REC Scoping Audit and Engineering Study Guidelines

This document describes the requirements for the completion of REC Scoping Audits, and Engineering Studies, including the methodology and requirements for the quantification of project energy savings and greenhouse gas emissions reductions.

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MCCAC
Municipal Climate Change Action Centre

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1.0 Introduction

1.1 Purpose

This guideline serves to provide the minimum requirements for delivering Scoping Audits, Engineering Studies, and Implementation Projects as part of the Recreation Energy Conservation (REC) program. The purpose of performing a Scoping Audit and Engineering Study with quantified greenhouse gas emissions reductions and energy savings is to provide both the participating municipality and the MCCAC accurate estimates of the cost, energy savings, and greenhouse gas (GHG) reductions for a project.

Detailed quantification tracking of energy performance before and after energy efficiency retrofits has many benefits:

- Accurately assess energy savings for a project
- Help municipalities maintain and improve building performance and operations
- Data can be used by grant administrators to improve energy efficiency programs
- Identification of other energy savings opportunities

Due to the nature and scale of the program, the greenhouse gas emission and energy reduction quantification requirements for REC are intended to balance accuracy and rigor with accessibility and cost. To achieve the full benefits of comprehensive data tracking, the MCCAC urges participants to go beyond the REC reporting requirements and continue with energy performance measurement and tracking over the life of the facility.

This document describes the greenhouse gas and energy savings measurement, quantification, and reporting requirements necessary for all energy efficiency measures implemented as a part of a REC Scoping Audit or Engineering Study project.

1.2 Scope

The scope of this document pertains to documenting the identified GHG reductions at eligible municipal recreational facilities. Scoping Audits involve high level assessments of energy use at facilities with the purpose of identifying quick and easy verifiable GHG reductions. Scoping Audits also help identify opportunities that may need more effort to determine the extent of GHG reduction through further in-depth engineering concept development as well as further financial and energy-saving analysis. This in-depth engineering analysis and the associated commercial review forms the basis for an Engineering Study. The Engineering Study provides a comprehensive analysis for complex capital energy efficiency projects.

1.3 Using Existing Scoping Audits and Engineering Studies

Municipalities may proceed directly to an Implementation Project provided they have the appropriate energy, cost, and GHG reduction information required in the REC Application Form or in the REC Application Portal. Municipalities may use Scoping Audits and Engineering Studies completed prior to the launch of the REC program to provide the required information. The accuracy of the energy, cost, and GHG reduction information will be assessed through a technical review.

1.4 Key Definitions

Energy conservation measure (ECM): Any work that is intended to reduce the energy consumption or increase the energy efficiency of a facility through equipment retrofit or installation of new energy management systems or controls. Routine equipment

maintenance is not eligible for consideration under this program. While there is a distinction between energy efficiency and energy conservation, these terms can be used interchangeably for the purposes of this document.

Possible measures: All ECMs that are feasible and applicable to the facility.

Recommended measures: All ECMs that are feasible, applicable to the facility, cost-effective, and recommended by a qualified energy professional given the requirements of the REC program.

Project measures: All ECMs that are included in the REC project application.

Measurement boundary: A conceptual boundary drawn around equipment or systems to define all elements and factors that influence the energy use for a given energy efficiency measure.

Baseline: The 'baseline' case describes the energy use characteristics of the facility prior to implementing ECMs. It should be a fair representation of normal operating conditions and must span at least one year to capture a full operating cycle.

Post-retrofit: The 'post-retrofit' case, synonymous with 'energy efficient' case, describes the facility energy use characteristics after all ECMs from the REC project have been implemented.

Abatement rate: Greenhouse gas emissions abatement rate refers to the ratio of the total MCCAC funding request (expressed in $) per amount of greenhouse gas emissions (expressed in metric tonnes of CO_2e) that are reduced or avoided through the implementation of an ECM.

Simple project: May include measures bundled into one project application to meet program incentive application threshold criteria. Simple measures are defined as ECMs that have predictable energy savings and consistent operating profiles.

Complex project: Defined as a single project application for large measures with variable operation and inconsistent energy drivers. Complex custom projects include but are not be limited to combined heat and power projects, boilers over 2,500,000 BTU, variable frequency drives in non-HVAC applications or over 50HP, compressor upgrades (excl. <75hp air compressor), ice plant measures, and building envelope measures if a defined modeling tool is not used by the participant.

1.5 Units and Emission Factors

All Scoping Audits and Engineering Studies must use metric units. The following table provides units for each energy source.

