CLIMATE LENS GUIDANCE

A Resource for British Columbia Local Governments, February 2026

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Executive Summary

Local governments directly or indirectly influence approximately 50% of B.C.'s GHG emissions through their decisions on infrastructure investments, transportation, buildings, and land use.[1] Considering this, and British Columbia's legislated greenhouse gas reduction targets under the *Climate Change Accountability Act*, the Province is updating its Climate Lens Assessment Guidance for Local Governments (CLA) and associated calculators.

The purpose of this guide and toolkit is to assess the climate impacts of infrastructure from both greenhouse gas and resilience perspectives along with potential measures to manage climate impacts. It is an important tool to enable informed asset management decisions and foster alignment with Official Community Plans, Regional Growth Strategies, risk assessment policies, and future federal funding requirements.

The CLA follows the 6 principles[2] of the International Organization of Standardization (ISO) Standard 14064-2, which provide guidance on how to quantify, monitor, and report on projects' greenhouse gas (GHG) impact. In accordance with the 6 principles of ISO 14064-2, each CLA will include:

1. Baseline and Project scenarios to determine GHG emissions and reduction potential.
2. An assessment boundary to outline what is and isn't included with respect to energy sources, timescale, and activities, GHGs considered, emission scopes, and data considerations (collection, calculation, assumptions, methodologies).

This guide also provides project examples, GHG reduction potential, and resiliency implications for 6 common municipal project types that can be helpful when deciding on replacing or buying new assets or planning infrastructure projects. Project types include:

- Critical Infrastructure Required by Regulation
- New Buildings and Retrofits of Existing Buildings
- Fuel Switching to Renewable Energy
- Active Transportation
- Low-Carbon Vehicle Charging and Fueling Infrastructure
- Organic Waste and Composting

Sample calculation methodologies are provided for each project type and can be used "as-is" wherever applicable or as the basis for similar projects. These methodologies are informed by applicable provincial and federal regulations, list the required information and assumptions to conduct the necessary calculations, and provide detailed calculations for the Baseline and Project scenarios.

[1] Province of BC, 2021. CleanBC Roadmap to 2030. www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

[2] 6 ISO 14064-2 principles: Relevance, Completeness, Consistency, Accuracy, Transparency, and Conservativeness

Introduction

The *Climate Change Accountability Act* has established a target to reduce climate-changing emissions by 40% by 2030. Although some progress is already being made, the scale of the climate emergency we are living through demands that we act with urgency. Recognizing this urgency, and the critical role communities have in addressing climate change, the Province works in collaboration with local governments and Indigenous communities to reduce greenhouse gas emissions and improve resilience to climate change, while contributing to community social and economic development. Examples include:

- A range of actions outlined in B.C.'s Climate Preparedness and Adaptation Strategy for 2022-2025 to address climate impacts and build resilience across B.C.
- Support through the Disaster Resilience and Innovation Funding (DRIF) program for First Nations and local governments in B.C. to enhance their capacity to withstand and adapt to natural and climate-driven hazards.
- The Local Government Climate Action Program, which provides local governments and Modern Treaty Nations with funding to reduce emissions and prepare for our changing climate.
- New requirements for all buildings to be zero carbon by 2030
- Ensure that all new space and water heating equipment sold and installed in B.C. will meet the highest standards of efficiency by 2030
- Continued work with local governments to develop voluntary carbon pollution standards (Zero Carbon Step Code).
- Support for "mode shifting" to more energy efficient forms of transport by establishing energy intensity targets for personal and commercial transportation, including:
    - Increasing the share of trips (e.g., commuting for work and personal activities) made by walking, cycling, transit to 30% by 2030, 40% by 2040 and 50% by 2050.
    - Reducing the energy intensity of goods movements by 10% in 2030, 30% by 2040, and 50% by 2050.
- A target to install 10,000 public EV charging stations in the province by 2030.

What is a Climate Lens Assessment?

The CLA is a tool used to determine the climate impacts of infrastructure projects from both greenhouse gas and resilience perspectives. The three intakes of the CleanBC Communities Fund (CCF) that ran from 2018 to 2022 provided funding for emissions-reducing infrastructure projects, included a CLA as an application requirement. The goal of including the CLA in CCF was to raise awareness of the operational emissions and climate risks and impacts associated with projects and encourage improved choices by project planners, designers and decision-makers. Moving forward, the Government of British Columbia is aiming to provide additional resources, including this guide, to support the inclusion of GHG mitigation and resiliency considerations in critical and municipal infrastructure planning and decisions in the province.

The CLA has four main components:

- **Project Overview:** A description of the project, including geographical and spatial details (e.g. timeline, location, and activities).
- **GHG Emissions & Mitigation**: Quantification of the anticipated GHG emissions impact of the infrastructure project. This requires clear identification of methodology used to calculate emissions, any assumptions made, and resources sought, aligning with ISO 14064-2. Further details can be found below.

- **Climate Resiliency**: An assessment of potential risks and resiliency of the project, in response to climate related impacts. Potential risks are assessed based on the level of impact, exposure, and likelihood. If the assessment concludes that some aspects of the project carry medium or high levels of risk, project planners must also include mitigation measures along with any data and resources required to help determine said risks. This section aligns with the ISO 14092 standard for Requirements and Guidance on Adaptation Planning for Local Governments and Communities. See Appendix A for more details about ISO 14092.
- **Climate Objectives:** Identifies alignment between the project and relevant climate objectives (e.g. Climate Action Plan, Asset Management Plan, Official Community Plan, contributing to provincial GHG targets, etc.)

All projects undergoing a CLA require a Baseline and a Project scenario. The Baseline is the "Business As Usual" (BAU) case and outlines a hypothetical reference case where no Project-related upgrades occur. Note that in the absence of energy efficiency upgrades, the BAU must still include all regulatory provisions (e.g. BC Building Code). The Project scenario refers to an instance in which project-related upgrades do occur. Comparing the BAU and Project scenarios determines the annual and overall energy and GHG reductions of the Project. See Appendix B for examples of Baseline and Project scenarios for different types of infrastructure.

The overarching methodology for calculating emission reductions is derived from ISO standard 14064-2, which provides project-level guidance to quantify, monitor, and report GHG emissions. ISO 14064-2 is based on the following principles: relevance, completeness, consistency, accuracy, transparency, and conservativeness. See the Guidance on Quantifying Greenhouse Gases section for more details on the ISO 14064-2 standard and the B.C. Best Practices Methodology for Quantifying GHG Emissions.

Alignment with Local, Provincial, and Federal Climate Goals

The original Climate Lens Assessment was developed at the federal level as a project-level requirement for funding distributed through Housing, Infrastructure, and Communities Canada's Investing in Canada Infrastructure Program (ICIP) and Disaster Mitigation and Adaptation Fund (DMAF). This document is intended to provide a broad resource to support local governments in integrating mitigation and resiliency considerations into infrastructure decisions. As guidance with federal efforts, including future funding requirements evolves, the Province will continue to be a resource and provide updates, including but not limited to reviewing this guidance document. More information on the current federal process is referenced below on p.18, within the section on how to determine risks.

Conducting a Climate Lens Assessment provides project planners and decision-makers with a clear outline of how much energy and GHGs a project is expected to eliminate and what co-benefits it offers. This straight-forward messaging can support engagement with councilors, directors, and other government leaders making informed asset management decisions. It can also be useful in communicating with constituents during public engagement efforts. Examples of the indicators provided include amount of: vehicles converted to electric, heat pumps installed, and vehicles taken off the road from walking/cycling, transit. For a more comprehensive list of key climate indicators quantified in the CLA, see Table 1.

Local governments are encouraged to align Official Community Plans, Regional Growth Strategies, risk assessment policies, and/or asset management policies with the CLA. Examples include the District of Saanich's Asset

Management Policy[3], District of Summerland's Asset Management Policy[4], and Village of Salmo's Official Community Plan[5].

The CLA is also an important step to bring infrastructure projects into alignment with new Provincial risk assessment requirements, in particular, the new *Emergency Disaster Management Act* (EDMA) which contains requirements for local authorities, Provincial Ministries and critical infrastructure owners to conduct risk assessments, create emergency management plans and business continuity plans (in the event of noted risks occurring).

TABLE 1 – EXAMPLES OF KEY INDICATORS FROM CLIMATE LENS ASSESSMENT

Climate Lens Component	Examples of Indicators	Associated Policies
Mitigation	# tonnes CO_2e reduced % of annual GHG emissions reduced	Official Community Plan/Regional Growth Strategy Corporate Energy & Emissions Plan Low Carbon Resilience (LCR) Plan
Resilience	Area of restored or protected natural habitats Avoided maintenance costs PM2.5 – Indoor air quality % of buildings with heat pumps Risk and Vulnerability Assessment completed*	Official Community Plan/Regional Growth Strategy Asset Management Policy LCR Plan

* Risk and Vulnerability Assessment should include key risks identified in Regional and Provincial risk assessments

Alignment with Federal Guidance, Provincial and Local Government Climate Goals

Considerations

Although a CLA requires some technical knowledge, the main purpose is to support decision-makers in:

- evaluating and implementing strategies to minimize emissions associated with the design, construction and operation of the project
- evaluating current and projected disaster and climate change risks and impacts associated with the design, construction, and operation of project
- adjusting plans to reduce risks by incorporating mitigation measures into the project's design and budget

[3] District of Saanich, 2019. *Council Policy – Asset Management, Key Principle 2.*
[4] District of Summerland, 2019. *Asset Management Policy – Section 4.5.*
[5] District of Salmo, 2020. *Official Community Plan – Section 3.1.2.*

This tool is not meant to be highly granular and analytical. Asking yourself the following questions when considering the cost of a CLA may be helpful:

- Reach: Is this for retrofitting a small corporate building with limited resilience implications, or a large active transportation network that will merit considerations for wildfire, flooding, and erosion risk, wildlife corridors, and rights of way, but may also present many co-benefits such as improved physical and mental health, improved community cohesion, and reduced air pollution?
- Budget: What percent of the project can you allocate to a CLA? To what degree do you anticipate the CLA influencing or altering your project?
- Ease of Gathering Data: For GHG mitigation and quantification of resilience implications, do you have the data necessary to quantify the baseline and project scenarios? Is the data readily available, or do you need to gather the data separately?
- Internal or external: Can you complete the CLA with internal staff, or do you need to hire a consultant? If going external, what would be important to include in your Request for Proposals?

All these considerations will be important when establishing the necessary cost for a CLA.

It is important to remember that conducting a climate lens assessment is a good practice – even when data is imperfect – because it helps identify potential climate risks and opportunities early, guiding more resilient and sustainable project decisions. **Acting on the best available information is better than waiting for perfect data**.

Priority Project Types

The following section outlines and describes infrastructure project types that are common for Provincial infrastructure funding programs. Several of these project types have profiles and calculators on the Resources for Local Governments – Reducing GHG emissions page that can provide additional context and allow non-technical staff to quickly estimate GHG savings over the project lifetime. Projects with calculators available are hyperlinked below in Table 2, also see Appendix C for calculation methodologies for each project type.

