Richmond Clean and Green Fleet Report:

Alternative Fuel Analysis and Action Plan

Prepared by:

Alleyn Harned, Executive Director
(804) 539-9425 aharned@vacleancities.org

Matthew Wade, Deputy Director
(540) 568-4051 mwade@vacleancities.org

Virginia Clean Cities
C/O James Madison University
1401 Technology Drive MSC 4115
Harrisonburg, VA 22807

City of Richmond:
Office of Sustainability
Department of Public Works

Updated May 18, 2021

Contents

Introduction

To assist the City of Richmond in evaluating the costs and benefits of potential electric vehicle projects, Virginia Clean Cities utilized the Department of Energy's Argonne National Laboratory's Alternative Fuel Life-Cycle Environmental and Economic Transportation Model (AFLEET). This tool allows the user to evaluate all the advantages of electric vehicles, including long-term cost-effectiveness, more consistent operational costs, increased energy security, reduced greenhouse gas emissions, reduced local air pollution, and reduced noise pollution. The AFLEET Model demonstrates the relationship between project profitability and fleet operating parameters. This report describes how Virginia Clean Cities used the AFLEET Model and other tools to provide guidance for the decision to use electricity in the City's fleet.

Virginia Clean Cities (VCC) at James Madison University collaborated with City staff to perform a review and analysis of the City of Richmond's passenger and light duty classes of its fleet (excluding CNG vehicles) for an optimum understanding of a potential transition to plug-in hybrid electric vehicle (PHEV), electric vehicle (EV) or a combination of both. These alternative fuels present a cleaner, domestic option, which often achieves reduced fuel and maintenance costs in comparison to traditional gasoline and diesel. They are also part of the Commonwealth of Virginia's fleet transition.

Executive Summary

As part of the Mayor's Green Fleet Initiative (GFI), the City's fleet can reduce its carbon dioxide emissions by 44.03% by 2035 by replacing the 1,221-existing gasoline-powered passenger and light duty vehicles with all-electric and plug-in hybrid vehicles. The conversion of a fleet to an alternative fuel is a decision that should be evaluated from financial, logistical, and environmental considerations. The City of Richmond has an opportunity to not only reduce harmful vehicle emissions, but to reduce costs on fuel and maintenance, improve driver efficiency, reallocate resources, reduce idle time, improve local air quality, and build goodwill in the community by successfully implementing this conversion.

The City of Richmond should also consider installing electrical vehicle supply equipment (EVSE, or "charging stations") to support these vehicles. This report provides five Action Items and implementation recommendations for a Green Fleet Initiative.

The first action item is to develop and implement a Clean and Green Fleet Policy and a Clean and Green Fleet Procurement Plan and Schedule. The policy will operationalize the City's targets to reduce fleet GHG emissions, fuel use and vehicle miles traveled (VMT) and require that the City will only purchase and operate low and zero emission vehicles such as Plug-in Hybrid Vehicles (PHEV) or Electric Vehicles (EV) for its passenger and light duty vehicle classes. With the Clean and Green Fleet Procurement Plan and Schedule, the City's Procurement team will identify commercially-available low and zero emission passenger and light duty vehicles and mandate that all new vehicles purchased by the City meet this standard.

The second action item is to develop a comprehensive electric vehicle charging network for City fleet vehicles. The City's Fleet Management and Facilities Management divisions shall work together to identify suitable electric vehicle charging areas in City-owned parking areas. The City should work with an appropriate equipment vendor to acquire and install the EVSE. Backup generator equipment should be installed to eliminate any EVSE down-time in the event of a power outage.

The third action item is to provide education and training to City staff on how to safely and effectively operate and maintain electric vehicles. This will include training on how to properly charge these vehicles. New diagnostic equipment will need to be purchase to support these vehicles. Additionally, the fleet technicians will receive formal training in electric vehicle maintenance.

The fourth action item is for the City's management to provide leadership on five fuel reduction initiatives. Each city department should perform an assessment of their fleet vehicle use to identify potential fuel and cost reductions.

The fifth action is for the city to annually evaluate the program and assess if additional vehicle classes, such as school buses or heavy duty equipment, can be converted to a low or zero emission fuel.

Table 1: Summary of Actions with Projected Costs

Fiscal Year	Action 1	Action 2	Action 3	Total Expenses
2021	Implement clean & green fleet policy & procurement plan	EVSE Site Assessment	EVSE Pilot with 10 installed units	$85,000
2022	Install 42 EVSE with backup generation	Equipment & Technician Training	_	$216,500
2023	Purchase 49 EV and PHEVs	Install 49 EVSE with backup generation	Technician & Driver education	$2,340,954
2024	Purchase 66 EV and PHEVs	Install 25 EVSE with backup generation	Technician & Driver education	$3,014,336
2025	Purchase 90 EV and PHEVs	Install 53 EVSE with backup generation	Technician & Driver education	$4,150,640

2026	Purchase 96 EV and PHEVs	Install 23 EVSE with backup generation	Technician & Driver education	$4,323,716
2027	Purchase 129 EV and PHEVs	Install 25 EVSE with backup generation	Technician & Driver education	$5,776,634
2028	Purchase 101 EV and PHEVs	Install 48 EVSE with backup generation	Technician & Driver education	$4,617,946
2029	Purchase 107 EV and PHEVs	Install 37 EVSE with backup generation	Technician & Driver education	$4,848,022
2030	Purchase 119 EV and PHEVs	Install 6 EVSE with backup generation	Technician & Driver education	$5,281,174
2031	Purchase 117 EV and PHEVs	Technician & Driver education	_	$5,160,482
2032	Purchase 99 EV and PHEVs	Technician & Driver education	_	$4,371,254
2033	Purchase 94 EV and PHEVs	Technician & Driver education	_	$4,152,024
2034	Purchase 90 EV and PHEVs	Technician & Driver education	_	$3,976,640
2035	Purchase 57 EV and PHEVs	Technician & Driver education	_	$2,529,722

Five Action Items for Success

Action 1: Sustainable Fleet Plan through Green Vehicle Procurement

The City should establish a Clean and Green Fleet Policy and a Clean and Green Fleet Procurement Plan and Schedule. The policy will operationalize the City's targets to reduce fleet GHG emissions, fuel use and vehicle miles traveled (VMT). The Procurement Plan and Schedule should set a target of replacing the current fleet of gasoline-powered 546 passenger vehicles and 675 light duty vehicles with EVs and PHEVs by 2035. To do so, the City should establish a "Green Vehicle" procurement standard for any new vehicles that will replace the existing gasoline-powered vehicles. On an annual basis, this procurement standard should survey and evaluate the commercially-available types of electric and plug-in hybrid vehicles. This list of low-emission vehicles will comprise the list of vehicles that City departments can purchase. If a department insists on purchasing a vehicle that does not meet the Green Vehicle standard, then it must provide a compelling business reason which will be subject to Procurement approval.

Procurement considerations

Aggregated Procurement: By aggregating purchasing with other localities and/or the Commonwealth of VA, Richmond can benefit from lower vehicle costs.

Cooperative procurement: By participating through a cooperative purchasing effort, Richmond can benefit from a streamlined procurement process.

Leasing option: Localities as non-taxed entities cannot access federal tax credits for EVs. Localities can, essentially through a capital purchasing lease through a leasing agency access the tax credit and reduce the upfront cost of the vehicle and ultimately the total operational costs of an EV.

Beginning in FY 2022, the City should begin phasing out gasoline passenger vehicles and light duty vehicles that have reached their end of useful life and replace them with electric and plug-in electric vehicles based on the Vehicle Replacement Schedule in Appendix 9.

Project Parameters and Key Performance Indicators

This analysis uses multiple input variables and discounted cash flow analyses in the AFLEET Model to simulate the actual financial circumstances faced by the City fleet over a project period. The AFLEET Model was used in an innovative way to account for the fleet's usage and purchasing scenarios. For EV's the station costs were estimated level 1 and level 2 stations based on current

pricing from a vendor. Electricity prices are based on real-world costs. For each procurement scenario the following inputs in Table 2 were used in the AFLEET Model.

Table 2: Summary of Baseline Vehicle Data				
Parameter	**Passenger Gas**	**Light Duty Gas**	**Passenger EV/PHEV**	**Light Duty EV/PHEV**
Replacement Schedule	42 per year	52 per year	42 per year	52 per year
Fuel Cost per gallon (on 10/31/19)	$2.20	$2.20	$2.20	$2.20
Electricity cost per kWh	N/A	N/A	$0.08	$0.08
Maintenance Cost Per Mile	$0.24	$0.20	$0.16	$0.18
Fueling Station Cost	N/A	N/A	$500-$3000/unit	$500-$3000/unit
Average Annual Vehicle Miles Traveled	7,308	7,894	7,308	7,894
Average MPGE	17.3	11.3	35.9-72.1	23.8-44.3
Base Vehicle Cost	$17,110	$26,762	$28,000-33,000	$45,000-65,000
Average Vehicle Life in years	10	10	10	10

Passenger EV and PHEV

Total Cost of Ownership

To establish a baseline for comparison of different fuel usage scenarios, VCC employed the AFLEET Model to create a scenario for the purchase of 1,221 passenger and light duty vehicles. Table 3 shows the projected total cost of ownership for these 1,221 new vehicles over a 13-year lifespan. The total cost of ownership for 1,221 vehicles over 13 years is $99,066,801, or $81,202 per vehicle.

Table 3: Total Cost of Ownership Summary - Per Lifetime Ownership of 1,221 Gasoline Passenger and Light Duty Vehicles

Cost Sectors	PV Costs	LD Costs
Depreciation	$8,462,605	$16,393,810
Fuel	$7,413,656	$15,184,690
Maintenance and Repair	$13,282,902	$19,826,553
Total Cost of Ownership	$29,159,162	$51,405,053

Environmental and Energy Impact Data - Gasoline

To establish a baseline for comparing the petroleum usage and greenhouse gas emissions of gasoline and electricity, the operational data for the passenger and light duty vehicles was entered into the AFLEET Model to generate estimates for these vehicles. Over their 13-year lifespan, the total petroleum consumption is 190,320 barrels and 110,753 tons of GHG emissions for 1,221 gasoline vehicles. Figure 1 illustrates the carbon dioxide emissions created by this petroleum consumption by City departments in FY 2018.

Department	Emissions CO2e	% Emissions CO2e
Police	4234.59	57%
Public Utilities	1014.77	14%
Public Works	767.87	10%
Fire Department	234.37	3%
Social Services	157.30	2%
Parks & Rec	320.19	4%
Planning and Development	168.36	2%
Sheriff Office	159.46	2%
Courts	152.38	2%
Animal Shelter	87.96	1%
Justice Services	40.44	1%
Office of Emergency Management	19.05	0%
Department of Emergency Communication	11.63	0%
Cemeteries	28.18	0%
Finance & Tax Enforcement	6.16	0%
Library	6.56	0%
Mailing Services	4.93	0%
Assessor's Office	2.61	0%
Information Technology	2.62	0%
Mayor's Office	3.65	0%
Total	**7423.08**	

Figure 1: Tons of CO_2 Emissions by Department

Data Analysis and Results

Electric and Plug-in Hybrid Passenger and Light Duty Vehicles

In this vehicle replacement scenario, the Data Analysis and Results section provides an analysis of the data generated in the AFLEET Model for the purchase and ownership of 1,221 gasoline, EV and PHEV over a 13-year lifespan. The EVs and PHEVs were assumed to drive the same duty cycle and accumulate the same amount of mileage as gasoline vehicles. Electric vehicles have significant fuel economy improvements over traditional gasoline vehicles and therefore provide notable operational cost savings, petroleum displacement and GHG emission reductions. The financing costs for the EVs and PHEVs were assumed to be zero. Most importantly, the fuel cost savings generated from using low-cost electricity can produce a reasonable payback of the upfront capital costs for electric vehicles.