Table 1.0: Energy Units

Energy Source	Units
Electricity	kWh
Electrical Demand	kW
Natural Gas	GJ
Propane	Litre
Diesel	Litre
Gasoline	Litre
Light Fuel Oil	Litre
Heavy Fuel Oil	Litre

GHG Emission estimations in Scoping Audits and Engineering Studies must be calculated with the emission factors from the Carbon Offset Emission Factors Handbook. Below for the most common emissions factors. For other emissions factors, please refer to the Carbon Offset Emission Factors Handbook (ESRD, Climate Change, 2015, No. 1).

Table 2.0: Emissions Factors

Factor	Value	Description
Renewable electricity generation	0.64 tCO_2e/MWh	Distributed renewable displacement at point of use (includes line loss). Applicable to projects displacing grid electricity with distributed renewable generation at point of use.
Reduction in grid electricity usage	0.64 tCO_2e/MWh	Reduction in grid electricity usage (includes line loss). Applicable to energy efficiency measures resulting in decreased grid electricity usage.
Combustion of natural gas	1929 gCO_2e/m^3 (equivalent to 0.05 tCO_2e/GJ)	For residential, commercial and institutional buildings. Calculated from ESRD Handbook, Table 6 (2015, No. 1)
Combustion of propane	1540 gCO_2e/m^3	For other uses (institutional buildings). Calculated from ESRD Handbook, Table 6 (2015, No. 1)
Combustion of light fuel oil	2735 gCO_2e/L	For commercial / institutional buildings. Calculated from ESRD Handbook, Table 7 (2015, No. 1)
Combustion of diesel	2786 gCO_2e/L	Calculated from ESRD Handbook, Table 7 (2015, No. 1)
Combustion of motor gasoline	2295 gCO_2e/L	Calculated from ESRD Handbook, Table 7 (2015, No. 1)

2.0 Scoping Audit

2.1 General Requirements

Scoping Audits help inform the municipality of the energy-saving opportunities within their facility and recommend which measures to retrofit as a part of an Implementation Project. Should a municipality proceed with a Scoping Audit, the municipality is then responsible for commissioning the Scoping Audit with a Program Ally contractor. The Scoping Audit will provide enough detail to quantify the energy, GHG, and financial savings of a potential project, which is needed to proceed to an Implementation Project.

The requirements for the detailed energy assessment are as follows:

- The Scoping Audit must be completed to a level of rigour that falls between an ASHRAE Level I and an ASHRAE Level II audit guidelines. It must be sufficient to provide the data necessary to perform all required quantification calculations detailed in this document. Scoping Audits are required to have a minimum +/- 40 % accuracy with regards to GHG reduction and associated project cost estimates.

- The Scoping Audit and quantification must be completed by a Program Ally with a legal right to work in Canada. A qualified professional will be a Professional Engineer (P. Eng) or Certified Energy Manager (CEM). This individual is bound by legal responsibility and the professional code of conduct of their respective associations.

2.2 Quote Requirements

All quotes for Scoping Audits prepared by Program Allies shall include the following:

- Enrollment number, if available (EA-XXXXX)
- Customer name, address, contact name(s), telephone number(s)
- Facility information (if different than above)
- Facility type (e.g. arena, swimming pool, multiplex, etc.)
- Brief facility description
- Most recent available 12-month energy use of facility/system(s) under review (applicable sources i.e. electricity when reviewing compressed air systems, natural gas when reviewing boilers and steam systems, etc.)
- Information of person responsible for signing off on the Scoping Audit
- Itemized cost breakdown by tasks, roles, hours and hourly rates (excl. taxes)
- List estimated audit disbursements/expenses separately
- Overall scope of Scoping Audit and limitations of quote and system(s) excluded
- Limitations of proposal, system(s) excluded
- Estimated date of completion

2.3 Application Process

All Scoping Audit applications will be tracked in the Third-Party Administrator's Management Tracking platform. All logged applications by Municipalities and Program Allies (on behalf of Municipalities) will be screened for necessary completeness of information provided. The application intake process, technical review, and approval will be conducted by the Third-Party Administrator. The application process includes the following steps:

1. Application Intake & Administrative Review

   Apply online by registering and filling out an application at: http://mccac.ca/programs/REC. At a minimum the application will be verified for:

- Completeness and accuracy of municipal information
- Eligibility criteria including eligibility of the applicant and their facility
- That the municipality has a minimum 12 months of energy use information
- Costs and proposed project completion time

2. Technical Screening Review

During this process, the application and the supporting documentation will be reviewed by the Third-Party Administrator to qualify the Scoping Audit for approval. If any required information is missing, the Third-Party Administrator will follow up with the municipality and/or Program Ally and request additional information.