TABLE 2 – PRIORITY PROJECT TYPES

Project Type	CNF Profile	CNF Calculator
Energy Efficiency for New/Existing Buildings	1B	1B
Fuel Switching to Renewable Energy for Buildings	1B/1C	1B/1C
Active Transportation **(in development)**	n/a	n/a
Low-Carbon Vehicle Charging and Fueling Infrastructure	1A	1A
Avoided Forest Conversion/Urban Tree Canopy	1E	1E
Organic Waste and Composting	1D	1D

Critical Infrastructure Required by Regulation

Critical infrastructure (CI) is defined by [the *Emergency And Disaster Management Act*] as *"a system, network, facility or asset, whether physical or virtual and whether publicly or privately owned."* At the local government level, examples of CI include:

- Drinking water and wastewater systems
- Policing
- Fire protection

This section will outline examples related to drinking water and wastewater infrastructure. Other CI are captured under the other categories (e.g. Police or Fire Station >> New and existing buildings, City vehicles >> EV charging infrastructure).

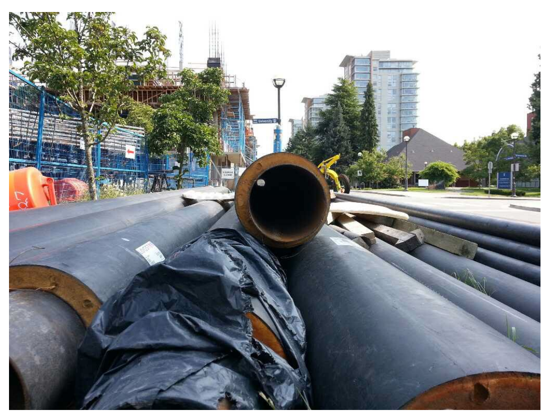
Drinking Water

Within drinking water, CI may include pump stations, reservoirs, wells or equipment in the treatment plants themselves. Energy savings associated with equipment and process optimization are predominantly electricity, which carry considerable cost savings, but minimal emissions savings due to the low electricity emission factor in BC. The one exception to this would be for off-grid remote communities that are connected to diesel generators, in which case the emission savings could be substantial.

Wastewater Treatment Plant

Wastewater systems also have numerous pump stations and equipment in the treatment plant that operate on electricity. Sewage heat recovery, which involves capturing latent heat in sewage piping, is most often used to offset building heating, and could be used for the wastewater treatment plant, or as a source for district energy systems. Emission savings will depend on whether the heat that is being displaced is from fossil fuels (e.g. natural gas, propane), or electricity. Biogas is a byproduct of anaerobic digestion and can be captured for combustion on-site to offset heating needs or scrubbed and refined to inject into natural gas pipelines as renewable natural gas (RNG). In both cases, biogas has the potential to offset natural gas, possibly leading to considerable emission savings.

The plants often have back up diesel generators.



Resilience

Climate Hazards that will impact both drinking water and wastewater systems:

- Increase in rainfall
- Increase in summer temperatures
- Increase in winter temperatures
- Drought
- Snowfall – on site & watershed scale

Energy Efficiency for New/Existing Buildings

This project type captures all non-fuel switching measures (e.g. envelope improvements, lighting upgrades, HVAC efficiency improvements, controls and monitoring systems, etc.) that reduce energy consumption in a building (fuel switching is captured in the next section).[6] For new buildings, it refers to energy and emissions reductions from all modifications, in comparison to the same building built to minimum standards required by regulation. For existing buildings, it refers to changes in structure or systems after it has already been built. Note that for new buildings only, minimum standards will eventually span both the BC Energy Step Code (ESC), which sets minimum fuel-agnostic[7] energy efficiency standards for new buildings, and the new Zero Carbon Step Code (ZCSC), which sets minimum standards for decarbonization of space and water heating equipment in Part 9 and Part 3 buildings. Adherence to the ESC is mandatory and is currently at Step 3 (20% more efficient than the 2018 BC Building Code), while the ZCSC is currently voluntary province-wide, though some communities have made this a mandatory requirement. Check your community's specific requirements on the ZCSC, which can be found at the link above.

Some examples of projects in this category include:

New buildings

- Step 5 City Hall
- Zero Carbon Public Works Building
- Low-income housing with combined heat and power system

Existing buildings

- New high R-value insulation and air sealing in library building envelope
- Heat recovery ventilator in recreation complex

Building upgrades often consist of a mix of energy conservation (i.e. reduced use) and energy efficient equipment, lighting, automatic controls, improved insulation, windows and doors, and air sealing. Generation of on-site renewable energy is covered in a separate section. Equipment and lighting upgrades predominantly reduce electricity consumption (low emission savings), while insulation, windows, doors, and air sealing primarily affect space heating consumption. Note that energy-efficient lighting can unintentionally increase heating demand in some buildings by removing incandescent and halogen bulbs that convert electrical energy into heat instead of light. Emissions savings potential will therefore depend on the fuel source for the space heating. Generation of on-site renewable energy will offset electricity in most cases, except in a combined heat and power, or solar thermal system configuration that offsets fossil-fuel heating in addition to electricity.

Communities in BC Hydro's electric service area can take advantage of rebates for energy audits and feasibility studies to guide their building retrofits plans, and funding for equipment upgrades. Those in FortisBC's service area may also take advantage of their Commercial Energy Assessment Program for free energy audits, and for large consumers, the Custom Efficiency Program to fund energy efficiency retrofits. These programs can also be extended to electrical service if the community is within FortisBC's electric service area.

[6] Fuel switching refers to the replacement of one energy source, typically fossil-fuel, with another that has a lower emission profile, usually electricity. Most often seen in space and water heating.

[7] Fuel-agnostic: Where the fuel source and associated emissions does not factor into compliance

Fuel Switching

This project type captures all equipment that either generates renewable energy on-site or uses low- carbon fuel in place of conventional fossil fuel technology for space or water heating. Low-carbon fuel refers mainly to electricity, although district energy[8] and renewable natural gas (RNG) may be other options. With respect to carbon accounting for RNG, refer to the percentage blend of RNG in your natural gas account. For district energy, the emission savings will depend on the feedstock used and its respective emission factor, which will need to be calculated on a case-by-case basis. More detail on how to calculate emissions and emission savings from district energy systems can be found in the B.C. Best Practices Methodology document, section 2.3.

This project type can be applied to both new and existing buildings, with examples for each shown below:

- New buildings:
  - Designing a new city hall with solar thermal hot water heating vs. conventional natural gas
  - An underground district energy network supplying a recreation complex and arena
- Existing buildings:
  - Replacing aging natural gas boilers with air source heat pumps
  - Adding solar photovoltaics (PV) to the rooftop of a museum as part of a building envelope retrofit

A note about heat pumps is that they can provide both cooling and heating. They provide reliable cooling even in high temperatures, ensuring indoor comfort during heat waves. With enhanced cooling capabilities, community buildings may be designated as emergency heat shelters.

Active Transportation

This project type covers infrastructure that improves the ability of community members to use other modes of active transportation. Active transportation includes all human-powered and electrically assisted modes of transportation, such as walking, cycling, wheelchairs, or scooters. The latter three modes of transportation can also be electrically assisted (i.e. e-bikes, motorized wheelchairs, e-scooters).

Examples of active transportation infrastructure include:

- Separated and painted bike lanes
- Walking, cycling, and multi-modal trails

It's important that any active transportation infrastructure is designed in alignment with overall land use plans, overall transportation plans as well as any intersecting regional active transportation corridors.

[8] District Energy: An underground infrastructure asset where thermal energy is provided to multiple buildings from a central energy plant or plants. Steam or hot water produced at the plant is transmitted 24/7 through highly insulated underground thermal piping networks. *International District Energy Association,* 2023. https://www.districtenergy.org/topics/district-heating

Equity is becoming increasingly important when designing active transportation corridors and networks. The term "All Ages and Abilities", or AAA, refers to making cycling trails accessible for "All ages from school-aged children to older adulthood, and All abilities from less confident cyclists and people experiencing various physical and/or cognitive disabilities"[9]. The City of Vancouver has designed Transportation Design Guidelines for All Ages and Abilities Cycling Routes that could be adopted by other communities.

Emissions reductions from active transportation projects arise from the displacement of passenger vehicles. Though vehicle usage per capita and subsequent emission reductions from active transportation are usually minor (~3%), their impact can be greatly increased to 15-30% with strategic integration of Transportation Demand Management and Smart Growth policies in conjunction with public transportation improvements.[10] Furthermore, the co-benefits of active transportation (e.g improved physical and mental health, reduced traffic congestion, reduction in sprawl, vehicle ownership and fuel cost savings, improved mobility for non-drivers) should be considered as well. For example, for every dollar invested in walkability, three dollars in health benefits can be realized.[11]

Low-Carbon Vehicle Charging and Fueling Infrastructure

This project profile covers all charging and fueling-related infrastructure for both passenger and commercial low-carbon vehicles. The Zero Emissions Vehicle Act includes a target for Zero Emission Vehicle's (ZEV) to account for of 100% new light duty vehicle sales by 2035. To meet this goal, comprehensive networks of EV charging infrastructure will be necessary to match demand.

For light duty vehicles, infrastructure upgrades will predominantly be for electric vehicles. Electric vehicles may include both battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs), with BEVs being 100% electric in nature and PHEVs including both electric and internal combustion components. Charging infrastructure is often categorized by "levels" according to the output power of the infrastructure. See Appendix D for descriptions of the different levels of charging.

For commercial vehicles, infrastructure may include charging stations for EVs, or fueling stations for hydrogen, compressed natural gas (CNG) or liquefied natural gas (LNG) vehicles. For commercial EVs, they will likely be Level 3 DCFCs or larger due to the large battery size necessary to handle duty cycles.

Emission reductions will come from the replacement of a conventional internal combustion vehicle (ICV) with the low-carbon option. In all cases, only the portion of travel that is offset by the low-carbon option is considered. This is specifically important with PHEVs as the offset portion may vary significantly depending on battery capacity, diligence in charging regularly, and driving habits. Also important to note is that emission reductions will also depend on the type of energy used to displace the conventional vehicle.

A consideration with respect to emission reductions is that the embodied emissions associated with electric vehicles are higher than those for an internal combustion vehicle due in large part to the mining and refining of

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[9] NACTO, 2017. *Designing for All Ages & Abilities. Contextual guidance for high-comfort bicycle facilities*. https://nacto.org/wp-content/uploads/2017/12/NACTO_Designing-for-All-Ages-Abilities.pdf

[10] Office, T., 2022. *Evaluating Active and Micro Mode Emission Reduction Potentials Todd Litman*, Victoria Transport Policy Institute. https://policycommons.net/artifacts/3330193/evaluating-active-and-micro-mode-emission-reduction-potentials-todd-litman/4129003/

[11] Rosso, Auchincloss and Michael (2011) in BC Healthy Communities, 2023. *Active Transportation*. https://bchealthycommunities.ca/take-action/active-transportation/

battery materials.[12] Throughout the lifetime of a vehicle, the total emissions from a BEV are significantly lower than an ICV counterpart. While embodied emissions are out of scope for this Climate Lens Assessments, it can be useful to consider their impact on lifecycle GHG emissions.