Total Cost of Ownership for EVs and PHEVs

Table 4 shows the total cost of ownership for 1,221 passenger and light duty EVs over a 13- year period. Note the reduction in fuel and maintenance costs delivered by these vehicles compared to gasoline. In VCC's model, 1,221 electric vehicles are estimated to save Richmond $3,490,736

in fuel and maintenance costs over 13 years. The projected payback of the incremental costs of the 546 electric passenger vehicles is 9.0 years and the projected payback for electric light duty vehicles is 18.5 years.

Table 4: Total Cost of Ownership Summary - Per Lifetime Ownership of 1,221 Electric Passenger and Light Duty Vehicles

Cost Sectors	PV	LD
Depreciation	$12,668,545	$35,283,986
Fuel	$1,987,579	$4,326,698
Maintenance and Repair	$11,012,303	$14,539,782
Total Cost of Ownership	$25,668,427	$54,150,465
Estimated Savings over 13 years	-$3,490,736	None
Payback Period	9.0 years	18.5 years

Table 5 shows the total cost of ownership for 1,221 passenger and light duty PHEVs over a 13-year period. Note the reduction in fuel and maintenance costs delivered by these vehicles compared to gasoline. In VCC's model, plug-in hybrid electric vehicles are estimated to save Richmond $4,666,564 in fuel and maintenance costs over 13 years. The projected payback of the incremental costs of the 546 PHEV passenger vehicles is 7.9 years and the projected payback for 675 PHEV light duty vehicles is 12.1 years.

Table 5: Total Cost of Ownership Summary - Per Lifetime Ownership of 1,221 PHEV Passenger and Light Duty Vehicles		
Cost Factors	**PV**	**LD**
Depreciation	$12,859,552	$29,407,696
Fuel	$2,850,962	$6,033,016
Maintenance and Repair	$8,782,084	$11,749,068
Total Cost of Ownership	$24,492,598	$47,189,780
Estimated Savings Over 10 Years	-$4,666,564	None
Payback Period	7.9 years	12.1 years

Cash Flow Analysis

A cash flow analysis shows the flows of cash into and out of the project. This is an important tool that shows future anticipated costs and savings. This analysis assumes that Richmond will be purchasing gasoline on the state contract and using existing fleet fueling facilities. For the electric vehicle charging equipment, it is assumed the city will contract with a vendor to install and maintain all relevant charging infrastructure and will include the cost of said infrastructure in the fuel charge. For this project, EVs and PHEVs accumulate a significant operational cost savings over the 13-year period. The AFLEET Model calculates a positive cash flow of $3,867,564for EVs compared to gasoline vehicles (shown in Figures 2 & 3). This is due to the anticipated savings achieved in fuel and maintenance. PHEVs also produce a total cost savings over the 13-year period of $4,659,868. The AFLEET Model calculates a positive cash flow for light duty PHEVs but not for light duty EVs compared to gasoline vehicles (Figures 2 & 3).

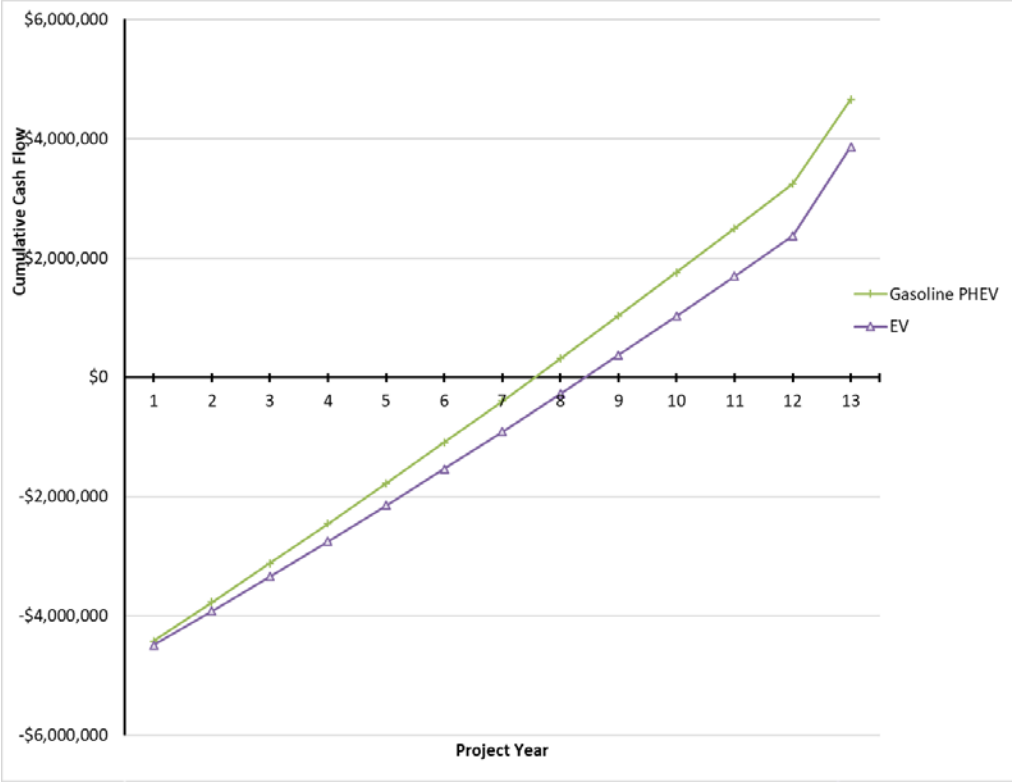


Figure 2: Passenger Vehicle EV and PHEV Cash Flow

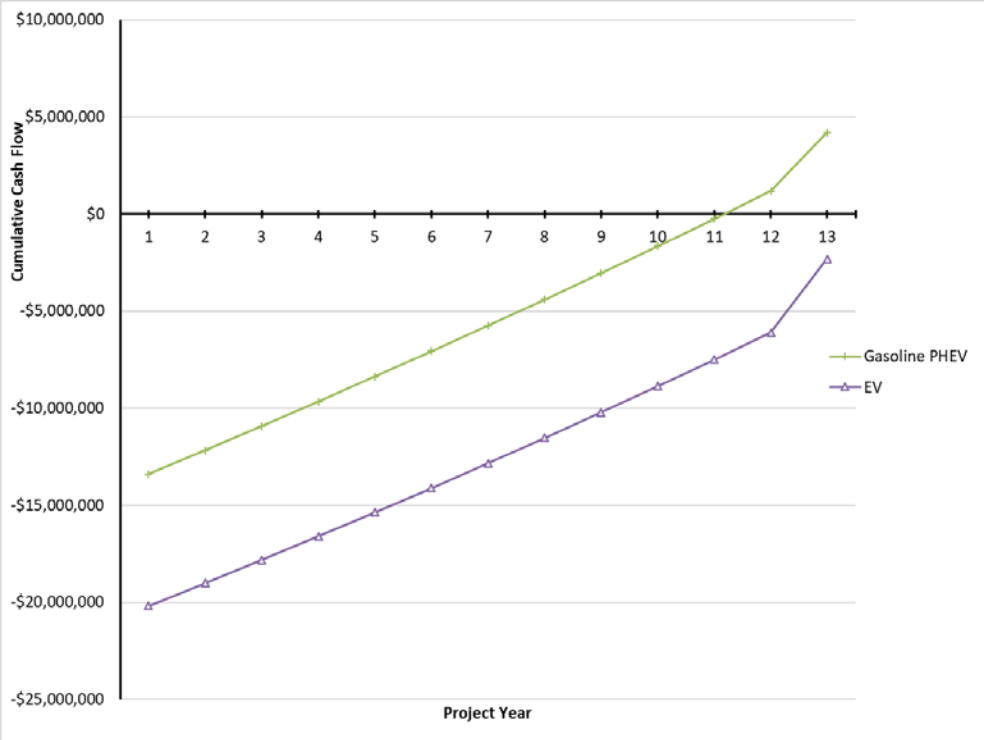


Figure 3: Light Duty EV and PHEV Cash Flow

Environmental and Energy Impact Data

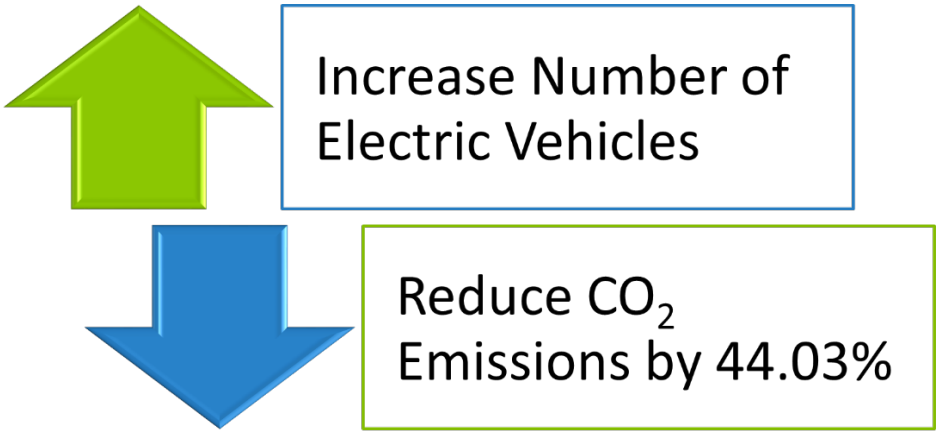
Petroleum displacement and greenhouse gas (GHG) reductions are two important benefits of electric vehicles. Figure 4 shows the actual gasoline and diesel consumption by City departments in FY 2018.

Department	Gasoline	Diesel
Police	478,042	2,240
Public Utilities	105,034	8,732
Public Works	81,734	4,685
Parks & Rec	28,111	7,111
Fire Department	24,133	2,085
Planning and Development	19,084	0
Social Services	17,813	0
Courts	17284.66	0
Sheriff Office	17,192	760
Animal Shelter	9984.71	0
Justice Services	4,581	0
Cemeteries	3202.37	0
Office of Emergency Management	2,157	0
Department of Emergency Communication	1317.93	0
Library	745	0
Finance &Tax Enforcement	697.9	0
Mailing Services	559	0
Mayor's Office	415	0
Information Technology	297	0
Assessor's Office	295.92	0
Subtotal	812,680	25,614
Total Fuel Use	**838,294**	

Figure 4: FY 2018 Fuel Consumption by Department

Figures 5 and 6 summarize the total petroleum consumption and GHG emissions of the 1,221 gasoline, electric and plug-in hybrid vehicles over their 13-year lifespan.

