QUANTIFYING GREENHOUSE GAS REDUCTIONS PROJECT PROFILE

LOW EMISSION VEHICLES

The new Local Government Climate Action Program (LGCAP) provides local governments and Modern Treaty Nations with predictable and stable funding to support reducing greenhouse gas emissions and preparing for the impacts of a changing climate. LGCAP is built on the foundations of CleanBC, the Climate Preparedness and Adaptation Strategy and the BC Climate Action Charter (the Charter). Carbon neutrality is not a component of LGCAP, but the carbon neutral framework remains available as a resource to local governments to quantify community mitigation projects and account the reductions in a credible manner against corporate emissions. The carbon neutral framework can also support climate lens assessments and meeting commitments under the Charter. This decision was a result of engagements with local governments who indicated concerns that a focus on carbon neutrality could detract from funding other, local and more climate-effective initiatives. Additionally, with an increasing number of B.C. local governments adopting net-zero targets, carbon neutrality has been seen as less of a priority pathway. Establishing net-zero targets illustrates leadership in climate action and aligns with provincial commitments on net-zero by 2050 legislation. Please view all requirements in the project profiles as recommendations for establishing credible reductions.

Project Profile Overview

This document provides guidance on estimating the emission reductions potential associated with replacing conventional vehicles with low emission vehicles (LEVs), such as those used in local government fleets, by public transit, police departments and airports. Significant advancements in vehicle technology have been made in the past decade, providing many options across multiple vehicle classes for improving fuel efficiency. Hybrid-electric, full electric and high efficiency internal combustion engines all represent a clear opportunity for fuel savings and emission reductions over conventional vehicle counterparts. Because of these benefits, an increasing number of fleet operators are switching to LEVs.

With the complexities associated with comparing emissions between different sizes of vehicles and the embodied emissions of different fuel types, the scope of eligible vehicle types under this project type is limited to high efficiency internal combustion engines that use fossil fuels, hybrid-electric engines, plug-in hybrid electric engine systems, and full battery electric systems. Local governments are encouraged to align actions with the Provincial zero-emission vehicle (ZEV) mandate. Electric airport conveyors are also included in this project due to the significant emission reduction potential for switching away from gas- or diesel-powered conveyors.

Calculating Emission Reductions

Annual Net Emission Reductions = Annual Baseline Emissions – Annual Project Emissions

To determine Annual Net Emission reductions, a local government must determine the Baseline Emissions and Project Emissions on an annual basis. Given the amount of distance travelled or time in use within one year, this is basically a comparison of the emissions that would have been created if a conventional vehicle was used instead of an LEV.

The Annual Baseline Emissions represent those that would have been created if the decision was to purchase a conventional vehicle. For example, for a police department replacing patrol vehicles, this would be the standard model that most police departments are using at that time. The Baseline Emissions do not represent the emissions that were generated in the past with older vehicles.

The Annual Project Emissions represent the emissions generated by the LEV in the year of assessment.

To calculate the Annual Baseline Emissions and Annual Project Emissions for any given year, the following information is needed:

- Vehicle Emissions Intensity (kg CO_2e/100km or kg CO_2e/hr). These intensities can be derived from the fuel economy for each vehicle provided by manufacturers; and
- Total Vehicle Usage (km or hours). This can be easily collected from odometers or timers.

The Annual Net Emission Reductions in any given year is therefore a function of the level of improvement in vehicle emissions intensity and the amount the vehicle is used.

Project Examples

The following are illustrative examples of how to estimate the emission reductions potential associated with replacing conventional vehicles with LEVs.

- **Police Vehicle Example:** Hybrid police cars are beginning to be used in cities across North America and use about half as much fuel per kilometre as conventional vehicles used by police departments. Two conventional police cars that consume 11 litres per 100 km and travel 30,000 km per year would emit 14.09 tonnes CO_2e annually. If these two vehicles were replaced with hybrid police cars, consuming 5.5 litres per 100 km of E10 (gasoline blended with 10% ethanol), emissions would be 6.82 tonnes CO_2e annually. The annual avoided emissions associated with replacing the two conventional police cars would therefore be 7.27 tonnes CO_2e. *(See spreadsheet Option 1 for details of calculations.)*
- **Airport Example:** A conventional, gasoline-powered belt loader consumes 2 litres of fuel per hour. If three loaders operate for 1,750 hrs per year each, they will emit 22.42 tonnes CO_2e annually. An electric belt loader uses 0.7 kWh/hr; if three operate for the same amount of time, they will generate 0.04 tonnes CO_2e annually. By switching to the electric belt loader, emissions would be reduced by 22.37 tonnes CO_2e annually. *(See spreadsheet Option 1 for details of calculations.)*

Spreadsheet Direcions

The LEV spreadsheet simplifies the calculations needed to determine the annual emission reductions associated with switching to LEVs. Annual emission reductions can be determined using either published fuel consumption ratings (Option 1) or community-estimated fuel consumption (Option 2). Option 1 is preferred, and Option 2 should only be used if manufacturer-specified fuel consumption ratings are unavailable, or otherwise unsuitable for the application.