Organic Waste and Composting

When organic waste[13] (primarily food) is placed in a landfill, it gradually decomposes in the absence of oxygen over decades into methane and other metabolic products. Organic-based methane is a potent GHG, with a global warming potential (GWP)[14] of 28 over a 100-year time frame, and 84 over a 20-year time frame.[15] Given its potency, preventing methane caused by the decomposition from organics when they are landfilled is critical. This project profile covers organic waste diversion and composting programs that reduce the amount of GHGs from the decomposition of waste in a landfill.

Communities will first need to determine what control they have over waste collection, as waste collection is often coordinated at the regional level in more rural communities. Landfills are also more likely to be operated regionally as well and may already have landfill gas capture technology in place. Note that landfill gas capture (LFG) is not included here as a potential technology, as large landfills that generate at least 1000 tonnes of methane annually are already required to have an LFG capture system in place.[16]

Potential organic waste diversion projects may range widely depending on the local context, the type of organic waste to process, and waste collection/landfill operation practices. These may include:

- Curbside pickup of residential organics and yard waste to a central composting facility
- Curbside pickup of wood waste to a central biogas generation facility
- Distribution of food dehydrators to residents for compost pre-treatment or direct soil conversion[17]

Beyond direct GHG reductions, there are several co-benefits and value-added materials from organics diversion, including:

- Extending the life of landfills by reducing material being disposed, delaying cost of closure and siting/constructing a new landfill
- Supporting agricultural and landscaping sectors through production of soil for public use and/or resale

[12] Bieker, G., 2021. *A Global Comparison of the Life-Cycle Greenhouse Gas Emissions of Combustion Engine and Electric Passenger Cars*. https://theicct.org/publication/a-global-comparison-of-the-life-cycle-greenhouse-gas-emissions-of-combustion-engine-and-electric-passenger-cars/

[13] Organic waste can include food waste and organic yard waste such as grass clippings, but should try to avoid branches and other woody debris. This is because woody material does not decompose at the same rate.

[14] Global Warming Potential: A measurement of a greenhouse gas's ability to trap heat in the atmosphere compared to carbon dioxide (CO_2) over a specific time horizon. https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/quantification-guidance/global-warming-potentials.html

[15] Intergovernmental Panel on Climate Change, 2007. *IPCC Fourth Assessment Report (AR4) Working Group 1: The Physical Science Basis.* *https://archive.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html*

[16] Province of BC, 2008. *Landfill Gas Management Regulation.* https://www2.gov.bc.ca/assets/gov/environment/waste-management/garbage/landfillgasmanreg.pdf

[17] City of Nelson, 2023. *Pre-Treated Organics Program.* https://nelson.ca/842/Organic-Waste-Diversion

- Biogas production from organic and wood waste for direct substitution of fossil fuel heating, or resale as renewable natural gas
- Yard waste processed into fuel

Guidance on Quantifying Greenhouse Gases

This section provides general support on how to approach the mitigation portion of a Climate Lens Assessment, particularly with regards to principles involved (ISO 14064-2: Greenhouse gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements), and the estimation approach to quantifying GHGs.

ISO Principles

The Climate Lens Assessment draws upon the principles in ISO Standard 14064-2.[18] This ISO Standard specifies "*principles and requirements and provides guidance at the project level for the quantification, monitoring and reporting of activities intended to cause GHG emission reductions or removal enhancements. It includes requirements for planning a GHG project, identifying and selecting GHG sources, sinks and reservoirs (SSRs) relevant to the project and baseline scenario, monitoring, quantifying, documenting, and reporting GHG project performance and managing data quality.*"[19]

The standard identifies 6 principles to follow when documenting and calculating GHG emissions: relevance, completeness, consistency, accuracy, transparency, and conservativeness. For detailed information on these principles, please refer to the International Standards Organization 14064 – Part 2 Guidance.

Estimation Approach

As part of the mitigation portion of the Climate Lens Assessment, a complete description of the estimation approach including boundary, gases considered, scope, data collection and calculations procedures, exclusions from the assessment and assumptions will be required. In all cases, baseline and project scenarios (described below) will need to be identified to inform calculations. It is required to document all calculations, methodologies, data sources, and assumptions in an appendix when completing your Climate Lens Assessment.

Baseline and Project Scenarios

Project GHGs will need to be compared to a baseline scenario to determine the estimated reduction. The **Baseline scenario** is a hypothetical reference case/description of what would have most likely occurred in the absence of a proposed project. For example, the Baseline scenario for new buildings would be a building built to the minimum requirements to comply with the BC Building Code. For existing buildings, the Baseline scenario would be if no retrofits were built. For active transportation projects, the Baseline scenario would be if no trail/pathway was built, and commuters continued to travel by automobiles.

In the case of existing facilities, historical information on the use of energy and emissions from at least 3 years prior to project implementation should be used in the baseline calculations. For facilities less than 3 years old, any historical data available should be used (with a minimum of one year of data required).

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[18] International Standards Organization, 2019. Greenhouse Gases Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements. https://www.iso.org/standard/66454.html

[19] International Standards Organization, 2019. *ISO 14064-2:2019.* https://www.iso.org/standard/66454.html

The **Project scenario** includes all upgrades/retrofits beyond the baseline scenario. For example, in buildings it may refer to reductions in heat loss or air changes per hour from improved building envelope design or insulation material used, or addition of low-carbon technologies employed for space/water heating. For active transportation projects, it refers to the addition of the trail/pathway with GHG reductions resulting from the mode shift from vehicles to walking/cycling/e-scooters.

See Appendix B for more examples of baseline and project scenarios for different project types.

Assessment Boundary

The assessment boundary represents the required scope and/or limits of the assessment. In the context of a GHG assessment, specific elements could include the timescale, what energy sources, materials, and activities are considered, geographical boundaries, etc. For example, embodied emissions are currently considered to be beyond the scope of a Climate Lens Assessment, however in the case of a new building, it may be worth considering the impact of using low-carbon or carbon sequestering building materials vs. a baseline scenario which uses conventional materials.

At a minimum, the scope and boundary of emission calculations should include direct (Scope 1) and indirect (Scope 2) emissions in the baseline and project scenarios over the lifespan of the project, ideally with an annual breakdown as well.

Greenhouse Gases Considered

GHGs absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. The seven GHGs tracked through the National Inventory Report are: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulphur hexafluoride (SF_6); and nitrogen trifluoride (NF_3).

For a CLA, it is necessary to identify which GHGs your baseline and project scenarios will include, as they will be converted to tonnes CO_2 equivalent (tCO2e) for the purpose of calculations. See the BC Best Practices for Quantifying Greenhouse Gas Emissions for more information on the different greenhouse gases.

Emission Scopes

The scope of emissions as related to the project are typically represented by:

- Scope 1: Direct emissions from sources owned or controlled by an applicant, such as boilers, furnaces or vehicles;
- Scope 2: Indirect emissions from sources that are owned or controlled by an applicant, such as purchased heat or electricity;
- Scope 3: Other indirect emissions from sources not owned or directly controlled by an applicant, such as fuel consumed by workers commuting to the project site.

When determining emissions to include or exclude as part of your CLA, it may be useful to delineate the assessment boundary, and whether each emission source falls within or outside the boundary. In general, include sources, sinks, and reservoirs (SSRs) that are material in nature (e.g. fuel combustion, electricity), and exclude those that are immaterial (e.g. manufacturing of vehicles, transmission of electricity, transport of fuel to retailer). See Figure 1 for an example of a typical assessment boundary for consideration of which GHGs to include.

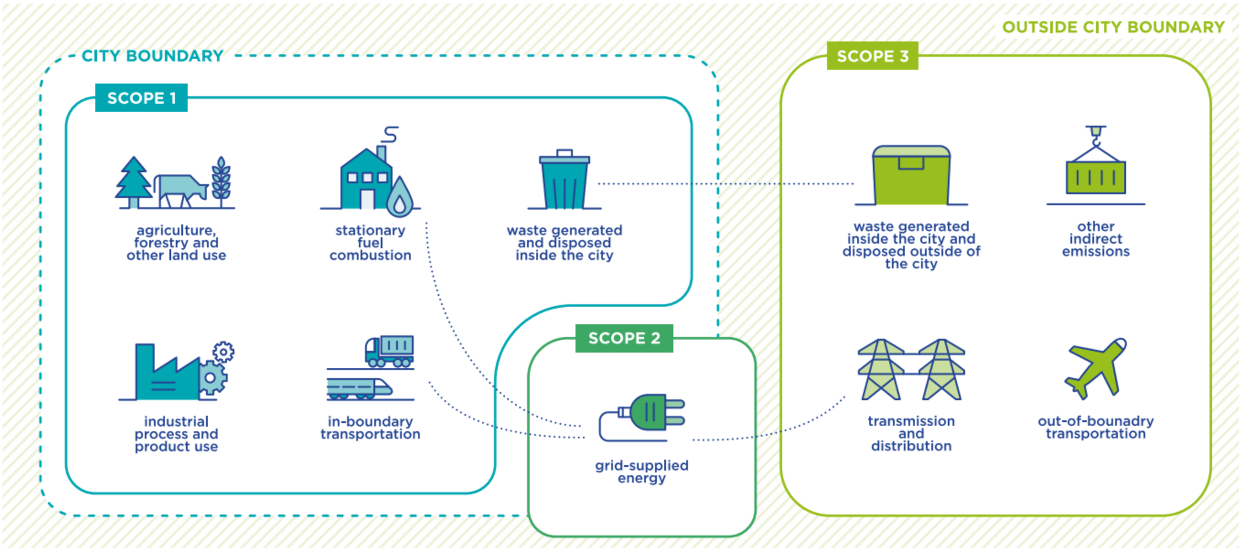

Figure 1 – Example of Scope Emissions Within and Beyond Assessment Boundary

Source: C40 Knowledge Hub, 2024[20]

Small Emissions Sources

For many projects, measuring small emissions sources can be challenging. If an emissions source is onerous to collect and the sum of the small sources is expected to comprise less than 1% of the project's total emissions, they are considered out of scope.

Data Collection, Calculation Procedures, and Assumptions

Information on surveys, modelling, algorithms, emissions factors, activity data, calculations or any other pertinent data sources used to inform your analysis, as well as assumptions that were used in place of known data or information, should be included in the CLA.

Data should be sourced from reputable agencies (e.g. National Inventory Report, Province of BC or other government-based databases, operational data such as utility bills, peer-reviewed articles, etc.). Methodologies used to calculate Baseline and Project scenario emissions should be described in such a manner that the calculations are replicable by another party when using the same data sources. Methodologies should also be based off best practices (e.g. ISO Standards, BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions, or other similar resources). Clearly state all assumptions used to complete emission reduction calculations and provide justification where possible (e.g. usage in similar calculations, information sources).