For electric, the total petroleum consumption is 1,223 barrels and total GHG emissions produced are 35,920 tons over 13 years, representing a 99% reduction in petroleum use and 68% reduction in GHG emission compared to gasoline.



For PHEV, the total petroleum consumption is 48,334 barrels and 35,436 tons of GHG emissions over 13 years. This represents a 74.5% reduction in petroleum usage and 58% reduction in GHGs compared to gasoline as shown in Figures 5 and 6.

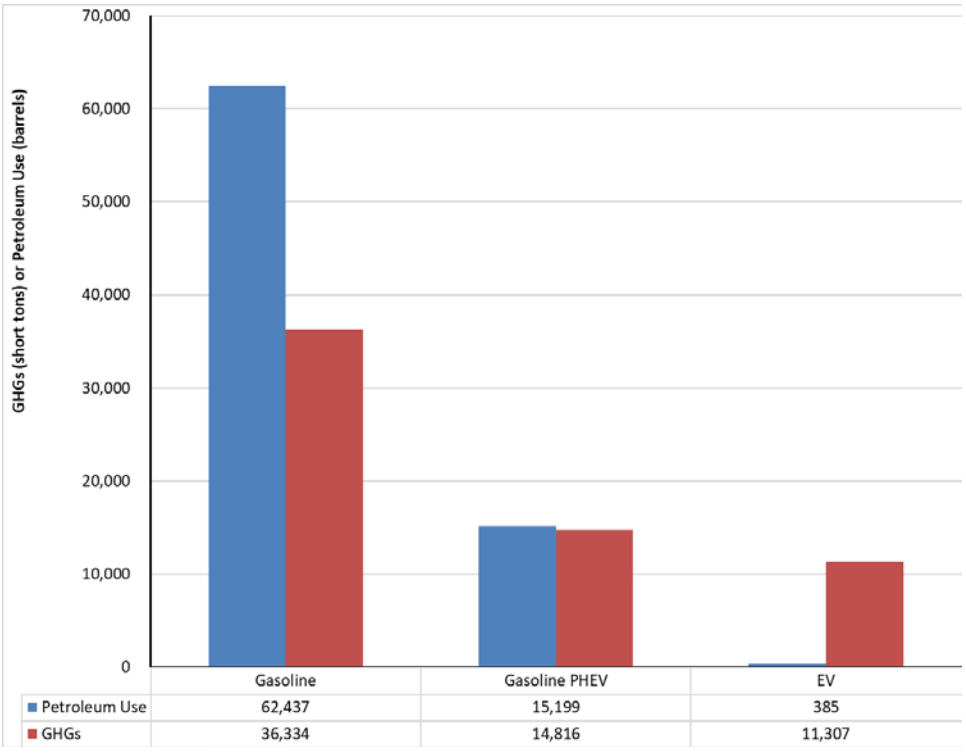


Figure 5: Passenger Vehicle GHG Emissions

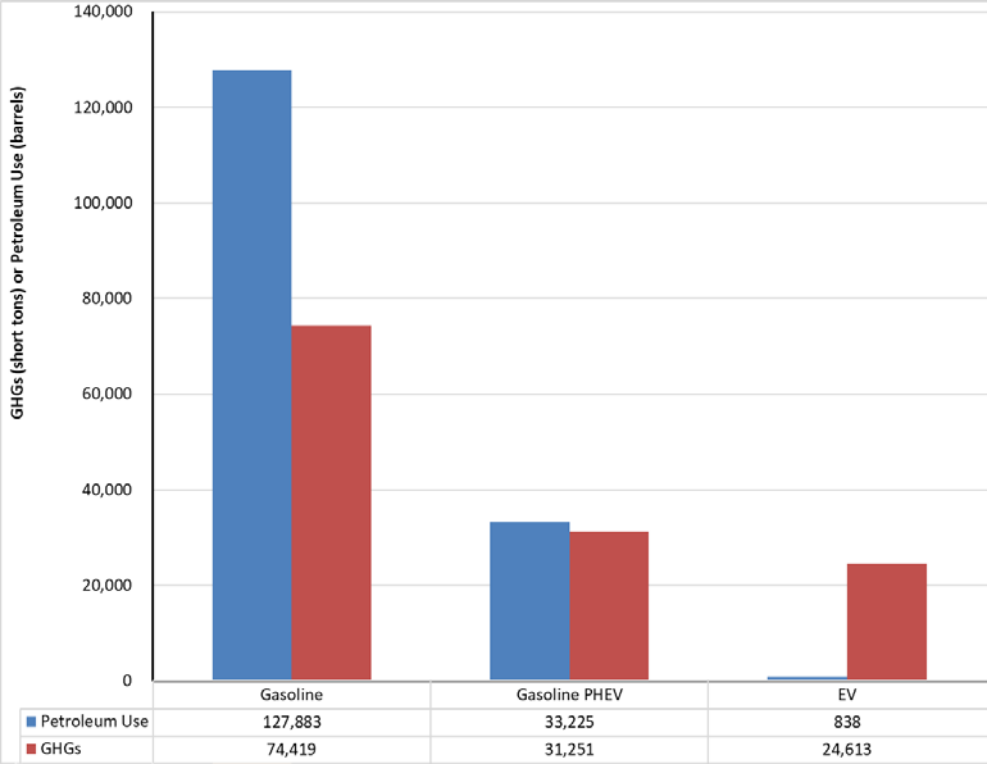


Figure 6: Light Duty Vehicle GHG Emissions

Environmental Justice and the Social Cost of Carbon

Electric vehicles have zero tailpipe emissions and provide significant environmental benefits compared to vehicles powered by an internal combustion engine. No matter where an EV is charged, the electricity used to charge the vehicle will generate less pollution than if the vehicle were powered by gasoline or diesel. In addition to reducing carbon dioxide pollution, use of electric vehicles also results in fewer emissions of nitrogen oxides and particulate matter, both dangerous pollutants with significant health consequences.

A Green Fleet policy that reduces emissions can have a significant positive impact in Environmental Justice (EJ) communities in Richmond. These communities and populations that face disproportionately high and adverse health, environmental, social, and economic burdens caused by their exposure to air pollution from gasoline and diesel vehicles. The adoption of a Green Fleet Plan can mitigate these burdens by reducing the amount of pollution these citizens are subjected to on a daily basis. Please see the _____ report for additional information on EVs and Environmental Justice.

Other environmental benefits of using electric vehicles include reduced deposition of air pollutants, such as nitrogen, into Virginia waters and the Chesapeake Bay. Further, use of EVs reduce runoff onto roads because they do not leak gasoline or other oils associated with internal combustion engines; and the regenerative braking employed in electric vehicles results in reduced PM 2.5 from brake dust and tire wear.

Societal Value of Emissions Reduced (Social Cost of Carbon): EPA has calculated the 2020 social value of one ton of carbon dioxide at $42. By 2027, this value increases to $47 per ton. (EPA Technical Volume, 2016). Thus, the range of net social value to Virginia from carbon dioxide reduction from EV adoption during the program period is estimated to be

between $3,150,000 by 2035.

Action 2: Develop Comprehensive Electric Vehicle Charging Infrastructure

The City should establish a comprehensive network of electric vehicle supply equipment (EVSE) for its fleet of PHEVs and EVs. This will require City staff to identify suitable parking areas to install EVSE, evaluate electrical capacity and upgrades, partner with the local electrical utility, develop a procurement timeline, select qualified equipment vendors, and assign equipment maintenance processes and responsibilities.

Challenges

Challenges to implementing a comprehensive charging infrastructure network for city fleet include: funding the installation cost, lack of electrical capacity in sites, establishing roles and responsibilities of planning, site acquisition, ownership and maintenance between city departments.

EVSE Site Assessment and Feasibility Study

The City should task Fleet Management and Facilities Maintenance with conducting an EV Site Assessment Feasibility Study and work with a vendor to provide technical assistance to identify suitable locations and parking sites for fleet EV charging. This study will include an evaluation of the location and number of available sites and parking spaces for EVs, the current electrical supply, any electrical upgrades to accommodate EV charging infrastructure, and the estimated costs for emergency on-site electricity generation. It will also define the roles and responsibilities related to the purchase, installation, maintenance and replacement of EV charging stations and how the associated costs will be recovered. The City should work with its electricity provider to determine the appropriate upgrades to its electrical service at each designated site.

Pilot

During the first year of this program, the City should task Fleet Management with conducting a pilot program to install EV charging infrastructure to gain an understanding of the costs and logistics associated with installation of EVSE at various locations where fleet vehicles are parked.

Procurement and Installation

Based on estimated electricity consumption of the vehicles, the City should scale up their EVSE capacity by purchasing and installing EVSE on an incremental basis with the goal of achieving a ratio of 1 level 2 charger for every 10 full electric vehicles. This ratio requires a total of 120 level 2 chargers for daily and priority charging. The City should install an additional 230 level 1 chargers for overnight and non-priority charging. Table 6 outlines the EVSE installation schedule.

Table 6: EVSE Installation Schedule						
Fiscal Year	**Level 1 EVSE**	**Level 2 EVSE**	**Estimated cost level 1 installation**	**Estimated cost per level 2 installation**	**Backup generator**	**Total Estimated Installation costs**
2021	5	5	$1000	$3000	$15,000	$85,000 (pilot & site assessment)
2022	20	22	$1000	$3000	$15,000	$70,000-$141,000
2023	40	24	$1000	$3000	$15,000	$70,000-$162,000
2024	30	10	$1000	$3000	$15,000	$60,000-$90,000
2025	28	15	$1000	$3000	$15,000	$125,000-$175,000
2026	28	10	$1000	$3000	$15,000	$60,000-$85,000
2027	30	10	$1000	$3000	$15,000	$75,000-$90,000
2028	25	10	$1000	$3000	$15,000	$130,000-$160,000
2029	24	10	$1000	$3000	$15,000	$115,000-125,000
2030	0	6	$1000	$3000	$15,000	$30,000-$40,000

Develop a Site Plan

The City should choose the site for the EVSE based on the following considerations; proximity to electrical supply, hazard mitigation, local building codes, lighting requirements. TheCity should work with a qualified electrician to design the layout of the EVSE parking area, install new electric circuits and meters, and execute any trenching and landscaping.

Vendor Selection

The City should identify their fleet-specific EVSE needs and develop a Request for Procurement. Many EVSE vendors are currently on Virginia's state contract or the City can use cooperative procurement.