Option 1: Published fuel consumption ratings (Preferred)

Fuel consumption ratings are typically based on distance. However, for certain applications (such as for airport vehicles), time may be a more accurate measure of fuel consumption and emissions. For distance-based calculations, use Option 1A; for time-based calculations, use Option 1B. *Where differences occur between the two methodologies, actions required for Option 1B are in italics.*

Description of Task	Input/Output
Step 1: Determine fuel consumption rating	
Fuel consumption rating. Determine the fuel consumption rating of both the LEV (project) and conventional new vehicle (baseline). Fuel consumption ratings can be found through various sources, including: ♦ The manufacturer ♦ Natural Resources Canada Fuel Consumption Ratings per 100km If no fuel consumption ratings are available, use Option 2.	The amount and type of fuel required to travel 100 km *(or one hour)*, both in the city and on the highway.
Step 2: Estimate share of city and highway driving	
City/highway driving. Estimate the share of city and highway driving, over the entire year.	Share of city and highway driving, by distance (%).
Combined city/highway fuel consumption. The spreadsheet calculates a combined city/highway fuel consumption rating.	Spreadsheet output.
Step 3: Specify renewable fuel blends if applicable	

Ethanol. If an ethanol fuel blend is used in either the baseline or project, specify the grade. For example, for E10, specify 10%. **If no ethanol is used, enter 5% in line with the Renewable and Low Carbon Fuel Requirements Regulation (RLCFR).**	Ethanol fuel blend (% ethanol mixed with gasoline).
Biodiesel. If a biodiesel fuel blend is used in either the baseline or the project, specify the grade. For example, for B20, specify 20%. **If no biodiesel is used, enter 4% in line with the Renewable and Low Carbon Fuel Requirements Regulation (RLCFR).**	Biodiesel fuel blend (% biodiesel mixed with diesel).
Blended fuel required. The spreadsheet calculates the volume of blended gasoline and/or diesel required, accounting for the lower energy density of biofuels.	Spreadsheet output.
Step 4: Calculate total fuel consumption and emissions intensity	
Total fuel consumption. The spreadsheet summarizes total fuel consumption, including renewable fuels, per distance *(time)* travelled.	Spreadsheet output.
GHG emissions intensity. The spreadsheet calculates GHG emissions per distance *(time)* travelled based on fuel consumption estimates and emission factors for each fuel.	Spreadsheet output.
Step 5: Enter annual travel estimates and fleet size	
Distance *(time)* traveled. Enter the average annual distance *(time)* traveled per vehicle.	Average distance per vehicle (km/yr). *Average operation time per vehicle (hrs/yr).*
Fleet size. Enter the number of vehicles included in the project.	Fleet size (number of vehicles).
Total distance *(time)* travelled. Total distance *(time)* travelled equals the distance *(time)* traveled per vehicle multiplied by fleet size.	Spreadsheet output.
Step 6: Calculate annual baseline and project emissions	
Baseline emissions. Baseline emissions are equal to baseline emissions intensity multiplied by total distance *(time)* traveled per year.	Spreadsheet output.
Project emissions. Project emissions are equal to project emissions intensity multiplied by total distance *(time)* traveled per year.	Spreadsheet output.
Step 7: Calculate annual avoided emissions	
Avoided annual emissions are equal to baseline emissions minus project emissions. Avoided emissions are equivalent to Emission Reduction Credits and are shown for the total project and per vehicle.	Spreadsheet output.

Option 2: Community-estimated fuel consumption (Alternative)

Option 2 is identical to Option 1, except that Step 1 requires the community to measure fuel consumption over a representative period of time. Steps 2 and 3 also do not apply. As with Option 1, provisions are made for both time-based and distance-based measures. For distance-based calculations, use Option 2A; for time-based calculations, use Option 2B. Where differences occur between the two methodologies, *actions required for Option 2B are in italics*.

Description of Task	Input/Output
Step 1: Estimate fuel consumption rating	
Odometer readings. Enter the odometer readings at the beginning and end of the measurement period. This period should be as long as practicable to ensure it encompasses a representative period of use.	Start and end odometer readings (km) *(hours)*.
Fuel consumption data. Enter the amount of fuel consumed that corresponds to the odometer measurement period. If any biofuels are used, these should be entered here. For example, if 100 litres of B20 (20% biodiesel) is consumed, enter 20 litres as "biodiesel" (20% x 100 litres) and 80 litres as "diesel" (1-20% x 100 litres).	Fuel consumption and type (various units).

