was written for the City of Sequim as a means of providing a comprehensive analysis of all known factors associated with integrating electric vehicles into the City's fleet, as of May 2020. This analysis was written by Connor Holm, a Peninsula College student, who, as a requirement of his Bachelor's in Applied Business Management program, was required to intern for a local organization. As someone who is passionate about environmental sustainability, the decision to task Connor with writing this report was mutual.

Lastly, the author would like to thank Ann Soule, the City of Sequim's Resource Manager and Connor's intern supervisor, for the help and advice that she offered throughout the process of writing this report. Additionally, the author would like to thank several City of Sequim staff who provided documents and information relevant to the report as well as provided critical feedback during the revision process. In particular, Sarah VanAusdle, Cindy Swegle, Pete Agostine, Ty Brown, and David Garlington were all very helpful

PART I: Costs & Benefits of EV Fleets

Purchase Price Cost Comparison

With electric vehicle (EV) technology still being in its infancy, limited production and demand of EVs has yet to reach a place that has significantly lowered the price when purchasing an electric vehicle brand new. Instead, in general, the MSRP of an EV over a comparable internal combustion engine (ICE) vehicle can range anywhere from \$10,000 - \$20,000 more.

The chart below provides the MSRPs for popular electric vehicles:

ELECTRIC CAR PRICES

MAKER ↕	MODEL ↕	MSRP ↕
BMW	i3	\$44,450
TESLA	Model 3	\$39,490
HYUNDAI	Kona	\$38,305
CHEVROLET	Bolt	\$36,620
VOLKSWAGON	e-Golf	\$31,895
NISSAN	LEAF	\$29,990

Source: CNBC (2019), Electric Vehicle Prices Finally in Reach of Millennial, Gen Z Car Buyers

Throughout this report, both the Chevrolet Malibu and Chevrolet Bolt EV will be compared and referred to, because these vehicles are quite similar in both functionality and practicality. On Chevrolet's online vehicle 'designer', MSRP for a base model 2019 Chevrolet Malibu is ~\$23,000 while MSRP for a base model 2019 Chevrolet Bolt EV is ~\$37,500. Excluding the additional sales tax associated with purchasing a more expensive vehicle, this makes the initial cost of purchasing an EV \$14,500 more than purchasing a comparable ICE vehicle.

However, when purchasing a single vehicle at the Sourcewell fleet price through the National Auto Fleet Group (NAFG), the price of both vehicles decline. The price of the Chevrolet Malibu decreases to ~\$21,000 while the price of the Chevrolet Bolt decreases to ~\$36,000.¹ As a result of the prices of both of these vehicles declining by similar values, the price gap between the two vehicles remains relatively similar to before at \$15,000.

In addition to purchasing the vehicles online through either Chevrolet or NAFG, vehicles can be purchased new directly from a dealership. Although purchasing a vehicle this way may not decrease the sale price of the vehicle by much, in general, it is possible to get a vehicle for roughly \$1,000 - \$3,000 less than the online MSRP depending on dealer discounts, vehicle incentives, and the dealer's willingness to negotiate.

¹ See Appendix for a copy of the email quote.

Another method of procuring vehicles for the City's fleet is to purchase the vehicle used from a third-party or used from a dealership. As time goes on, the range of new electric vehicles will likely increase, resulting in decreased resale values for older EVs. Since it is impossible to know just how much EV technology will improve in the future, there is no way of predicting the actual depreciation rate for an electric vehicle. However, Edmunds, an online organization that specializes in vehicle data and reviews, has a 5-year 'cost of car ownership calculator' that calculates the estimated depreciation amount for vehicles. Since the Bolt has only been on the market since 2017, there is not enough information available for the calculator to estimate the Bolt's depreciation rate. The only comparable alternative is the Nissan LEAF S Plus which has an almost identical range and MSRP to that of the Bolt. Using this calculator for a 2019 Chevrolet Malibu, it estimates its 5-year depreciation to be \$13,985. Using the calculator for a 2019 Nissan LEAF Plus, it estimates its 5-year depreciation to be \$29,503. With these estimates, the EV's depreciation is 2.11X more than that of the ICE vehicle.

Of course, the actual purchase price of the vehicle greatly depends on the seller's willingness to negotiate, the year of the vehicle, the mileage of the vehicle, and the market-demand for the vehicle. Older Nissan LEAFs, for example, have been on the market since 2010 and, as a result, are relatively inexpensive compared to purchasing the latest model-year LEAF directly from a dealership. These older LEAFs (2011-2016), in good condition, can often be found used for between \$9,000 and \$15,000.² In fact, paired with these lower prices, the 80-100 miles of range that these vehicles offer may be entirely practical for municipal use.³ Regardless, it is reasonable to assume that purchasing a vehicle used from a third-party or used from a dealer has the potential to save money and will most likely be the cheapest of the options listed above.

Maintenance Needs and Costs

As can be seen, the initial cost of an electric vehicle is substantially more than the that of a comparable internal combustion engine vehicle. However, the lifetime ownership costs of an EV are considerably less than the ownership costs of an ICE vehicle, particularly over the long term.⁴ While EVs have numerous electrical components, they contain considerably fewer mechanical parts than ICE vehicles. In an EV, there is no engine, no transmission, no catalytic converter, no exhaust system, and no driveshaft, just to name a few. Additionally, with an EV, there is no need for oil changes or transmission fluid changes, and, because of electric vehicles' ability to regeneratively brake, the brakes receive very little wear and, therefore, require very little maintenance. Although electric vehicles require considerably less maintenance than ICE vehicles, there are common maintenance requirements that both vehicles share: air filter replacements; brake fluid, windshield wiper fluid, and coolant system fluid changes; tire replacements and rotations; 12v accessory battery replacements; and routine mechanical inspections.

² These prices were found on Seattle Craigslist, and most of the listings were from dealerships.

³ This, of course, depends on the average trip length for comparable fleet vehicles.

⁴ Forbes (2017), The Bottom Line on Electric Cars: They're Cheaper to Own

As can be seen in the chart below from New York City’s March 2019 Fleet Newsletter, maintenance costs for EVs are significantly lower than the maintenance costs of ICE vehicles:

NYC Fleet: Savings Maintenance Costs with Electric Vehicles			
Vehicle Model	System	Number	2018 Maintenance Cost (\$/vehicle)
Bolt	All Electric (BEV)	93	\$ 204.86
Leaf	All Electric (BEV)	149	\$ 344.14
Focus Electric	All Electric (BEV)	7	\$ 386.31
Fusion Energi	Hybrid Gas/Electric Plug-in (PHEV)	154	\$ 496.73
Prius	Hybrid Gas/Electric (HEV)	1131	\$ 893.31
Taurus	Gas	38	\$ 922.67
Volt	Hybrid Gas/Electric Plug-in (PHEV)	43	\$ 1,210.40
Fusion hybrid	Hybrid Gas/Electric (HEV)	205	\$ 1,310.89
Fusion	Gas	62	\$ 1,621.34
Focus	Gas	11	\$ 1,805.24

Source: GoEV City, Electrify Municipal Fleets: Policy Tools

Note: This data originally appeared in New York City’s March 2019 Fleet Newsletter (Issue 255). However, the table has been reformatted by GoEV so that the maintenance costs are displayed from lowest to highest.