Exclusions From the Assessment

When completing a CLA, it is also necessary to outline information or data that was intentionally omitted from the assessment with a rationale or justification for exclusion. This may be relevant in cases where expected impacts on emissions are negligible, where emissions are out of scope, or data is outdated etc. For example, Scope 3 emissions generally are not included in a CLA unless specifically included in the assessment boundary. Another example is in the development of an active transportation corridor using traffic count data only on routes adjacent to the

[20] C40 Cities Climate Leadership Group, C40 Knowledge Hub. 2024. *How to develop and manage a city-wide greenhouse gas emission inventory.* Accessed February 26, 2024. https://www.c40knowledgehub.org/s/guide-navigation?language=en_US&guideArticleRecordId=a3s1Q000001iai1QAA&guideRecordId=a3t1Q0000007lEWQAY

corridor itself for improved accuracy, and not as a proportion of traffic counts on city intersections as a whole. The sections on Emission Scope and Assessment Boundaries can be used as the foundation for delineating what is included in the assessment and what is not.

Guidance on Priority Project Types

For calculation methodologies for specific Priority Project Types, see Appendix C.

Guidance on Assessing Climate Resilience, Risk & Vulnerability

This section provides general guidance for assessing climate resilience, risk and vulnerability at a project level.

Note, this is not guidance on conducting risk assessments as per the new BC *Emergency and Disaster Management Act* (EDMA). The new Regulation to support the *Act* is currently under development by the BC Ministry of Emergency Management and Climate Readiness with an expected release of late 2026. Further updates will be provided as they become available. The new EDMA requirements for risk assessments include not only identification of hazards and mitigation measures, but also identification of vulnerable populations, and consideration of intersectional disadvantage factors such as age, disability, socioeconomic status and gender identity when identifying the impacts of hazards. EDMA also requires cooperation and consultation with Indigenous peoples as part of a risk assessment. These requirements are not included in this CLA, however they may be advantageous for some project level assessments. More information on EDMA can be found here.

As stated at the beginning of this document in “Alignment with Local, Provincial, and Federal Climate Goals”, the climate lens was originally developed to support federal infrastructure projects with an approach to determine risk and resilience factors for infrastructure projects. The federal approach has evolved to become a “Rapid Risk Assessment”. Under the new Canada Housing Infrastructure Fund (CHIF) requirements, projects will need to determine whether a project is exposed to specific hazards, followed by what they are doing to mitigate these. A risk assessment is not required. However, a Rapid Risk Assessment process is now available online to support projects as well as possible adaptation measures and linked standards and guidelines. More information on the federal approach can be found here.

The approach described here for the Climate Lens is a more exhaustive approach akin to a full climate risk assessment with a broad scope for application.

The general categories for a project-level resilience assessment are:

1) Identify current and future climate-influenced hazards.
2) Assess the risks of the identified hazard(s) to your project.
3) Describe the risk mitigation measures to address the hazards.
4) List the data and tools used to determine risks.
5) Note if there is alignment with an existing Climate Action Plan or target.

Identify Current and Projected Climate-Influenced Hazards

1. Identify all current and projected climate-related hazards given the project's location such as flooding, wildfire risk, permafrost thaw, extreme heat or coastal erosion. Assess high or medium risks (in likelihood and severity) to the project and the services it is to provide over its lifespan.

You may wish to consult municipal or regional climate adaptation reports to identify the climate-influenced hazards that are relevant to your project location. For each hazard, it is recommended to look at both the current and future climate data projections for the lifespan of the project. (E.g., if your project will be complete in 2024 and has an expected lifespan of 30 years, you will want to look at current climate data as well as the 2050 RCP-8.5 climate projections).

The climate projections can be provided in a chart or written format, describing how these parameters are projected to change against the historical baseline. (E.g. According to The Local Government's Climate Risk Report, precipitation is expected to increase by 11% over current historical baseline by 2080 under a high climate change scenario).

Example Chart:

Climate influenced hazard	Historic value (1976-2005)	Short- term forecast (2020-2050)/ percent change	Long term forecast (2050-2080)/ percent change	Data source
Number of very hot days (+30)	1 day annually	4.9 annually (+3.9%)	16.3 days annually (+15.2%)	Climateatlas.ca

Etc.

A starting point for determining risks can be the BC Preliminary Strategic Climate Risk Assessment 25 pager - Summary of Results (gov.bc.ca) released in 2019 and the BC Disaster and Climate Risk and Resilience Assessment (DCRRA), released in November 2025.

Information on future climate projections across British Columbia can be found on the Pacific Climate Impacts consortium (PCIC) website. Specific pages for impacts can be found here:

- Plan2Adapt
- PCIC Design Value Explorer

The new ClimateReadyBC website hosts the 2025 B.C. Provincial Disaster and Climate Risk and Resilience Assessment information as well as data sets to support assessing climate and disaster risks provincewide.

Assess the Risks of the Identified Hazard(s) to your Project

To understand the risks associated with the natural hazards identified above, the various components of the project must be assessed against each hazard. The likelihood of the hazard impacting the project, and the consequence or level of severity of that impact, must also be analyzed. Using both the likelihood and severity of a hazard will help identify those aspects of a project that are at highest risk to climate impacts (e.g., High Risk = Very High likelihood + Very high consequence).[21]

[21] Investing in Canada Infrastructure Program (ICIP). Government of Canada. https://housing-infrastructure.canada.ca/pub/other-autre/cl-occ-eng.html

Please follow Steps 1 to 4 to assess the risks of the natural hazard to your project. Please include a written description of which project components will be subject to the highest risks and why. All risks can additionally be listed in the Table provided under Step 4.

For example:

- Wildfires will present a risk to a Community Center Project due to its location near a forested area that is experiencing increased occurrence of drought and increasing temperatures; or
- Projected increases in rainfall will present a high risk to bus shelters as it can lead to flash flooding that can cause damage to the physical infrastructure, obstruct access for bus users, cause disruptions to maintenance work, and result in delays of services.

Step 1: Assess the severity or consequence of the hazard's impact on the project.

- Consequence refers to the impact of the hazard on the project. Note a hazard can lead to a range of consequences. A consequence can be certain or uncertain and can have both positive or negative effects on the project's objectives.
- Determine the level of consequence from very-low to very high.

Step 2: Assess the likelihood of the hazard's impact on the project.

- Likelihood can be understood as the chance of something occurring or the chance of a defined climate hazard over a given time horizon. Applicants can use discretion when determining the likelihood risk for each hazard and are encouraged to consider additional climate data relevant to the hazards identified as well as the modernized [Federal Disaster Financial Assistance Arrangements](). Additional resources are listed in Section 3.
- Determine the level of likelihood from very low to very high.

Step 3: Identify the number and level of risks of each hazard on the project.

- Using the matrix in the table below, assess the risk level for each interaction by finding where the consequence risk and likelihood risk meet.
- For each hazard identified, record whether the hazard poses a low, medium, or high risk to the project.
- Referring to the corporate Enterprise Risk Management scoring matrix, it may be helpful here.

Table 9 – Risk Management Scoring Matrix

Consequences	Very High	Medium Risk	High Risk	High Risk	High Risk	High Risk
	High	Low Risk	Medium Risk	High Risk	High Risk	High Risk
	Moderate	Low Risk	Low Risk	Medium Risk	High Risk	High Risk
	Low	Negligible Risk	Low Risk	Low Risk	Medium Risk	Medium Risk
	Very Low	Negligible Risk	Negligible Risk	Low Risk	Low Risk	Low Risk
		Very Low	Low	Moderate	High	Very High
	Likelihood					

Cascading/Compounding Impacts

A further step in assessing impacts is to consider both cascading and compounding impacts.

Compounding impacts occur when two or more risk events occur simultaneously, thus increasing the consequence and/or likelihood of a hazard. For example, wildfires may be more extreme if they occur during a drought event and/or a prolonged extreme heat event. Such events should be considered in overall risk assessment.

Cascading impacts are those events which occur as a result of a hazard event but are often just as, or more impactful than the hazard itself. For example, severe wildfire events may lead to the evacuation of communities. This will have impacts such as how to evacuate a large number of people, where to shelter them, and how to ensure vulnerable populations are able to evacuate. Similarly, if a severe flood event disrupts power infrastructure what are the impacts of power being out for a prolonged period? What are the impacts on populations and services they require? Does this affect water and sewer/sanitation? These impacts should also be assessed to see if the infrastructure being designed needs to take these factors into account to ensure resilience to the hazards.

Step 4: Record Risks

Climate Influenced Hazard	Consequence Risk	Justification of consequence risk	Likelihood risk	Justification of likelihood risk	Overall risk
Flooding	High	Project could be damaged by flooding if 1-in-100 year flood were to occur	Moderate	Level of flood required to damage or impact the project is rare in frequency	Medium risk

If helpful, applicants may complete the following template to identify the risks of each hazard.
Note, as defined by the Public Engineering Vulnerability Committee (PEIVC) Protocol:

- Low Risk requires minimal action
- Medium Risk may require further action
- High Risk requires action

Please list any methodology that was used to assess future climate risks such as ISO 31000, PIEVC or the PIEVC High Level Screening Guide. Applicants can refer to the PIEVC Climate Lens website for additional support / methodologies for assessing climate risk.

If no climate risks were identified, please justify why not (e.g., the climate risks examined only pose a minimal risk). The Government of British Columbia may follow up if known potential climate hazards are missing or the analysis does not align (e.g., a community center on a coastline is not considering risk of sea level rise).

2. Describe all of the risk mitigation measures that will be taken to improve the climate resiliency of your project.

Identify measures for all the medium, high and very high risks identified in Section 1 above. If no measures are being taken to improve the climate resiliency of your project, please describe why not. If your project is a protective infrastructure, please mention that.

- Please identify and describe risk treatment or adaptation measures for all medium, high and very high risks to reduce unacceptable risks to acceptable levels.

    - Your response should address all risks identified in Section 1 and describe how they will address the specific climate risks to the project.
- Examples include building a seawall or restoring wetlands to address flooding; providing firebreaks to decrease severity of wildfires; installing flooding sensors in elevators; or elevating electrical and HVAC systems to minimize flood risk. This can include considering nature-based solutions.
- Please list any resilience standards, guidance, or tools that were consulted. For example: CSA S900.1:18 Climate change adaptation for wastewater treatment plants; CSA PLUS 4011-19 Technical guide: Infrastructure in permafrost: A guideline for climate change adaptation; and the National guide for wildland-urban-interface fires. For guidance and standards that incorporate climate resilience visit: Housing, Infrastructure and Communities Canada - Climate-Resilient Buildings and Core Public Infrastructure Initiative.
- If climate risk reduction measures were identified but not implemented, please justify why not.
- The Government of British Columbia may follow up and request more information on why resiliency measures have not been taken if the justification is not clear, or if resilience measures for potential climate risks identified in Section 1 are missing.
- Applicants can refer to the PIEVC website for additional resources on climate adaptation.