3. Scoping Audit Approval

An Offer Letter will be sent to the Municipality upon approval. To reserve program funds and begin the Scoping Audit, the municipality must return a signed copy of the Offer Letter to the Third-Party Administrator.

2.4 Scoping Audit Report Structure

This section describes the minimum requirements and minimum content that shall be included in the Scoping Audit report. This information is required to create a standard format for all program participants. The intent is not to limit or prescribe the services provided, but to ensure the completeness and quality of the information presented to the REC program.

Note: the report must also include all data and calculations as described in the sections above that may not be summarized in this table.

Table 3.0: Summary of Required Scoping Audit Report Contents

Section	Report Content
Background	Description of the site and buildings: • Physical description including: number of buildings, building type, building configuration, envelope characteristics, building floor area, window area • Building operation/occupancy information including number of occupants, occupancy schedule, and primary building activities Description of energy systems: • A review and description of all energy systems (e.g. mechanical, electrical, plug loads, etc.) • Major equipment and load list • Typical annual building energy use by energy type • Typical building energy by end use (e.g. lighting, space heating, etc.) Quantification team: • Team members and qualifications • Date of report and site visit(s) Customer Information: • Site contact information • Municipality name • Facility name, type • Unique site identifier or facility address • Utility account numbers Utility Analysis • Billing Analysis (12-months minimum, 36-months preferred) • Annual utility rate analysis (monthly energy use breakdown)

	• Facility baseline GHG emissions Energy End-Use Breakdown • Detailed facility energy end-use breakdown by fuel/energy type • Independent variables affecting energy use (weather, occupancy, other)
Summary of energy conservation measures	Summary of ECMs within a table(s) including: • ECM number • ECM name • ECM electrical savings (kWh/year) • ECM electrical demand savings (kWh/year) • ECM natural gas savings (GJ/year) • ECM other fuel savings (ex. L/year) • ECM annual GHG reduction (tonne CO2e/year) • ECM lifetime emission reduction (tonne CO2e/lifetime) • ECM expected lifespan (years) • ECM cost savings ($/year) • ECM capital cost of equipment and installation ($) • ECM simple payback (years) • ECM expected REC rebate ($) • ECM lifetime abatement rate ($/tonneCO2e lifetime) • ECM implementation recommendation
Project energy conservation measures	*For each individual ECM include:* ECM description: • Description of ECM/retrofit: technology, specifications, efficiency, service lifetime, cost • Description of any changes to operation parameters or load profiles due to ECM • Assumptions made in calculating savings • Describe any non-energy benefits of ECMs Measure boundary: • A description of the scope of all equipment and measurement points in the boundary • List all potential energy flow interactions Measure baseline: • Description of existing equipment, technology, specifications, and age • Description of normal operating parameters for energy systems within boundary Energy and GHG Performance: • Baseline adjusted annual energy use (kWh or GJ) • ECM annual energy use adjusted for interactions (kWh or GJ) • ECM electrical savings (kWh/year) • ECM electrical demand savings (kW/year) • ECM natural gas savings (GJ/year) • ECM other fuel savings (ex. L/year) • ECM annual GHG reduction (tonne CO2e/year) • ECM lifetime emission reduction (tonne CO2e/lifetime) • ECM expected lifespan (years)

	• ECM cost savings ($/year) • ECM capital cost of equipment and installation ($) • ECM simple payback (years) • ECM expected REC rebate ($) • ECM lifetime abatement rate ($/tonneCO2e lifetime) • ECM implementation recommendation
Conclusion	Summary of Recommendations and Next Steps • Other recommendations as required
Appendix	All supporting materials as required in the described methodology, including: • Measurement processes, data sets, calculations, measure interaction estimates, measure uncertainty estimates, reference sources, assumptions, etc.

2.5 Additional Requirements

The following information shall be included with the submission of the Scoping Audit:

- An expected total of 3-5 no/low-cost measures, and 3-5 capital measures
- Fully accessible native electronic copies of the ECM analysis/calculations
- Analysis/calculations shall be systematic and easy to follow/review (workbooks with only values and no explanation how values are derived will be rejected)
- Methodology shall be clear and based on sound engineering principles
- All assumptions shall be stated
- Any supporting documentation (i.e. site measurements, shop drawings, vendor and installation quotes, etc.)