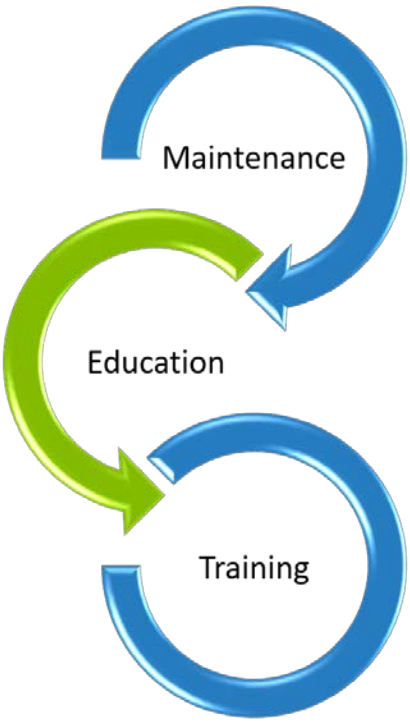
EVSE Administration and Maintenance

The City should develop policies that encourage the safe and responsible use of EVSE by employees. The City should restrict the use of EVSE to City employees.

Emergency Generator

Due to the City fleet needing to be on-call 24/7, the City should evaluate on-siteelectricity generation equipment with a focus on low and zero emission equipment such as natural gas or hydrogen fuel cell. The generation equipment should be a minimum 40kW, which is capable of supplying 3,840 miles of electric range per day.

Action 3: Maintenance, Education and Training



A transition to electric vehicles will require additional driver and fleet technician training on the vehicles and the charging infrastructure. The City's Human Resources department should engage a consultant to develop an EV and charging manual that will be placed in each EV. City employees should be required to watch a training video or read the manual on how to properly charge an EV.

This new technology will require the Fleet Manager to invest in new diagnostic equipment and new trainings for fleet maintenance technicians. New diagnostic equipment is estimated to be a one-time expense of $50,000 followed by an annual subscription of $3,000. Training is estimated to be $5,000 per technician. This additional technician training will lead to an increase in future personnel expenses which cannot be quantified at this time.

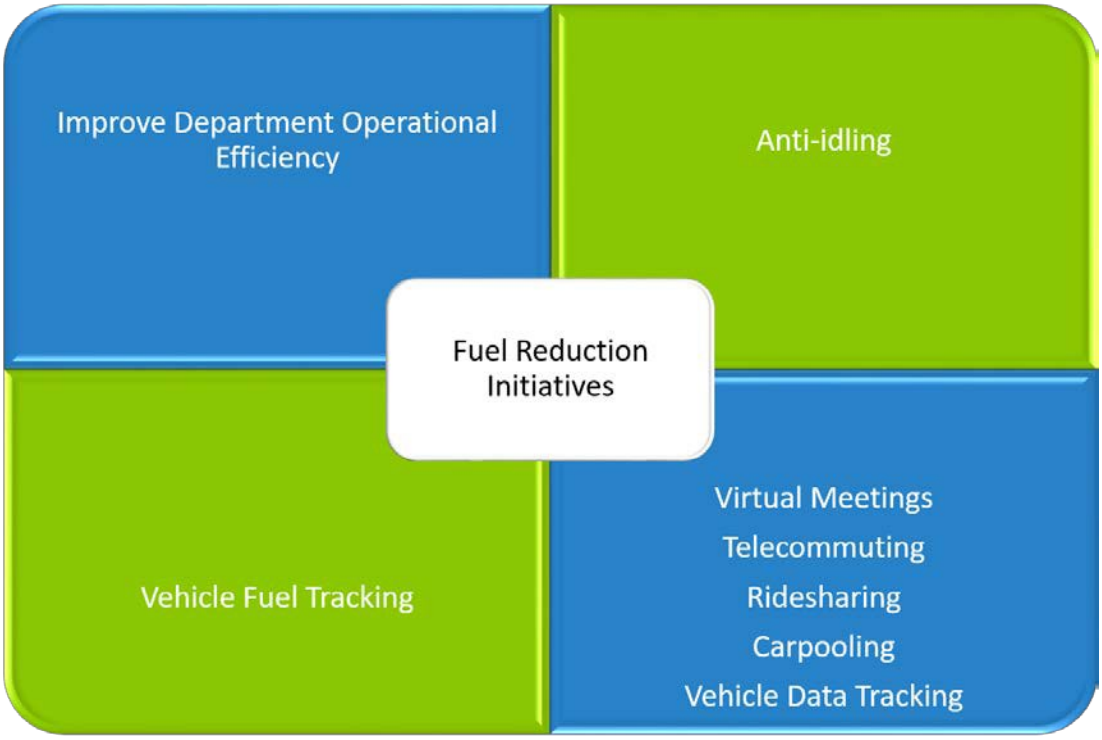
Table 7 projects the estimates expenses from 2021-2035.

Table 7: Training and Equipment Maintenance Expenses

Fiscal Year	Equipment	Licenses	EV/PHEV Technician Training	Staff Driver Training	Total Training and Equipment Expenses
2021	$50,000	$3,000	$20,000	$2,500	$75,500
2022	$10,000	$3,000	$15,000	$2,500	$30,500
2023	$10.000	$3,000	$15,000	$2,500	$30,500
2024	$10.000	$3,000	$15,000	$2,500	$30,500
Annually 2025-2035	$10,000	$3,000	$15,000	$2,500	$30,500

Action 4: Champion Fuel Reduction Initiatives

In addition to adding electric vehicles to the City's fleet, there are strategies that the city should employ to reduce the City's fuel consumption and emissions.



Annual Review Process

Each City Department should conduct an annual review of its use of fleet vehicles and determine what efficiencies can be made to reduce fuel use, vehicle miles traveled and GHG emissions.

Anti-idling

The City should update its anti-idling policy and develop enforcement mechanisms to ensure the policy is followed for its fleet of internal combustion engine vehicles. For example, the use of plug-in hybrid vehicles for police patrol will enable the vehicle's systems to operate without the engine running. Ford has recently unveiled an Explorer Interceptor Hybrid that can reduce vehicle emissions by up to 50% by eliminating the need to operate the engine during the long periods of idling required during shifts.

Vehicle Data Tracking

This analysis uncovered several data tracking issues identified in detail in Appendix 4. Fleet Management should identify process improvement steps to implement to correct these data issues.

Use of telematics/GPS

Telematics have the potential to improve driver behavior and incentivize efficient and safe driving. The City should evaluate the use of telematics for passenger and light duty vehicles. These devices will enable managers to effectively monitor driver behavior, idling and recharging and then prescribe any corrective actions.

Virtual Meetings/Telecommuting/ Alternative Travel Modes

The City should expand the use of its telecommuting policy as appropriate. The City should also promote the use of virtual meetings and incentivize alternative modes of travel including transit, biking, and walking. These efforts will not only reduce vehicle emissions but improve the city's traffic flow. The City should promote carpooling and ridesharing to reduce trips in both city-owned and personal vehicles.

Fleet Right Sizing

Fleet rightsizing is a management practice that can help vehicle fleet managers build and maintain sustainable, fuel-efficient fleets. Fleet inventories often grow over time to include vehicles that are highly specialized, rarely used, or unsuitable for current applications. By optimizing fleet size and composition, the City can minimize vehicle use, conserve fuel, reduce emissions, and save money on fuel and maintenance.

Metric to track reduction

The City should set annual targets for reducing GHG emissions, fuel use, and vehicle miles traveled. The annual reduction targets should be formalized in the new Clean and Green Fleet Policy and should be tracked and progress communicated to city departments annually.

Partnership Collaborations

The City should continue existing partnerships and seek to form new collaborations to further its efforts on greening its fleet.

Action 5: Expand Green Fleet Initiative in the Future

The City should plan for future expansion of Green Fleet Initiative to include the City's heavy duty fleets and additional public fleets (such as Richmond City Public schools). For vehicles and applications that do not fit with electrification, other options include compressed natural gas, propane auto gas, and renewable biofuels such as ethanol and biodiesel.

Grants and Incentives for Vehicles and Infrastructure

Federal Tax Credit for Qualified Plug-in Electric Vehicles - The Federal tax incentive for qualified plug-in electric vehicles is available on the first 200,000 EVs that a company sells. The vehicle dealer or a capital leasing company can take the tax credit and pass the savings to the City in the form of a reduced vehicle price.

Congestion Mitigation and Air Quality Program funding – The CMAQ program is federal funding that the Commonwealth and the metropolitan planning organizations annually receive for transportation projects. The City can present its EV and EVSE plan to the Richmond Regional Planning District and seek funding assistance through their CMAQ allocation.

Tesla Workplace Charging Program – Tesla will provide Tesla Destination charging stations and J1772 charging stations to fleets and workplaces who wish to install them.

EVgo fleet charging equipment donation program – EVgo, the Commonwealth's EV charging station contractor, will provide level 2 J1772 charging stations to municipalities for workplace charging. The stations need to be accessible to the public.

EPA DERA Program funding for Class 4-8 vehicles – The EPA's Diesel Emission Reduction Act program provides competitive grant funding opportunities for the replacement of heavy duty diesel vehicles with the electric vehicles.

Department of Energy Clean Cities Program – The Department of Energy provides annual competitive grant opportunities for innovative electric vehicle projects.

Federal Department of Transportation - The Department of Transportation announced in April 2021 over $40 billion in funding within existing programs for the deployment of electric vehicles and electric vehicle charging stations.

Conclusion

This report is designed to equip the City of Richmond with the framework and analysis needed to decide how to replace its passenger and light duty fleet with electric and plug-in hybrid vehicles. Table 8 summarizes the main conclusions and takeaways from each section of the report.

Table 8: Summary Table of Actions and Targets

Action	Working Target	Hard Target
Reduce Fleet GHGs	4% annual GHG reduction through replacement of gasoline vehicles with EVs and PHEVs	44.03% GHG Reduction by 2035
Create Clean & Green Policy & Vehicle Standard	Implement Clean & Green Policy. Implement Clean & Green Procurement Standard for all new vehicle purchases. Evaluate available low and zero emission passenger and light duty vehicles.	1,221 new passenger and light duty EVs and PHEVs by 2035
Install Fleet EVSE	Develop Site Plan by evaluating available City-owned parking areas for EVSE. Initialize RFP for EVSE Develop usage policies for EV charging Install low-emission backup generators	120 level 2 EVSE and 230 level 1 EVSE by 2030
Training and Education	Develop manuals and/or videos for operating and charging EVs Secure training for all fleet technicians Acquire new vehicle diagnostic equipment for EVs	Training manual in each EV Fleet Technicians trained and certified to maintain EVs and PHEVs

Champion Fuel Reduction	Departmental review of vehicles use Enforce anti-idling policy Vehicle fuel tracking and reporting Virtual meetings/Telecommuting	Department reports on vehicle fuel usage and areas of improvement Monthly fuel usage reports with associated GHG emissions Institute policies to reduce commuting and traveling
Expand Program to Other Vehicles	Continue evaluating the opportunities for expanding low and zero emission vehicles to other vehicle classes	Increase the use of low or zero emission fuels in heavy duty vehicles in the RPS and DPU

References

Alternative Fuel Data Center. Electric Vehicles. www.afdc.energy.gov

Alternative Fuel Life-Cycle Environmental and Economic Transportation Tool (AFLEET). National Renewable Energy Laboratory. https://afleet-web.es.anl.gov/home/

City of Richmond Fleet Data. City of Richmond, Virginia.

A Clean and Green Fleet. An Updated Action Plan for the City of Seattle. Andrea Pratt. Department of Finance and Administration. City of Seattle.

CALSTART. Sustainable Fleets Accreditation Program.

