HAYWARD

City of Hayward Fleet Electrification Assessment

Fleet electrification offers local governments economic benefits that include lower lifecycle costs and reduced risk of fuel price volatility when compared to internal combustion engine (ICE) vehicles. Deployment of electric vehicles (EV) in municipal fleets also benefits the local population through the use of clean electricity as fuel, which helps reduce criteria air pollutants and greenhouse gas (GHG) emissions.

To assist local government partners in overcoming barriers to municipal fleet electrification, Ava Community Energy (Ava) commissioned a consultant team to develop a plan on behalf of the City of Hayward (City) that evaluates the short- and long-term cost savings associated with the transition to EVs, determines impacts and benefits to the City, and outlines steps to efficiently and cost-effectively integrate EVs and charging infrastructure at municipal facilities.

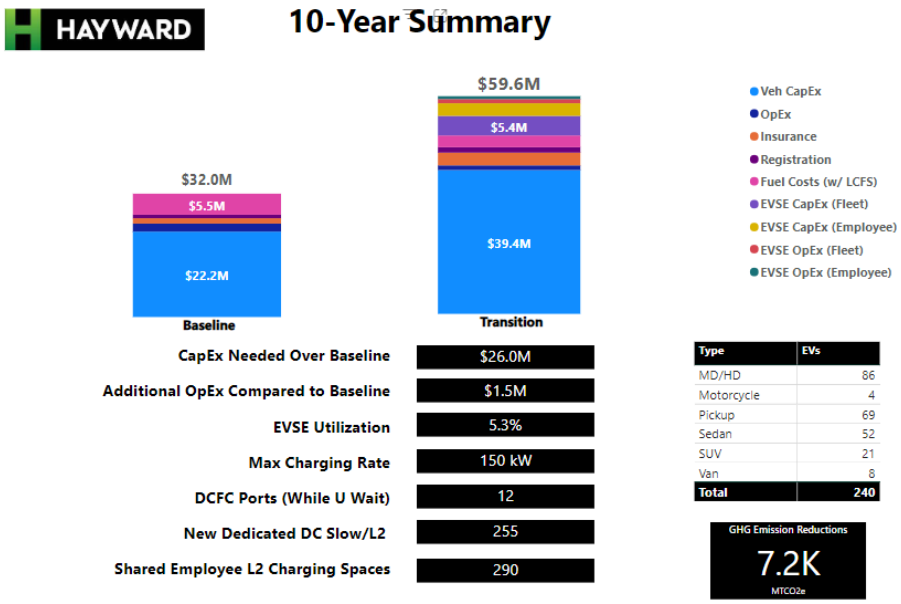
The purpose of this assessment was to evaluate the current municipal fleet composition and make recommendations for transitioning from ICE vehicles to EVs by 2033 to the extent feasible. Commitment to fleet electrification will help move the city closer to achieving its climate mitigation goals while leading by example in the community. Click here for more information on EV technology and currently available models.

This assessment was created using data provided by the City and supplemental information gathered during subsequent meetings and interviews. The objective of this analysis is to evaluate the current municipal fleet composition and make recommendations about transitioning from light-duty ICE vehicles to EVs by 2033 to the extent feasible. This analysis should align closely with the City's climate commitments and goals. Click here to view the Hayward Climate Action Plan. Our recommendations address 2024-2026 procurement cycles in detail and 2027-2033 procurement cycles more generally to ensure fiscally responsible procurement and deployment of EVs as well as proposed charging infrastructure.

Analysis Overview

The team analyzed the impacts of electrifying the City's fleet of 240 light-, medium- and heavy-duty vehicles domiciled in various locations and adding chargers for employee's use. The team recommends the deployment of Level 2 (L2) electric vehicle supply equipment (EVSE), Direct Current slow (DC slow) chargers, and Direct Current Fast Chargers (DCFC). Two transition scenarios are presented along with the baseline scenario:

- **Baseline** Scenario: Business as usual case where the city would continue using ICE vehicles.
- **Dedicated Transition** Scenario: The City would purchase EVs and install EVSE (L2, DC slow and DCFCs) so that each EV has its own charging plug and parking space (except for employee chargers).



Our analysis shows that transition of the City's municipal fleet to electric vehicles would cost the city about $25M and increase operating expenses by $1.3M when compared to the Baseline scenario over a ten-year period. This transition should also reduce GHG emissions by 7,183 MTCO2e over the same period. The cost reductions in the transition scenarios are driven by vehicle incentives, Low Carbon Fuel Standard (LCFS) credits, fuel cost savings and lower maintenance costs.

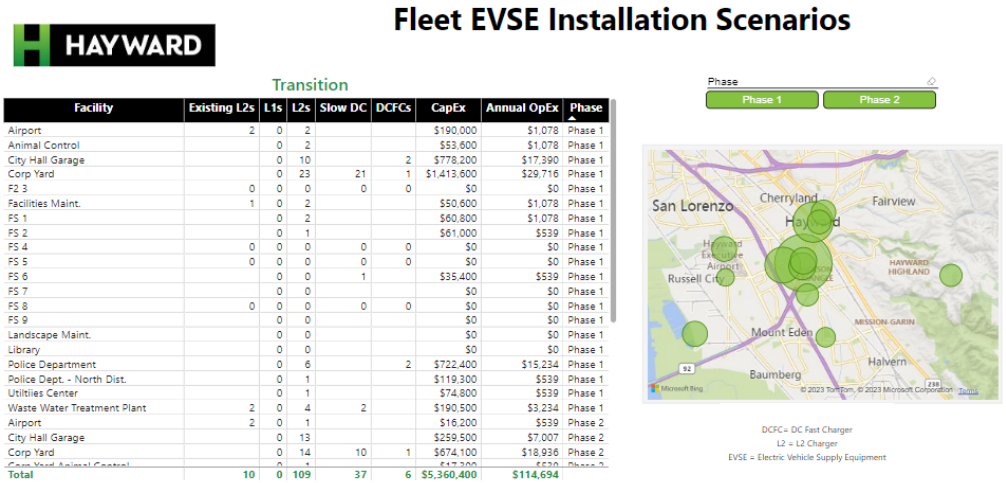
Charging Infrastructure Recommendations

In the Dedicated Transition scenario, we are recommending the City install six dual-port 150 kW DCFC in addition to the 109 dual-port L2s, and 37 DC slow chargers. This will provide 255 dedicated slots for charging vehicles using shared L2s and DC (slow) chargers.

For employee charging, we are recommending the City install 145 dual-port L2s. This will provide 290 shared slots for charging vehicles using shared L2s.

Two vehicles may be charged simultaneously at the DCFCs. We are assuming "take home" vehicles would be charged at home or at an available charger during operating hours.

