TAME+ Detailed Energy Assessment Requirements

This document describes the requirements for the completion of TAME+ Detailed Energy Assessments.

It includes the methodology and requirements for the quantification of project energy savings and greenhouse gas emissions reductions.

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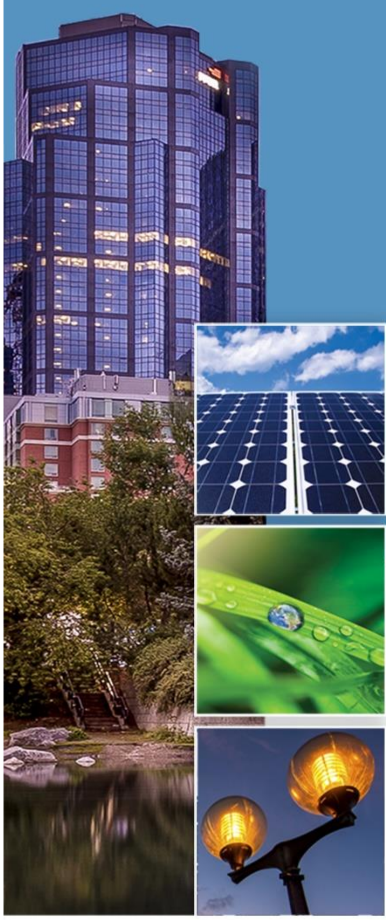

MCCAC
Municipal Climate Change Action Centre

Contents

1.0 Introduction

1.1 Purpose

This document has been developed to assist with the preparation of the Detailed Energy Assessment report required for participation in the TAME+ program. Please note that the provisions in this document must be met in order to be eligible to participate in the TAME+ program.

The purpose of performing a detailed energy assessment 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 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 TAME+ are intended to balance accuracy and rigor with accessibility and cost. In order to achieve the full benefits of comprehensive data tracking, the MCCAC urges participants to go beyond the TAME+ 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 TAME+ project.

1.2 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 energy conservation measures that are feasible and applicable to the facility.

Recommended measures: all energy conservation measures that are feasible, applicable to the facility, cost-effective, and recommended by a qualified energy professional given the greenhouse gas abatement requirements of the TAME+ program.

Project measures: all energy conservation measures that are included in the TAME+ 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 participation in the program. 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 energy efficiency measures from the TAME+ 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 energy efficiency or conservation measure.

2.0 Detailed Energy Assessment Report

2.1 General Requirements

The municipality is responsible for commissioning a detailed energy assessment for all buildings included in the project. The assessment will help the municipality make an informed decision about which measures to include as a part of the TAME+ project.

The requirements for the detailed energy assessment are as follows:

- The assessment must be completed to a level of rigour comparable to ASHRAE Level II audit guidelines and sufficient to provide the data necessary to perform all required quantification calculations detailed in this document.
- The assessment and quantification must be completed by a qualified professional 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 Requirements for Detailed Energy Assessments

An ASHRAE Level II audit will, at various levels of depth, explore all possible measures applicable to a particular facility. This analysis is completed with the intention of narrowing down a set of recommended measures that will be presented to the client in the Detailed Energy Assessment report.

For a guide on the requirements of an ASHRAE Level II audit, please refer to the document "Procedures for Commercial Building Energy Audits" (ASHRAE 2011). This document can be purchased and downloaded from the ASHRAE website.

2.3 Greenhouse Gas and Energy Saving Quantification Requirements

TAME+ projects must quantify and report the greenhouse gas emissions reductions and energy savings from the proposed project. This analysis applies to all project measures and must be included in the Detailed Energy Assessment Report. The detailed quantification methodologies for this analysis are provided below.

The project quantification requirements include:

- a quantified description of the facility operation and energy use prior to the TAME+ project (baseline);
- a comprehensive list of all project energy efficiency measures;
- estimated energy savings and greenhouse gas emissions reductions from each of the project measures and from the project as a whole;
- cost-effectiveness assessments for the measures and a calculated GHG abatement rate for the project; and
- reported assumptions, references, and details on the measurement and quantification process used for all recommended measures

2.4 Submission and Updates

The Detailed Energy Assessment report, completed by the energy consultant, must be submitted as a part of the TAME+ application process.

Once the project application has been submitted, if the municipality choses to modify the project in any way, updated greenhouse gas emissions reductions and energy savings for the project must be included as an amendment to the Detailed Energy Assessment report.