Pete Agostine, the City’s fleet mechanic, feels comfortable with performing this relatively basic type of maintenance and inspection. As can be seen below in the 2019 Chevrolet Bolt’s maintenance schedule, there should be almost no major maintenance needed during the life of the car, and all of the required maintenance is mechanical and familiar to Pete. This schedule is similar throughout all EVs. However, with so many electrical components, including the vehicle coolant circuits, he believes that, in the case of an electrical or coolant issue, it would be best to send the vehicle to a dealership that is familiar with working on these electrical systems.

Found below is the complete maintenance schedule for the 2019 Chevrolet Bolt:

Maintenance Schedule	7,500 miles	15,000 miles	22,500 miles	30,000 miles	37,500 miles	45,000 miles	52,500 miles	60,000 miles	67,500 miles	75,000 miles	82,500 miles	90,000 miles	97,500 miles	105,000 miles	112,500 miles	120,000 miles	127,500 miles	135,000 miles	142,500 miles	150,000 miles
Additional Required Services																				
Rotate tires and perform Required Services.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Replace passenger compartment air filter. (1)			✓			✓			✓			✓			✓			✓		
Drain and fill vehicle coolant circuits. (2)																				✓
Replace brake fluid. (3)		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Replace windshield wiper blades. (4)										✓										✓
Replace hood and/or body lift support gas struts. (5)																				

Footnotes - Maintenance Schedule Additional Required Services

(1) Or every two years, whichever comes first. More frequent passenger compartment air filter replacement may be needed if driving in areas with heavy traffic, poor air quality, high dust levels, or environmental allergens. Passenger compartment air filter replacement may also be needed if there is reduced airflow, window fogging, or odors. Your GM dealer can help determine when to replace the filter.

(2) Or every five years, whichever comes first.

(3) Replace brake fluid every five years.

(4) Or every 12 months.

Source: The table has been recreated using data from the 2019 Chevrolet Bolt EV's Owner Manual.

Note: The maintenance mentioned in this table is all of the required maintenance for the vehicle. In addition to the required maintenance, the manual recommends the following: accessory battery replacement; shocks and struts replacement; inspection of the brakes, fluids, hoses, and lamps; tire rotation; wheel alignment; windshield cleaning and maintenance; and wiper blade replacement. The lithium-ion battery pack comes with an 8-year, 100,000-mile warranty.

Although electric vehicles require very little maintenance compared to similar gas-powered vehicles, EVs have one thing to maintain that ICE vehicles do not have: a lithium-ion battery pack. With modern battery packs costing anywhere from \$10,000 to \$15,000 to replace ⁵, EVs have the potential to become expensive investments. However, while there is a common perception that electric vehicles' battery packs are prone to relatively quick degradation, it hasn't always proved true. In particular, modern battery technology has greatly reduced this problem, especially in electric vehicles that use active thermal management (ATM) to cool their battery packs.⁶ Earlier versions (2013-2016) of electric vehicles often only had battery packs that were capable of providing 50-100 miles of range and were often prone to battery degradation of ~15% in just a few years⁷, but exceptions to this do occur.⁸ However, current electric vehicles that use ATM often have a range of 225+ miles and experience less battery degradation (~7%) after three years.⁹ Regardless of how the battery pack is cooled, research shows that warmer climates and frequent DC fast charging are likely to increase the battery's rate of degradation.¹⁰

⁵ This price refers to a Chevrolet Bolt battery pack and excludes installation. Replacement battery packs for older Nissan LEAFs, for example, can be purchased for much cheaper.

⁶ This information comes from Clean Technica, a news website that primarily reports on electric vehicles.

⁷ Data comes from Geotab, a fleet analytics organization. The data refers to the 2013, 2014, 2015, and 2016 Nissan LEAF as these were some of the most popular EVs of these years.

⁸ In some instances, battery packs have degraded exceptionally fast while, in other instances, battery packs have experienced very minimal degradation after many years and thousands of miles of use. This information comes from both online and anecdotal sources.

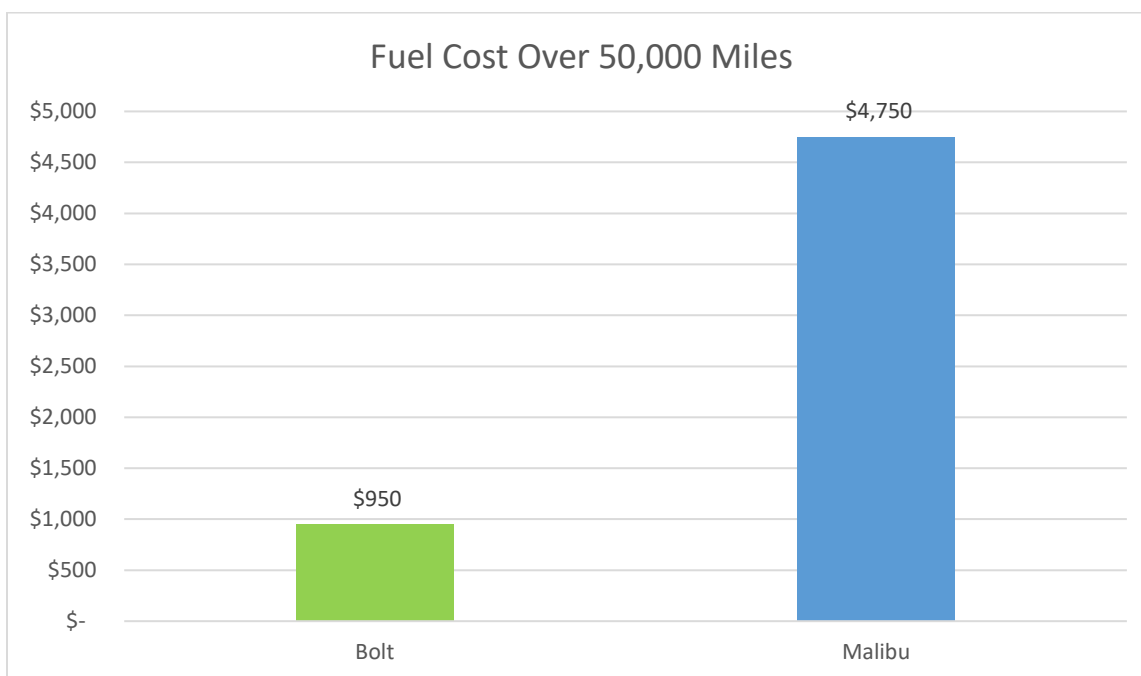
⁹ Data comes from Geotab and refers to the 2017 Chevrolet Bolt, 2016 Tesla Model X, and 2016 Tesla Model S.