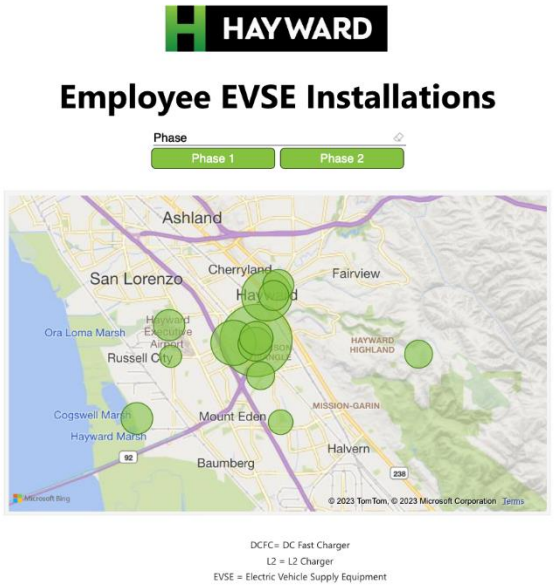
The Transition of the City's fleet to EVs will cost the City about $5.3M which will provide 94% more charging capacity than is needed to power the EV fleet. The EVSE Utilization rate is estimated by dividing the total daily kWh demand of the fleet by the total time available for charging at the peak charging rate. EVSE will only charge at peak rates when the vehicle's onboard charger will allow it and when the battery is fully discharged, so this metric should be viewed as a rough estimate of unused charging capacity. The visualization below includes maps of proposed EVSE installations along with their associated capital and operating costs.



Facility	Existing L2s	L1s	L2s	Slow DC	DCFCs	CapEx	Annual OpEx	Phase
Airport	2	0	2			$190,000	$1,078	Phase 1
Animal Control		0	2			$53,600	$1,078	Phase 1
City Hall Garage		0	10		2	$778,200	$17,390	Phase 1
Corp Yard		0	23	21	1	$1,413,600	$29,716	Phase 1
F2 3	0	0	0	0	0	$0	$0	Phase 1
Facilities Maint.	1	0	2			$50,600	$1,078	Phase 1
FS 1		0	2			$60,800	$1,078	Phase 1
FS 2		0	1			$61,000	$539	Phase 1
FS 4	0	0	0	0	0	$0	$0	Phase 1
FS 5	0	0	0	0	0	$0	$0	Phase 1
FS 6		0	0	1		$35,400	$539	Phase 1
FS 7		0	0			$0	$0	Phase 1
FS 8	0	0	0	0	0	$0	$0	Phase 1
FS 9		0	0			$0	$0	Phase 1
Landscape Maint.		0	0			$0	$0	Phase 1
Library		0	0			$0	$0	Phase 1
Police Department		0	6		2	$722,400	$15,234	Phase 1
Police Dept. - North Dist.		0	1			$119,300	$539	Phase 1
Utilities Center		0	1			$74,800	$539	Phase 1
Waste Water Treatment Plant	2	0	4	2		$190,500	$3,234	Phase 1
Airport	2	0	1			$16,200	$539	Phase 2
City Hall Garage		0	13			$259,500	$7,007	Phase 2
Corp Yard		0	14	10	1	$674,100	$18,936	Phase 2
Total	10	0	109	37	6	$5,360,400	$114,694	

Employee Charging

Facility	Existing L2s	L2s	CapEx	Annual OpEx	Phase
Airport	2	3	$79,600	$1,617	Phase 1
Animal Control		5	$196,600	$2,695	Phase 1
City Hall Garage		14	$325,600	$7,546	Phase 1
Corp Yard		4	$147,900	$2,156	Phase 1
Facilities Maint.	1	7	$226,800	$3,773	Phase 1
FS 1		5	$117,200	$2,695	Phase 1
FS 2		4	$184,700	$2,156	Phase 1
FS 3	0	2	$54,800	$1,078	Phase 1
FS 4	0	2	$55,100	$1,078	Phase 1
FS 5	0	2	$55,700	$1,078	Phase 1
FS 6		2	$56,200	$1,078	Phase 1
FS 7		5	$192,600	$2,695	Phase 1
FS 8	0	2	$53,000	$1,078	Phase 1
FS 9		2	$46,700	$1,078	Phase 1
Library		2	$52,100	$1,078	Phase 1
Police Dept. - North Dist.		3	$77,100	$1,617	Phase 1
Utiltiies Center		7	$230,900	$3,773	Phase 1
Waste Water Treatment Plant	2	7	$158,800	$3,773	Phase 1
Airport	2				Phase 2
City Hall Garage		54	$925,200	$29,106	Phase 2
Corp Yard		13	$216,000	$7,007	Phase 2
Facilities Maint.	1				Phase 2
FS 3	0				Phase 2
FS 4	0				Phase 2
FS 5	0				Phase 2
FS 8	0				Phase 2
Water Poll. Control Fac.	2				Phase 2
Total	**10**	**145**	**$3,452,600**	**$78,155**	



Charging Employees for EVSE usage

The table below is a sampling of how other state agencies in California are managing their employee's usage of agency owned EVSE.

City	Organization	Free for Employees?
Agoura Hills	Sheriff Lost Hills Station	No
Bakersfield	San Joaquin Valley Air Pollution Control District	Yes
Baldwin Park	Environmental Health Headquarters	No
Camarillo	Camarillo Corp Yard 1-20	No
Clarksburg	Yolo County Library – Clarksburg Branch	Yes
Colton	Electric Utility Yard	No
Downey	Probation Department Ardis Lot	Yes
Los Angeles	Health Services	No
Los Angeles	LAX	Yes
Los Angeles	Martin Luther King Hospital	No
Los Angeles	South LA Sheriff Station	No
Sacramento	State Compensation Insurance Fund Sacramento	Yes
San Diego	Trillium – San Diego Metropolitan Transit System	Yes
Vallejo	Vallejo City Hall	Yes
West Hollywood	West Hollywood Station	No
West Sacramento	West Sacramento City Hall	No
Woodland	Police Department	Yes

Alameda County makes paid public charging a priority on their website, but it does not list free employee charging as an employee incentive like it does with free carpool parking and free shuttle service.

Detailed EVSE Assumptions

OVERVIEW

The estimated planning level project (capital) costs to install chargers at the City's fleet facilities include many items in addition to the EV chargers themselves which represent a small fraction of the total project costs for most charger installations. The full project costs include hard costs such as the purchase and installation of EVSE, associated materials, and ancillary equipment along with site restoration as well as soft costs such as project design and permitting, utility fees and contingencies.

The entire motorized fleet, including medium- and heavy-duty (M/HD) vehicles were included in this analysis. The light-duty (LD) vehicles were evaluated in the previous study conducted in 2022.

The charger recommendations for each domicile location are detailed in the section below. The summaries for each location will also document what has changed in the recommendations from the previous LD study, and what additional constraints and considerations could be required for the M/HD charging infrastructure.