The interactive effects between different energy sources shall be included in the analysis and report.

The interactive effects between ECMs, when bundled, shall be included in the analysis and report.

Sub-metering is NOT specifically required. The expectation is that measurements will be taken to substantiate assumptions made when estimating load factor, runtimes, thermal loads, mass flow, etc. Available information from plant control systems, building schedules or logs can be used to support calculations.

3.0 Engineering Studies

3.1 General Requirements

Engineering Studies help inform the municipality of the potential energy, cost, and GHG savings of 1-3 complex energy system retrofits. Should a municipality proceed with an Engineering Study, the municipality is then responsible for commissioning the Engineering Study with a Program Ally contractor. The Engineering Study will provide enough detail to quantify the energy, GHG, and financial savings of a potential project, which is needed to proceed to an Implementation Project.

The requirements for the detailed energy assessment are as follows:

- The Engineering Study must be a comprehensive, investment-grade report which analyzes the feasibility of capital energy efficiency projects. Engineering Studies will include in-depth analysis on GHG reductions and project economics and provide the data necessary to perform all required quantification calculations detailed in this document. Engineering Studies are required to have a minimum +/- 15 % accuracy with regards to GHG reduction and associated project cost estimates.

- The Engineering Study and quantification must be completed by a Program Ally with a legal right to work in Canada. A qualified professional will be a Professional Engineer (P. Eng) or Certified Energy Manager (CEM). This individual is bound by legal responsibility and the professional code of conduct of their respective associations.

3.2 Quote Requirements

All quotes for Engineering Studies prepared by Program Allies shall include the following:

- Enrollment number, if available (EA-XXXXX)
- Enrollment Application (EA) number applicable to ECMs included in earlier Scoping Audits (if applicable)
- Customer name, address, contact name(s), telephone number(s)
- Facility information (if different than above)
- Facility type (e.g. arena, swimming pool, multiplex, etc.)
- Most recent available 36-month energy use of facility/system(s) under review (applicable sources i.e. electricity when reviewing compressed air systems, natural gas when reviewing boilers and steam systems, etc.)
- Brief facility description
- Detailed description of systems under review
- ECMs included in Engineering Study
- Estimate of GHG reductions that can be achieved under scope of work
- Proposed methodology for estimating/analyzing the ECMs
- Information of person responsible for signing off on the Engineering Study
- Itemized cost breakdown by tasks, roles, hours and hourly rates (excl. taxes)
- List estimated study disbursements/expenses separately
- Overall scope of Engineering Study and limitations of quote and system(s) excluded
- Estimated date of completion

3.3 Application Process

All Engineering Study applications will be tracked in the Third-Party Administrator's Management Tracking platform. All logged applications by Customers and Program Allies (on behalf of Customers) will be screened for necessary completeness of information provided. Initial application intake process will be conducted by the Third-Party Administrator.

1. Application Intake & Administrative Review

Apply online by registering and filling out an application at: http://mccac.ca/programs/REC. At a minimum the application will be verified for:

- Completeness and accuracy of municipal information
- Eligibility criteria including eligibility of the applicant and their facility
- That the municipality has a minimum 36 months of energy use information
- Costs and proposed project completion time

2. Technical Screening Review

During this process, the application and the supporting quote will be reviewed by the Third-Party

Administrator to qualify the Engineering Study for approval. This submittal, at a minimum, shall include all information as described in Section 3.2. As next steps, a site visit may be arranged to discuss the scope and schedule of the proposed Engineering Study. A REC Program Ally will conduct a walk through and verify the information submitted in the proposal. The Engineering Study approval will then be sent back to the Third-Party Administrator for processing.

3. Engineering Study Approval

An Offer Letter will be sent to the Municipality upon approval. To reserve program funds and begin the Engineering Study, the municipality must return a signed copy of the Offer Letter to the Third-Party Administrator.

3.4 Engineering Study Report Structure

This section describes the minimum requirements and minimum content that shall be included in the Engineering Study report. This information is required to create a standard format for all program participants. The intent is not to limit or prescribe the services provided, but to ensure the completeness and quality of the information presented to the REC program.

Note: the report must also include all data and calculations as described in the sections above that may not be summarized in this table.