Such updates will not be the responsibility of the energy consultant, but rather the municipality should work with the MCCAC in order to update or adjust the quantification values for the project. If changes are substantive, a new detailed energy assessment may be required.

2.5 Project Completion Statement

Upon project completion, a Project Completion Statement must be submitted by the municipality to the MCCAC. The Project Completion statement must include a list of all measures that were implemented and their associated project greenhouse gas emission reductions, signed by the municipality. This statement should document any deviation from the implementation plan.

A template for the Project Completion Statement will be made available on the MCCAC website.

3.0 Quantification and Emissions Reductions Methodology

3.1 Energy Use Measurement

The MCCAC energy savings measurement and quantification process is based on the Alberta Quantification Protocol for Energy Efficiency in Commercial and Institutional Buildings and the International Performance Measurement & Verification Protocol (2010).[1]

[1] These documents are publically available and may be referenced.

As outlined in these protocols, energy measurement and verification can follow one of four typical approaches, summarized below.

Table 3.1: Summary of IPMVP Measurement and Verification Options

Approach	Description
A. Retrofit Isolation: Key Parameter Measurement	Engineering calculations of energy savings are completed for each measure through a combination of field measurements and estimates for key performance parameters. Measurement frequencies are short-term and range from samples to continuous measurements. Non-measured values are estimated based on historical data, manufacturer's specifications and engineering judgement
B. Retrofit Isolation: All Parameter Measurement	Same process as Approach A, but with no estimation. All values calculated from field measurements.
C. Whole Facility	Savings are calculated using the measured energy use at the whole facility or sub-facility level. Continuous measure of facility energy use over a baseline year are compared to continuous measurements for at least one year post-retrofit. Adjustments are required to account for factors such as weather and occupancy.
D. Calibrated Simulation	Savings are calculated through simulation of energy use across the whole facility or sub-facility. Simulation is calibrated with hourly or monthly data.

Recognizing the unique challenges of municipalities in terms of resources, capacity limitations and remote locations, the quantification requirements for TAME+ are to follow a **modified Approach A**. This reduced burden of quantification is acceptable for TAME+ projects as they are relatively small in scale and this assessment is not used to quantify emissions reductions on the Alberta carbon offset market.

The recommended approach and minimum requirements are described below. However, if the qualified energy professional deems that another method will be lower cost and of equal or greater accuracy, Approach B, C, or D can be employed in place of the described approach. In such cases, the energy consultant must provide a measurement and verification plan appropriate to the selected methodology to MCCAC for approval, prior to completion of the Detailed Energy Assessment report.

3.1.1 Baseline Measurement

The baseline energy use of all energy equipment or systems within the scope of project ECMs must be quantified. The baseline measurement and quantification is completed using a combination of measured data and estimated parameters as outlined below:

Provide an overview of the site and building: in order to provide context for the baseline, provide a description of the site and building, and an overview of energy systems within the building. This must include basic physical parameters such as location, building type, total building floor area, and relevant occupancy and operational information to illustrate how the building is used. Finally, an overview of all energy systems must be provided which lists the systems and includes a physical description including the age and specifications of equipment, and an energy use break-down by system.

Define the measurement boundary: a measurement boundary must be defined for each energy efficiency measure. Doing so allows the narrowing of the scope of variables and factors that must be measured or quantified for an ECM and helps identify key metering points. Only changes to energy systems and operating variables within the measurement boundary must be included in the baseline and post-retrofit calculations. The measurement boundary also helps identify possible energy flows that may interact with other ECMs.

Determine normal operating parameters: for each ECM, determine the operating conditions that are representative of a typical facility over a full year operating cycle. Factors will vary for each ECM but generally include: building/room occupancy patterns, operating hours, load changes and cycles, building activities, and environmental factors. Parameters should be based on measured or observed data when possible. Stipulations based on historical data or extrapolated patterns can be used when applicable.

Determine performance of existing equipment: for each ECM, determine the annual energy use for the baseline equipment and systems within the measurement boundary.

ECM Energy Use $_{Baseline}$ is defined as the annual energy consumption within the ECM boundary prior to ECM installation, calculated for each energy type

Key energy performance parameters should be based on measured data taken at the component or system level. A single spot measurement may be sufficient for conditions with little variation. Otherwise, measurements should be short-term and may be periodic or continuous. The length of measurement period and frequency should be determined by the energy professional based on the equipment type, anticipated variation, length of operating cycles, and influence on energy consumption.

In cases where measurements are not possible or practical, stipulated data may be used to determine performance parameters or other influencing factors. Stipulations may be based on historical data, databases, engineering references, or manufacturer data.