All recommended Level 2 (L2) and DC Fast chargers (DCFC) would be dual-port unless otherwise specified; low output L2 chargers rated at 6.6 kW; medium output L2 chargers rated at 12 kW; single-port low output DC slow chargers rated at 12.8 kW; high output DCFC rated at 150 kW.

Site visits were conducted in 2022 for the LD analysis. The recommendations and assumptions are based on those findings, as-built drawings, and discussions with city staff.

FLEET CHARGING RECOMMENDATIONS SUMMARY

Fleet vehicle assignments, existing and proposed EV chargers, and information on electrical service are summarized below for each fleet domicile location. Fleet charger analysis for the five fire stations in this summary does not account for fire engines. Police pursuit vehicles have

also been excluded from this analysis. The Corp Yard, Facilities Maintenance, Animal Control, Landscape Maintenance, and Utilities Center are all adjacent to each other and form a campus-like location. For the purpose of this analysis as well as for operational convenience by each City department, these sites have been divided into individual facilities to clearly represent how many chargers and associated infrastructure are required for the vehicles assigned to each of the five sub-locations.

Airport at 20301 Skywest Drive: A total of five fleet vehicles are domiciled at this location, four of which are light duty and one of which is medium duty. Fleet vehicles park on the north end of the property in a gated area. There is one existing dual-port L2 which is for public charging and will not be considered for fleet charging. The Dedicated scenario would require three low output L2s. The main electrical room is located on the southwest end of the building. Field verification was not done at the airport, but based on discussions with city staff, the existing electrical service does not have available capacity for the proposed chargers for either scenario. Therefore, an electrical upgrade is recommended including a new step down transformer to accommodate the proposed electrical demand. Installation would require surface mounted and/or trenched conduit from the main electrical room to wall-mounted or pedestal-mounted chargers adjacent to the fleet parking stalls.

Animal Control at 16 Barnes Court: A total of four light-duty fleet vehicles are domiciled at this location, one is light duty and three are medium duty. The Dedicated scenario requires one low and two medium output L2 chargers. The fleet vehicles park adjacent to the southeast end of the property. The main electrical room with an 800A switchboard is on the southeast end of the property as well. Based on review of as-built drawings and field verification, panel “LP” in the main electrical room has spare capacity for the proposed chargers. Additional electricity upgrades are not required. The chargers could be installed along the wall to the east of the electrical room. Installation would involve surfaced mounted conduit feeding power from the main electrical room to the exterior of the building. Additional surface mounted conduit could feed power to wall-mounted chargers adjacent to the fleet parking stalls.

City Hall Parking Garage at 871 B Street: A total of 45 LD vehicles are domiciled at this location. There are 10 existing L2s on the ground floor of the garage which are currently used for public charging and are not considered for fleet charging. Fleet vehicles park on the third floor, which is restricted by a gate for employee and fleet access only. The Dedicated scenario would require 22 low output L2s, one medium output L2, and two supplemental DCFC.

The main electrical room is located on the northwest end of the building, with equipment in an enclosed room and on the exterior of the building. As-built drawings were not provided for this location but based on the proposed electrical demand and field verification, an electrical service upgrade would be required to meet the projected electrical load from fleet EV charging. Further coordination with PG&E would be required to confirm the existing capacity and determine the size of the service upgrade. Installation would include a new service panel with surface mounted conduit feeding power from the first-floor electrical room vertically to the third-floor fleet parking stalls. Surface mounted conduit would carry power to wall-mounted chargers adjacent to the fleet parking stalls.

Corp Yard at 24505 Soto Road: There are 104 fleet vehicles domiciled at this location consisting of 21 LD and 83 M/HD vehicles. The Dedicated scenario would require 11 low output L2s, 26 medium output L2s, 31 single-port low output DC chargers, and two high output DCFCs.

Fleet vehicles park to the east and south of the main building in marked outdoor stalls. Based on review of as-built drawings, field verification, and discussion with City staff, electrical upgrades are recommended to meet the additional proposed electrical demand. A new pad-mounted utility transformer could be installed south of the main Corp Yard building to feed a new switchboard and service panels. Conduit would need to be trenched from the new panels to pedestal-mounted chargers installed in the paved fleet parking areas.

Facilities Maintenance at 16 Barnes Court: Five LD vehicles are domiciled at this location. The Facilities Maintenance fleet shares the same warehouse building as Animal Control and Landscape Maintenance, with the facilities vehicles parking near the northwest end of the warehouse.

There is one existing L2 mounted on the exterior of the east side of the building, which is used for employee charging and will not be considered for fleet charging. The Dedicated scenario would require three low output L2s.

The nearest electrical room is southeast of the fleet parking, and the newest panel "HDP1" is located on the west end property mounted on the wall, in the same warehouse room as the fleet vehicles. No as-builts were provided for this location but based on field verification, panels "HDP1" and "LDC" have spare circuit breakers that could accommodate the electrical demand. Note that the proposed chargers for the Landscape Maintenance fleet could also be fed from the same power source, and the existing electrical capacity should be enough to meet electrical demands for both domiciles. Installation would include surface mounted conduit from the existing panel carrying power to wall-mounted chargers near the fleet vehicles.

Fire Station 1 at 22690 Main Street: One LD vehicle and four M/HD vehicles are domiciled at this facility. There is one existing wall-mounted L2 on the northeast exterior of the main building. The following charger recommendations are in addition to the one existing charger. The Dedicated scenario requires one low output L2, and two medium output L2s.

The vehicles park in a gated parking area on the northeast end of the property. The main electrical room is at the south end of the property with an 800A main switchboard. Based on review of as-built drawings and field visits, existing electrical capacity is sufficient to meet charging demand. Panels "A", "EA", "EC", and "ED" have spare breakers and available capacity to service the fleet chargers. Surface mounted conduit could be installed from the main electrical room to the exterior of the building on the eastside. Conduit would then need to be trenched to feed the pedestal mounted chargers in the landscaped area adjacent to the parking stalls.

Fire Station 2 at 360 West Harder Road: Three medium-duty fleet vehicles are domiciled at this location. The vehicles park in a gated area on the south end of the property in unmarked parking areas. The Dedicated scenario requires two medium output L2s. The main 400A switchboard is located outside in this area, adjacent to the east side of the main building, with

spare 25A and 100A breakers. As-built drawings were not provided for this location, but based on field review, a new service panel for the fleet chargers is recommended to be installed on the east or south walls of the building. Installation would involve surface-mounted or trenched conduit from the service panel (dependent on its location) carrying the power to pedestal mounted chargers installed in pavement adjacent to fleet vehicles.

Fire Station 6 at 1535 West Winton Avenue: Only one heavy-duty vehicle is domiciled at this location, so only one low output DC charger is needed. A field visit was not conducted at this site as it was still under construction during the time of this analysis. Based on reviews of as-built drawings provided, existing electrical capacity is available for fleet charging needs. Panels "LP-B1A", "LP-B1B" and "LPH-B1A" could be used to feed the proposed charger. Installation would involve surface mounted conduit carrying power to the exterior of the property, with conduit trenched in pavement carrying power to a pedestal mounted charger adjacent to the fleet parking.