3. Please list all of the climate change data and tools that were used to determine the risks to your project.

List the climate data and tools, such as future climate projections available through the Canadian Centre for Climate Services, that were consulted to assess any current and future climate risks to your project.

- Examples include:
    - Future Climate Design Data: Design Value Explorer | Pacific Climate Impacts Consortium
    - ClimateData.ca: https://climatedata.ca/
    - Canadian Centre for Climate Services: https://www.canada.ca/en/environment-climate-change/services/climate-change/canadian-centre-climate-services.html
    - Climate Atlas of Canada: https://climateatlas.ca/home-page

4. Does your community / local government have a Climate Action Plan and if yes, does your project align with this plan?

- Please indicate the specific community/Local Government climate action plan.
- This can be a stand-alone climate action plan or integrated into a broader Strategic Plan or Official Community Plan.
- Please describe how the project (or measures being considered) fits into the climate action plan, and how this will contribute to a more sustainable future for your community.

Appendix A. Resources

The following resources may be of aid in helping you in completing a Climate Lens Assessment. Note that this is not an exhaustive list.

BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions

This annual document, which is in the resources section of the link above, contains methods for estimating greenhouse gas emissions from stationary sources (e.g. buildings), mobile sources (e.g. transportation), and business travel. It also contains energy density values for various fuels, and updated emission factors.

The Climate Lens – General Guidance v. 2.1 – Infrastructure Canada

This document details the requirements and steps in completing a CLA for federal infrastructure funding. As the requirements for the BC CLA will closely follow this Federal variate, this resource should be utilized by anyone looking to complete a CLA.

Climatedata.ca and Climateatlas.ca

These databases contain adaptation data including heating degree days, cooling degree days, Representative Concentration Pathway (RCP) scenarios, and other key indicators that may be useful in developing climate-related projections. RCPs simulate plausible future scenarios of climate conditions at varying levels of GHG mitigation, usually ranging from active mitigation (RCP 2.6), intermediate mitigation (RCP 4.5 or RCP 6.0), to high emission (RCP 8.5).

Community Energy & Emissions Inventory

The annual Community Energy & Emissions Inventory (CEEI) is a cost-effective and flexible data collection, analysis and reporting system for B.C. local governments and other interested parties. The system establishes and enables inventory baselines, ongoing monitoring and periodic reporting. The database includes three sets of data:

- Transportation data
- Buildings and solid waste data
- Historic CEEI data from 2007, 2010, and 2012

ISO 14092 Adaptation to climate change — Requirements and guidance on adaptation planning for local governments and communities

This document specifies requirements and guidance on adaptation planning for local governments and communities.

This document supports local governments and communities in adapting to climate change based on vulnerability, impacts and risk assessments. In working with relevant interested parties, it also supports the setting of priorities, and the development and subsequent updating of an adaptation plan.

National Inventory Report

This annual document outlines all of Canada's greenhouse gas emissions, including emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF6) and nitrogen trifluoride (NF_3) in the following five sectors: Energy; Industrial Processes and Product Use (IPPU); Agriculture; Waste; and Land Use, Land-Use Change and Forestry (LULUCF). It is Canada's reporting obligations under the United Nations Framework Convention on Climate Change (UNFCCC), and is the official benchmark for greenhouse gas emissions in Canada.

Appendix B. Project Specific GHG Baseline and Project Scenario Examples

The following provides an overview of various greenhouse gas baseline and project scenarios acceptable under the Climate Lens Assessment[22].

Project Type	Baseline	Project
New Building – Recreation or Sports Complex, Community Centre, Library, Housing Complex	Facility designed and operated according to minimum building codes in province/local government.	Facility designed and operated with GHG measures above and beyond standard codes, such as use of solar energy, LEED design
	For facilities that are not being designed or operated with any additional GHG mitigation measures, the project = baseline and no operational GHG reductions will result from the project.	
Building/Facility Retrofits	If no changes to building use or occupancy is expected, a historical 3 year average of all operational sources can be used. If changes are expected to use or occupancy, operational sources must be estimated to reflect these changes.	Facility retrofitted to increase energy efficiency and/or minimize fugitive emissions and/or installation of renewable energy.
Facility or rural community installing Renewable Energy (Solar/Wind)	Energy source that was being used previously or would be used in absence of the renewable energy source (e.g., Diesel or natural gas.	Renewable Energy generation (considered zero-emitting)
Renewable Energy generation as part of "greening" the provincial grid	Energy generation facility that would have been built instead of the renewable energy facility (On-the margin) Ex. Natural gas generation facility	Renewable Energy generation (considered zero-emitting)
Electrification of Industrial Facility	Energy source that was being used previously or would be used in absence of the connection to the grid ex. Diesel/Natural gas.	The provincial grid
Fleet Replacement	Fuel that was being used or would be used instead of the new fuel source ex. Diesel, gas	Clean energy source ex. Electricity, hydrogen, biofuels
Large Transit (e.g. Light Rail Transit, Bus Rapid Transit)	The continuation of personal vehicle use without the new transit system.	The transition (modal shifting) from personal vehicle use to public transit, which is considered less fuel - intensive.

[22] Investing in Canada Infrastructure Program (ICIP). Government of Canada. https://housing-infrastructure.canada.ca/pub/other-autre/cl-occ-eng.html

	If the new transit system includes the construction of stations or storage facilities, the GHGs from these facilities should be quantified separately according to the new buildings baseline and project scenarios.

Project Type	Baseline	Project
Active Transit (walking or biking paths)	The continuation of personal vehicle use without the new active transit system.	The transition (modal shifting) from personal vehicle use to active transit, which is considered zero-emitting.
New Wastewater/Drinking Water Facilities	Facility built to minimum building codes and wastewater/drinking water standards in province/municipality.	Facility built with GHG measures beyond building codes & standards, such as implementation of energy efficient equipment or renewable energy or equipment/ processes to minimize fugitive or process emissions (CH4/N2O).
For infrastructure that is not being designed or operated with any additional GHG mitigation measures, the project = baseline and no operational GHG reductions will result from the project.		
Wastewater/Drinking Water Facility Retrofits	If no changes to facility use or capacity (volume of water or wastewater treated) is expected, a historical 3 year average of all operational sources can be used. If changes are expected to facility use or capacity, sources must be estimated to reflect these changes.	Facility retrofitted to increase energy efficiency and/or minimize fugitive or process emissions (CH4/N2O) and/or installation of renewable energy.
Critical Infrastructure (Roads, Bridges, Culverts, Broadband)	Infrastructure designed and operated according to minimum building codes/ standard practices in province/municipality	Infrastructure designed and operated with GHG measures beyond standard codes ex. Use of low-carbon materials or vehicles/equipment using clean fuels
For infrastructure that is not being designed or operated with any additional GHG mitigation measures, the project = baseline and no operational GHG reductions will result from the project.		
Disaster Mitigation and Adaptation projects	Infrastructure designed and operated according to minimum building codes/ standard practices.	Infrastructure designed and operated with GHG measures beyond standard codes ex. Use of low-carbon materials or vehicles/equipment using clean fuels

For infrastructure that is not being designed or operated with any additional GHG mitigation measures, the project = baseline and no operational GHG reductions will result from the project.		
Landfills	Facility meeting minimum standard regulations.	Facility flaring (where not required by regulations)

Source: Infrastructure Canada, 2021[23]

[23] Infrastructure Canada, 2021. *The Climate Lens – General Guidance v 2.1*.

Appendix C. Calculation Methodologies for Priority Project Types

Below are sample scenarios and calculation methodologies for each Priority Project Type. It includes the necessary information required to conduct calculations including energy consumption, emission factors (EF), and lifespan. It also includes scenario emission calculation methodologies, associated assumptions, and sample calculations. For emission factors, please consult the BC Best Practices for Quantifying Greenhouse Gas Emissions.

Critical Infrastructure Required by Regulation

Sample project: A community is planning on adding a biogas capture system to offset natural gas heating in their wastewater treatment plant building.

Baseline scenario methodology: Calculate the building's average annual natural gas emissions from heating using the last three years' data, and then the lifetime natural gas emissions. Include any applicable regulations that may influence projections.

Project scenario methodology: Calculate the building's annual natural gas emissions, subtract the natural gas emissions offset from the addition of biogas.

Required Information

- Expected lifespan of the new biogas system (years)
- Average projected biogas production per year (e.g. GJ/yr)
- Average additional electricity required to produce biogas per year (e.g. GJ/yr), or assumption that associated emissions will be negligible
- Current average annual natural gas consumption of building (e.g. GJ/year)
- Emission factors (EF): Natural gas, electricity, biogas (can be found from BC Best Practices for Quantifying Greenhouse Gas Emissions)
- Energy density of methane for fugitive biogas emissions (0.018 tCH_4/GJ)

Assumptions

- Electricity consumption of the building other than the energy needed to produce biogas is negligible
- Annual energy consumption and biogas production is fixed and does not change with population
- Fugitive emissions from biogas production and equivalent natural gas consumption under baseline scenario cancel each other out.

Baseline Scenario

Annual Baseline Emissions in year i

$$\boldsymbol{Annual\ Baseline\ Emissions_i\left(\frac{tCO_2e}{yr}\right) =}$$

$$Baseline\ NG\ consumption\ \left(\frac{GJ}{yr}\right) * NG\ EF\left(\frac{tCO_2e}{GJ}\right)$$

Lifetime Baseline Emissions over n years

$$\boldsymbol{Lifetime\ Baseline\ Emissions\ (tCO_2e) =}$$

$$Annual\ Baseline\ Emissions_i * Lifespan\ (n\ yrs)$$

Project Scenario

Annual Project Emissions in year i

$$\boldsymbol{Annual\ Project\ NG\ Emissions_i\left(\frac{tCO_2e}{yr}\right) =}$$

$$\left[\left(Annual\ NG\ consumption\ \left(\frac{GJ}{yr}\right) - \ Biogas\ production\ \left(\frac{GJ}{yr}\right)\right) * NG\ EF\left(\frac{tCO_2e}{GJ}\right)\right]$$

Lifetime Project NG Emissions over n years

$$\boldsymbol{Lifetime\ Project\ NG\ Emissions\ (tCO_2e) =}$$

$$Annual\ Project\ NG\ Emissions_i * Lifespan\ (n\ yrs)$$

Lifetime Project Biogas Emissions over n years

$$\boldsymbol{Lifetime\ Project\ Biogas\ Emissions\ (tCO_2e) =}$$

$$Annual\ Biogas\ consumption\ \left(\frac{GJ}{yr}\right) * Biogas\ EF\left(\frac{tCO_2e}{GJ}\right) * Lifespan\ (n\ yrs)$$

Lifetime Project Elec Emissions over n years

$$\boldsymbol{Lifetime\ Project\ Elec\ Emissions\ (tCO_2) =}$$

$$Annual\ Elec\ consumption\ \left(\frac{kWh}{yr}\right) * Elec\ EF\left(\frac{tCO_2e}{kWh}\right) * Lifespan\ (n\ yrs)$$

Lifetime Project Emissions

$$\boldsymbol{Lifetime\ Project\ Emissions\ (tCO_2e) =}$$

$$Lifetime\ Project\ NG\ Emissions\ (tCO_2e) + Lifetime\ Project\ Biogas\ Emissions\ (tCO_2e) + Lifetime\ Project\ Elec\ Emissions\ (tCO_2e)$$

Lifetime Project Emissions Savings

$$\boldsymbol{Lifetime\ Project\ Emissions\ Savings\ (tCO_2e) =}$$

$$Lifetime\ Baseline\ Emissions\ (tCO_2e) - Lifetime\ Project\ Emissions\ (tCO_2e)$$

Energy Efficiency for New/Existing Buildings

Sample project: A community is planning to renovate the building envelope of its recreation facility, including new insulation, roofing, and windows. The building currently uses natural gas for space and water heating.