If multiple versions of the same equipment are included within the measurement boundary, a statistically valid sample may be used in place of measuring all units.

Measured and stipulated energy performance of all equipment types and energy uses should be aggregated to the metering level and compared with metered data to validate assumptions.

Calculate baseline energy use of the project: using the equipment performance data and operating parameters, calculate the total annual energy use of the baseline equipment and systems for all ECMs in the facility.

Project baseline energy use is calculated for each energy type as:

$$\textit{Equation 1: } Project\ Energy\ Use_{Baseline} = \sum ECM\ Energy\ Use_{Baseline}$$

In addition, include total annual facility energy use, based on historical utility data to be used as reference data for validation and context.

Calculate adjusted baseline energy use: the baseline is intended to be used for an equivalent comparison of a facility's energy use before and after ECM implementation. Variables that affect energy use but are unrelated to the efficiency project must be normalized to a reference condition which is held constant across the baseline and post-retrofit scenarios. Adjustments are typically made for weather-dependent measures and, in special cases, for changes to operating parameters.

All baseline energy use values for ECMs individually and for the project as a whole should be reported as 'adjusted' energy use in the final report with adjustment calculations and assumptions provided in the report appendix.

For weather dependent variables, normalize the baseline energy use to long-term average weather using a valid mathematical technique.[2] Temperature (e.g. heating degree days) must be considered. Humidity, wind, and other weather variables are to be considered as deemed relevant by the energy professional. Seasonal weather should be normalized to a period no less than 5 years and should be based on the nearest available meteorological data. Weather conditions during measurement periods must be reported for weather sensitive ECMs. Below is an example of baseline weather adjustment:

Equation 2: $$\textit{Energy Use}_{\textit{Adjusted Baseline}} = \textit{Project Energy Use}_{\textit{Baseline}} \times \frac{HDD_R}{HDD_B}$$

Where:

HDD_B *is heating degree days during the baseline period*

HDD_R *is heating degree days averaged for the reference period*

If it is anticipated that operating parameters affecting any ECM will be substantially different in the post-retrofit period for reasons unrelated to the energy efficiency project, the baseline should be adjusted to reflect these conditions. Changes in conditions that result from ECMs such as controls or occupancy sensors should not be included in baseline adjustments.

Document calculations, assumptions, and stipulated data: all calculations and relevant data must be clearly documented. For stipulated parameters, include all assumptions, supporting information and data sources. A third party should be able to verify calculations and understand the rational for assumptions. This can be included in an appendix.

3.1.2 Post-Retrofit Estimation

The post-retrofit energy use of all energy equipment or systems within the scope of project ECMs must be quantified. As these calculations are performed in advance of project implementation, measured operational data is unavailable. Therefore, these estimates should be completed with the best available information as outlined below:

Determine performance of new equipment: for each ECM, determine the annual energy use for all equipment or systems within the given measurement boundary.

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[2] For guidance on weather data and assessing the validity of mathematical methods refer to section 8.9 and Appendix B of the International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1 (2010) prepared by Efficiency Valuation Organization.

$ECM\ Energy\ Use_{Post-retrofit}$ is defined as the annual energy consumption within the ECM boundary after ECM installation, calculated for each energy type (with the effects of significant ECM interactions accounted for as described below)

Performance parameters should be based on the best available data including manufacturer specifications, measured performance of similar equipment, databases and other engineering references.

ECMs that improve energy efficiency by altering use or loading cycles, for example occupancy sensors and variable frequency drives, will require the development and use of a new load profile. This should be factored into the annual energy use calculations for these measures to ensure that the full benefit of the ECM is considered.

Analyze ECM interactions: some energy efficiency measures, once implemented, can have an effect on other measures by altering the energy flow through the system or by changing the load conditions.

For all energy efficiency measures, interactions with other ECMs must be identified and a rudimentary estimation of the interaction should be performed to evaluate the significance. Any significant interaction, estimated to affect the energy use of another ECM by over 15 percent or has a greater than 5 percent effect on the total baseline energy use, must be quantified and accounted for using detailed engineering calculations. All other interactions can be identified and noted as negligible. All relevant supporting information and calculations relating to ECM interactions must be summarized in the appendix.

Calculate post-retrofit energy use of the project: using the performance data for new equipment, calculate the total annual post-retrofit energy use of all ECMs in the facility. Calculations should be completed using the same core facility operating parameters and weather conditions as defined in the adjusted baseline. Exceptions include operating parameters that are directly and intentionally affected by the implementation of ECMs, such as control systems and occupancy sensors.