Fire Station 7 at 28595 Hayward Boulevard: Two medium-duty vehicles are domiciled at this location, so just one medium output L2 is needed. Fleet vehicles park on the east side of the property in a gated area.

There is a 600A switchboard outside on the northeast end of the site. An additional 600A distribution switchboard is located in the electrical room on the north end of the main building. As-built drawings were not provided for this location, but based on field review, existing electrical capacity is likely sufficient for the proposed charger. Panel "LC", mounted in the interior of the main building, has spare circuit breakers potentially available for charging, but further analysis is recommended to confirm electrical capacity. Additionally, the distribution switchboard in the main electrical room has a spare 225A circuit breaker that could be used for a new service panel for fleet charging. Surface mounted conduit could be installed from the existing panel to the exterior of the building, and conduit would be trenched in the pavement to feed pedestal mounted chargers installed by the parking stalls.

Fire Station 9 at 24912 Second Street: Only one medium-duty fleet vehicle is domiciled at this location, which is parked in a gated area on the north end of the property. Only one medium output L2 is needed. A 400A main switchboard is in a covered outdoor area on the northwest corner of the property, adjacent to the living quarters. No as-built drawings were provided for this location, but based on field review, existing electrical capacity is sufficient for the proposed electrical demand. Panels "REA" and "A" have spare breakers which could be used to feed the proposed L2. Installation would require surface mounted conduit and trenched-in-pavement conduit carrying power from the existing panel to the pedestal-mounted charger installed near the east fence, south of the Fire Station building.

Landscape Maintenance at 16 Barnes Court: Two LD vehicles are domiciled at this location. Fleet vehicles park in the northwest corner of the property adjacent to the Facilities Maintenance fleet. The Dedicated scenario requires just one low output L2. As previously noted in the Facilities Maintenance section, the same panels "HDP1" and "LDC" could be used to power the chargers for the Landscape Maintenance fleet. Construction would involve surface mounted conduit from the existing panel carrying power to wall-mounted chargers near the fleet vehicles.

Library at 27300 Patrick Avenue: Only one medium-duty fleet vehicle is domiciled at this location, parked in a public parking lot north of the library building. The Dedicated scenario would require one low output L2. The main electrical room with 600A main switchboard is located on the southwest corner of the building. No as-built drawings were provided for this site, however it was confirmed during the site visit that the existing electrical capacity should be sufficient for electrical demand from fleet EV charging. Panels "B" and "C" have spare breakers which could be used for the L2 charger. Surface mounted conduit could be installed from the existing panel to the north end of the building, and conduit can be trenched through the landscaping to a pedestal mounted charger adjacent to a parking stall.

Hayward Police Department at 300 West Winton Avenue: A total of 35 fleet vehicles are domiciled at this location, with 28 LD vehicles and seven M/HD vehicles. Fleet vehicles are

parked in a gated area south of the main building in marked parking stalls. The Dedicated scenario requires 14 low output L2s, three medium output L2s, one low output DC charger, and two supplemental high output DCFCs.

The main electrical room with a 2500A switchboard is at the south end of the main building, adjacent to the fleet parking area. Based on the site visit, most electrical panels seem to be at capacity and additional electrical upgrades are recommended to meet the proposed electrical demand. A new step down transformer and sub-panel could be installed in the electrical room. Surface mounted conduit would be installed to bring power to the exterior of the building, and trench-in-pavement conduit could be installed to power pedestal mounted chargers installed on raised curb or asphalt adjacent to the parking stalls.

Hayward Police Department Northern District at 22701 Main Street: A total of eight LD police fleet vehicles are domiciled at this location which has 4 existing L1s. These fleet vehicles park in an outdoor lot south of the main building that is also used by employees for parking. The following charger recommendations are in addition to the existing L1s. The Dedicated scenario requires four low output L2s. No as-built drawings were provided for this location, but based on field review, electrical upgrades are recommended. An exterior 200A main switchboard supplies the building, and existing panels inside the main building do not have spare capacity. A new step down transformer and service panel could be installed at the southeast side of the building. Surface mounted conduit could be installed to feed the wall-mounted chargers on the east exterior side of the building. Additional chargers could be installed in the landscape areas to the south, adjacent to the parking stalls, which would require trenched conduit.

Utilities Center at 24499 Soto Road: Nine LD vehicles are domiciled at this location. These park in an outdoor gated parking lot to the south of the building, and the lot is also used for employee parking. There are two existing L2s adjacent to the parking area. The Dedicated scenario requires five low output L2s.

The electrical room with 800A main switchboard is in the northeast end of the main building. No as-built drawings were provided for this location, but based on the site visit, there is existing

electrical capacity for the proposed charging demand. Panels “EP” and “LP1” have spare circuit breakers which should be sufficient for the proposed EV chargers. Construction would require surface mounted conduit carrying power from the main electrical room out to the exterior of the building. Conduit trenched in pavement will carry power to pedestal-mounted chargers adjacent to the parking stalls, installed in landscape or in pavement.

Water Pollution Control Facility at 3700 Enterprise Avenue: A total of 12 vehicles are domiciled at this location, with five LD vehicles and seven M/HD vehicles. There are two existing dual-port L2s which are for employee charging and will not be considered for fleet charging. Fleet vehicles are parked throughout the property and are not assigned to specific parking stalls. City staff at this facility indicated that they are flexible with the charging locations for the electrified fleet. The Dedicated scenario requires three low output L2s, two medium output L2s, and four low output DC chargers.

The main electrical building is on the northeast corner of the property. No as-builts were provided for this location, but from the field visit and discussions with city staff, the existing electrical capacity should be sufficient to meet the proposed charging demand. Additionally, there is a new administration building being designed for this domicile that will modify the current parking area on the east end of the property. New service panels will be installed for this administration building that can be an option for use for the fleet chargers. New junction boxes and conduit pathways will also be installed from the 12kV substation, which could be utilized for the proposed EVSE. Further coordination is needed as the plans for the administration building are developed. Construction would require surface mounted conduit carrying power from service panels or the electrical room to the exterior of the building. Conduit trenched in pavement would feed pedestal mounted chargers installed on raised curbs adjacent to parking stalls. Coordination is needed to confirm fleet parking locations.

PLANNING LEVEL COST ESTIMATES

Each of these categories of project capital costs are explained and listed below.

The following tables summarize the six cost categories that are considered in the cost estimates, including needed EVSE quantities by charger type and their purchase costs, material costs, civil/site restoration, contracting/design, permitting, and utility upgrade costs.