Best Practices

The following checklist includes best practices for quantifying greenhouse gas emissions from local government GHG mitigation projects. Please also refer to the BC Best Practices Guidance on Quantifying GHG Emissions and the Emission Factors Catalogue.

Checklist:

1. Emission reductions have occurred before they are counted
2. Emission reductions are credibly measured
3. Emissions reductions are beyond business as usual
4. Accounting of emission reductions is transparent
5. Emission reductions are only counted once
6. Project proponents have clear ownership of all emission reductions

Local Applicability and Cost Factors

- **Age of Fleet and Timing of Vehicle Purchases.** This project type will make the most economic sense if fleet vehicles are replaced according to their normal capital budgeting cycles. Replacing older, less fuel-efficient vehicle fleets with new low-carbon vehicles will present the best economic and GHG reduction business case.
- **Project Monitoring and Reporting Effort and Costs.** The data needed to quantify emissions reductions and complete monitoring and reporting requirements is typically already collected by fleet managers. This includes kilometres traveled and litres of fuel consumed for transit and police vehicles. For airport vehicles, data that needs to be tracked includes kilometres traveled or hours operated, and the total or typical loads carried (for vehicles that move equipment, luggage and planes). Most fleet managers will be able to complete project monitoring and reporting without assistance from an external consultant.

Examples

- CRD's Zero-Emissions Fleet Initiative: https://www.crd.bc.ca/project/past-capital-projects-and-initiatives/zero-emissions-fleet
- YVR ground support equipment and vehicles electrification: Carbon Reduction | YVR

Technology Options Overview

Technology	Suitable Application	Typical capital cost ($ per vehicle)	Typical operating cost savings versus conventional vehicle	Sample Technology	Issues
Hybrid-Electric Police Car	Complete replacement of some traditional police vehicles	$29,000 - $50,000	Payback period based on fuel savings can be as short as one year	Toyota Prius, Toyota Camry Hybrid, Nissan Altima Hybrid, Ford Fusion Hybrid, Ford Escape Hybrid	Unfamiliar technology for most police forces
Fully Electric Police Car	Replacement of some traditional police vehicles	$50,000 - $ 140,000	Depends on car and distance travelled among other variables. See here.	Ford Focus, Mustang Mach-E, Nissan Leaf, Tesla X, Tesla Y	Unfamiliar technology for most police forces
Electric ground vehicles at airports	Replacement of diesel and CNG vehicles	Wide cost range	Payback period based on fuel savings of 3 to 7 years		Unfamiliar technology for airport operators
Bicycles for Police Patrols	Alternate to conventional vehicles for *some* patrols	$2000	Payback period based on fuel savings can be as short as one year		Unfamiliar technology for many police forces; a different methodology would be required to calculate emission reductions

Project Variations

Project examples include:

- **Bikes**: Bikes are playing an increasingly important role in many institutional environments, including police forces and airports. As with alternative motorized vehicles (above), they cannot replace all the activities of a traditional patrol car, so an activity-oriented vs. vehicle-oriented methodology could be developed.
- **Low carbon fuels**: Many local governments in B.C. are already using biodiesel blends in fleet vehicles. Some biofuels based on high input agricultural crops or transported long distances have minimal carbon gains. However, other biofuels, such as those created from second generation oils are very low carbon and additionally support community-based processing – they are also clearly not business as usual activities, easily meeting additionality tests. A different methodology would have to be developed with defensible emission factors for different fuels to support an alternative fuels project.
- **Green Fleet Program**: LEVs. are just one component of more comprehensive green fleet programs which typically involve route planning, right sizing for activities, activity-sizing (e.g., using bikes or Segways for certain applications), idle reduction, and driver education amongst other strategies. Airports that have dramatically reduced ground-based transportation fuels have focused as much on baggage and air traffic flows as LEVs. Communities considering this could benefit from collecting data on current activities now. Typically, these programs save money and yield a range of other benefits including strengthening employee morale.

Resources

- Natural Resources Canada Vehicle Fuel Consumption Guides and Tools: http://www.nrcan.gc.ca/energy/efficiency/transportation/cars-light-trucks/buying/7487
- The E3 Green Fleet Program provides more comprehensive guidance for emission performance: http://www.e3fleet.com
- RCMP's first electric police vehicle unveiled in B.C. | CTV News

- Electric Ground Support Vehicles for Airports Research Initiative, Idaho National Laboratory, US DOE
  - Cost-Benefit Analysis Model
  - Testing Reports https://avt.inl.gov/sites/default/files/pdf/airport/GSECostBenefitHigh.pdf