Project post-retrofit energy use is calculated for each energy type as:

Equation 3: $$Project\ Energy\ Use_{Post-retrofit} = \sum ECM\ Energy\ Use_{Post-retrofit}$$

Document calculations, assumptions, and stipulated data: clearly document all calculations and relevant data. For stipulated parameters, include all assumptions, supporting information and data sources. A third party should be able to verify calculations and understand the rationale for assumptions. Include this information in the appendix.

Identify significant uncertainty: with the above approach, a degree of uncertainty is anticipated in the post-retrofit calculations. In some cases, uncertainty may be high due to limited data or the nature of assumptions. Uncertainty levels should be estimated and must be noted in the report for all ECMs where uncertainty in annual energy use is greater than 50 percent. If there are post-retrofit measurements that could be taken upon completion to reduce uncertainty, recommendations should be made in the report. The MCCAC will review these recommendations with the municipality and determine if any actions are necessary to enhance quantification calculations.

3.1.3 Energy Savings

Energy savings must be calculated for each measure and for the project as a whole. These calculations assume that all project measures will be implemented and that any significant interaction effects are accounted for in the energy performance of each measure.

Note: all energy savings calculations must be performed using adjusted baseline energy use values.

Annual energy savings:
Annual energy savings for each ECM are calculated for all fuel types as follows:

$$\textit{Equation 4: } \boldsymbol{ECM\ Energy\ Savings = ECM\ Energy\ Use_{Baseline} - ECM\ Energy\ Use_{Post-retrofit}}$$

Annual project energy savings are calculated for all fuel types as follows:

$$\textit{Equation 5: } \boldsymbol{Project\ Energy\ Savings = Project\ Energy\ Use_{Adjusted\ Baseline} - Project\ Energy\ Use_{Post-retrofit}}$$

Project lifetime energy savings:
To determine the full effect of the retrofit, energy savings resulting from TAME+ projects must also be quantified over the life of the project. This is calculated by considering the annual energy savings from individual measures and their corresponding operational life. The expected operational life of each equipment included in the project ECMs should be determined using the best available information such as, manufacturer specifications, databases, research, and other engineering references. All equipment life values used in calculations and their source must be included in the report.

Project-life emissions reductions for each project ECM are calculated as follows:

$$\textit{Equation 6: } \boldsymbol{ECM\ Energy\ Savings_{Project\ life} = \sum ECM\ Energy\ Savings_{Annual} \times Equipment\ life}$$

Where:

Equipment life is the operational life of the equipment installed for each ECM in years

Project-life emissions reductions for the project as a whole are calculated as:

$$\textit{Equation 7: } \boldsymbol{Project\ Energy\ Savings_{Project\ life} = \sum ECM\ Energy\ Savings_{Project\ life}}$$

Eligible energy savings:
As specified in the Quantification Protocol for Energy Efficiency in Commercial and Institutional Buildings (2010), a multiplier factor must be applied to energy savings to account for uncertainty. Accordingly, the eligible energy savings of a project are defined as:

$$\textit{Equation 8: } \boldsymbol{Eligible\ Energy\ Savings = Energy\ Savings \times M}$$

Where:

$\boldsymbol{M\ is\ the\ eligibility\ multiplier, for\ all\ TAME+\ projects\ use\ a\ value\ of\ M = 0.90}$

This general equation must be applied to all energy savings calculations.

3.2 Greenhouse Gas Emissions

Greenhouse gas emission reductions must be quantified for all ECMs individually and for the project as a whole. Greenhouse gas must be calculated for all energy types affected by project ECMs. Energy types for TAME+ project typically include natural gas and grid electricity, but may include others depending on the building.

3.2.1 Annual GHG Reductions

Annual emission reductions for each ECM are calculated as:

Equation 9: $ECM\ Emission\ Reduction_{Annual} = \sum ECM\ Eligible\ Energy\ Savings \times Emission\ Factor_{Energy\ type}$

Where:

$Emission\ Factor_{Energy\ type}$ is the emission factor for each type energy use, expressed in tonnes of $CO_{2\ equivalent}$ per unit energy. Emission factors are provided in Appendix A.

Annual emission reductions for the project as a whole are calculated as:

Equation 10: $Project\ Emission\ Reduction_{Annual} = \sum ECM\ Emission\ Reduction_{Annual}$

3.2.2 Project Lifetime GHG Reductions

To determine the full effect of the retrofit, emission reductions resulting from TAME+ projects must also be quantified over the life of the project.