Dedicated Transition Scenario

Dedicated Transition Scenario

Domicile Location	1. EV Chargers	2.Materials/ Equipment	3. Site restoration	4.Contracting/Design	5. Permitting	6. Utility fees	Total by Location
Airport	$25,200	$71,100	$7,200	$30,200	$6,000	$66,500	$206,200
Animal Control	$25,200	$28,400	$3,600	$7,700	$6,000	–	$70,900
City Hall Parking Garage	$531,600	$222,000	$43,200	$84,400	$6,000	$150,500	$1,037,700
Corp Yard	$910,000	$729,900	$46,800	$196,400	$6,000	$198,600	$2,087,700
Facilities Maintenance	$25,200	$30,300	$3,600	$8,100	$6,000	–	$73,200
Fire Station 1	$25,200	$36,000	$5,400	$10,800	$6,000	–	$83,400
Fire Station 2	$16,800	$40,100	$3,600	$10,000	$6,000	–	$76,500
Fire Station 6	$8,400	$12,900	$3,600	$4,500	$6,000	–	$35,400
Fire Station 7	$8,400	$18,700	–	$5,000	$6,000	–	$38,100
Fire Station 9	$8,400	$22,300	–	$5,700	$6,000	–	$42,400
Landscape Maintenance	$8,400	$9,400	$1,800	$3,500	$6,000	–	$29,100
Library	$8,400	$14,900	–	$4,200	$6,000	–	$33,500
Police Department	$437,300	$224,400	$32,400	$80,900	$6,000	$140,700	$971,700
Police Department Northern District	$33,600	$32,000	$7,200	$22,400	$6,000	$66,500	$167,700
Utilities Center	$42,000	$80,100	$10,800	$19,500	$6,000	–	$158,400
Water Pollution Control Facility (WPCF)	$76,000	$125,000	$12,600	$28,900	$6,000	–	$248,500
Total by Cost Category	$2,240,100	$1,697,500	$181,800	$522,200	$96,000	$622,800	$5,360,400

HARD COSTS:

1. EV Chargers

This includes:

- Level 1 EV chargers (120V receptacles)
- Level 2 EV chargers (ChargePoint CT4000 or equivalent)
- Power cords and cable management for Level 1 or 2 chargers
- DC Fast Chargers (150 kW Blink/BTC/ABB or equivalent)
- Gateway Module/ Load Management Devices

Note: this excludes costs for warranties because the standard warranty that vendor offers is part of the cost estimate tool.

2. Materials/Equipment

This includes costs of purchasing and installing materials typically required for fleet EV charging projects (other than the EV chargers themselves) including the following items:

- Wiring (Note 50 feet of conduit, wiring assumed per Level 1 and 100 feet per Level 2 and DC Fast charger)
- Conduit Systems (underground and/or surface-mounted)
- Trenching and/or directional drilling
- Pull Boxes (installed in the ground and/or surface mounted)
- Aerial wire spans
- Footings for installation of EV charger pedestals and electrical service panels
- Bollards
- Wheel stops
- Step Down transformers
- Electrical service panels including sub panels
- Circuit breakers

- Signage
- Striping for parking stalls

3. Site restoration

Site restoration covers the costs to install Civil/Landscaping improvements to restore the site following excavation and other construction activities including:

- Minor restoration for civil infrastructure such as roadway and/or sidewalk repaving
- Minor curb and gutter restoration
- Minor surface water (drainage infrastructure) restoration
- Minor landscaping restoration such as replanting

SOFT COSTS:

4. Contracting/Design

An estimated 20% mark-up has been applied to the total project costs to include:

- Engineering design fees
- Contractor profits

5. Permitting

Each local authority with jurisdiction mandates electrical permits for installation of EV chargers:

- Electrical permit fees charged by local jurisdictions, typically $5k per site plus $1k for labor and contingency.

6. Utility fees

This consists of fees charged by the electrical utility (Ava) to bring additional power to the fleet charging depot to power the EV chargers, including:

- Electrical upgrade design
- Transformer replacement/new utility transformer

7. Contingencies

A 20% mark-up has been applied to the project costs for each cost category (categories #1, #2, #3, #5, and #6 including contracting/design) consistent with public agency capital project budgeting.

SUMMARY

The Dedicated Transition scenario offers a more convenient solution and reduces the risk of EVs becoming discharged, and can possibly eliminate the need for active fleet charging management that would be necessary to ensure all vehicles remain adequately charged during operating hours.

The EVSE costs per EV at the Airport, Library, and Fire Stations #6 and #9 are high. These costs could be eliminated if EVs domiciled there charge at another facility.

Electric Vehicle Transition Planner

Recognizing that there are many ways to achieve full fleet electrification, a Transition Planner (see visualization below) will allow the City to consider many different approaches to achieving this goal. For example, the City may prioritize the replacement of the oldest vehicles first, or it may decide to replace vehicles by facility, based on availability of EVSE. Use the Transition Planner visualization below to explore ways to adjust costs and timelines to fit anticipated budgets. The average replacement year can be used to track the average time vehicles remain in service beyond their planned useful life.

Electric Vehicle Procurements

Many light-duty EVs in the market today could meet the City's needs and are reasonably priced. However, it might take five or more years for Class 3 – 8 EVs to reach sticker price and range parity with their conventionally-fueled equivalents.

The City might also consider replacing some of its medium duty vehicles with light-duty vehicles (e.g., Ford F-250 replaced with a Ford F-150) where increased towing and hauling capacity is not needed. The Ford F-150 Lightning loses around 50% of its range when towing equipment, but this might still be acceptable performance for some of the City's duty cycles.

For M/HD vehicles that haul or tow short distances, there are a number of EV options available now. Some vehicle types are better suited to electrification than others. For example, bucket trucks, yard tractors, buses and panel vans typically have duty cycles where an EV alternative is suitable. Other vehicle types are much more difficult to electrify, such as dump trucks, vacuum trucks and rodders, which require significant amounts of energy to operate. Battery electric refuse trucks and sweepers are available now, though their range and performance is still rather limited.