¹⁰ Heat, in general, causes battery degradation, but research points to warm climates and DC fast charging as being the leading factors. This information comes from Quartz,

Refueling Cost Comparison

While ICE vehicles use gasoline or diesel to refuel, EVs use electricity to recharge their battery packs. In Washington State, the current average gasoline price is \$3.09 per gallon while the average electricity rate is 8.14¢ per kilowatt hour.¹¹ In a Chevrolet Malibu, which has a ~16-gallon gas tank, this makes a full tank of gas \$49.44 while a full charge of a Chevrolet Bolt's 60kwh battery pack is \$4.88. However, the fuel prices and electricity rates in Sequim are often lower than the state's averages. With a current average of \$3.08/gallon for gas and Clallam County PUD's rate of 7.4¢/kwh for electricity, refueling the Malibu costs \$49.28 while charging the Bolt costs \$4.44.¹²

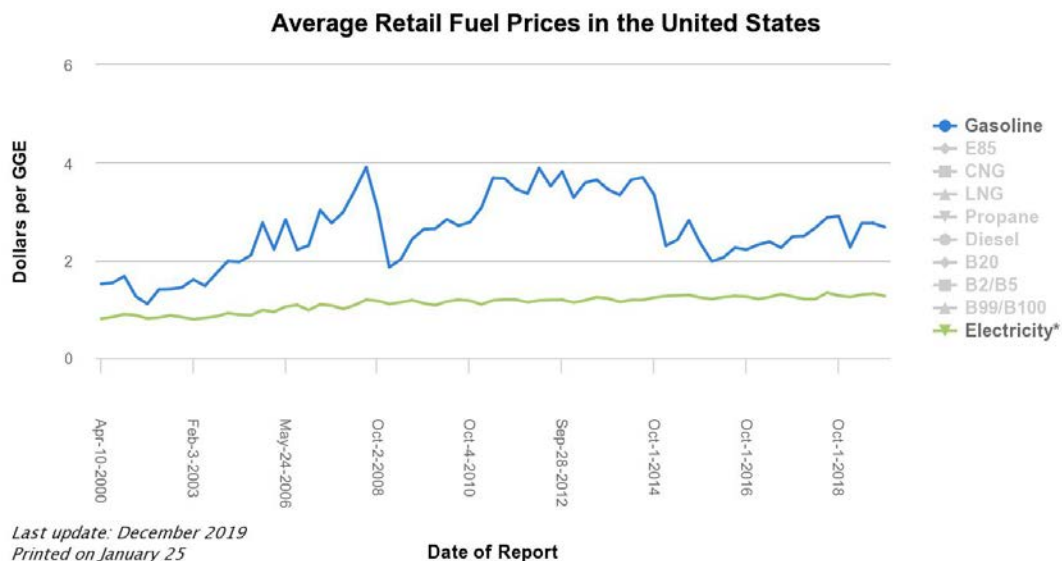
With a combined MPG of 32.5, the Chevrolet Malibu should be able to travel ~520 miles on a single tank of gas while the Chevrolet Bolt's battery pack has a range of ~238 miles. For a direct comparison, the Malibu costs 9.5¢ per mile in gas to drive while the Bolt costs 1.9¢ per mile in electricity to drive. Using the Bolt's estimated 238 miles of range as a point of comparison, the Malibu would cost \$22.61 in gas to travel 238 miles while the Bolt would cost \$4.44 in electricity to travel the same distance. Expanding these numbers to 50,000 miles, the Malibu costs ~\$4,750 to fuel while the Bolt costs ~\$950 to fuel.



¹¹ The average gasoline price comes from AAA and is the current average as of February 19, 2020. The average electricity rate is for February 2020 and comes from the U.S. Energy Information Administration.

¹² The average gasoline price was calculated by averaging out the gas prices from 6 local gas stations: $(\$2.70 + \$2.79 + \$3.20 + \$3.20 + \$3.16 + \$3.40)/6 = \$3.075$

Not only is an electric vehicle consistently cheaper to refuel, but electricity rates are comparatively more stable than gasoline prices. As can be seen in the Department of Energy's graph below, nationally, electricity has experienced only minor fluctuations in price between 2000 and 2019 while gasoline prices have experienced many major fluctuations.



Source: U.S. Department of Energy's Alternative Fuels Data Center

Note: "GGE", as referred to on the y-axis of this graph, stands for 'gasoline gallon equivalents'. The U.S. Department of Energy defines the electricity gas gallon equivalent to be $GGE = \text{Electricity kWh} \times 0.031$. For the Bolt, this would be $GGE = 60\text{kWh} \times 0.031 = 1.86$. In essence, if the Bolt was a gasoline powered vehicle, it would require 1.86 gallons to travel the advertised 238 miles.

Global events can have a direct impact on the price of gasoline both nationally and locally. Tensions in the Middle East, for example, can cause the cost of importing gasoline to rapidly climb in price, resulting in local prices increasing as well. Most of Washington State's electricity, on the other hand, is produced in the Pacific Northwest and, therefore, is not subject to global conditions that cause the price of gasoline to dramatically rise and fall.

Infrastructure Needs and Costs

Electric vehicle chargers come in three different 'levels': level 1, level 2, and level 3. Each level provides significantly more power than the previous level, resulting in the battery being able to charge significantly faster. While the charging capabilities of different model EVs are often quite similar, different EV models have different on-board equipment, meaning that some vehicles are able to charge faster at a certain level than others.

Level 1 charging is commonly referred to as 'trickle charging'. It is significantly slower than the other levels, but it has the convenience of being able to be plugged into a typical grounded wall outlet. At this level, the Chevrolet Bolt gains 4 miles of charge per hour, and, if plugged in from 5:00 pm until 8:00 am, it would regain ~60 miles of charge in this 15-hour window. These chargers are often included when purchasing an EV, but they are also available aftermarket and, in general, cost anywhere from \$175 – \$250 depending on the brand.

Level 2 charging is commonly used as a residential, commercial, and public charging option. Depending on the vehicle, it is usually about five times faster than level 1 charging, but it requires the installation of a 240V outlet and a larger amperage circuit breaker. At this level, the Chevrolet Bolt gains 25 miles of charge per hour, and, if plugged in from 5:00 pm until 8:00 am, the battery would fully recharge well within this 15-hour window. In general, these chargers cost anywhere from \$200 – \$1,000 depending on the brand and the capabilities of the charger.