Project-life emission reductions for each ECM individually and for the project as a whole are calculated using the following general equation:

Equation 11: $Emission\ Reduction_{Project\ life} = Eligible\ Energy\ Savings_{Project\ life} \times Emission\ Factor_{Energy\ type}$

3.3 Cost-effectiveness Tests

Cost-effectiveness tests are used to evaluate the economics of energy efficiency projects. Various calculations and metrics are used in the design phase to select appropriate efficiency measures and to evaluate the business case for the project. Other metrics are used to assess grant effectiveness and to ensure funding is allocated appropriately.

To ensure consistency across TAME+ projects, section 3.3.1 describes the requirements and methodologies for cost-effectiveness calculations that must be included in the Detailed Energy Assessment report. For consistency, all payback calculations are to be completed for costs prior to the application of any rebates. Additional information comparing cost-effectiveness after applying TAME+ rebates is optional and must be clearly labelled.

3.3.1 Simple Payback

Simple payback is used to quantify the cost-effectiveness of a retrofit project from a participant perspective.

Simple payback calculations are required for all individual ECMs and for the project as a whole and are calculated using the equations below:

Equation 12: $\textit{Simple Payback (years)} = \frac{\textit{Initial Capital Cost}}{\textit{Annual Cost Savings}}$

Where:

Annual cost savings are calculated using the measure or project energy savings defined in the sections above

For the purpose of the simple payback assessment, calculations should assume a constant energy price applied to the energy savings based on current rates. Initial capital cost values and energy prices should be included in the report appendix.

3.3.2 Net Present Value (NPV) Life-cycle Cost

Full life-cycle cost accounting is a cash flow analysis technique that is well suited to capture the full benefits of a retrofit project from a participant perspective. This approach enables comparison between the baseline and post-retrofit scenarios in a way that accounts for equipment life, replacement costs, and the value of currently installed equipment.

NPV life-cycle cost calculations comparing the baseline to the post-retrofit cases are required for all individual ECMs and for the project as a whole.

Full life-cycle cost accounting can become relatively onerous depending on the scope and detail of the analysis. In order to ensure calculations are performed consistently and efficiently, a pre-determined scope definition and required calculation assumptions are included in the methodology below.

Cash flow analysis should be expressed in net present value using the equation below:

Equation 13: $NPV = C_0 + \sum_{t=1}^{n} \frac{C_T}{(1+d)^t}$

Where:

C_0 *is the initial investment cost in cashflow year zero (expressed as negative for a cost)*

C_T *is the sum of cash flow in year t (expressed in current dollars)*

d *is the discount rate (does not include inflation)*

n *is the number of cashflow periods (based on ECM equipment life)*

t *is the current time period (year)*

Note: Equation 13 and the methodology outlined below can be applied to the calculation of NPV for individual ECMs. As the *n* value may vary across ECMs, the NPV life-cycle cost of the project as a whole should be calculated using a weighted sum of individual measures.

Required assumptions and approaches:

- The number of cash flow periods should be based on the equipment life of each ECM. The baseline and post-retrofit NPV for each measure should be calculated over the same time period.
- Baseline equipment replacement is consistent: assume for the baseline that existing equipment will be replaced by equipment types matching what is currently installed or what would be required by current codes (if applicable).

- 5% discount rate: while different discount rates can be used in NPV calculations, a set discount rate is required to ensure comparability across ECMs and projects.
- Initial energy prices should be defined by the energy consultant based on rates that reflect costs currently experience by the municipality.
- Energy prices increase 1% per year: energy prices can have a significant influence on the economics of projects over the life of the equipment. While price escalation can be assumed, it is difficult to predict future prices with any degree of accuracy. To ensure calculation consistency, assume energy prices start at current rates and increase by 1% each year, over the life of the measure. This growth rate is deliberately set to be conservative. Note: no other inflation calculations are required for energy prices as NPV calculations express prices in present day values.
- The scope of cash flow items should include: purchase cost, installation cost, replacement cost and energy cost savings - for the baseline equipment and the post-retrofit equipment. These terms are defined below. Other items such as maintenance and disposal costs are considered out of scope.

Purchase cost: the up-front capital cost required for the ECM equipment and associated materials. This does not include labour and installation. This should be included in the C_O term of the cash flow analysis (see Equation 13).