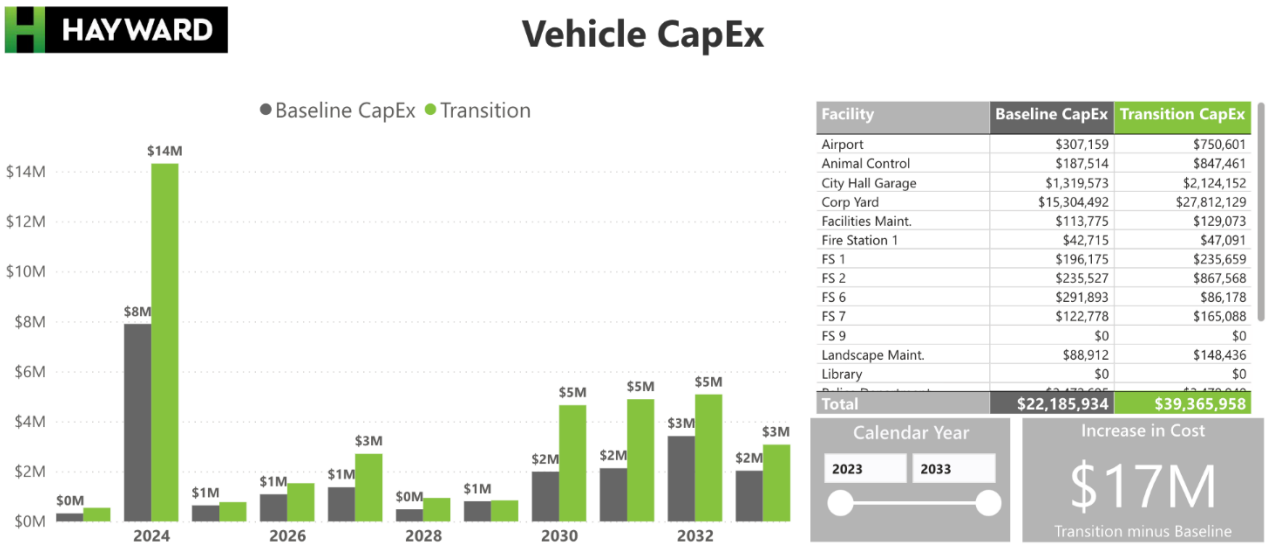
Ancillary LED lighting and cabin air conditioning/heating do not require much energy, particularly if high efficiency heat pumps are used. However, cabin heating using resistance heating does draw significant amounts of power. One advantage of EVs is that they can provide power to equipment, lifts and lights without needing an engine to be idling.

Electric vehicles typically recharge where they park. For light-duty EVs, L2 charging adds 10-20 miles of range per hour and can recharge a battery in 6-12 hours. Larger vehicles have bigger batteries and need either more time to charge (8-to-12 hours) or to be charged at a DCFC.

No EV replacements have been included in the 10-year analysis period. Frontier expects the City will instead prioritize replacement of ICE vehicles before replacing EVs in order to more effectively meet it's climate action and sustainability goals. No vehicle battery replacements are

anticipated, since any loss in a vehicle's battery capacity is not likely to affect its usability given the relatively short distances most vehicles travel each day.

The visualization below provides more details on the electric vehicle capital costs considered in this assessment. Adjust the slider lever to show the marginal increase in cost each year for EV acquisitions for either Transition scenario, as compared to the Baseline scenario. The timeframe scale can be adjusted to view a single year or up to the full ten (10) years covered in this analysis. The net increase in cost for the timeframe being considered is shown in the box labeled "Transition minus Baseline."



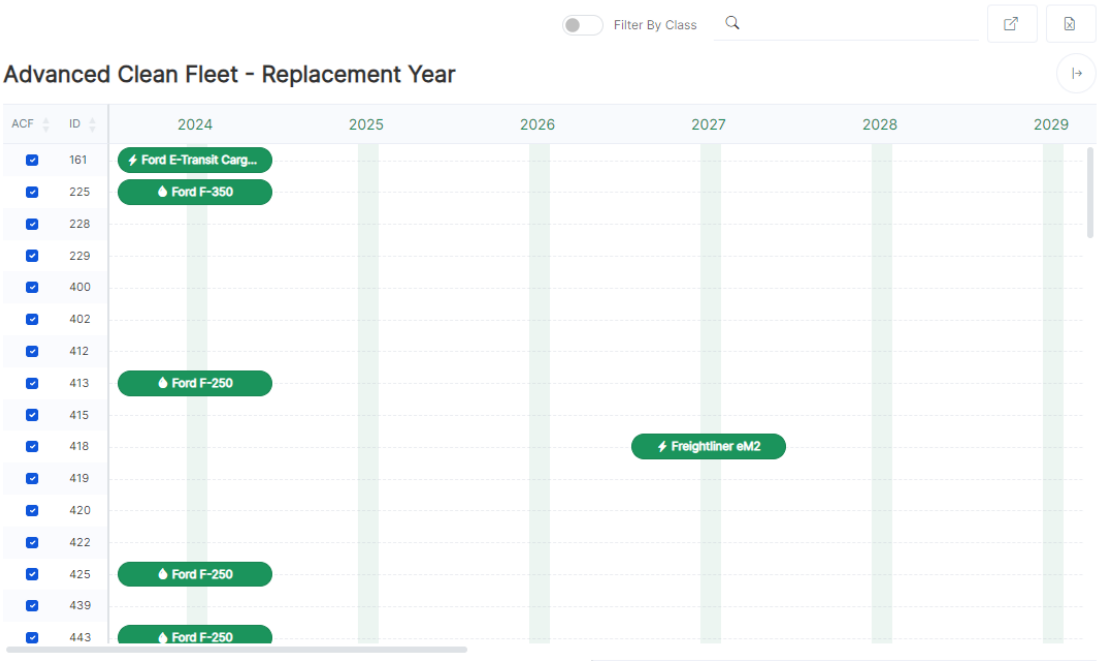
ACF Compliance Tool

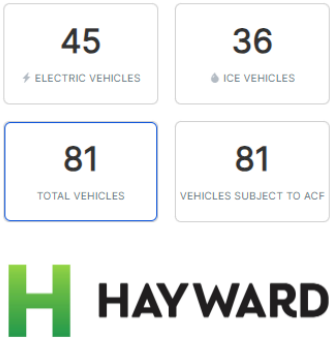
Inflation Reduction Act

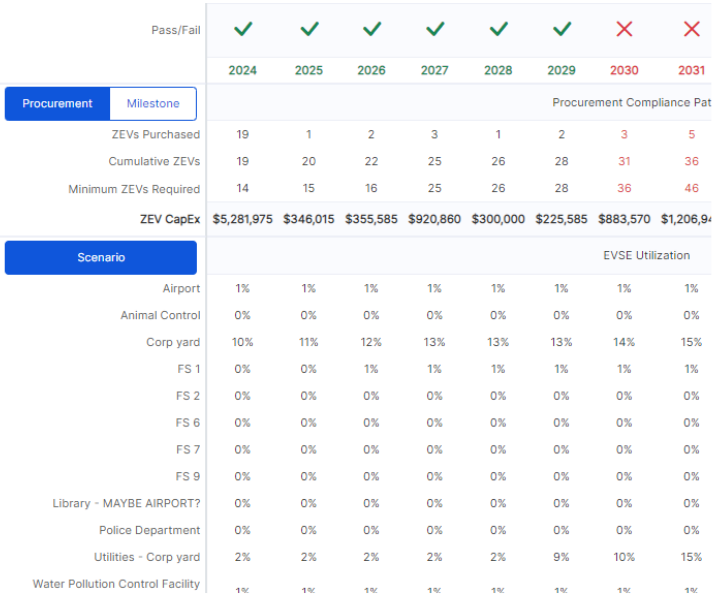
The Advanced Clean Fleet (ACF) Compliance tool can be used to help plan medium- and heavy-duty vehicle purchases to ensure compliance with the ACF CARB rule and to ensure enough chargers are installed and operational before the delivery of EVs. The Pass/Fail table automatically updates to indicate whether or not the replacement vehicles above comply with either the Procurement Pathway or the Milestone Pathway.