Level 3 charging is by far the quickest charging option. Commonly referred to as ‘DC fast charging’ (DCFC), these chargers are able to provide up to 100 miles of charge in 30 minutes for a Chevrolet Bolt. However, due to the battery chemistry of EVs, the fuller the battery’s charge when plugged in, the slower the charge rate. This means that EVs, including the Bolt, will charge faster the lower their battery is. These chargers are often placed conveniently along interstate routes for EV owners to use as they pass through since they can provide a relatively quick charge. Fast chargers have immense electrical demands, requiring their own transformer and high-voltage power lines. The lower powered DC fast chargers (25kwh) range in price from \$8,000 - \$15,000 while the more powerful DC fast chargers (50kwh) range in price from \$36,000 - \$50,000.¹³ As a side note, there is evidence that the repetitive use of DC fast charging can degrade an EV’s battery prematurely.

The graphic below describes each level of charger:

Types of ELECTRIC VEHICLE CHARGERS			
			
LEVEL ONE:	Basic Outlet Anywhere	11-20 Hours to Charge	120 Volts
LEVEL TWO:	Installed Public or Private	3-8 Hours to Charge	240 Volts
FAST CHARGE:	Installed Along Highways	30-60 Minutes to Charge	208-600 Volts

Source: Maryland Electric Vehicles

Note: This graphic appears to be based on an electric vehicle with a smaller (older) battery. While the general principles of this chart are accurate, the charging times do not reflect those of newer electric vehicles with larger batteries which require longer charge times.

While there are upfront costs associated with purchasing electric vehicle chargers, there are also installation and inspection costs that need to be considered. Installation of a level 2 charger, for example, can cost as little as a few hundred dollars to as much as several thousand dollars; the price greatly depends on the location of the charger relative to its power source. Depending on

¹³ This price range was established by searching the websites of numerous EV charger manufacturers.

the current capabilities of the electrical panel and its connected wiring, parts may need to be upgraded, resulting in more expenses. On average, workplace level 2 charger installations cost ~\$2,200,¹⁴ but the cost can be much higher if existing pavement must be removed. In addition to installation costs, building and electrical permits need to be purchased up front and the chargers must be inspected upon completion of the installation. Permit fees and inspection fees will vary depending on if the charger is installed in a residential, commercial, or public location. Some fees are calculated based on the ‘value’ of the project while other fees are flat-rate.

As an example of what these fees may be, in 2019, the City of Sequim partnered with Clallam County PUD in installing two level 2 EV chargers at 150 N Govan Ave. This project was valued at \$13,850; this valuation resulted in building permit fees of \$258.67 and plan review fees of \$206.94 for a combined total of \$465.61.

Regardless of the level of charger selected and installed, having parking locations dedicated for electric vehicle charging can prove to be advantageous. These locations allow EVs guaranteed access to chargers when needed and for whatever length of time needed. Depending on how many miles the electric vehicles are driven per day and the time of day they need to refuel, it may be feasible for multiple vehicles to share one charger. EV chargers often have a 15ft or longer charging cable which, if installed in a suitable location, may be able to reach numerous parked EVs.

Found below is an example of a relatively common EV charging solution for a parking garage:



Source: Parksmart, Yorkdale Shopping Centre – Parkades E and G

¹⁴ As determined by ‘The EV Project’, run by the Office of Energy Efficiency and Renewable Energy, the average level 2 workplace installation cost was \$2,223 excluding the cost of the charger.

Practicality for City Transport Needs

Practicality for Limited Types of Vehicles

In general, fleet vehicles can be classified into five categories: commuter, passenger, light-duty utility, medium-duty utility, and heavy-duty utility. While there are numerous electric vehicles on the market, larger EVs are still relatively uncommon.

The most common EVs are on the smaller side, designed to seat 5 people, and have a range from 111 miles to 322 miles. All of these vehicles are capable of DC fast charging, although, on some vehicles, it is an optional extra.

Vehicle	Range (Miles)
Tesla Model 3 Long-Range	322
Chevrolet Bolt	259
Hyundai Kona EV	258
Tesla Model 3 Mid-Range	250
Kia Niro EV	239
Nissan LEAF Plus (S/SV/SL)	226
Hyundai Ioniq EV	170
Nissan LEAF (S/SV/SL)	150
Volkswagen e-Golf	125
Kia Soul EV	111

While the electric vehicles listed above primarily fall into the ‘commuter’ category, many can also be used as ‘passenger’ vehicles. While each of these vehicles vary slightly in hip, head, shoulder, and leg room amount, cargo volume varies quite a bit from vehicle to vehicle. The Chevrolet Bolt EV, for example, has 16.9 ft³ of cargo space behind the second row while the Hyundai Kona EV has 19.2 ft³. The Kia Niro EV has 18.5 ft³ of cargo space behind the second row while the Nissan LEAF has 23.6 ft³. Comparing these numbers to the Chevrolet Malibu mentioned earlier in this report, each of these four EVs has more than the Malibu’s 15.7 ft³ of cargo space. However, this does make sense since most of the electric vehicles mentioned above are hatchbacks. The only EV that has less rear cargo space than the Malibu is the Tesla Model 3 which, like the Malibu, has a standard trunk. But, unlike the Malibu, the Tesla Model 3 does have a ‘frunk’ (front trunk) which does provide slightly more cargo space.

Because of the hatchback design and the size of the rear cargo space, electric vehicles, in some instances, may be capable of performing tasks that are typically demanded of ICE ‘light-duty utility’ vehicles. Although not overly spacious, these EVs may be capable of carrying cleaning supplies, inspection equipment, tool bags, along with a wide variety of other items. In all of the electric vehicles named above, the back-row seats fold down relatively flat to provide more room for cargo. For example, the Chevrolet Bolt has 16.9 ft³ of cargo space behind the second-row seats. However, with the rear seats folded down, this cargo space increases to 56.6 ft³. As another example, the Kia Niro EV has 18.5 ft³ of cargo space behind the second row but has 53 ft³ with the rear seats folded down. Lastly, with the back-row seats up, the Nissan LEAF has 23.6 ft³ of cargo space. But, when the back seats are folded down, the LEAF gains 6.4 ft³ of cargo

space, resulting in a total of 30 ft³. However, while the back-row seats fold relatively flat in many of these EVs, some do not fold entirely flat, resulting in a reasonably large lip between the back of the seat and the floor of the trunk.

The image below is an example of the lip that is found in the Chevrolet Bolt:



Source: Cars (2019), Hyundai Kona Electric Vs. Chevrolet Bolt EV: Which Is the Better Electric Car?

Note: In the Chevrolet Bolt, the gap between the bottom of the trunk and the back of the seats can become nearly flat with the optional false cargo floor.

Other Practical Concerns

When determining whether or not to incorporate electric vehicles into the City's fleet, the question of 'could vs. should' must be considered. This is important because, while certain EV models may currently be able to replace some fleet vehicles, certain practical needs of the City may not be addressable with current technology and slow charging.

Although not covered in the scope of this report, electric vehicles may not be able to meet the demands of situations that require a vehicle to be ready at all times. Emergency vehicle use and unscheduled vehicle trips, for example, may require an ICE vehicle's ability to quickly refuel whenever needed.