Baseline scenario methodology: Calculate the annual consumption and associated emissions for both natural gas and electricity. Then determine the lifetime emissions based on the expected operational lifespan of the project materials and equipment. Include any applicable regulations that may influence projections.

Project scenario methodology: Determine the building's annual consumption and associated emissions for both natural gas and electricity. This will likely require the use of building energy modeling software to factor in the building's configuration, new materials (insulation, roofing, windows), and their impact on air sealing, air exchanges per hour, and heat loss.

Required information

- Expected lifespan of the building retrofits (years)*
- Current average annual natural gas consumption of building (GJ/year)
- Current average annual electricity consumption of building (kWh/year)
- Modelled annual natural gas consumption with retrofits (GJ/year)
- Modelled annual electricity consumption with retrofits (kWh/year)
- Heating degree days (HDD) and cooling degree days (CDD)[24] at chosen RCP scenario to calculate expected change in annual heating and cooling consumption due to climate change. See Appendix A for links to HDD/CDD databases[25]
- Emission factors (EF): Natural gas, electricity (can be found from BC Best Practices for Quantifying Greenhouse Gas Emissions)

Assumptions

- Climate change primarily affects heating and cooling only

* When multiple materials/equipment are being retrofit, it is suggested to use the material with the lowest lifespan as the basis for calculating project and baseline scenario emissions.

Baseline Scenario

Annual Baseline NG Emissions in year i

$$\boldsymbol{Annual\ Baseline\ NG\ Emissions_i}\left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$Baseline\ NG\ consumption\ \left(\frac{GJ}{yr}\right) * NG\ EF\left(\frac{tCO_2e}{GJ}\right) * \frac{HDD\ (year\ i)}{HDD\ (current\ year)}$$

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[24] HDDs are an indication of annual building heating necessities. Each day, the # of HDDs is equivalent to (18ºC – Daily average temperature), with negative values defaulted to zero. CDDs, similarly are an indication of annual building cooling necessities, equivalent to (Daily average temperature – 18ºC). The annual HDDs and CDDs are the summation of the respective daily values.

[25] If energy modelling software incorporates HDDs or other metrics to account for changes in climate over the project lifetime, remove the additional HDD adjustments as appropriate.

Annual Baseline Elec Emissions in year i

$$\boldsymbol{Annual\ Baseline\ Elec\ Emissions_i}\ \left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$Baseline\ Elec\ consumption\ \left(\frac{kWh}{yr}\right) * Elec\ EF\left(\frac{tCO_2e}{kWh}\right)$$

Lifetime Baseline Emissions over n years

$$\boldsymbol{Lifetime\ Baseline\ Emissions}\ (\boldsymbol{tCO_2e}) =$$

$$\sum_{i=1}^{n}\left[Baseline\ NG\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right) + Baseline\ Elec\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right)\right]$$

Project Scenario

Annual Project NG Emissions in year i

$$\boldsymbol{Annual\ Project\ NG\ Emissions_i}\ \left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$Project\ NG\ consumption\ \left(\frac{GJ}{yr}\right) * NG\ EF\left(\frac{tCO_2e}{GJ}\right) * \frac{HDD\ (year\ i)}{HDD\ (current)}$$

Annual Project Elec Emissions in year i

$$\boldsymbol{Annual\ Project\ Elec\ Emissions_i}\ \left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$Project\ Elec\ consumption\ \left(\frac{kWh}{yr}\right) * Elec\ EF\left(\frac{tCO_2e}{kWh}\right) * \frac{HDD\ (year\ i)}{HDD\ (current)}$$

Lifetime Project Emissions over n years

$$\boldsymbol{Lifetime\ Project\ Emissions}\ (\boldsymbol{tCO_2e}) =$$

$$\sum_{i=1}^{n}\left[Project\ NG\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right) + Project\ Elec\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right)\right]$$

Lifetime Project Emissions Savings

$$\boldsymbol{Lifetime\ Project\ Emissions\ Savings}\ (\boldsymbol{tCO_2e}) =$$

$$Lifetime\ Baseline\ Emissions\ (tCO_2e) - Lifetime\ Project\ Emissions\ (tCO_2e)$$

Fuel Switching to Renewable Energy

Sample project: A community is planning to convert its municipal office from heating oil space heating to an air-source heat pump that will provide both heating and cooling. The office currently doesn't have air conditioning. The heating oil system will be retained as a backup and will run 10% of the time on average.

Baseline scenario methodology: Calculate the annual consumption and associated emissions for the heating oil system. Then determine the lifetime emissions based on the expected operational lifespan of the project equipment, adjusting for changes in annual consumption due to climate change. Include any applicable regulations that may influence projections. Data to support analysis on changes due to climate change can be found here from the Pacific Climate Impacts Consortium.

Project scenario methodology: Determine the annual consumption and associated emissions for electricity as the main heating and cooling source, and heating oil as the backup heating source, accounting for changes in climate over time.

Required information

- Expected lifespan of the heat pump
- Current average annual heating oil space heating consumption (GJ/year)
- Modelled annual building space cooling energy requirements (GJ/year)
- Oil heater efficiency (%)
- COP/HSPF and SEER of heat pump[26]
- Modelled annual electricity space heating consumption from heat pump (kWh/year)
- Modelled annual electricity space cooling consumption from heat pump (kWh/year)
- Modelled annual heating oil consumption for backup heating (GJ/year)
- Heating degree days (HDD) and cooling degree days (CDD) at chosen RCP scenario to calculate expected change in annual heating and cooling consumption due to climate change. See Resources section for links to HDD/CDD databases
- Emission factors (EF): Heating oil, electricity (can be found from BC Best Practices for Quantifying Greenhouse Gas Emissions)
- Conversion factors: SEER to COP (COP = SEER * 0.293)

Assumptions

- Climate change primarily affects heating and cooling only

Baseline Scenario

Annual Baseline Oil Emissions in year i

$$\boldsymbol{Annual\ Baseline\ Oil\ Emissions_i\left(\frac{tCO_2e}{yr}\right) =}$$

$$Baseline\ Oil\ consumption\left(\frac{GJ}{yr}\right) * Oil\ EF\left(\frac{tCO_2e}{GJ}\right) * \frac{HDD\ (year\ i)}{HDD\ (current)}$$

Lifetime Baseline Oil Emissions over n years

$$\boldsymbol{Lifetime\ Baseline\ Oil\ Emissions\ (tCO_2e) =}$$

[26] COP: Coefficient of Performance, HSPF Heat Seasonal Performance Factor (Heating), SEER: Seasonal Energy Efficiency Ratio (Cooling)

$$\sum_{i=1}^{n} Annual\ Baseline\ Oil\ Emissions_i \left(\frac{tCO_2e}{yr}\right)$$

Lifetime Baseline Emissions

$$\boldsymbol{Lifetime\ Baseline\ Emissions\ (tCO_2e) =}$$

$$Lifetime\ Baseline\ Oil\ Emissions\ (tCO_2e)$$

Project Scenario

Annual Project Elec Heating Emissions in year i

$$\boldsymbol{Annual\ Project\ Elec\ Emissions_i \left(\frac{tCO_2e}{yr}\right) =}$$

$$\frac{Baseline\ Oil\ consumption\ \left(\frac{GJ}{yr}\right) * Oil\ Heater\ Efficiency\ (\%)}{COP} *\ Elec\ EF\ \left(\frac{tCO_2e}{GJ}\right) * \frac{HDD\ (year\ i)}{HDD\ (current)}$$

Annual Project Oil Heating Emissions in year i

$$\boldsymbol{Annual\ Project\ Oil\ Emissions_i \left(\frac{tCO_2e}{yr}\right) =}$$

$$Baseline\ Oil\ consumption\ \left(\frac{GJ}{yr}\right) * Backup\ \% * Oil\ EF \left(\frac{tCO_2e}{GJ}\right) * \frac{HDD\ (year\ i)}{HDD\ (current)}$$

Annual Project Elec Cooling Emissions in year i

$$\boldsymbol{Annual\ Project\ Elec\ Emissions_i \left(\frac{tCO_2e}{yr}\right) =}$$

$$\frac{Building\ Cooling\ Requirement \left(\frac{kWh}{yr}\right)}{SEER * 0.293} *\ Elec\ EF \left(\frac{tCO_2e}{kWh}\right) * \frac{CDD\ (year\ i)}{CDD\ (current)}$$

Lifetime Project Emissions over n years

$$\boldsymbol{Lifetime\ Project\ Emissions\ (tCO_2e) =}$$

$$\sum_{i=1}^{n} \left(Project\ Elec\ Heating\ Emissions_i \left(\frac{tCO_2e}{yr}\right) + Project\ Oil\ Heating\ Emissions_i \left(\frac{tCO_2e}{yr}\right) + Project\ Elec\ Cooling\ Emissions_i \left(\frac{tCO_2e}{yr}\right)\right)$$

Lifetime Project Emissions Savings

$$\boldsymbol{Lifetime\ Project\ Emissions\ Savings\ (tCO_2e) =}$$

$$Lifetime\ Baseline\ Emissions\ (tCO_2e) - Lifetime\ Project\ Emissions\ (tCO_2e)$$

Active Transportation

Sample project: A community intends to construct a 5 km multi-use pathway adjacent to a major arterial road, suitable for accommodating walking, cycling, e-scooters, and wheelchairs.

Baseline scenario methodology: Assumes no pathway is developed, baseline emissions assume that all trips would be by passenger vehicles. Users can use the total passenger vehicle emissions from the community's GHG inventory as the baseline (see CEEI transportation data), or instead directly calculate the vehicle kilometers travelled (VKTs) displaced by the project to determine its impact. Include any applicable regulations that may influence projections.

Project scenario methodology: Determine the expected number of VKTs displaced from the project per year. Convert to equivalent liters of gasoline displaced, and subsequent emissions displaced.