How to use this tool:

1. Click on the green or red bars to select a replacement vehicle from the dropdown list.
2. Move the green or red bars left or right to line up with the desired replacement year.
3. To add/remove a vehicle from the table calculations, check/uncheck the box on the far left.
4. To expand/contract the existing vehicle table, click on the |-> symbol at the top.
5. To filter the dropdown list by vehicle class, select the toggle at the top “Filter by Class”.
6. To search on any field, use the search bar at the top next to the  icon.
7. To open the tool in a new tab, click on the new tab icon in the upper right corner.
8. To save a configuration, click on the  icon in the upper right to “Export Current Configuration”. This action will download an excel spreadsheet to your computer. **Send this file to tpaddon@frontierenergy.com so it can be uploaded into this webpage.** Once this is completed, your new configuration will be saved as the new starting state (but not until then).







Inflation Reduction Act

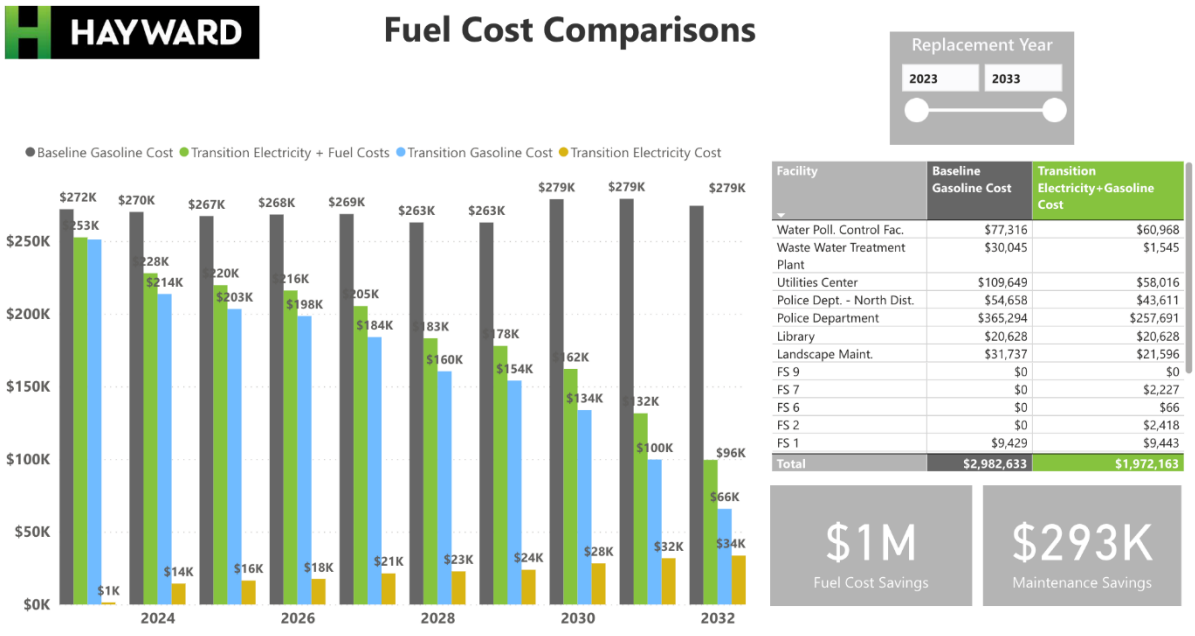
Light-duty EVs may be eligible for a Qualified Plug-in Electric Drive Motor Vehicle Credit of up to $7,500. The credit, available under Section 30D of the Internal Revenue Code, was modified with the passage of the Inflation Reduction Act. Guidance from the IRS indicates that the City should be able to benefit from the tax credit even though it doesn't have federal tax liability.

Fuel/Maintenance Cost Savings

A significant benefit of transitioning to electric vehicles is the reduced fuel and maintenance costs. In the visualization below, the green bars represent the total fuel costs of the transition fleet (gasoline, diesel & electricity), which is significantly less than the fuel costs in the Baseline scenario (gasoline & diesel), as indicated by the black bars.

Maintenance costs for EVs were estimated to be 50% of the equivalent ICE vehicle cost by Consumer Reports.

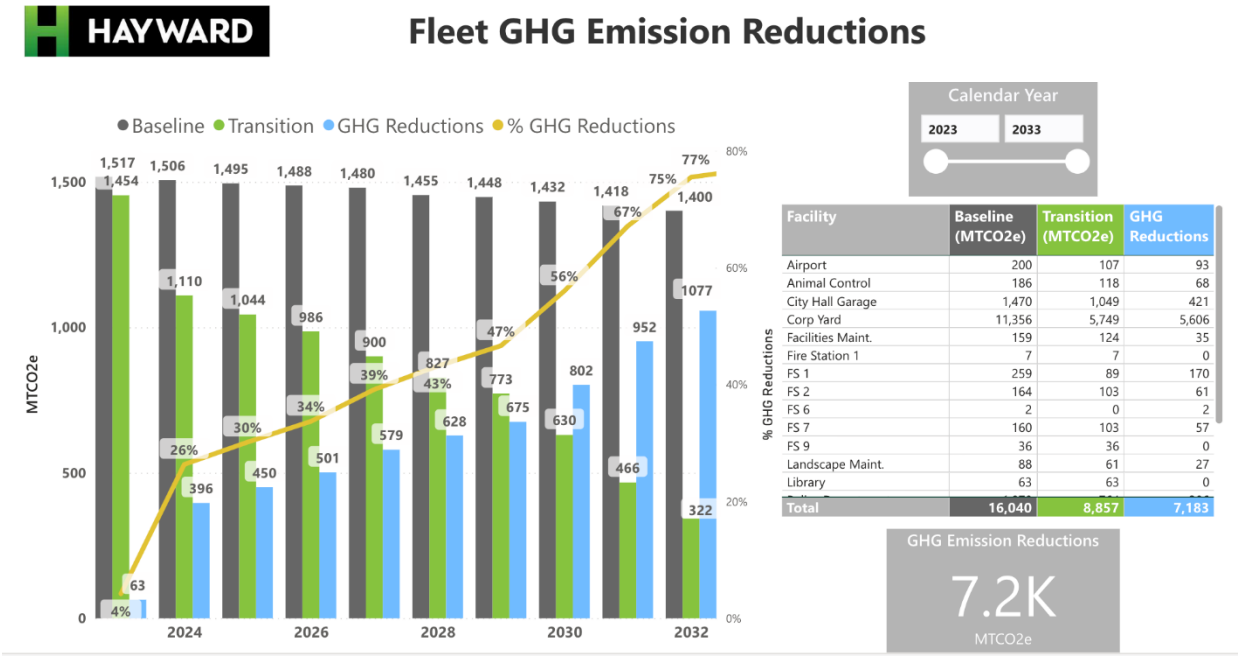
The costs to fuel an electrified fleet would still be lower than a conventionally powered fleet, even without LCFS credits. Fuel cost savings are based on the transition of the City's existing conventional fleet to electric vehicles.