PART II: Integrating EVs into Sequim's Fleet

Reasons to Integrate EVs

Research shows that transportation-related air pollution accounts for almost 30% of the United States' greenhouse gas emissions.¹⁵ This pollution has direct effects on the earth's ozone layer and breaks it down over time, resulting in changes in weather patterns, natural disasters, Earth-wide temperature averages, air quality, animal habitats, and human health. In order to combat this pollution, Washington State Legislature calls for local governments to, to the extent practicable, transition to vehicles powered by alternative fuels:

RCW 43.19.648 (2a): “Effective June 1, 2018, all local government subdivisions of the state, to the extent determined practicable by the rules adopted by the department of commerce pursuant to *RCW 43.325.080*, are required to satisfy one hundred percent of their fuel usage for operating publicly owned vessels, vehicles, and construction equipment from electricity or biofuel.”¹⁶

RCW 43.325.080 (2): “Factors considered to determine compliance with the goal in *RCW 43.19.648(2)*, including but not limited to: The regional availability of fuels; vehicle costs; differences between types of vehicles, vessels, or equipment; the cost of program implementation; and cost differentials in different parts of the state...”¹⁷

While the transition to alternative fuel powered vehicles would prove to be environmentally beneficial in any location, transitioning to EVs on the Peninsula stands to provide an even greater positive impact. Throughout much of the United States, and throughout much of the world, electricity is produced through the burning of fossil fuels. However, Clallam County PUD, for example, produces much of its electricity through the use of hydroelectric and nuclear plants, resulting in 97% of its electricity being cleanly produced. This clean energy production is quite common in the Pacific Northwest.

Integrating electric vehicles not only benefits the environment and helps the City conform to State-issued policy, but it also demonstrates to the community that the City is working towards reducing its environmental footprint; in fact, in 2012, the City adopted a resolution (R2012-11) which outlines numerous steps that will be taken in order to reduce the City's greenhouse gas emissions. Furthermore, in 2016, the City adopted a resolution (R2016-16) which identifies and adopts policies that help improve the City's environmental sustainability and resiliency.

Making changes like these are important, because research shows that over ~50% of Americans consider climate change to be a global threat.¹⁸ While incorporating electric vehicles into the City's fleet is only a small step towards fighting climate change and its related effects, it is a step that will hopefully begin to pave a way for the community to follow.

Although the use of electric vehicles has clear benefits in terms of harmful emissions, there is the concern that the production of EV lithium-ion batteries negatively impacts the environment due

¹⁵ Environmental Protection Agency, Sources of Greenhouse Gas Emissions

¹⁶ Washington State Legislature, RCW 43.19.648

¹⁷ Washington State Legislature, RCW 43.325.080

¹⁸ Pew Research Center (2020), U.S. concern about climate change is rising, but mainly among Democrats

to the need for rare metals and/or toxic components, and, at the end of the battery pack's life, its disposal. Over time, it is anticipated that components of used batteries can be recycled and reduce the need for mining; until then there may soon be a cost to recycle used batteries. The entire production process of electric vehicles may create more pollution of certain types than the production of ICE vehicles¹⁹; however, since EVs have no tailpipe emissions, they produce, cumulatively, much less air pollution relative to that of ICE vehicles over the course of their lifetime.

The production of EV battery packs has environmental and social justice implications, but it is also true that the mining, transport, and distribution of fossil fuels to power ICE vehicles also has major consequences to both as well. Many actions, whether large or small, that are taken by individuals, organizations, and society, are environmentally impactful – particularly wherever regulations are not protective of the environment. As a result, when considering the integration of electric vehicles into the City's fleet, it is important to consider all impacts, whether those be positive or negative.

Availability of EVs

As the electric vehicle market continues to grow, the availability of EVs increases along with it. Electric vehicles are available new from dealerships, the manufacturer, or fleet sources, and, since some models of EVs have been on the market for quite a few years, numerous models are also available used through third party sellers.

New –

- *Dealership*: The typical experience of purchasing a new vehicle directly through a dealership applies to purchasing a new electric vehicle as well. Since fewer models of EVs are on the market compared to ICE vehicles, finding an EV at a local dealership may prove challenging. If none are available locally, dealerships in the greater-Seattle area should most certainly have the vehicle in stock.
- *Manufacturer*: In the automotive industry, a reasonably new option for purchasing vehicles has occurred. Many manufacturers now allow their customers to order a new vehicle directly through them rather than through a dealership. By ordering a vehicle online directly through the manufacturer, consumers are able to easily add what options they would like as well as see how the options appear on a virtual vehicle. Chevrolet, Nissan, and Volkswagen are just a few of many manufacturers that offer this.
- *National Auto Fleet Group (NAFG)*: The National Auto Fleet Group is an organization that specializes in bulk vehicle sales for fleet use. In order to receive the lower vehicle price that the NAFG offers, purchasers must be a member of Sourcwell. Sourcwell is a Minnesota government agency that helps increase organizational efficiency by offering products and services through exclusive contracts. Although not all EV models are available through the NAFG, the Chevrolet Bolt, Nissan LEAF, Volkswagen e-Golf, and the BMW i3 are all available for purchase.

¹⁹ Forbes (2019), Are Electric Vehicles Really Better For The Environment?

Used –

- **Local:** In many locations, EVs are available used from third party sellers. These electric vehicles can often be found on Craigslist, Facebook Marketplace, local newspaper ads, etc. Since only a few models of electric vehicles have been on the market for more than a few years, finding a variety of used models may prove to be a challenge. However, looking in more populated locations, like the Seattle area, will provide more used options.
- **Dealership:** Often, local dealerships sell used vehicles. These vehicles typically cost more than purchasing through private sellers but have the added advantage of offering a more streamlined process. Additionally, some dealerships offer perks when purchasing a vehicle through them such as complimentary roadside assistance and tire rotations.