Specification Sheet for Spark-ignited Natural Gas Generator Set. Cummins. https://powersuite.cummins.com/PS5/PS5Content/SiteContent/en/Binary_Asset/pdf/Commercial/SparkIgnited/NAS-5692-EN.pdf

Appendix 1: Clean & Green Fleet Report-Vehicle Counts

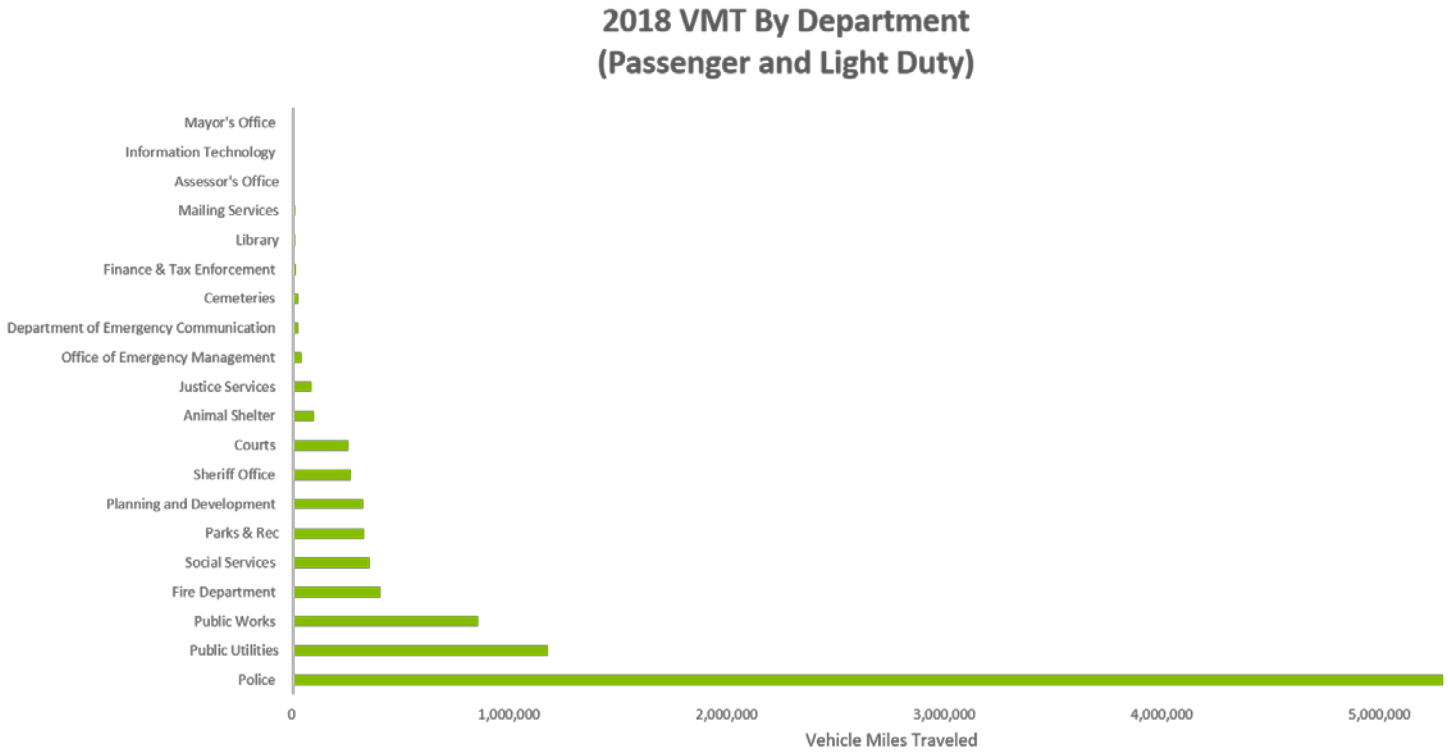
This report assessed 1,221 vehicles (546 passenger and 675 light duty).

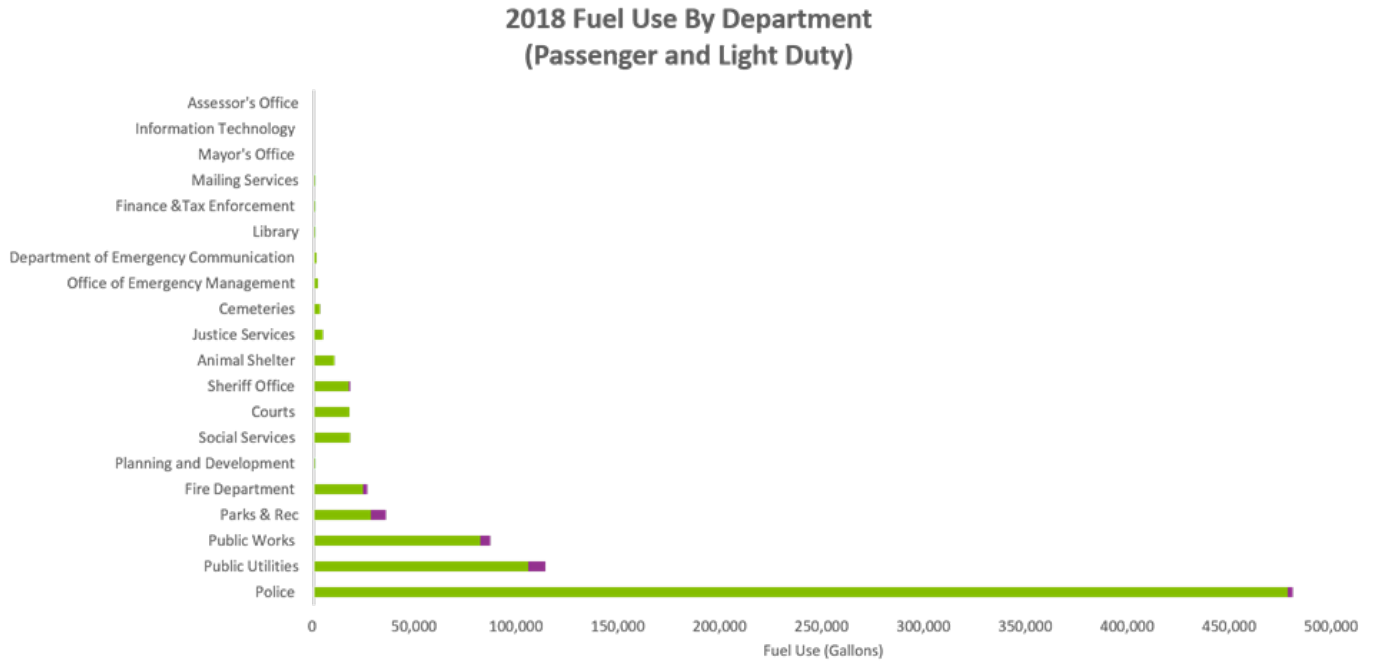
Total Vehicle Count	
Passenger	546
Light Duty	675
Total	1,221

Of the 1221 vehicles, 574 units are assigned to the police and fire departments. The chart below provides details regarding the number of passenger and light duty units assigned to each department.

Department	Passenger	Light Duty	Total by Department
Police	337	190	**527**
Fire	0	47	**47**
Total by Vehicle Class	**337**	**237**	
Total Police and Fire Units Assessment			**574**

Appendix 2: Vehicle Miles Traveled (VMT) and Fuel Use by Department and GHG Emissions per VMT





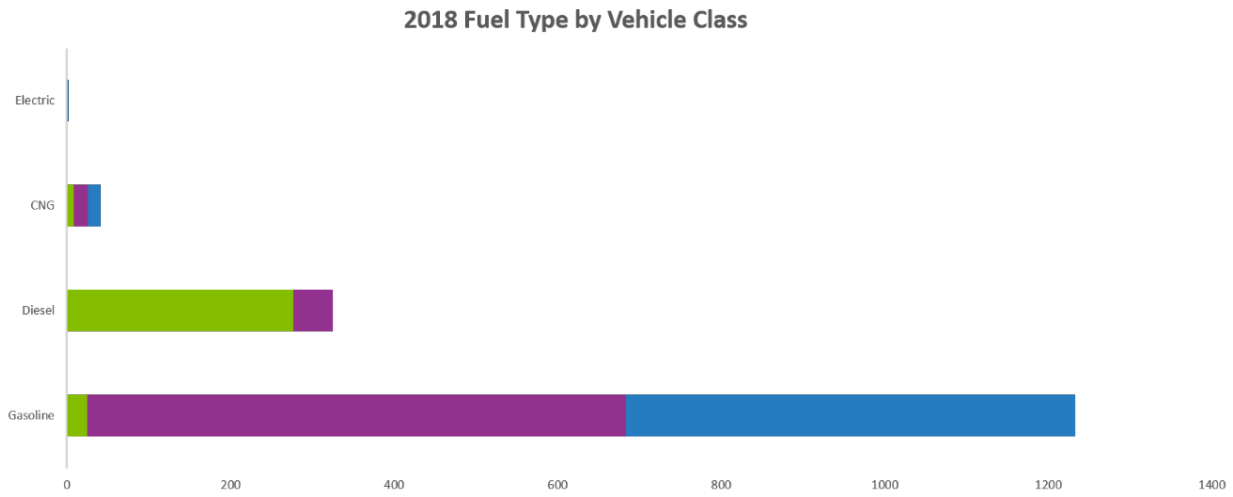
	Police	Public Utilities	Public Works	Parks & Rec	Fire Department	Planning and Development	Social Services	Courts	Sheriff Office	Animal Shelter	Justice Services	Cemeteries	Office of Emergency Management	Department of Emergency Communication	Library	Finance & Tax Enforcement	Mailing Services	Mayor's Office	Information Technology	Assessor's Office
Gasoline	478,042	105,034	81,734	28,111	24,133	19,084	17,813	17284.66	17,192	9984.71	4,581	3202.37	2,157	1317.93	745	697.9	559	415	297	295.92
Diesel	2,240	8,732	4,685	7,111	2,085	0	0	0	760	0	0	0	0	0	0	0	0	0	0	0

Department	2018 VMT	%VMT
Police	5,347,633	56%
Public Utilities	1,170,143	12%
Public Works	850,374	9%
Fire Department	401,405	4%
Social Services	352,640	4%
Parks & Rec	325,409	3%
Planning and Development	321,082	3%
Sheriff Office	262,910	3%
Courts	254,340	3%
Animal Shelter	93,455	1%
Justice Services	83,720	1%
Office of Emergency Management	36,257	0%
Department of Emergency Communication	22,982	0%
Cemeteries	20,981	0%
Finance & Tax Enforcement	9,867	0%
Library	7,295	0%
Mailing Services	5,832	0%
Assessor's Office	5,014	0%
Information Technology	4,180	0%
Mayor's Office	3,145	0%
Total	**9,578,664**	

Emissions per vehicle	
Total CO2e (MT)	7423.08
Total Vehicles	1221
CO2e per vehicle	6.08

Emission per VMT	
Total CO2e (MT)	7423.08
Total VMT	9,578,664
Average CO2e per VM	0.00077496

Appendix 3: Fleet Profile-City of Richmond (Entire Fleet)



	Gasoline	Diesel	CNG	Electric	Total Number of Units
Heavy Duty	25	277	8	0	**310**
Light Duty	659	48	18	0	**725**
Passenger	549	0	15	2	**566**
Total Number of Units	**1233**	**325**	**41**	**2**	
Total Units in Inventory					**1601**

Appendix 4: Data Errors - 2018 Fleet Inventory

Data Errors: 2018 Fleet Inventory

The vehicle fleet inventory containing active (A), deferred (D), and sold (S) vehicles was obtained from the Department of Works Vehicle Fleet Division. These vehicles were categorized by vehicle class: passenger (971 units), light duty (976), heavy duty (410). Vehicle miles traveled (VMT) and fuel use data were used to determine the average fuel efficiency for vehicles. Approximately 41% of the passenger, 28% of light duty, and 36% of heavy duty vehicle data obtained appeared to have identifiable errors (negative mileage, zero mileage and zero fuel use, zero mileage, zero fuel use), which resulted in inaccurate fuel efficiency information. According to the Bureau of Transportation Statistics (BTS), the average mpg for passenger vehicles and light duty vehicles were 24 mpg and 17 mpg respectively. In 2017, the average mpg for heavy duty vehicles was 6.5. Based on mileage and fuel use data, some units fuel efficiency was as low as 0.006 and as high as 567.24. Most of the unit that contained data with 0 mileage and 0 fuel use error were 10+ years old. Vehicle idling can also contribute to higher fuel use and low mileage.