Facility	Baseline Gasoline Cost	Transition Electricity+Gasoline Cost
Water Poll. Control Fac.	$77,316	$60,968
Waste Water Treatment Plant	$30,045	$1,545
Utilities Center	$109,649	$58,016
Police Dept. - North Dist.	$54,658	$43,611
Police Department	$365,294	$257,691
Library	$20,628	$20,628
Landscape Maint.	$31,737	$21,596
FS 9	$0	$0
FS 7	$0	$2,227
FS 6	$0	$66
FS 2	$0	$2,418
FS 1	$9,429	$9,443
Total	$2,982,633	$1,972,163

Greenhouse Gas Emission Reductions

Over this study's 10-year evaluation period, we estimate that the City can reduce its GHG emissions by 7,183 metric tons of carbon dioxide equivalents (MT CO2e) by converting the City's fleet to all electric vehicles. The visualization below shows GHG emission reductions on an annual basis, as the current fleet is replaced with EVs following the City's normal replacement schedule. Any delays in EV acquisitions will slow the progress of GHG reductions during this period. The time frame can be adjusted using the slider lever to set the view to anywhere between one and ten years and/or to individual facilities to see the GHG emissions at that level.

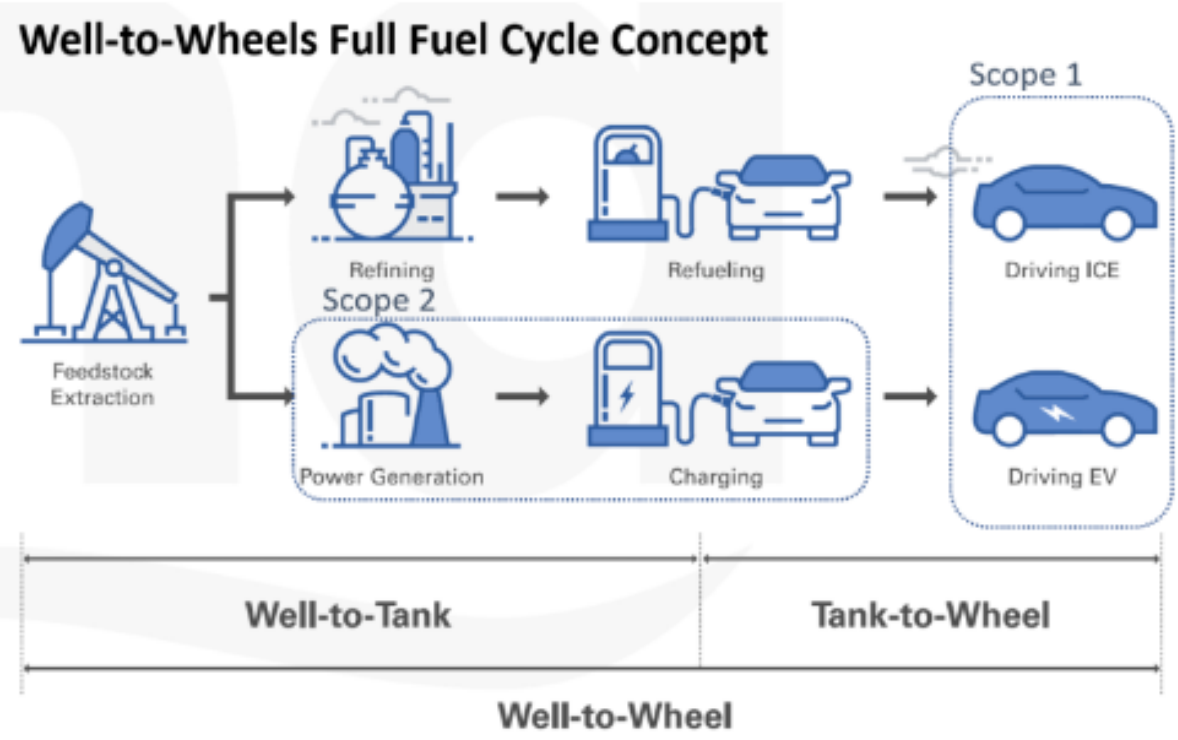


GHG Analysis Approach

Full Fuel Cycle Approach

- GHG emissions are calculated using "carbon intensity" (CI) values for fuels as defined in the LCFS program.
- The CI represents all GHG emissions associated with the production, transport, distribution, and end use of the fuel.

Emissions (MT) = Fuel Volume x CI x Energy Density / 1,000,000



Carbon Intensity Assumptions

- Gasoline – **99.44 gCO2e/MJ** (per CARB LCFS)
- Electricity – **0.00 gCO2e/MJ** (assumed for Ava's Renewable 100 mix of renewable electricity generation)

Energy Densities

- Gasoline – 115.83 MJ per gallon
- Electricity – 3.6 MJ per kWh

Greenhouse Gas Emissions Projections

- GHG emissions and energy consumption metrics for light duty fleets are calculated based on projected fuel/electricity use under the Baseline and Transition scenarios. Values are shown for the cumulative analysis period as well as each calendar year. Activity and emissions are calculated on a vehicle-by-vehicle basis for each calendar year.

GHG Emissions Factors

- GHG emissions reflect well-to-wheels emissions using the LCFS program methodology. Gasoline, diesel, and CNG values use current LCFS program "lookup table" values for these fuels. Their values are not assumed to decline over the analysis period.
- Electricity supplied by PV systems or under Ava Community Energy's Renewable 100 zero carbon electricity program is assumed to have a zero carbon intensity.

Relation to GHG Protocol Framework

- GHG Protocol refers to Scopes 1 & 2 emissions (see figure above). Scope 1 covers direct equipment and facility emissions and is essentially equivalent to "Tank-to-Wheels" emissions. EVs have no Scope 1 emissions, while all combustion vehicles have Scope 1 emissions.
- Emissions from production of electricity used to charge EVs falls into Scope 2. For electricity produced by wind and solar generation, Scope 2 emissions are zero.
- GHG Protocol does not clearly address GHG emissions associated with fuel feedstock production, refining, etc and is not included in our analysis.

Conclusion

The transition of the City's motor vehicle fleet will require the purchase of EVs to replace conventional ICE vehicles and the installation of EVSE and related infrastructure to support the transition. L2 and DC charging infrastructure installations are recommended at various locations to offer dedicated charging spaces for EVs. The transition of the City's fleet to EVs is expected to cost the City approximately $25M as compared to the Baseline scenario, and also cost the City $1.3M in additional operational expenses over the next 10 years. The City's EV fleet transition is estimated to provide GHG emission reductions of 7,183 MTCO2e over a ten-year period.

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