Analysis of Vehicle Trips

The City currently owns and operates 61 vehicles, which, in this report, are defined as any vehicle that has a motor and can be driven:

- **5 Commuter/Passenger Vehicles** – Compact vehicles, sedans, crossovers, and SUVs
- **22 Pickup Trucks** – Any pickup truck smaller than a Ford F-450
- **5 Specialty Pickup Trucks** – Any pickup truck customized for specific tasks or that is larger than a Ford F-350
- **29 Specialty Vehicles** – Dump trucks, street sweepers, bucket trucks, tankers, forklifts, mowers, skidsteers, and cement rollers, among others

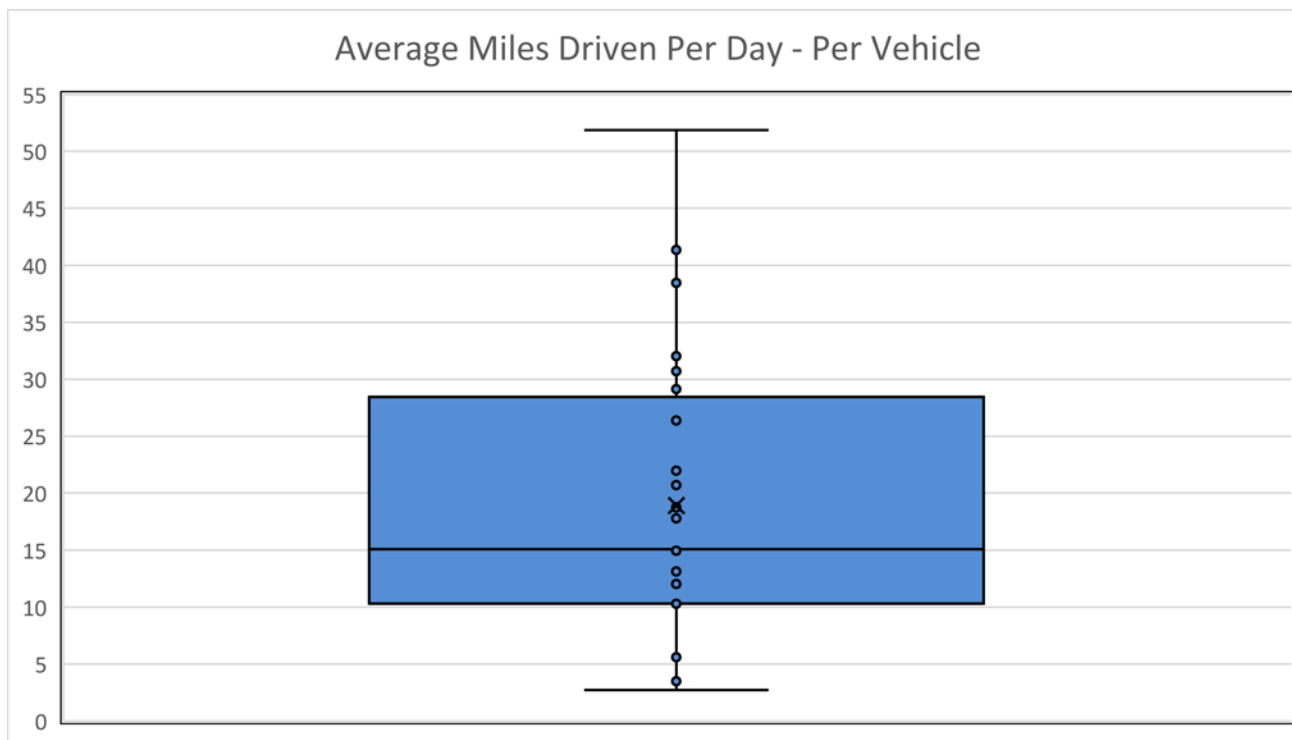
In this report, it is assumed that specialty pickup trucks and specialty vehicles are only driven locally. For this reason, and because there are currently very limited electric vehicle alternatives, these vehicles have been excluded from this report. Although the market for EV pickup trucks is still in its infancy, pickup trucks have been included in this report because it may be feasible to replace some of them with smaller electric vehicles.

The table below summarizes available fuel log data for City-owned pickup trucks and commuter/passenger vehicles:

Vehicle	Model Year	Estimated Combined MPG	Total Fuel Used (Gallons)	Total Fuel Cost (Dollars)	Average Miles Driven Per Day	Average Miles Driven Per Month
WR-02 Chevrolet 2500	1999	7	97	260	3	57
SR-46 F-350	1995	11	70	199	4	73
SR-04 Chevrolet 2500	1994	14	83	251	4	83
TP-36 Chevrolet 1500	1995	11	100	234	6	117
ST-13 Dodge 1500	2007	18	136	351	6	119
SH-75 RAM 3500	2017	12	236	656	10	215
PW-66 Ford Explorer 4WD	2016	17	154	414	10	217
DC-50 Honda Insight Hybrid	2011	30	77	222	12	252
WR-18 Chevrolet 3500	1993	12	264	700	12	257
AD-54 Ford Escape Hybrid Black	2009	29	71	221	13	275
PW-83 Chevy Silverado 4WD Crew Cab Pickup	2017	17	263	672	15	313
PK-49 Ford F-350	2006	8	330	953	15	315
ST-64 Ford F-350 4X2	2015	13	341	962	15	316
SH-03 Ford F-150	2005	16	459	1285	18	372
AD-53 Honda Insight Hybrid	2012	48	51	164	19	393
SR-97 Ram 3500 4x4 Crew Cab Pickup	2018	12	634	2094	21	433
SR-52 Ford F-250	2012	12	416	1202	22	460
AD-84 Dodge Grand Caravan	2017	29	194	807	29	609
WR-73 Dodge Ram 2500	2002	10	537	1500	31	642
WR-65 Chevy Colorado 4WD Ext Cab	2016	15	408	1160	32	670
ST-102 Ford F350 4x4	2019	13	90	303	38	805
TP-98 Ram 2500 4x4 Crew Cab Pickup	2018	13	721	2103	41	864
WR-82 Chevy Silverado 2500HD	2017	9	1012	2718	52	1085
TOTALS			6741	19430	428	8944
AVERAGES		16.3	293	845	19	389

Note: The totals and averages found above were calculated using data from the City's 2019 vehicle fuel-up log. Where possible, a vehicle's 'Estimated Combined MPG' was averaged from three MPG calculations. However, some vehicles had very few fuel entries, and some vehicles may be missing fuel entries altogether. As a result, the numbers found above are estimates based off of the information provided in the log as of March 13, 2020.

Of the 27 vehicles that have the potential to be replaced by EVs, mileage and refueling data are available for 23 vehicles: 5 commuter/passenger vehicles and 18 pickup trucks. With this available data, it was found that commuter/passenger vehicles are driven, on average, 14 miles per working day and 245 miles per month. Pickup trucks, on average, are driven 19.5 miles per working day and 269 miles per month. Combined, both types of vehicles are driven, on average, 19 miles per working day and 275 miles per month.



Note: The box plot found above was created using data points from the 23 vehicles mentioned above that had available fuel and mileage data.

Of course, some of these vehicles may be occasionally taken on reasonably long trips, so the averages may not be exact representations of real-world everyday driving. Additionally, although the City encourages employees to drive City-owned vehicles for work-related trips, employees sometimes drive their own vehicles. As a result, the averages calculated above are representative of known trips in City-owned vehicles.

For these work-related trips, City staff have access to three vehicles for work-related driving: a Honda Insight Hybrid (vehicle #53), a Ford Escape Hybrid (vehicle #54), and a Dodge Grand Caravan (vehicle #84). During the period from May 2019 – January 2020, City staff checked out these three vehicles for a combined total of 151 times.