In an effort obtain a more accurate analysis of the fleet, vehicle use descriptions and using department data were obtained for each vehicle. This information was used to substitute vehicle with inaccurate fuel efficiency information with mpg values from comparable vehicles based on make, model, model year, using department, and use description. Vehicles with the status S (sold)[1] and vehicles that were assigned to Richmond Behavioral Health Administration (RBHA)[2] were removed from the inventory.[3] After the sold and RBHA units were removed, there was 566 passenger, 725 light duty, and 310 units remaining in the inventory. Heavy duty vehicles and vehicles that use compressed natural gas were not included in the Green Fleet Assessment. Vehicles with fuel efficiency errors that did not have comparable use descriptions, makes and models, were removed from the Green Fleet Assessment.

Data Errors: 2018 Fleet Inventory						
	Passenger Units		Light Duty Units		Heavy Duty Units	
Errors	Passenger Units	% of Inventory with Errors	Light Duty Units	% of Inventory with Errors	Heavy Duty Units	% of Inventory with Errors
Negative Mileage	4	1%	7	1%	1	0%
Zero Mileage & Zero Fuel Use	7	1%	5	1%	8	3%
Zero Mileage (Only)	4	1%	8	1%	34	11%
Zero Fuel Use (Only)	10	2%	31	4%	13	4%
Total Units with errors	**25**	**5%**	**51**	**7%**	**56**	**18%**
Total Units in Fleet Inventory	**566**		**725**		**310**	

[1] A total of 354 passenger, 205 light duty, and 100 heavy duty vehicles had a sold status. Some of these sold units were assigned to RBHA.

[2] After sold units were removed, RBHA was assigned 54 passenger and 46 light duty active and deferred units. As of July 1, 2018, DPW's Fleet Division no longer maintains the fleet vehicles for RBHA. The City Of Richmond, no longer has influence over vehicles assigned to RBHA.

Appendix 5: Business Case Assumptions

Based on the AFLEET Model, an evaluation of sites for vehicle charging infrastructure, upgrades to the Transportation Center, the availability of fuel, and the incremental pricing of vehicles, VCC recommends that select combination of PHEV and electric vehicles to replace their current fleet of gasoline-powered internal engine passenger vehicles. VCC recommends that installing level 1 and level 2 EV charging infrastructure at the following City owned parking lots.

Business Case Analysis of Fuels

Gasoline

The City can continue the status quo of using gasoline vehicles The capital costs of purchasing new gasoline vehicles are lower than PHEV or EVs. Gasoline is a familiar technology for both drivers and mechanics. However, there are significant costs associated with continuing to use gasoline vehicles. Newer gasoline vehicles reduce some emissions compared to older vehicles but are subject to price volatility in the world oil markets. The AFLEET Model calculates that the average cost per mile (incremental vehicle costs + annual fuel costs + discounted annual maintenance/annual mileage cost) for gasoline vehicles during the 13-year project period to be $0.37 to $0.47.

Electricity

Electricity is an inexpensive, easily accessible and zero tailpipe-emission fuel that can save money on fuel, operations, and maintenance. Electricity is produced by power plants using coal, natural gas, nuclear fuel and renewable energy (wind, solar and hydropower). Electricity is readily available and affordable for vehicle applications. Virginia's electricity is 100% domestically produced domestically. The cost of electricity per Gasoline Gallon Equivalent at $0.08 per kWh is equivalent to paying $.85 for a gallon of gasoline. Charging during off-peak hours can lead to further electricity cost reductions as rate are lower during these time. The estimated average cost per mile (annual fuel costs + annual maintenance/annual mileage) of electric vehicles during the 13-year project period is $0.25. This translates into a total cost of ownership of $27,936,784 or an estimated cost savings (compared to gasoline) of $1,839,424 or $338 annually per passenger EV. For light-duty vehicles, there were no costs savings achieved during the 13-year project period, primarily due to the high cost of the vehicles.

The incremental cost of a similarly-equipped EV when compared to a gasoline vehicle is about $15,890. The infrastructure costs to install level 1 and level 2 EV charging stations are estimated to be between $720 and $8,700 per station (depending on service upgrades, trenching, beautification, signage).

Plug-in Hybrid Electric Vehicles

Plug-in hybrid vehicles (PHEVs) are another vehicle that use affordable, domestically abundant and zero emission electricity. The key difference is that these vehicles have an internal combustion engine and use gasoline as a backup or for longer trips. Utilized correctly, these vehicles can save money on fuel, operations, and maintenance. Much like EVs, the price stability of electricity in Virginia allows for easier long-range budgeting and planning.

The incremental cost of a similarly equipped PHEV when compared to a gasoline vehicle is about $12,890. The estimated average cost per mile (annual fuel costs + annual maintenance/annual mileage) of electric vehicles during the 13-year project period is $0.18. This translates into a total cost of ownership of $26,908,871 or an estimated cost savings (compared to gasoline) of $2,873,587 or $526 annually per passenger PHEV. For light-duty vehicles, there were no costs savings achieved during the 13-year project period, primarily due to the high cost of the vehicles.

Appendix 6: AFLEET Projections

Table 1 provides a summary comparison of Key Projections for each fuel.

Table 1: Summary Comparison of Key Projections Passenger Vehicle			
Cost Factors*	**Gasoline**	**PHEV**	**Electricity**
Electric Vehicle Incremental Cost	$0	$12,890	$15,890
Federal Tax Incentive	N/A	$3,750	$7,500
GGE Fuel Cost	$2.21	$2.21	$0.08 kWh
Infrastructure Upgrade Required?	No	Moderate	Yes, Major
Infrastructure Upgrade Cost for 55 L2 units and 115 L1 units	$0	$72,000	$478,775
Maintenance/Training Upgrade Required?	No	Minor	Moderate
Maintenance Infrastructure Upgrade Cost	$0	$TBD	$50,000
Fuel Cost per Mile**	$0.16	$0.07	$0.04

Cost Factors*	Gasoline	PHEV	Electricity
Average Maintenance Cost per Mile**	$0.24	$0.18	$0.20
Fueling Station Cost per Mile	$0	$0	$0.01
Total Cost per Mile (including vehicles)**	$0.40	$0.25	$0.25
Average Annual Cost-Savings over 13 Years	N/A	$358,966	$268,518
Average Annual Savings Per Vehicle	$0	$635	$492
Net Present Value (13 Years)	$0	$1,892,423	$624,667
Payback Period	NA	7.9 years	9.0 years
Wells to Wheels Petroleum Use (barrels)	62,437	15,199 (76% reduction)	385 (99% reduction)
Total WTW GHG Emissions (tons)	36,334	14,816 (59%)	11,307 (69%)

**AAA Reveals True Cost of Vehicle Ownership, Include EVs, Hybrids (http://news.aaa-calif.com/news/aaa-reveals-true-cost-of-vehicle-ownership-including-evs-hybrids)

Table 2: Summary Comparis on of Key Projections Light Duty			
Electric Vehicle Incremental Cost	$0	$25,238	$38,238
Incentive	N/A	$3,750	$7,500
GGE Fuel Cost	$2.21	$2.21	$0.08 kWh
Infrastructure Upgrade Required?	No	Moderate	Yes, Major
Infrastructure Upgrade Cost[ZAR-D8] for 67 L2 Unites and 115 L1 Units	$0	$93,600	$583,158
Maintenance/Training Upgrade Required?	No	Minor	Moderate
Maintenance Infrastructure Upgrade Cost	$0	$TBD	$TBD
Fuel Cost per Mile**	$0.157	$0.10	$0.07
Average Maintenance Cost per Mile**	$0.242	$0.18	$0.20
Fueling Station Cost per Mile	$0	$0	$0.01
Total Cost per Mile (including vehicles)**	$0.40	$0.28	$0.28

Cost Factors*	Gasoline	PHEV	Electricity
Average Annual Operating Cost-Savings over 13 Years	$0	$1,294,162	$1,176,725
Average Annual Savings Per Vehicle	$0	$152	N/A
Net Present Value (10 Years)	$0	N/A	N/A
Payback Period	NA	12.1years	18.5 years
Wells to Wheels Petroleum Use (barrels)	127,883	33,225 (74% reduction)	838 (99% reduction)
Total WTW GHG Emissions (tons)	74,419	31,251 (58% reduction)	24,613 (67% reduction)

Appendix 7: Electric Vehicle Supply Equipment Assumptions

The average annual mileage for a City passenger vehicle is 7,800 miles (30 miles per day, 150 miles per week or 7.5 kWh per day and 37.5 kWh per week). Assuming an EV will be recharged every 200 miles (20% battery remaining on 240 mile range EV), this results in 39 charging episodes per year, or less than 0.75 episodes per week. This results in a rule of “charging once every two weeks” routine for drivers. For an entire fleet of 549 passenger EVs, this equates to 82.3 charging episodes per day. For the City’s 675 light duty vehicles, the number of charging episodes per day is 102.5 for a grand total of 185 charging episodes per day. The time required to charge a 60 kWh battery from 20% to 100% on a level 2 charger is 6 hours. A charging depot with 120 level 2s for frequently used EVs and 230 level 1’s for less frequently used EVs and PHEVs is sufficient to meet the re-charging demands of the fleet.

