QUANTIFYING GREENHOUSE GAS REDUCTIONS
PROJECT PROFILE
ENERGY EFFICIENT BUILDING RETROFITS AND FUEL SWITCHING

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

This document provides guidance on estimating the emission reductions potential associated with increasing the energy efficiency of existing building envelopes and the technologies used for space heating/cooling and hot water, as well as for switching building systems to allow the use of lower carbon fuels. One of the greatest opportunities within communities for reducing greenhouse gas (GHG) emissions is the existing building stock. This project involves retrofitting non-government-owned buildings in the community or local government-owned / operated buildings that are outside the boundaries of “traditional local government services” (such as social housing).

There is a broad array of retrofit options available to building owners that can result in reductions of GHG emissions. The retrofit options include measures that (1) increase the efficiency of building shells through better insulation and windows, (2) increase the efficiency of building equipment (e.g., furnaces, air conditioners, boilers, district energy, hot water heaters, reduced hot water flow), (3) cause fuel switching from a high-carbon energy source (e.g., light fuel oil) to a low-carbon energy source (e.g., electricity, solar), and (4) recover heat generated that would otherwise be “dumped” into the environment and not reused (waste heat).

All retrofit measures that result in GHG emission reductions using the guidance below are included in this project type. Lighting and other non-heating / cooling retrofit projects are not covered by this project description because of challenges developing a simplified calculation.

Calculating Emission Reductions

In order to meet the heating, cooling and hot water needs of a building, energy (e.g., natural gas, propane, wood, fuel oil, and electricity) is used to achieve a desired room or water temperature. The emissions from these sources (Baseline Emissions) depend on the type of energy used, the efficiency of the furnace, heater or air conditioner, and the efficiency of the building envelope or water system. A project addressing any of these factors can improve the GHG performance of an existing building. The equation for estimating emission reductions is as follows:

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

This summary provides a high-level outline of the most important variables involved in determining emission reductions from a project compared to a baseline situation.

There are multiple accepted approaches for quantifying emission reductions among building energy efficiency carbon credit protocols. To simplify data provisions for building owners, a “whole facility” quantification approach is used for this project type. Under this approach energy use for the entire building is included in the baseline and project calculations

utilizing conservative assumptions and methods for determining energy use and calculating energy reductions.[1] The accounting methodologies used here were designed with the data that building managers have available to them in mind. Calculating energy use and GHG reduction is based on utility data.

Project Example

The spreadsheet demonstrates the following example.

A local government decides to retrofit 25 households within the community. The retrofits include replacing oil furnaces with air source heat pumps and sealing all gaps and cracks with new weather stripping.

Task	Input/Output
Step 1: Enter dates	
Enter the dates for the baseline and project years.	In the example, the baseline years are 2011 to 2013, and the project year is 2014.
Step 2: Calculate baseline consumption	
Enter the baseline energy consumption from the last three years of utility bills (electric, natural gas, wood, heating oil and propane). Total electricity (kWh), heating oil (GJ), natural gas (GJ), wood (GJ) and propane (GJ) consumption are entered for each year to establish a three-year average.	In this example, the average annual electricity consumption over three years for the 25 households used for appliances, lighting, and hot water heating totalled 280,000 kWh. The average annual heating oil consumption for space heating in the 25 households over the same three years totalled 1,900 GJ.
Step 3: Calculate project consumption	
Enter the energy consumption for the project year from utility bills. In this example the oil furnaces are replaced with air source heat pumps so there is only an electricity bill.	Total electricity use goes up in the project year to 320,000 kWh due to the new air source heat pumps.
Step 4: Estimate energy use for heating and cooling	
Estimate the share of electricity consumed for space heating and cooling. This step is required to determine what portion of an electricity bill is due to space heating and cooling	In this example, electricity was not used for space heating in the baseline. However, the air source heat pumps use electricity in the project year. The amount of electricity used by the air sourced heat pumps is estimated to be 106,656 kWh, or 33.33% of total electricity use in the project year. The total electricity used by the heat pumps was determined by using manufacturers' specifications that are provided with the product.
Step 5: Enter heating degree days	
Enter the average annual and 30-year average heating degree days to calculate the "weather-adjusted" energy consumptions. This step is needed to correct for annual average temperatures that are colder or warmer than average. Heating degree days are used to estimate how cold it was for the project and baseline period and how much energy may be needed to keep buildings warm.	In this example, the baseline years were slightly warmer than the project years
Step 6: Calculate emission reductions	
The spreadsheet does the calculations to estimate the total annual net emission reductions.	In this example, the net annual emission reductions from all 25 households are 131.1 tonnes.