The table below summarizes relevant data for May 2019 – January 2020:

Vehicle	Number of Times Checked Out	Trips to Locations on the North Olympic Peninsula	Percentage of Trips to Locations on the North Olympic Peninsula	Average Miles Driven Per Working Day
Honda Insight Hybrid (#53)	61	48	79%	19
Ford Escape Hybrid (#54)	58	48	83%	13
Dodge Grand Caravan (#84)	32	12	38%	29

Overall, combined, 72% of these three specific vehicles' trips were to locations on the North Olympic Peninsula (Sequim, Port Angeles, and Port Townsend). In addition to these locations, other common destinations were Silverdale, Forks, Poulsbo, Shelton, Bremerton, Olympia, Port Ludlow, and Mt. Vernon.

Funding Assistance

There are currently several types of funding assistance for purchasing EVs and the associated infrastructure:

Tax Credit: A tax credit is a specific dollar amount that can be applied towards various types of taxes paid during a fiscal year. The credit can be federal, state, or local.

As of the writing of this report, there are two tax credits that are applicable when purchasing an electric vehicle; they may or may not apply to a municipality making a purchase.

1. **Federal Tax Credit** – This income tax credit is offered by the federal government and provides a tax credit of up to \$7,500 for purchasing a new electric vehicle or plug-in hybrid vehicle (PHEV). The credit amount offered varies based on the size of the battery, but most modern EVs have batteries large enough to qualify them for the full credit amount.

However, the tax credit does not last forever and begins to phase out after a manufacturer has sold 200,000 eligible EVs or plug-in hybrids in the United States. For example, during the third quarter of 2018, Chevrolet crossed the 200,000-vehicle threshold. For the next two quarters (October 2018 – March 2019), all EVs and PHEVs sold by Chevrolet were eligible for the full \$7,500 tax credit. During quarters two and three of 2019 (April 2019 – September 2019), the eligible credit amount was cut in half, making the credit \$3,750. Finally, for the following two quarters (October 2019 – March 2020), the tax credit for Chevrolet’s EVs and PHEVs was \$1,875. Once quarter two of 2020 began, all Chevrolet EVs or PHEVs became ineligible for the federal tax credit.

2. **Alternative Fuel Vehicle Refueling Property Credit (IRS Form 8911)** – This tax credit is offered by the federal government and covers up to 30% or \$30,000, whichever is smaller, towards the purchase and installation of alternative fuel vehicle refueling equipment on business/investment use property. Electric vehicle chargers are included in the tax credit qualifications. As an example, this means that a \$4,000 EV charger installation (including purchase costs) would be eligible to receive a tax credit of \$1,200, making the total cost of the installation \$2,800.

Sales Tax Exemption: Sales tax exemptions are offered as an upfront reduction in the sales tax of a qualifying product. Note, however, that municipalities are not always eligible for sales tax exemptions.

1. **Washington State Sales Tax Exemption** – In Washington State, EVs and PHEVs (with at least 30 miles of all-electric range) are eligible for a sales tax exemption. For new vehicles, the following table explains the tax exemption amount and the phaseout period:

Date	Sales or use tax exemption available
Aug. 1, 2019 – Jul. 31, 2021	up to \$25,000 of the sales or lease price
Aug. 1, 2021 – Jul. 31, 2023	up to \$20,000 of the sales or lease price
Aug. 1, 2023 – Jul. 31, 2025	up to \$15,000 of the sales or lease price

Source: This table was recreated using information from Washington State’s Department of Revenue website.

This sales tax exemption is also applicable for the purchase of used EVs. Until July 31, 2025, all used EV purchases will be free from sales tax up to \$16,000. This means that if an EV is purchased used for \$25,000, then sales tax only needs to be paid on \$9,000.

2. **Electric Vehicle Infrastructure Tax Exemption (RCW 82.08.816)** – In Washington State, and until July 1, 2025, all parts, labor, and services associated with the purchase and installation of electric vehicle infrastructure are exempt from the State’s sales tax. This exemption includes the purchase of electric vehicle chargers as well as the payment for any related installation or construction labor or services. At the time of payment, the payee must provide the applicable tax exemption certificate.

Rebate: A rebate is a cash lump sum that is either deducted upfront from the purchase price of a qualifying product or is reimbursed after the purchase of a qualifying product. Rebates are often offered by large organizations or by the product’s manufacturer, but some states also do offer electric vehicle rebates. Generally, rebates are only available for a limited time.

- **Nissan LEAF Public Power Utility** – A rebate offered by the American Public Power Association was available to customers of Clallam County PUD through March of 2020. It was applicable when purchasing a new 2019 Nissan LEAF as follows: \$3,500 for a 40kWh LEAF to \$2,500 for a 62kWh LEAF.

Manufacturer-Offered Discount: These discounts can have many different names, but they are, essentially, cash discounts offered by the vehicle’s manufacturer.

- **Chevrolet Customer Cash** – Chevrolet recently offered \$8,500 in ‘customer cash’ towards the purchase of a new Chevrolet Bolt EV. This discount was available through April 30, 2020 from all Chevrolet dealerships. The \$8,500 acts as a cash discount and is applied upfront to the purchase price of the vehicle. However, sales tax is paid on the discount since it the \$8,500 is a discount and not a price decrease.

Grant: A grant is awarded by the federal, state, or local government to help fund projects that are seen as beneficial. These are typically quite competitive and are not guaranteed.

- **Electrification of Transportation Systems Program: Clean Energy Fund (CEF)** – Each year, the Washington State Department of Commerce offers funding opportunities through its Clean Energy Fund. If awarded a portion of this grant, the funds can be used by local government, along with other entities, to help fund the construction of electric vehicle charging infrastructure. The Clean Energy Fund attempts to emphasize the needs of communities that are highly impacted by transportation pollution, but projects in other locations will also be considered. All applicants are required to submit a Letter of Intent prior to submitting their full application; for 2020, this date has passed, meaning that the City cannot take advantage of this grant during 2020. Assuming that legislature will again allocate funds for this grant, there will be future opportunities for the City to apply to receive a portion of these funds.

Although there are currently no grant opportunities for the City to take advantage of, it is possible that the following state and federal agencies may offer relevant grants in the future: Department of Commerce, Department of Transportation, Department of Ecology, Department of Energy, Department of Agriculture, Department of Natural Resources, Department of Health,

Environmental Protection Agency, and the Federal Department of Energy's Vehicle Technologies Office.

Analysis of Aggressive vs Moderate Transition to EVs

When determining when to, and to what extent, transition a fleet to electric vehicles, it is important to consider whether the transition should be gradual or more aggressive. Each of these timeframes have benefits that should be considered.

For example, a more aggressive transition has the following benefits:

- It is better for the environment
- It would be an example to the community

On the other hand, a more gradual transition has the following benefits:

- Financial incentives may be available in the future
- The price of some electric vehicles will most likely be lower ²⁰
- Electric vehicles will likely have longer range batteries ²¹
- More models of electric vehicles will likely be available from a wider variety of automakers ²²
- More electric vehicles will be available used
- There will likely be EV options for medium- and heavy-duty vehicles ²³

While many of the benefits of a gradual transition to an electric vehicle fleet are likely to occur, technological advancements are not always predictable or guaranteed, meaning that these benefits may not materialize for numerous years or at all.