Installation cost: the estimated cost of labour for installation of the ECM and associated materials. These costs may vary due to factors including the building type, location, and ECM installation location. This should be included in the C_O term of the cash flow analysis.

Replacement cost - baseline: to compare the baseline NPV with the post retrofit NPV, currently installed equipment will likely require replacement one or more times over the cash flow analysis period (*n*). As stated above, the baseline should assume that equipment replacements will match what is currently installed or what would currently be required if the minimum standards have since changed. The replacement costs should be considered in the C_T term in the replacement year of the cash flow analysis (see Equation 13). This value should include the cost of purchase and installation for the replacement.

Energy cost savings: the cost savings associated with the energy saved in the post-retrofit scenario. The annual cost savings is defined as annual the energy savings, as calculated above, multiplied by the energy price in a given year. This should be considered in the C_T term in all years of the post-retrofit cash flow analysis (see Equation 13).

3.3.3 GHG Abatement Rate

The MCCAC uses a program-administrator cost-effectiveness test when evaluating project applications to ensure that funding resources are allocated toward projects that effectively reduce greenhouse gas emissions.

To qualify for TAME+, projects must achieve a minimum level greenhouse gas reductions per dollar of funding that is received. The GHG abatement rate of a project must not exceed $20/tonne. To ensure compliance with this criteria, all participants must calculate the GHG abatement rate for the project as a whole, relative to requested funding amounts.

GHG abatement rate is calculated using the equation below:

$$\textit{Equation 14:}\ \ GHG\ Abatement = \frac{Total\ MCCAC\ implementation\ funding\ request}{Total\ Emission\ Reduction_{Project\ life}}$$

The participant should work with the energy professional to compile a set of ECMs that are compatible with this target. The simple payback and NPV life-cycle cost calculations are valuable tools to evaluate which ECMs to include or exclude.

Note: projects not meeting the abatement requirements will not be rejected but rather will receive pro-rated funding levels to bring the project into compliance. In these cases, the MCCAC will work with the participant to determine project scope.

4.0 Summary of Required Detailed Energy Assessment Report Contents

This report provides the requirements and methodology for completing the required Detailed Energy Assessment report. While there is no prescribed format requirement for the report, the report must include all of the contents described in this document as a whole. The table below provides a summary of these requirements for quick reference.

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 Detailed Energy Assessment 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 high-level review of all energy systems (e.g. mechanical, electrical, plug loads, etc.) • 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)
Project energy conservation measure summary	*For each individual ECM include:* 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 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 Energy and GHG Performance: • Baseline adjusted annual energy use (kWh or GJ) • ECM annual energy use, adjusted for interactions (kWh or GJ) • ECM annual energy savings (kWh or GJ) • ECM Eligible annual energy savings (kWh or GJ) • ECM annual emission reduction (tonne CO_2e) • ECM simple payback (years) • Baseline NPV life-cycle cost ($) • ECM NPV life-cycle cost ($)
Project energy savings summary	ECM summary • A table summarizing the annual baseline and ECM energy use and eligible energy savings from the section above (for quick comparison) • A table summarizing the equipment life and project-lifetime energy savings for all ECMs Project totals • Total eligible annual energy savings • Total eligible energy savings over equipment life
Project GHG emission reduction summary	ECM summary: • Table summarizing the annual and project lifetime GHG emission reductions for each ECM Project totals: • Total annual GHG emission reductions • Total GHG emission reductions over project lifetime
Financial analysis summary	ECM summary: • A table summarizing the annual and project-life greenhouse gas emissions reductions for each ECM Project cost-effectiveness totals: • The simple payback and NPV life-cycle cost for the project Project capital cost: • Total estimated capital cost for each ECM (including equipment and installation) • Total capital cost for the project • Requested funding for the project under TAME+ • Project GHG abatement rate

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.

Appendix A: Emissions Factors

Greenhouse gas emissions shall be expressed in metric tonnes of CO_2 equivalent and must be calculated for all energy types affected by project ECMs. Emissions factors must be appropriately selected to reflect the operation as well as all relevant emission types.

Below are the most common emissions factors. For other emissions factors, please refer to the Carbon Offset Emission Factors Handbook (ESRD, Climate Change, 2015, No. 1).

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 projects 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)

Below are the most common global warming potential emissions factors. For other gas types, please refer to the Carbon Offset Emission Factors Handbook (ESRD, Climate Change, 2015, No. 1).

Gas type	Formula	100-year GWP
Carbon dioxide	CO_2	1
Methane	CH4	25
Nitrous oxide	N_2O	298