For this project type, two calculation methodologies are described:

- Standard reduction method: A standard reduction value which is easier to calculate but not specific to the community context
- Reduction with vehicle count data: Required vehicle count data for intersections expected to be impacted by the pathway to estimate number of trips and associated VKTs displaced

Standard Reduction Method

This method requires an average VKT reduction per km of pathway constructed. Once that is obtained, the equivalent litres of gasoline and associated emissions displaced can be calculated. One will also need to estimate the expected percentage of passenger vehicles that are electric/zero-carbon for each year as that will reduce potential emission reductions.

Required Information

- Expected lifespan of the pathway
- Annual community passenger vehicle emissions (from inventory)
- Average VKT reduction per km of multi-use pathway
- Average passenger vehicle gas mileage, gasoline energy density, and gasoline emission factor (from BC Best Practices for Quantifying Greenhouse Gas Emissions)
- Projected % of passenger vehicles as electric for each year of project
- Emission factors (EF): Gasoline, electricity (can be found from BC Best Practices for Quantifying Greenhouse Gas Emissions)

Assumptions

- Vehicle gas mileage is consistent year over year
- VKTs displaced per year is consistent as a conservative estimate
- Embodied emissions in the construction of vehicles and batteries are not included

Baseline Scenario

Annual Baseline Vehicle Emissions in year i

$$\boldsymbol{Annual\ Baseline\ Vehicle\ Emissions_i}\left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$Community\ Vehicle\ Emissions\left(\frac{tCO_2e}{yr}\right) * (1 - \%\ Vehicles\ as\ EV_i\ (\%)) * (1 + Population\ Growth(\%))^i$$

Lifetime Baseline Vehicle Emissions over n years

$$\boldsymbol{Lifetime\ Baseline\ Emissions\ (tCO_2e)} =$$
$$\sum_{i=1}^{n} Annual\ Baseline\ Vehicle\ Emissions_i \left(\frac{tCO_2e}{yr}\right)$$

Project Scenario

Annual Project Emissions Reduced in year i

$$\boldsymbol{Annual\ Project\ Vehicle\ Emissions\ Reduced_i \left(\frac{tCO_2e}{yr}\right)} =$$
$$\frac{VKT}{km\ pathway}\left(\frac{km}{yr}\right) * km\ of\ pathway\ (km) * Gas\ Mileage\ \left(\frac{L}{100\ km}\right) * \frac{0.035\ GJ\ gasoline}{L} * \ Gasoline\ EF\ \left(\frac{tCO_2e}{GJ}\right)$$
$$* (1 - \%\ Vehicles\ as\ EV_i\ (\%)) * (1 + Population\ Growth(\%))^i$$

Annual Project Emissions in year i

$$\boldsymbol{Annual\ Project\ Vehicle\ Emissions_i \left(\frac{tCO_2e}{yr}\right)} =$$
$$Annual\ Baseline\ Vehicle\ Emissions_i \left(\frac{tCO_2e}{yr}\right) - Annual\ Project\ Vehicle\ Emissions\ Reduced_i \left(\frac{tCO_2e}{yr}\right)$$

Lifetime Project Emissions over n years

$$\boldsymbol{Lifetime\ Project\ Vehicle\ Emissions\ (tCO_2e)} =$$
$$\sum_{i=1}^{n} Annual\ Project\ Vehicle\ Emissions_i \left(\frac{tCO_2e}{yr}\right)$$

Lifetime Project Emissions Savings

$$\boldsymbol{Lifetime\ Project\ Vehicle\ Emissions\ Savings\ (tCO_2e)} =$$
$$Lifetime\ Baseline\ Vehicle\ Emissions\ (tCO_2e) - Lifetime\ Project\ Vehicle\ Emissions\ (tCO_2e)$$

Vehicle Count Method

This method requires vehicle count data for all intersections and thoroughfares expected to be impacted by the addition of the pathway, average distance of commuter trip displaced[27], expected percentage of vehicles that are on commuter trips[28], and expected percentage of commuter trips that will be displaced annually. Once that is obtained, the equivalent liters of gasoline and associated emissions displaced can be calculated. One will also need to estimate the expected percentage of passenger vehicles that are electric/zero-carbon for each year as that will reduce potential emission reductions.

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[27] Trip distance can be calculated by using the pathway's length or estimate the expected origins and destinations (e.g. neighbourhoods, schools, commercial/industrial centers) and determine the expected average trip distance.
[28] Commuter trips: Vehicle trips that are for non-leisure. Most often happens during weekday peak hours.

Required Information

- Expected lifespan of the pathway
- Annual community passenger vehicle emissions (from [CEEI Inventory])
- Vehicle count data from all impacted intersections and thoroughfares
- % of vehicles from vehicle counts designated for commuter trips
- % commuter trips diverted to the pathway
- Projected % of passenger vehicles as electric for each year of project
- Average passenger vehicle gas mileage, gasoline energy density
- Emission factors: Gasoline, can be found in BC Best Practices for Quantifying Greenhouse Gas Emissions
- Gasoline energy density (0.035 GJ/L)

Assumptions

- Vehicle gas mileage is consistent year over year
- VKTs displaced per year is consistent as a conservative estimate

Baseline Scenario

Annual Baseline Vehicle Emissions in year i

$$\boldsymbol{Annual\ Baseline\ Vehicle\ Emissions_i}\left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$Community\ Vehicle\ Emissions\left(\frac{tCO_2e}{yr}\right) * (1 - \%\ Vehicles\ as\ EV_i\ (\%))$$

Lifetime Baseline Vehicle Emissions over n years

$$\boldsymbol{Lifetime\ Baseline\ Emissions\ (tCO_2e)} =$$

$$\sum_{i=1}^{n} Annual\ Baseline\ Vehicle\ Emissions_i\left(\frac{tCO_2e}{yr}\right)$$

Project Scenario

Annual VKTs Reduced Per Intersection x

$$\boldsymbol{VKTs\ Reduced_x}\left(\frac{\boldsymbol{km}}{\boldsymbol{yr}}\right) =$$

$$Average\ Daily\ Vehicle\ Count\ (vehicles) * \%\ commuter\ trips\ (\%) * \%\ commuter\ trips\ shifted\ (\%) *$$

$$length\ of\ displaced\ distance\ (km) * \frac{365\ days}{yr}$$

Annual Total VKTs Reduced by Project for y Intersections

$$\boldsymbol{Total\ VKTs\ Reduced}\left(\frac{\boldsymbol{km}}{\boldsymbol{yr}}\right) =$$

$$\sum_{x=1}^{y} VKTs\ Reduced_x\left(\frac{km}{yr}\right)$$

Annual Project Emissions Reduced in year i

$$\boldsymbol{Annual\ Project\ Vehicle\ Emissions\ Reduced_i}\ \left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$Total\ VKTs\ Reduced\ \left(\frac{km}{yr}\right) * Gas\ Mileage\ \left(\frac{L}{100\ km}\right) * Gas\ density\ \left(\frac{0.035\ GJ\ gasoline}{L}\right) *\ Gasoline\ EF\ \left(\frac{tCO_2e}{GJ}\right)$$

$$* (1 - \%\ Vehicles\ as\ EV_i\ (\%))$$

Annual Project Emissions in year i

$$\boldsymbol{Annual\ Project\ Vehicle\ Emissions_i}\ \left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$Annual\ Baseline\ Vehicle\ Emissions_i\ (tCO_2e) - Annual\ Project\ Vehicle\ Emissions\ Reduced_i\ (tCO_2e)$$

Lifetime Project Emissions over n years

$$\boldsymbol{Lifetime\ Project\ Emissions}\ (\boldsymbol{tCO_2e}) =$$

$$\sum_{i=1}^{n} Annual\ Project\ Vehicle\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right)$$

Lifetime Project Emissions Savings

$$\boldsymbol{Lifetime\ Project\ Vehicle\ Emissions\ Savings}\ (\boldsymbol{tCO_2e}) =$$

$$Lifetime\ Baseline\ Emissions\ (tCO_2e) - Lifetime\ Project\ Emissions\ (tCO_2e)$$

Low-Carbon Vehicle Charging and Fueling Infrastructure

Sample project: A community intends to install 20 dual-head Level 2 charging stations for public use on several assets (e.g. recreation center, parks).

Baseline scenario methodology: Assumes no stations are built, baseline emissions assume that all trips would be by internal combustion engine (ICE) passenger vehicles. Note that the baseline line will need to consider the gradual shift to electric vehicles through forces outside this project (e.g. Provincial and Federal ZEV standards). Users can use the total passenger vehicle emissions from the community's GHG inventory as the baseline if required, or instead calculate the amount of electricity dispensed to determine direct emission reductions. Include any applicable regulations that may influence projections.

Project scenario methodology: Determine the expected electricity consumption from all project stations per year. Convert to vehicle kilometers travelled, then liters of gasoline displaced, and subsequent emissions displaced.

Required Information

- Expected lifespan of the stations
- Annual community passenger vehicle emissions (from inventory)
- Average passenger vehicle gas mileage, electric vehicle mileage (can be found from BC Best Practices for Quantifying Greenhouse Gas Emissions)
- Average consumption per charging station in the community if available, may need to consult external resources for consumption data if no local data is available (e.g. BC Hydro, Province of BC, ChargePoint, FLO)
- Emission factors (EF): Gasoline, electricity (can be found from BC Best Practices for Quantifying Greenhouse Gas Emissions)
- Gasoline energy density (0.035 GJ/L)
- Conversion factors: kWh to GJ (1 GJ = 277.8 kWh)

Assumptions

- Vehicle gas mileage and EV mileage is consistent year over year
- Station usage remains constant over the project lifetime (conservative estimate)

Baseline Scenario

Annual Baseline Vehicle Emissions in year i

$$\boldsymbol{Annual\ Baseline\ Vehicle\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right)} =$$

$$Community\ Vehicle\ Emissions\ \left(\frac{tCO_2e}{yr}\right) * (1 - \%\ Vehicles\ as\ EV_i\ (\%))$$

Lifetime Baseline Vehicle Emissions over n years

$$\boldsymbol{Lifetime\ Baseline\ Emissions\ (tCO_2e)} =$$

$$\sum_{i=1}^{n} Annual\ Baseline\ Vehicle\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right)$$

Project Scenario

Annual Project Electricity Dispensed

$$\boldsymbol{Annual\ electricity\ consumed}\ \left(\frac{\boldsymbol{kWh}}{\boldsymbol{yr}}\right) =$$

$$\frac{Annual\ electricity\ consumption}{station}\left(\frac{kWh}{station}\right) * \#\ of\ stations$$

Annual Project Emissions Reduced for year i

$$\boldsymbol{Annual\ Project\ Vehicle\ Emissions\ Reduced_i}\ \left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$\left[\frac{Annual\ electricity\ consumed\ \left(\frac{kWh}{yr}\right)}{EV\ mileage\left(\frac{kWh}{100\ km}\right)} * Gas\ mileage\ \left(\frac{L}{100\ km}\right) * \frac{0.035\ GJ\ gasoline}{L} * Gasoline\ EF\ \left(\frac{tCO_2e}{GJ}\right)\right] -$$

$$\left[Annual\ electricity\ consumed\ \left(\frac{kWh}{yr}\right) * \frac{1\ GJ}{277.8\ kWh} * Elec\ EF\ \left(\frac{tCO_2e}{GJ}\right)\right]$$

Annual Project Emissions in year i

$$\boldsymbol{Annual\ Project\ Vehicle\ Emissions}\ _i\left(\frac{\boldsymbol{tCO_2e}}{\boldsymbol{yr}}\right) =$$

$$Annual\ Baseline\ Vehicle\ Emissions\ _i\ \left(\frac{tCO_2e}{yr}\right) - Annual\ Project\ Vehicle\ Emissions\ Reduced_i\ \left(\frac{tCO_2e}{yr}\right)$$

Lifetime Project Emissions over n years

$$\boldsymbol{Lifetime\ Project\ Emissions\ (tCO_2e)} =$$

$$Annual\ Project\ Vehicle\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right) * Lifespan\ (n\ yrs)$$

Lifetime Project Emissions Savings

$$\boldsymbol{Lifetime\ Project\ Vehicle\ Emissions\ Savings\ (tCO_2e)} =$$

$$Lifetime\ Baseline\ Emissions\ (tCO_2e) - Lifetime\ Project\ Emissions\ (tCO_2e)$$

Organic Waste and Composting

Sample project: A community/regional district intends to institute a residential curbside organics pickup program to divert organic waste from the landfill, along with a centralized forced aeration composting facility.