²⁰ Geotab (2020), Electric vehicle trends 2020: Top 6 factors impacting fleet electrification

²¹ Ibid.

²² Ibid.

²³ Ibid.

Conclusions

The following summarizes the key findings of this report:

Costs

The purchase price of a new electric vehicle and the costs associated with purchasing and installing EV infrastructure are significantly higher than purchasing a comparable, new ICE vehicle. However, over the course of an electric vehicle's life, maintenance and fueling costs are lower. Therefore, the longer an EV is owned, the better the value.

City of Sequim's fleet management assumes new vehicles will be kept for 20 years. Found below is a comparison of the estimated costs over 20 years or 200,000 miles for the Chevrolet Malibu and the Chevrolet Bolt, based on data presented earlier in this report:

	Chevrolet Malibu	Chevrolet Bolt
Purchase Price	\$23,000	\$37,500
Fuel Cost Per 200,000 Miles	\$19,000	\$3,800
Maintenance Costs Over 20 Years	\$34,000	\$4,000
EV Battery Replacement Cost	N/A	\$15,000
EV Infrastructure and Installation	N/A	\$3,000
Lifetime Totals	\$76,000	\$63,300

Note: Vehicle maintenance costs come from New York City's fleet data. New York City uses the Chevrolet Bolt but does not use the Malibu; the City instead uses the Ford Focus and Ford Fusion. Since these vehicles are both comparable to the Chevrolet Malibu, the \$1,700 maintenance should provide a relatively accurate estimate. EV battery replacement estimated at \$15,000 is not certain within 10 years but can be assumed within 15-20 years (current battery technology is too new to have certainty of its lifespan or cost of replacement). Finally, the EV infrastructure and installation cost was calculated with the following: \$2,200 installation + \$800 charger. If it's available to the City, a 30% EV infrastructure tax credit would lower this cost to \$2,250. Note that infrastructure costs may be spread over time and may not be required for each new EV.

Given these conservative assumptions, the total cost over a 20-year period is estimated at \$76,000 for the Chevrolet Malibu and \$63,300 for the Chevrolet Bolt. Depreciation is assumed to be roughly equivalent for both vehicles.

Integration of EVs into the City's Fleet

Certain fleet vehicles require qualities only found in ICE vehicles. For this reason, until more EV options become available on the market, it is unlikely that a large portion of the City's heavy-duty fleet can be replaced with EVs. However, if some compromises are possible in regards to vehicle qualities, such as cargo space and range, replacing some portion of the City's fleet with EVs may be feasible. Passenger vehicles that are used for trips, in-city inspections, and in-city maintenance, for example, would likely be suitable candidates for being replaced by consumer electric vehicles.

Many City vehicles may not often be driven long distances and may not often require large amounts of cargo space even though they currently have the capabilities. Replacing these vehicles with EVs would likely be entirely possible and would also provide the benefit of lower maintenance and fuel costs.

EV Availability

In recent years, more and more auto manufacturers have begun producing electric vehicles, and, as a result, consumers today have far more EV options available to them than what they had just a few years ago. If this trend continues, in future years, it is highly probable that numerous additional EV models will be brought to market. Along with these additional models will likely come a range of sizes, prices, and functionality.

Financial Assistance

Currently, there is limited funding assistance available to the City to help offset the cost of purchasing electric vehicles. In the future, it is possible that incentives and grants may become available through State agencies or through federal programs. There are, however, still incentives available to the City; these primarily help offset the cost of purchasing and installing EV infrastructure.

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Appendix

1/22/2020

Sell, service, and deliver letter



National Auto Fleet Group

A Division of Chevrolet of Watsonville

490 Auto Center Drive, Watsonville, CA 95076

(855) 289-6572 • (831) 480-8497 Fax

Fleet@NationalAutoFleetGroup.com

1/22/2020

Quote ID: **12606**

Order Cut Off Date: **TBA**

Mr Connor Holm

City of Sequim

152 W. City Cedar St.

Sequim, Washington, 98382

Dear Connor Holm,

National Auto Fleet Group is pleased to quote the following vehicle(s) for your consideration.

One (1) New/Unused (2020 Chevrolet Malibu (1ZC69) 4dr Sdn LS w/1LS, Factory Order) and delivered to your specified location, each for

	One Unit
Contract Price	\$19,320.76
Factory Order	\$0.00
Tax (8.8000 %)	\$1,700.23
Tire fee	\$0.00
Total	\$21,020.99

- per the attached specifications.

This vehicle(s) is available under the **Sourcewell (Formerly Known as NJPA) Contract 120716-NAF** . Please reference this Contract number on all purchase orders to National Auto Fleet Group. Payment terms are Net 20 days after receipt of vehicle.

Thank you in advance for your consideration. Should you have any questions, please do not hesitate to call.

Sincerely,

Jesse Cooper

Account Manager

Email: Fleet@NationalAutoFleetGroup.com

Office: (855) 289-6572

Fax: (831) 480-8497

Quoting Department

Account Manager

Fleet@NationalAutoFleetGroup.com

(855) 289-6572



GMC

Appendix (Continued)

1/21/2020

Sell, service, and deliver letter



National Auto Fleet Group

A Division of Chevrolet of Watsonville

490 Auto Center Drive, Watsonville, CA 95076
(855) 289-6572 • (831) 480-8497 Fax
Fleet@NationalAutoFleetGroup.com

1/21/2020

Quote ID: 12602

Order Cut Off Date: TBA

Mr Connor Sholm
City of Sequim
152 W. City Cedar St.
Sequim, Washington, 98382
Dear Connor Sholm,

National Auto Fleet Group is pleased to quote the following vehicle(s) for your consideration.

One (1) New/Unused (2020 Chevrolet Bolt EV (1FB48) 5dr Wgn LT, Factory Order) and delivered to your specified location, each for

	One Unit
Contract Price	\$33,095.70
Factory Order	\$0.00
Tax (8.8000 %)	\$2,912.42
Tire fee	\$0.00
Total	\$36,008.12

- per the attached specifications.

This vehicle(s) is available under the **Sourcewell (Formerly Known as NJPA) Contract 120716-NAF**. Please reference this Contract number on all purchase orders to National Auto Fleet Group. Payment terms are Net 20 days after receipt of vehicle.

Thank you in advance for your consideration. Should you have any questions, please do not hesitate to call.

Sincerely,

Jesse Cooper
Account Manager
Email: Fleet@NationalAutoFleetGroup.com
Office: (855) 289-6572
Fax: (831) 480-8497

Quoting Department
Account Manager
Fleet@NationalAutoFleetGroup.com
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GMC