Table 4.0: Summary of Required Engineering Study Report Contents

Section	Report Content
Background	Description of the site and buildings: • Physical description including: number of buildings, building type, building configuration, envelope characteristics, building floor area, window area • Building operation/occupancy information including number of occupants, occupancy schedule, and primary building activities Description of energy systems: • A review and description of all energy systems (e.g. mechanical, electrical, plug loads, etc.) • Major equipment and load list • Typical annual building energy use by energy type • Typical building energy by end use (e.g. lighting, space heating, etc.) Quantification team: • Team members and qualifications • Date of report and site visit(s) Customer Information: • Site contact information • Municipality name • Facility name, type • Unique site identifier or facility address • Utility account numbers Utility Analysis • Billing Analysis (36-months minimum) • Annual utility rate analysis (monthly energy use breakdown) • Facility baseline GHG emissions (tCO2e)

	Energy End-Use Breakdown • Detailed facility energy end-use breakdown by fuel/energy type • Independent variables affecting energy use (weather, occupancy, other)
Summary of energy conservation measures	Summary of ECMs within a table(s) including: • ECM number • ECM name • ECM electrical savings (kWh/year) • ECM electrical demand savings (kWh/year) • ECM natural gas savings (GJ/year) • ECM other fuel savings (ex. L/year) • ECM annual GHG reduction (tonne CO2e/year) • ECM lifetime emission reduction (tonne CO2e/lifetime) • ECM expected lifespan (years) • ECM cost savings ($/year) • ECM capital cost of equipment and installation ($) • ECM simple payback (years) • Baseline NPV life-cycle cost ($) • ECM NPV life-cycle cost ($) • ECM expected REC rebate ($) • ECM lifetime abatement rate ($/tonneCO2e lifetime) • ECM implementation recommendation
Project energy conservation measures	*For each individual ECM include:* ECM description: • Description of ECM/retrofit: technology, specifications, efficiency, service lifetime, cost • Description of any changes to operation parameters or load profiles due to ECM • Assumptions made in calculating savings • Describe any non-energy benefits of ECMs Measure boundary: • A description of the scope of all equipment and measurement points in the boundary • List all potential energy flow interactions Measure baseline: • Description of existing equipment, technology, specifications, and age • Description of normal operating parameters for energy systems within boundary Energy and GHG Performance: • Baseline adjusted annual energy use (kWh or GJ) • ECM annual energy use adjusted for interactions (kWh or GJ) • ECM electrical savings (kWh/year) • ECM electrical demand savings (kW/year) • ECM natural gas savings (GJ/year) • ECM other fuel savings (ex. L/year) • ECM annual GHG reduction (tonne CO2e/year) • ECM lifetime emission reduction (tonne CO2e/lifetime) • ECM expected lifespan (years)

	• ECM cost savings ($/year) • ECM capital cost of equipment and installation ($) • ECM simple payback (years) • ECM expected REC rebate ($) • ECM lifetime abatement rate ($/tonneCO2e lifetime) • ECM implementation recommendation • Baseline NPV life-cycle cost ($) • ECM NPV life-cycle cost ($) • High level description of the business case of the recommended ECMs
Measurement and Verification	• Description of how ECMs can be measured and verified based on IPMVP principles • Include description of instrumentation required and independent variables affecting energy use/intensity
Conclusion	Summary of Recommendations and Next Steps • Other recommendations as required
Appendix	All supporting materials as required in the described methodology, including: • Vendor quotes, shop drawings, measurement processes, billing data, data sets, calculations, measure interaction estimates, measure uncertainty estimates, reference sources, assumptions, etc.

3.5 Additional Requirements

The following information shall be included with the submission of the Engineering Study:

- An expected total of 1-3 capital measures
- Fully accessible native electronic copies of the ECM analysis/calculations
- Analysis/calculations shall be systematic and easy to follow/review (workbooks with only values and no explanation how values are derived will be rejected)
- Methodology shall be clear and based on sound engineering principles
- All assumptions shall be stated
- Any supporting documentation (i.e. site measurements, shop drawings, vendor and installation quotes, etc.)

The baseline(s) for the identified ECMs shall be based on sub-metering (or available historian data) of the relevant system(s) for a duration of time sufficient to obtain a representative energy use profile providing a high degree of confidence. Major independent variables significantly affecting the baseline shall be identified and included in the analysis.

The interactive effects between different energy sources shall be included in the analysis and report.

The interactive effects between ECMs, when bundled, shall be included in the analysis and report.

Cost estimates shall be supported by comprehensive vendor and/or installation quotes or by engineering cost estimates. Project costs shall include all cost required to move a project from concept stage through to being fully operational.