Baseline scenario methodology: Determine the annual tonnage and emissions associated with solid waste from the community. This can be obtained from the Community Energy & Emissions Inventory - Solid waste data. It is recommended to use emissions from the waste commitment method as the baseline rather than waste-in-place, as waste commitment front-loads annual decomposition emissions into the year in which the waste entered the landfill, rather than the waste-in-place method which spreads out emissions, and emission reductions, over several years – into the years in which the gas is actually emitted from the landfill based on the US EPA's Land GEM model. Using waste-in-place, a reduction calculation would be more difficult. Include any applicable regulations that may influence projections.

Project scenario methodology: Determine percentage of waste tonnage entering landfill as organic. This can be estimated with a composition analysis or defaulted to 40%[29]. Estimate the expected tonnage of organics diverted from the waste stream and subtract associated emissions from composting activities including decomposition and additional vehicle usage for compost transportation.

Applicable Regulations

- BC Landfill Gas Management Regulation

Required Information

- Expected lifespan of the project
- Community waste tonnage from the Community Energy & Emissions Inventory – Solid waste data
- Composition of waste as organic[30] (see definition of organics below)
- Additional distance travelled due to composting pickup and transport activities
- Average diesel mileage for composting trucks
- Diesel energy density (0.0383 GJ/L)
- Annual population growth
- Emission factors: Diesel, electricity can be found from BC Best Practices for Quantifying Greenhouse Gas Emissions. Nitrous oxide and methane can be found from GHG Protocol
- Global warming potentials: Methane (CH_4), nitrous oxide (N_2O), can be found from BC Best Practices for Quantifying Greenhouse Gas Emissions

Assumptions

- Organics account for all GHG emissions from waste
- Annual waste tonnage increases proportionally with population growth

Baseline Scenario

Annual Baseline Waste Emissions in year i

$$\textbf{Annual Baseline Waste Emissions}_i\left(\frac{tCO_2e}{yr}\right) =$$

[29] Province of BC, 2024. *Food and Organic Waste*. https://www2.gov.bc.ca/gov/content/environment/waste-management/food-and-organic-waste#:~:text=In%20B.C.%2C%20organic%20waste%20currently,material%20sent%20to%20our%20landfills

[30] Organics include food waste, wood and straw waste, paper and textiles, and garden/park waste

$$Community\ Waste\ Emissions\ \left(\frac{tCO_2e}{yr}\right) * (1 + Population\ Growth\ (\%))^i$$

Lifetime Baseline Waste over n years

$$\boldsymbol{Lifetime\ Baseline\ Waste\ Emissions\ (tCO_2e)} =$$

$$\sum_{i=1}^{n} Annual\ Baseline\ Waste\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right)$$

Project Scenario

Annual Project Waste Emissions Diverted in year i

$$\boldsymbol{Annual\ Project\ Waste\ Emissions\ Diverted_i\left(\frac{tCO_2e}{yr}\right)} =$$

$$Community\ Waste\ Emissions\ \left(\frac{tCO_2e}{yr}\right) * \%\ Diverted * (1 + Population\ Growth(\%))^i$$

Annual Project Waste Emissions Created by Compost in year i

$$\boldsymbol{Annual\ Project\ Compost\ Emissions\ Created_i\left(\frac{tCO_2e}{yr}\right)} =$$

$$Community\ Waste\ Tonnage\ \left(\frac{t\ tonnage}{yr}\right) * \%\ Diverted * \ \%\ Waste\ as\ Compost\ \left(\frac{t\ compost}{t\ tonnage}\right) *$$

$$\left(N_2O\ EF\left(\frac{tN_2O}{t\ compost}\right) * GWP_{N2O}\left(\frac{tCO_2}{tN_2O}\right) + CH_4\ EF\left(\frac{tCH_4}{t\ compost}\right) * GWP_{CH4} + \left(\frac{tCO_2}{tCH_4}\right)\right) *$$

$$(1 + Population\ Growth(\%))^i$$

Annual Project Waste Emissions Created by Transport of Compost in year i

$$\boldsymbol{Annual\ Project\ Compost\ Transport\ Emissions\ Created_i\left(\frac{tCO_2e}{yr}\right)} =$$

$$Distance\ travelled\ per\ pickup\ cycle\ (km) * \frac{\#\ pickups}{yr} * Diesel\ truck\ mileage\ \left(\frac{L}{100\ km}\right)$$

$$* Diesel\ density\ \left(\frac{0.038\ GJ}{L}\right) * Diesel\ EF\ \left(\frac{tCO_2e}{GJ}\right)$$

Annual Project Waste Emissions Created by Composting Facility in year I for all fuels

$$\boldsymbol{Annual\ Project\ Compost\ Total\ Facility\ Emissions\ Created_i\left(\frac{tCO_2e}{yr}\right)} =$$

$$\sum^{All\ fuels} Annual\ Compost\ Facility\ Fuel\ Consumption\ \left(\frac{GJ}{yr}\right) * Fuel\ EF\ \left(\frac{tCO_2e}{GJ}\right)$$

Net Annual Project Waste Emissions Created in year i

$$\boldsymbol{Annual\ Project\ Emissions\ Created_i\left(\frac{tCO_2e}{yr}\right)} =$$

$$Annual\ Project\ Compost\ Emissions\ Created_i\left(\frac{tCO_2e}{yr}\right) +$$

$$Annual\ Project\ Compost\ Transport\ Emissions\ Created_i\left(\frac{tCO_2e}{yr}\right) +$$

$$Annual\ Project\ Compost\ Facility\ Emissions\ Created_i\left(\frac{tCO_2e}{yr}\right)$$

Annual Project Waste Emissions in year i

$$\boldsymbol{Annual\ Project\ Waste\ Emissions_i\left(\frac{tCO_2e}{yr}\right)} =$$

$$Annual\ Baseline\ Waste\ Emissions_i\left(\frac{tCO_2e}{yr}\right) - Annual\ Project\ Waste\ Emissions\ Diverted_i\left(\frac{tCO_2e}{yr}\right) +$$

$$Annual\ Project\ Emissions\ Created_i\left(\frac{tCO_2e}{yr}\right)$$

Lifetime Project Waste Emissions over n years

$$\boldsymbol{Lifetime\ Project\ Waste\ Emissions\ (tCO_2e)} =$$

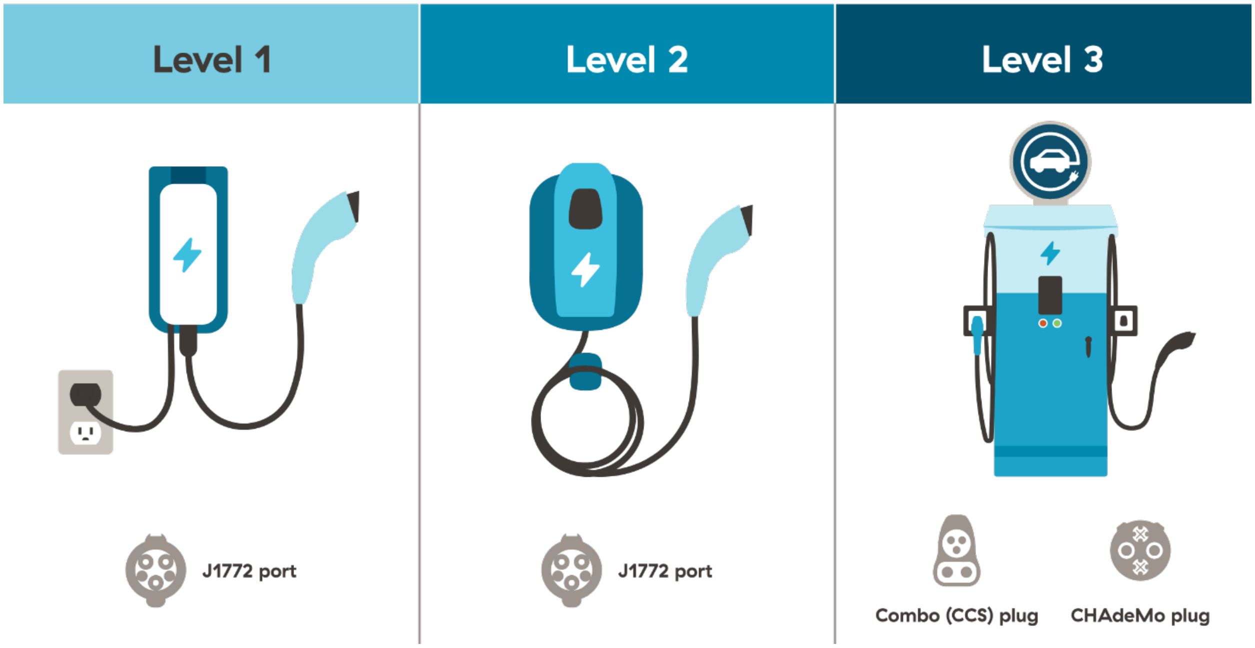
$$\sum_{i=1}^{n} Annual\ Project\ Waste\ Emissions_i\ \left(\frac{tCO_2e}{yr}\right)$$

Lifetime Project Emissions Savings

$$\boldsymbol{Lifetime\ Project\ Emissions\ Savings\ (tCO_2e)} =$$

$$Lifetime\ Baseline\ Waste\ Emissions\ (tCO_2e) - Lifetime\ Project\ Waste\ Emissions\ (tCO_2e)$$

Appendix D. Electric Vehicle Charger Options



Source: BC Hydro (2023)