Appendix 8: Anticipated Department EVSE Installation Schedule

Fiscal Year										
Department	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Animal Shelter		1		2						3
Assessor		1								1
Cemetery	2									2
Courts		2	2	1		1	2			8
DIT			1							1
Emergency Communication				1			1			2
Emergency Management		1					1			2
Finance				1		1				2
Fire Department	1	5		3				3		12
Fleet Services	1	1		1						3
Justice Services	2	1	1	1	1	1	2	1		10
Library				1						1
Mail Services		1								1

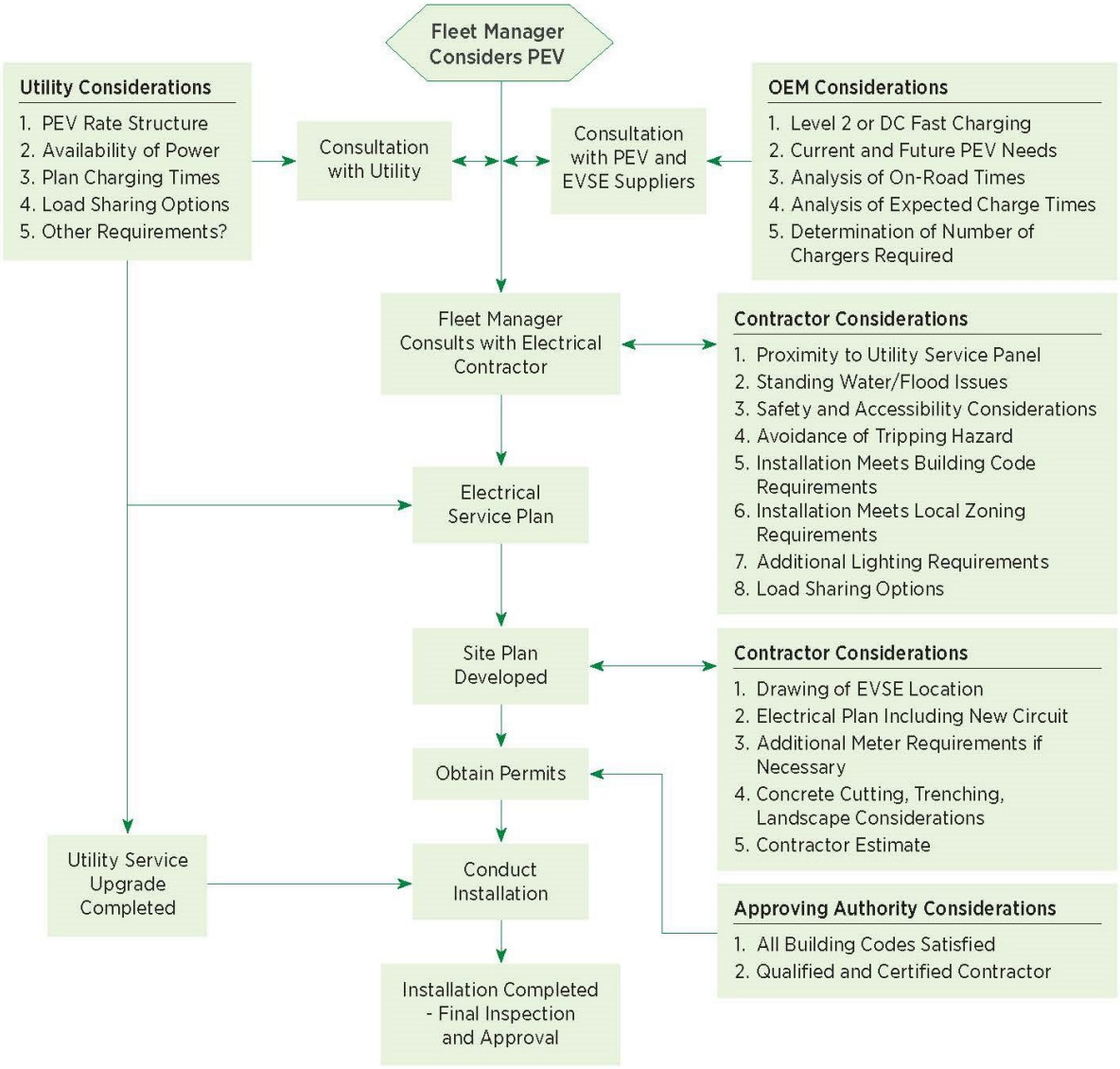
Fiscal Year										
Department	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Mayor's Office		1								1
Motor Pool	1	3		1			1			6
Parking & Transportation						1				1
Parks and Recreation	2	2	1	5	2	1	2	1	1	17
Planning and Development	2	2	2	1		2	3	6		18
Police	5	11	10	20	6	11	22	17	5	107
Public Utilities	10	1	2	5	12	3	6	4		43
Public Works	20	10	3	3	2	2	3	2		45
PW - Urban Forestry				1		0	1			2
Sheriff	1	1	5	2		1	1	2		13
Social Services	5	1	2	4		1	3	1		17
Total	52	45	29	53	23	25	48	37	6	318

Appendix 9: Vehicle Replacement Schedule by Department

Fiscal Year													
Department	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Animal Shelter			2	2	6								
Assessor			1										
Cemetery	4	3								3			
Courts			3	4	4	2	4	5	6				
DIT					1								
Emergency Communication					1	1	1	1					
Emergency Management			1	1	1			2	1				
Finance					1		2						
Fire Department	1	2	8	9	5	2	3	2	5	2	2	2	
Fleet Services	1		2	2	1	1		1	1				
Justice Services	3	4	1	1	5	3	2	5	2	4			
Library					1								
Mail Services			1										
Mayor's Office			1						1				

Fiscal Year													
Department	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Motor Pool	2		5	5	3	1		1	1				
Parking & Transportation							1						
Parks and Recreation	4	5	4	3	10	4	5	7	5	5	3	1	1
Planning and Development	4	3	7	7	3	4	4	4	9	3	4	4	
Police	8	9	31	37	45	45	45	45	53	48	53	52	52
Public Utilities	9	9	2	2	20	20	20	20	18	9	18	17	
Public Works	9	18	17	18	8	10	8	15	6	18	5	5	
PW - Urban Forestry					1			4	1	0			
Sheriff		1	2	3	6	3	2	5	5	1	5	5	
Social Services	4	12	2	2	7	5	10	2	3	12	4	4	4
Total	49	66	90	96	129	101	107	119	117	105	94	90	57

Appendix 10: General Process for Installing EVSE at a Fleet Facility



Appendix 11: CALSTART Sustainable Fleets Accreditation Program Report

CONFIDENTIAL

CALSTART Sustainable Fleets Accreditation Program

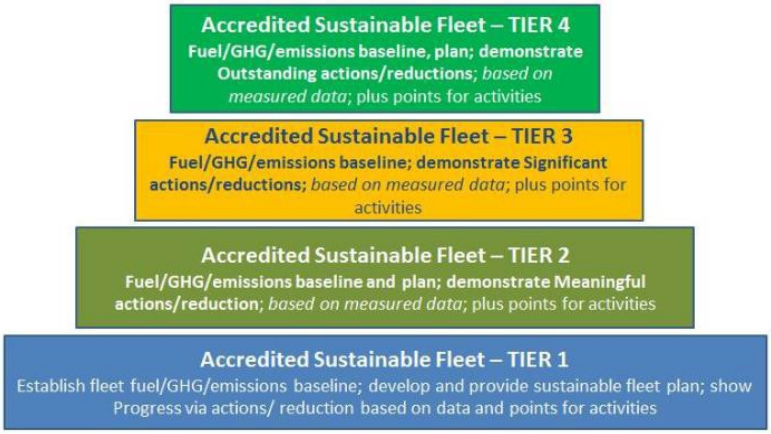
City of Richmond Scoring Sheet

Company Name:	City of Richmond
Fleet Contact Name:	Khilia Logan
Phone Number:	804-646-5211
Email:	khilia.logan@richmondgov.com
Baseline Year:	2016
Reporting Year:	2018
System of Measurement	US Units

City of Richmond CALSTART Sustainable Fleets Score	**38** **Tier 1**	*out of 125*

CALSTART Sustainable Fleet Score Breakdown:		
Sustainable Fleet Plan	10	*out of 10*
Reporting Baseline Data	10	*out of 10*
Idle Reduction	1	*out of 5*
Efficient Driver Training	0	*out of 5*
Vehicle Fuel / Tracking	3	*out of 5*
Percentage of Advanced Technology Vehicles in Fleet	2	*out of 10*
Percentage of Alternative Fuel Used	2	*out of 10*
Percentage Improvement in Total Fleet Average Fuel Economy	0	*out of 20*
Air Quality Improvement	10	*out of 20*
GHG Emissions	0	*out of 30*

Sustainable Fleet Levels of Achievement


Accredited Sustainable Fleet – TIER 4
Fuel/GHG/emissions baseline, plan; demonstrate Outstanding actions/reductions; based on measured data; plus points for activities
Accredited Sustainable Fleet – TIER 3
Fuel/GHG/emissions baseline; demonstrate Significant actions/reductions; based on measured data; plus points for activities
Accredited Sustainable Fleet – TIER 2
Fuel/GHG/emissions baseline and plan; demonstrate Meaningful actions/reduction; based on measured data; plus points for activities
Accredited Sustainable Fleet – TIER 1
Establish fleet fuel/GHG/emissions baseline; develop and provide sustainable fleet plan; show Progress via actions/ reduction based on data and points for activities

Committed Sustainable Fleet
Establish minimum fleet fuel/GHG/emissions baseline; develop and provide basic sustainable fleet plan; demonstrate Commitment to sustainability

CALSTART Sustainable Fleet Scoring Details:

Sustainable Fleet Plan

Did City of Richmond submit a Sustainable Fleet Plan that satisfies the requirements?	Yes

Comments

Reporting Baseline Data

Did City of Richmond report fleet baseline data that satisfies the requirements?	Yes

Comments

Idle Reduction

Did City of Richmond provide evidence that anti-idling policy statements and documents are posted in appropriate locations?	Yes
Did City of Richmond provide documentation that anti-idling policy is being implemented and how it is being performed?	No
Did City of Richmond provide purchase orders/receipts for anti-idling system or software?	No

Comments Provided the administrative regulation from the office of the mayor called "Anti-Idling Policy: Vehicles & Equipment". Did not provided anything for how it is being implemented and evidence of anti-idling system or software purchase.

Efficient Driver Training

Did City of Richmond provide an efficient driving practices document, policy or equivalent that satisfies the requirements?	No
Did City of Richmond provide course outlines, training materials, class attendance records...?	No
Did City of Richmond provide outputs for on-board equipment, review forms or other processes to monitor, track and enforce or reward efficient driving?	No

Comments Provided Driver Safety Training instead of Efficient Driver Training.

Vehicle Fuel / Tracking

Did City of Richmond provide documentation showing fuel usage, measuring miles driven and/or hours operated by vehicle?	Yes
Did City of Richmond provide purchase orders or receipts for GPS tracking or vehicle telematics devices?	Yes
Did City of Richmond provide report/output from installed vehicle telematics system?	No

Comments	Provided fuel usage data for reporting and baseline years broken up by fuel type.