[1] This approach is based on a synthesis of guidance provided by: Government of Alberta (2018). *Quantification protocol for energy efficiency projects*. Version 2.0. June 2018.

Project Calculation Guidance

Information Requirements & Sources	Energy usage for each energy type (electricity, natural gas, wood, heating oil, propane) for one year ♦ Source: Utility and purchasing data Number of heating-degree-days for the calendar year ♦ Source: Government of Canada weather service; http://www.degreedays.net Climate normals 30-year average heating-degree days ♦ Source: Environment Canada Climate Normals Emission factor for each energy type ♦ Source: Climate Action Secretariat, Ministry of Environment (2023), BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions Adjustment Factors ♦ Source: Quantification Protocol for Energy Efficiency Projects, Government of Alberta, June 2018: https://open.alberta.ca/publications/9781460137932
Calculations	The energy calculations for the project and baseline years will need to be adjusted to account for potential differences in weather and building uses between years. Weather Correction Total energy consumption x ((1-heating dependent share of energy) + (heating dependent share x 30-year average heating-degree days /heating degree days in project or baseline year(s))) = weather adjusted energy consumption After annual energy use is estimated, annual GHG emissions can be calculated: CO_2e = Total annual energy use x emission factor
Notes	Total baseline emissions should be calculated based on one calendar year of activity

Note on Energy Audit GHG Quantification: Alternate methodologies that rely on pre- and post-project energy audits could also be used to quantify energy and GHG emission reductions. The set of assumptions used by energy auditing companies to forecast post retrofit energy usage would need to be specified and standardized for different building typologies.

Best Practices

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

Checklist:

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

Precedents

Currently in Canada, most building energy efficient retrofit programs are administered by federal and provincial agencies and energy utilities, with local governments mainly assisting in the dissemination of information through their websites. There are a few examples of local governments playing a more direct role in retrofit programs within BC and Canada.

- The City of Nelson's EcoSave Program, that offers discounted energy assessments and loan services for eligible energy efficiency upgrades that are repaid by Nelson Hydro customers on their electric bill (on-bill financing).
  http://www.nelson.ca/222/EcoSave-Program
- The City of Penticton's Home Energy Loan Program (HELP), is a loan service available for eligible energy efficiency upgrades. Loans are to be repaid over 10 years users monthly electric utility bills.
  https://www.penticton.ca/EN/main/departments/electricity/energy-retrofits.html

Resources

Quantification Protocols and Methods

- Quantification Protocol for Energy Efficiency Projects, Government of Alberta, June 2018:
  https://open.alberta.ca/publications/9781460137932#summary
- Efficiency Valuation Organization (2012). International Performance Measurement and Verification Protocol. Concepts and Practices for Determining Energy and Water Savings. Volume 1. EVO 10000 – 1:2012:
  http://www.eeperformance.org/uploads/8/6/5/0/8650231/ipmvp_volume_i__2012.pdf
- Energy efficiency and fuel switching measures for buildings --- Version 11, CDM-UNFCCC:
  http://cdm.unfccc.int/methodologies/DB/P4PO65N66CEQGPE2RJU15FIVB7AX4A
- Climate Action Secretariat, Ministry of Environment (2023), 2023 BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions:
  https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/methodology/2023_pso_methodology_for_quantifying_greenhouse_gas_emissions.pdf
- Climate Action Secretariat, Ministry of Environment (2023), Emission Factors Catalogue
  https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/guidance-documents/emission_factors_catalogue.xlsx

Grants, Rebates and Information on Existing Programs

- EfficiencyBC: https://efficiencybc.ca/
- FortisBC Gas Energy Efficiency Programs:
  - For homes & businesses: https://www.fortisbc.com/Rebates/RebatesOffers/Pages/default.aspx