Percentage of Advanced Technology Vehicles in Fleet

Total number of vehicles	1,601	vehicles
Total number of advanced technology vehicles	43	vehicles
Did City of Richmond select to have Ethanol E85 vehicles included as advanced technology vehicles?	No	
N/A	No	

Comments	

Percentage of Alternative Fuel Used

Total amount of fuel (in GGE)	1,198,686	GGE
Total amount of alternative fuel (in GGE)	3,862	GGE

Comments	

Percentage Improvement in Total Fleet Average Fuel Economy

Average fleet fuel economy in baseline year	11.32	MPG
Average fleet fuel economy in reporting year	8.60	MPG

Comments	

Air Quality Improvement

Scoring level achieved	Level I	*1st accreditation*
Number of vehicles MY2007 or better	1,229	vehicles
Number of vehicles MY2010 or better	888	vehicles
Total NOx Emissions in baseline year	2,595.0	kg
Total NOx Emissions in reporting year	1,967.2	kg
Total PM Emissions in baseline year	77.5	kg
Total PM Emissions in reporting year	58.7	kg

Comments	*Level I = 10* *Level II = 10*

GHG Emissions

Total GHG Emissions in baseline year	10,322	metric tons
Total GHG Emissions in reporting year	10,609	metric tons

Comments

CALSTART Sustainable Fleets Accreditation Program – Point Values

Action	Max Points
Sustainable Fleet Plan*	10
Reporting Baseline Data*	10
Idle Reduction **Policy Implementation** • 1 point: Anti-idling policy statement posted in appropriate locations **Tracking/Enforcement** • 3 points: Documentation that anti-idling policy is being implemented • 5 points: Purchase orders/receipts for anti-idling system - if software is used, provide a report/output from system.	5
Efficient Driver Training **Policy Implementation** • 1 point: Efficient driving practices document/policy, focused on efficiency **Tracking/Enforcement** • 3 points: Course outlines, training materials, class attendance records, participant's feedback, and/or photos/ videos of sessions. • 5 points: Purchase orders/receipts for on-board monitoring equipment, driver simulating equipment, dedicated vehicles/facility for efficient driver training; Alternate: tracking and reward/penalty system for efficient driving	5
Vehicle Fuel/Tracking **Policy Implementation** • 1 point: Electronic or hard copy documentation of usage of fuel and vehicles, measuring miles driven and/or hours operated **Tracking/Enforcement** • 3 points: Purchase orders/receipts for GPS tracking technologies • 5 points: Report/output from installed system that shows such data as fuel use, driving speed, idle time, etc.	5
% of Advanced Tech Vehicles in Fleet • 2 points: 1 - 5% of fleet alt fuel or hybrid/electric • 3 points: 5.1 - 10% of fleet alt fuel or hybrid/electric • 5 Points: 10.1 - 20% of fleet alt fuel or hybrid/electric • 10 points: >20% alt fuel or hybrid/electric	10
% of Alt Fuel Used • 2 points: 1 - 5% of fuel used • 3 points: 5.1 - 10% of fuel used • 5 Points: 10.1 - 20% of fuel used • 10 points: >20% of fuel used	10

% Improvement in Total Fleet-Average Fuel Economy • **5 points: 1 – 3%/year improvement** • **10 points: 3.1 - 5%/year improvement** • **15 Points: 5.1 - 8%/year improvement** • **20 points: 8.1 - 10%/year or more improvement**	20
Air Quality Improvements • **1 point: less than 50% of fleet 2007 or better** • **3 points: more than 50% of fleet 2007 or better** • **5 points: >50% of fleet 2010 or better** **-OR-** **NOx Emissions** • **5 points: 1- 15%/year reduction** • **10 points: more than 15%/year reduction** **PM Emissions** • **5 points: 1- 15%/year reduction** • **10 points: more than 15%/year reduction**	10 10 10
GHG Emissions • **10 points: 0.1 -1%/year reduction** • **15 points: 1.1% - 2%/year reduction** • **20 points: 2.1% - 3%/year reduction** • **25 points: 3.1% - 4.1%/year reduction** • **30 points: 4.2%/year or better reduction**	30
TOTAL Possible Points	**125**

Appendix 12: AFLEET Worksheets

Simple Payback Calculator Outputs

Light Duty Annual Simple Payback Calculator Outputs - Costs

	Gasoline	Gasoline PHEV	EV
Acquisition Cost			
Light-Duty (LD) Fleet & Infrastructure	$18,064,350	$32,568,750	$38,812,500
Heavy-Duty (HD) Fleet & Infrastructure			
Annual Operating Cost - Private Station Fueling			
LD Fleet & Infrastructure	$2,476,079	$1,269,200	$1,324,028
HD Fleet & Infrastructure			
Incremental Acquisition Cost			
Compared to Gasoline LD Fleet		$14,598,000	$21,331,308
Compared to Diesel HD Fleet			
Annual Operating Savings - Private Station Fueling			
Compared to Gasoline LD Fleet		$1,206,878	$1,152,051
Compared to Diesel HD Fleet			
Simple Payback (years) - Private Station Fueling			
LD Passenger Truck Fleet		**12.1**	**18.5**
LD High Fuel Price Sensitivity		10.5	15.4
LD Low Fuel Price Sensitivity		14.2	23.3
HD Combination Short-Haul Truck Fleet			
HD High Fuel Price Sensitivity			
HD Low Fuel Price Sensitivity			

Annual Simple Payback Calculator Outputs - Energy Use and Emissions

	Gasoline	Gasoline PHEV	EV
Annual Well-to-Wheels Petroleum Use (barrels)			
LD Petroleum Use	9,837.2	2,555.8	64.4
HD Petroleum Use			
Annual Well-to-Wheels GHGs (short tons)			
LD GHGs	5,724.5	2,403.9	1,893.3
HD GHGs			
Annual Vehicle Operation Air Pollutants (lb)			
LD Passenger Truck Fleet			
CO	29,176.9	15,753.7	0.0
NOx	2,099.2	952.1	0.0
PM10	451.3	411.2	364.2
PM2.5	120.8	86.9	47.0
VOC	1,482.7	501.4	0.0
SOx	135.2	34.7	0.0

Total Cost of Ownership Calculator Outputs

Light Duty Lifetime Cost of Ownership Calculator Outputs - Costs

	Gasoline	Gasoline PHEV	EV
Light-Duty Passenger Truck Fleet and Infrastructure			
Financing	$0	$0	$0
Depreciation	$16,393,810	$29,407,696	$35,283,986
Fuel	$15,184,690	$6,033,016	$4,326,698
Diesel Exhaust Fluid	$0	$0	$0
Maintenance and Repair	$19,826,553	$11,749,068	$14,539,782
Insurance	$9,237,098	$9,237,098	$9,237,098
License and Registration	$999,988	$999,988	$999,988
Total Cost of Ownership	$61,642,139	$57,426,866	$64,387,552
Heavy-Duty Combination Short-Haul Truck Fleet and Infrastructure			
Financing			
Depreciation			
Fuel			
Diesel Exhaust Fluid			
Maintenance and Repair			
Insurance			
License and Registration			
Total Cost of Ownership			

Lifetime Cost of Ownership Calculator Outputs - Energy Use and Emission

	Gasoline	Gasoline PHEV	EV
Lifetime Well-to-Wheels Petroleum Use (barrels)			
LD Petroleum Use	127,883	33,225	838
HD Petroleum Use			
Lifetime Well-to-Wheels GHGs (short tons)			
LD GHGs	74,419	31,251	24,613
HD GHGs			
Lifetime Vehicle Operation Air Pollutants (lb)			
Light-Duty Passenger Truck Fleet			
CO	350,181	189,076	0
NOx	24,888	11,288	0
PM10	5,717	5,265	4,734
PM2.5	1,477	1,079	611
VOC	18,922	6,668	0
SOx	1,757	451	0

Simple Payback Calculator Outputs

Passenger Vehicle Annual Simple Payback Calculator Outputs - Costs

	Gasoline	Gasoline PHEV	EV
Acquisition Cost			
Light-Duty (LD) Fleet & Infrastructure	$9,324,950	$14,306,250	$13,897,500
Heavy-Duty (HD) Fleet & Infrastructure			
Annual Operating Cost - Private Station Fueling			
LD Fleet & Infrastructure	$1,470,343	$834,277	$908,471
HD Fleet & Infrastructure			
Incremental Acquisition Cost			
Compared to Gasoline LD Fleet		$5,053,300	$5,051,325
Compared to Diesel HD Fleet			
Annual Operating Savings - Private Station Fueling			
Compared to Gasoline LD Fleet		$636,066	$561,872
Compared to Diesel HD Fleet			
Simple Payback (years) - Private Station Fueling			
LD Passenger Car Fleet		**7.9**	**9.0**
LD High Fuel Price Sensitivity		7.0	7.5
LD Low Fuel Price Sensitivity		9.2	11.3
HD Combination Short-Haul Truck Fleet			
HD High Fuel Price Sensitivity			
HD Low Fuel Price Sensitivity			

Annual Simple Payback Calculator Outputs - Energy Use and Emissions

	Gasoline	Gasoline PHEV	EV
Annual Well-to-Wheels Petroleum Use (barrels)			
LD Petroleum Use	4,802.8	1,169.2	29.6
HD Petroleum Use			
Annual Well-to-Wheels GHGs (short tons)			
LD GHGs	2,794.9	1,139.7	869.7
HD GHGs			
Annual Vehicle Operation Air Pollutants (lb)			
LD Passenger Car Fleet			
CO	13,803.6	6,876.9	0.0
NOx	776.3	324.9	0.0
PM10	303.1	283.2	263.4
PM2.5	67.3	51.1	35.1
VOC	950.1	303.9	0.0
SOx	66.0	15.8	0.0

Total Cost of Ownership Calculator Outputs

Passenger Vehicle Lifetime Cost of Ownership Calculator Outputs - Costs

	Gasoline	Gasoline PHEV	EV
Light-Duty Passenger Car Fleet and Infrastructure			
Financing	$0	$0	$0
Depreciation	$8,462,605	$12,859,552	$12,668,545
Fuel	$7,413,656	$2,850,962	$1,987,579
Diesel Exhaust Fluid	$0	$0	$0
Maintenance and Repair	$13,282,902	$8,782,084	$11,012,303
Insurance	$7,458,102	$7,458,102	$7,458,102
License and Registration	$807,398	$807,398	$807,398
Total Cost of Ownership	$37,424,662	$32,758,097	$33,933,926
Heavy-Duty Combination Short-Haul Truck Fleet and Infrastructure			
Financing			
Depreciation			
Fuel			
Diesel Exhaust Fluid			
Maintenance and Repair			
Insurance			
License and Registration			
Total Cost of Ownership			

Lifetime Cost of Ownership Calculator Outputs - Energy Use and Emission

	Gasoline	Gasoline PHEV	EV
Lifetime Well-to-Wheels Petroleum Use (barrels)			
LD Petroleum Use	62,437	15,199	385
HD Petroleum Use			
Lifetime Well-to-Wheels GHGs (short tons)			
LD GHGs	36,334	14,816	11,307
HD GHGs			
Lifetime Vehicle Operation Air Pollutants (lb)			
Light-Duty Passenger Car Fleet			
CO	175,177	87,272	0
NOx	9,730	4,072	0
PM10	3,892	3,657	3,424
PM2.5	820	638	457
VOC	12,970	4,347	0
SOx	858	206	0